Hart Engineering Corporation

SUBMITTAL:
16000-01

PROJECT: 9950. - Veolia/Taunton WWTP Improvements Phase 2 **DATE: 07/19/2024**

SUBMITTAL: 16000-01 - Electrical Distribution O&M Manual
REVISION: 0
STATUS: Eng
SPEC #: 16000

TO:
Enea Mushi
Veolia North America
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Milwaukee, WI 53214
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FROM:
Nick George
Hart Engineering Corporation
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Item	Revision	Description	Status	Date Sent	Date Returned
16000-01	0	Electrical Distribution O&M Manual	Eng	07/19/2024	
Notes:					

Additional Notes:

Status Codes
1-APP – No Exceptions Taken
2-ANR – Make Corrections Noted
3-R&R – Revise and Resubmit
4-REJ – Rejected
5-IPO – For Information Purposes Only
6-NRR – Not Required for Review
ENG – Submitted to Engineer

Sincerely,
Hart Engineering Corporation

DATE: 07/19/2024

EATON

Powering Business Worldwide

Taunton WWTF PH2

Operation & Maintenance Manual

General Order

LBS0031682

Volume 1 of 1

Equipment:

Motor Control Centers
Adjustable Frequency Drives
Panelboards
Dry Type Transformers
Enclosed Control (NEMA)
Safety Switches

USESI/ELEC WHOLESALERS WORCESTER MA   PO# S121374090

USESI/ELEC WHOLESALERS WORCESTER MA

Date: 12/21/2023

Powering Business Worldwide

Main Table of Contents

Domestic U.S.A. General Terms and Conditions of Sale for Distribution and Control Products and Services

Terms and Conditions of Sale. The Terms and Conditions of Sale set forth herein, and any supplements which may be attached hereto, constitute the full and final expression of the contract for the sale of products or services ("Product(s)" or "Services") by Eaton Corporation ("Seller") to the Buyer, and supersedes all prior quotations, purchase orders, correspondence or communications, whether written or oral, between the Seller and the Buyer. Notwithstanding any contrary language in the Buyer's purchase order, correspondence or other form of acknowledgment, Buyer shall be bound by these Terms and Conditions of Sale when it sends a purchase order or otherwise indicates acceptance of this contract, or when it accepts delivery from Seller of the Products or Services. THE CONTRACT FOR SALE OF THE PRODUCTS OR SERVICES IS EXPRESSLY LIMITED TO THE TERMS AND CONDITIONS OF SALE STATED HEREIN. ANY ADDITIONAL OR DIFFERENT TERMS PROPOSED BY BUYER ARE REJECTED UNLESS EXPRESSLY AGREED TO IN WRITING BY SELLER. No contract shall exist except as herein provided.

Complete Agreement. All Seller documents referenced in these Terms and Conditions of Sale are hereby incorporated by reference into the terms herein. No amendment or modification hereto nor any statement, representation or warranty not contained herein shall be binding on the Seller unless made in writing by an authorized representative of the Seller. Prior dealings, usage of the trade or a course of performance shall not be relevant to determine the meaning of this contract even though the accepting or acquiescing party had knowledge of the nature of the performance and opportunity for objection.

Quotations. A written quotation is valid for 30 days from its date unless otherwise stated in the quotation or terminated sooner by notice. Verbal quotations, unless accepted, expire the same day they are made. A complete signed order must be received by Seller within 20 calendar days of notification of award, otherwise the price and shipment will be subject to re-negotiation.

TERMINATION AND CANCELLATION

Products. Any order may be terminated by the Buyer only by written notice and upon payment of reasonable termination charges, including all progress billings and all incurred direct manufacturing costs.

Services. Any order may be terminated by the Buyer only by written notice and upon payment of reasonable termination charges including all costs plus profit**.** Seller shall have the right to cancel any order at any time by written notice if Buyer breaches any of the terms hereof, becomes the subject of any proceeding under state or federal law for the relief of debtors, or otherwise becomes insolvent or bankrupt, generally does not pay its debts as they become due or makes an assignment for the benefit of creditors.

Prices. All prices are subject to change without notice. In the event of a price change, the effective date of the change will be the date of the new price or discount sheet, letter or telegram. All quotations made or orders accepted after the effective date will be on the new basis. For existing orders, the price of the unshipped portion of an order will be the price in effect at time of shipment.

Price Policy – Products and Services. When prices are quoted as firm for quoted shipment, they are firm provided the following conditions are met:

1. The order is released with complete engineering details.
2. Shipment of Products is made, and Services purchased are provided within the quoted lead time.
3. When drawings for approval are required for any Products, the drawings applicable to those Products must be returned within 30* calendar days from the date of the original mailing of the drawings by Seller. The return drawings must be released for manufacture and shipment and must be marked "APPROVED" or "APPROVED AS NOTED." Drawing re-submittals which are required for any other reason than to correct Seller errors will not extend the 30-day period.

If the Buyer initiates or in any way causes delays in shipment, provision of Services or return of approval drawings beyond the periods stated above, the price of the Products or Services will be increased 1% per month or fraction thereof up to a maximum of 18 months from the date of the Buyer's order. For delays resulting in shipment or provision of Services beyond 18 months from the date of the Buyer's order, the price must be renegotiated.

Price Policy – BLS. Refer to Price Policy 25-050.

Minimum Billing. Orders less than $1,000 will be assessed a shipping and handling charge of 5% of the price of the order, with a minimum charge of $25.00 unless noted differently on Product discount sheets.

Taxes. The price does not include any taxes. Buyer shall be responsible for the payment of all taxes applicable to, or arising from, the transaction, the Products, its sale, value or use, or any Services performed in connection therewith regardless of the person or entity actually taxed.

TERMS OF PAYMENT

Products. Acceptance of all orders is subject to the Buyer meeting Seller's credit requirements. Terms of payment are subject to change for failure to meet such requirements. Seller reserves the right at any time to demand full or partial payment before proceeding with a contract of sale as a result of changes in the financial condition of the Buyer. Terms of Payment are either Net 30 days from the date of invoice of each shipment or carry a cash discount based on Product type. Specific payment terms for Products are outlined in the applicable Product discount schedules.

Services. Terms of payment are net within 30 days from date of invoice for orders amounting to less than $50,000.00. Terms of payment for orders exceeding $50,000.00 shall be made according to the following:

1. Twenty percent (20%) of order value with the purchase order payable 30 days from date of invoice.

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* 60 days for orders through contractors to allow time for their review and approval before and after transmitting them to their customers.

2. Eighty percent (80%) of order value in equal monthly payments over the performance period payable 30 days from date of invoice.

Except for work performed (i) under a firm fixed price basis or (ii) pursuant to terms of a previously priced existing contract between Seller and Buyer, invoices for work performed by Seller shall have added and noted on each invoice a charge of 3% (over and above the price of the work) which is related to Seller compliance with present and proposed environmental, health and safety regulations associated with prescribed requirements covering hazardous materials management and employee training, communications, personal protective equipment, documentation and record keeping associated therewith.

Adequate Assurances. If, in the judgment of Seller, the financial condition of the Buyer, at any time during the period of the contract, does not justify the terms of payment specified, Seller may require full or partial payment in advance.

Delayed Payment. If payments are not made in accordance with these terms, a service charge will, without prejudice to the right of Seller to immediate payment, be added in an amount equal to the lower of 1.5% per month or fraction thereof or the highest legal rate on the unpaid balance.

Freight. Freight policy will be listed on the Product discount sheets, or at option of Seller one of the following freight terms will be quoted.

F.O.B. – P/S – Frt./Ppd. and Invoiced. Products are sold F.O.B. point of shipment freight prepaid and invoiced to the Buyer.

F.O.B. – P/S – Frt./Ppd. and Allowed. Products sold are delivered F.O.B. point of shipment, freight prepaid and included in the price.

F.O.B. Destination – Frt./Ppd. and Allowed. At Buyer's option, Seller will deliver the Products F.O.B. destination freight prepaid and 2% will be added to the net price. The term "freight prepaid" means that freight charges will be prepaid to the accessible common carrier delivery point nearest the destination for shipments within the United States and Puerto Rico unless noted differently on the Product discount sheets. For any other destination, contact Seller's representative.

Shipment and Routing. Seller shall select the point of origin of shipment, the method of transportation, the type of carrier equipment and the routing of the shipment. If the Buyer specifies a special method of transportation, type of carrier equipment, routing or delivery requirement, Buyer shall pay all special freight and handling charges. When freight is included in the price, no allowance will be made in lieu of transportation if the Buyer accepts shipment at factory, warehouse or freight station or otherwise supplies its own transportation.

Risk of Loss. Risk of loss or damage to the Products shall pass to Buyer at the F.O.B. point.

Concealed Damage. Except in the event of F.O.B. destination shipments, Seller will not participate in any settlement of claims for concealed damage. When shipment has been made on an F.O.B. destination basis, the Buyer must unpack immediately and, if damage is discovered, must:
1. Not move the Products from the point of examination.
2. Retain shipping container and packing material.
3. Notify the carrier in writing of any apparent damage.
4. Notify Seller representative within 72 hours of delivery.
5. Send Seller a copy of the carrier's inspection report.

Witness Tests/Customer Inspection. Standard factory tests may be witnessed by the Buyer at Seller's factory for an additional charge calculated at the rate of $2,500 per day (not to exceed eight (8) hours) per Product type. Buyer may final-inspect Products at the Seller's factory for $500 per day per Product type.

Witness tests will add one (1) week to the scheduled shipping date. Seller will notify Buyer fourteen (14) calendar days prior to scheduled witness testing or inspection. In the event Buyer is unable to attend, the Parties shall mutually agree on a rescheduled date. However, Seller reserves the right to deem the witness tests waived with the right to ship and invoice Products.

Held Orders. For any order held, delayed or rescheduled at the request of the Buyer, Seller may, at its sole option, (1) require payment to be based on any reasonable basis, including but not limited to the contract price, and any additional expenses, or cost resulting from such a delay; (2) store Products at the sole cost and risk of loss of the Buyer; and/or (3) charge to the Buyer those prices under the applicable price policy. Payment for such price, expenses and costs, in any such event, shall be due by Buyer within thirty (30) days from date of Seller's invoice. Any order so held delayed or rescheduled beyond six (6) months will be treated as a Buyer termination.

Drawing Approval. Seller will design the Products in line with, in Seller's judgment, good commercial practice. If at drawing approval Buyer makes changes outside of the design as covered in their specifications, Seller will then be paid reasonable charges and allowed a commensurate delay in shipping date based on the changes made.

Drawing Re-Submittal. When Seller agrees to do so in its quotation, Seller shall provide Buyer with the first set of factory customer approval drawing(s) at Seller's expense. The customer approval drawing(s) will be delivered at the quoted delivery date. If Buyer requests drawing changes or additions after the initial factory customer approval drawing(s) have been submitted by Seller, the Seller, at its option, may assess Buyer drawing charges. Factory customer approval drawing changes required due to misinterpretation by Seller will be at Seller's expense. Approval drawings generated by Bid-Manager are excluded from this provision.

WARRANTY

Warranty for Products. Seller warrants that the Products manufactured by it will conform to Seller's applicable specifications and be free from failure due to defects in workmanship and material for one (1) year from the date of installation of the Product or eighteen (18) months from the date of shipment of the Product, whichever occurs first.

In the event any Product fails to comply with the foregoing warranty Seller will, at its option, either (a) repair or replace the defective Product, or defective part or component thereof, F.O.B. Seller's facility freight prepaid, or (b) credit Buyer for the purchase price of the Product. All warranty claims shall be made in writing.

Seller requires all non-conforming Products be returned at Seller's expense for evaluation unless specifically stated otherwise in writing by Seller. This warranty does not cover failure or damage due to storage, installation, operation or maintenance not in conformance with Seller's recommendations, including as set forth in these Terms and Conditions of Sale, and industry standard practice or due to accident, misuse, abuse, or negligence. This warranty does not cover breach of data or system security, including that of information technology infrastructure, computers, software, hardware, databases, electronic systems (including database management systems), and networks. This warranty does not cover reimbursement for labor, gaining access, removal, installation, temporary power or any other expenses, which may be incurred in connection with repair or replacement. This warranty does not apply to equipment not manufactured by Seller. Seller limits itself to extending the same warranty it receives from the third-party supplier, to the extent such third party permits assignment of its warranty.

Extended Warranty for Products. If requested by the Buyer and specifically accepted in writing by Seller, the foregoing standard warranty for Products will be extended from the date of shipment for the period and price indicated below:
24 months – 2% of Contract Price
30 months – 3% of Contract Price
36 months – 4% of Contract Price

Special Warranty (In and Out) for Products. If requested by the Buyer and specifically accepted in writing by Seller, Seller will, during the warranty period for Products, at an additional cost of 2% of the contract price, be responsible for the direct cost of:

1. Removing the Product from the installed location.
2. Transportation to the repair facility and return to the site.
3. Reinstallation on site.

The total liability of Seller for this Special Warranty for Products is limited to 50% of the contract price of the particular Product being repaired and excludes expenses for removing adjacent apparatus, walls, piping, structures, temporary service, etc.

Warranty for Services. Seller warrants that the Services performed by it hereunder will be performed in accordance with generally accepted professional standards. The Services, which do not so conform, shall be corrected by Seller upon notification in writing by the Buyer within one (1) year after completion of the Services. Unless otherwise agreed to in writing by Seller, Seller assumes no responsibility with respect to the suitability of the Buyer's, or its customer's, equipment or with respect to any latent defects in equipment not supplied by Seller. This warranty does not cover damage to Buyer's, or its customer's, equipment, components or parts resulting in whole, or in part from improper maintenance or operation (including failure to comply with Seller's recommendations) or from their deteriorated condition. Buyer will, at its cost, provide Seller with unobstructed access to the defective Services, as well as adequate free working space in the immediate vicinity of the defective Services and such facilities and systems, including, without limitation, docks, cranes and utility disconnects and connects, as may be necessary in order that Seller may perform its warranty obligations. The conducting of any tests shall be mutually agreed upon and Seller shall be notified of, and may be present at, all tests that may be made.

Warranty for Power Systems Studies. Seller warrants that any power systems studies performed by it will conform to generally accepted professional standards. Any portion of the study, which does not so conform, shall be corrected by Seller upon notification in writing by the Buyer within six (6) months after completion of the study. All warranty work shall be performed in a single shift straight time basis Monday through Friday. In the event that the study requires correction of warranty items on an overtime schedule, the premium portion of such overtime shall be for the Buyer's account.

Limitation on Warranties for Products, Services and Power Systems Studies. THE FOREGOING WARRANTIES ARE EXCLUSIVE EXCEPT FOR WARRANTY OF TITLE. SELLER DISCLAIMS ALL OTHER WARRANTIES INCLUDING ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. CORRECTION OF NON-CONFORMITIES IN THE MANNER AND FOR THE PERIOD OF TIME PROVIDED ABOVE SHALL CONSTITUTE SELLER'S SOLE LIABILITY AND BUYER'S EXCLUSIVE REMEDY FOR FAILURE OF SELLER TO MEET ITS WARRANTY OBLIGATIONS, WHETHER CLAIMS OF THE BUYER ARE BASED IN ONTRACT, IN TORT (INCLUDING NEGLIGENCE OR STRICT LIABILITY) OR OTHERWISE.

Asbestos. Federal Law requires that building or facility owners identify the presence, location and quantity of asbestos containing material (hereinafter "ACM") at work sites. Seller is not licensed to abate ACM. Accordingly, for any contract which includes the provision of Services, prior to (i) commencement of work at any site under a specific Purchase Order, (ii) a change in the work scope of any Purchase Order, the Buyer will certify that the work area associated with the Seller's scope of work includes the handling of Class II ACM, including but not limited to generator wedges and high temperature gaskets which include asbestos materials. The Buyer shall, at its expense, conduct abatement should the removal, handling, modification or reinstallation, or some or all of them, of said Class II ACM be likely to generate airborne asbestos fibers; and should such abatement affect the cost of ortime of performance of the work then Seller shall be entitled to an equitable adjustment in the schedule, price and other pertinent affected provisions of the contract.

Compliance with Nuclear Regulation. Seller's Products are sold as commercial grade Products not intended for application in facilities or activities licensed by the United States Nuclear Regulatory Commission for atomic purposes. Further certification will be required for use of the Products in any safety-related application in any nuclear facility licensed by the U.S. Nuclear Regulatory Commission.

Returning Products. Authorization and shipping instructions for the return of any Products must be obtained from Seller before returning the Products. When return is occasioned due to Seller error, full credit including all transportation charges will be allowed.

Product Notices. Buyer shall provide the users, including its employees, and in the case of permitted resale, any subsequent purchasers of the Products with all Seller supplied Product notices, warnings, instructions, recommendations and similar materials.

Cybersecurity. Seller is not responsible for a breach of data or electronic system security, including, but not limited to, a system intrusion or interference, virus or malicious code attack, loss of data, data theft, unauthorized access to confidential information and/or nonpublic personal information, hacking incident or any acts of data ransom, caused by any third-party equipment, modification made to a Product other than by Seller, or failure by Buyer to comply with Eaton Assemblies Cybersecurity Hardening Guidelines at **www.eaton.com/assemblies-security** (the "Cybersecurity Guidelines"). Seller may revise the Cybersecurity Guidelines at any time without prior notice.

Buyer is responsible for obtaining (at Buyer's expense) assurances from third party suppliers with respect to cybersecurity for third party equipment. As a condition of use and/or resale, Buyer shall direct all users of the Products purchased to access the applicable accompanying Eaton End User License Agreement (EULA) and the Cybersecurity Guidelines, all of which are subject to change in terms and practices, at Seller's discretion, at any time.

Force Majeure. Seller shall not be liable for failure to perform or delay in performance due to fire, flood, strike or other labor difficulty, act of God, act of any governmental authority or of the Buyer, riot, embargo, fuel or energy shortage, car shortage, wrecks or delays in transportation, or due to any other cause beyond Seller's reasonable control. In the event of delay in performance due to any such cause, the date of delivery or time for completion will be extended by a period of time reasonably necessary to overcome the effect of such delay. Seller cannot be held liable, and Buyer shall not be entitled to any damages and/or indemnifications, in case Seller is prevented, hindered or delayed from or in performing any of its obligations resulting from the impact of the outbreak of COVID-19 or any future pandemic or epidemic for reasons not attributable to Seller.

Liquidated Damages. Contracts which include liquidated damage clauses for failure to meet shipping or job completion promises are not acceptable or binding on Seller, unless such clauses are specifically accepted in writing by an authorized representative of the Seller at its headquarters office.

Patent Infringement. Seller will defend or, at its option, settle any suit or proceeding brought against Buyer, or Buyer's customers, to the extent it is based upon a claim that any Product or part thereof, manufactured by Seller or its subsidiaries and furnished hereunder, infringes any United States patent, other than a claim of infringement based upon use of a Product or part thereof in a process, provided Seller is notified in reasonable time and given authority, information and assistance (at Seller's expense) for the defense of same. Seller shall pay all legal and court costs and expenses and court-assessed damages awarded therein against Buyer resulting from or incident to such suit or proceeding. In addition to the foregoing, if at any time Seller determines there is a substantial question of infringement of any United States patent, and the use of such Product is or may be enjoined, Seller may, at its option and expense: either (a) procure for Buyer the right to continue using and selling the Product; (b) replace the Product with non-infringing apparatus; (c) modify the Product so it becomes non-infringing; or (d) as a last resort, remove the Product and refund the purchase price, equitably adjusted for use and obsolescence.

In no case does Seller agree to pay any recovery based upon its Buyer's savings or profit through use of Seller's Products whether the use be special or ordinary. The foregoing states the entire liability of Seller for patent infringement.

The preceding paragraph does not apply to any claim of infringement based upon: (a) any modification made to a Product other than by Seller; (b) any design and/or specifications of Buyer to which a Product was manufactured; or (c) the use or combination of Product with other products where the Product does not itself infringe. As to the above-identified claim situations where the preceding paragraph does not apply, Buyer shall defend and hold Seller harmless in the same manner and to the extent as Seller's obligations described in the preceding paragraph. Buyer shall be responsible for obtaining (at Buyer's expense) all license rights required for Seller to be able to use software products in the possession of Buyer where such use is required in order to perform any Service for Buyer.

With respect to a Product or part thereof not manufactured by Seller or its subsidiaries, Seller will attempt to obtain for Buyer, from the supplier(s), the patent indemnification protection normally provided by the supplier(s) to customers.

Compliance with OSHA. Seller offers no warranty and makes no representation that its Products comply with the provisions or standards of the Occupational Safety and Health Act of 1970, or any regulation issued thereunder. In no event shall Seller be liable for any loss, damage, fines, penalty or expenses arising under said Act.

Limitation of Liability. THE REMEDIES OF THE BUYER SET FORTH IN THIS CONTRACT ARE EXCLUSIVE AND ARE ITS SOLE REMEDIES FOR ANY FAILURE OF SELLER TO COMPLY WITH ITS OBLIGATIONS HEREUNDER. NOTWITHSTANDING ANY PROVISION IN THIS CONTRACT TO THE CONTRARY, IN NO EVENT SHALL SELLER BE LIABLE IN CONTRACT, IN TORT (INCLUDING NEGLIGENCE OR STRICT LIABILITY) OR OTHERWISE FOR DAMAGE TO PROPERTY OR EQUIPMENT OTHER THAN PRODUCTS SOLD UNDER THIS AGREEMENT, LOSS OF PROFITS OR REVENUE, LOSS OF USE OF PRODUCTS, LOST PRODUCTION, COST OF CAPITAL, LOSS OF, DAMAGE TO, OR UNAUTHORIZED ACCESS TO DATA, BREACH OF SYSTEM SECURITY, FAILURE TO TRANSMIT OR RECEIVE DATA,, BUSINESS INTERRUPTION, CLAIMS OF CUSTOMERS OF THE BUYER OR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES WHATSOEVER, REGARDLESS OF WHETHER SUCH POTENTIAL DAMAGES ARE FORESEEABLE OR IF SELLER HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. THE TOTAL CUMULATIVE LIABILITY OF SELLER ARISING FROM OR RELATED TO THIS CONTRACT WHETHER THE CLAIMS ARE BASED IN CONTRACT, IN TORT (INCLUDING NEGLIGENCE OR STRICT LIABILITY) OR OTHERWISE, SHALL NOT EXCEED THE PRICE OF THE PRODUCT OR SERVICES ON WHICH SUCH LIABILITY IS BASED.

Distributors and Third-Party Agents. In order to ensure that distributors and third party agents acting on behalf of Seller share Seller's commitment to doing business right, all distributors and agents shall abide by Seller's Anticorruption Policy.

Eaton Corporation.
1000 Cherrington Parkway Moon Township, PA 15108 United States
Tel: 1-800-525-2000
Eaton.com

EATON

Powering Business Worldwide

Contact Information

Visit our Web Site http://www.eatonelectrical.com to view the on-line catalog, pricing, document support, distribution directory, news and events.

For warranty support	**877-ETNCARE**
For a general directory of Eaton Electrical products	**(800) 525-2000**
For on-site field service, commissioning & maintenance	**(800) 498-2678**

Powering Business Worldwide

Motor Control Centers

Powering Business Worldwide

Section Table of Contents
Motor Control Centers

Powering Business Worldwide

Drawings

Master Document Index

Motor Control Centers
Freedom MCC

	Drawing Description	Document Name	Rev
1	Master Drawing List	C00LF8H-M.DOC	3
2	Certified Production Test Report	C00LF8H-9.DOC	1
3	TAUNTON WWTF PH2 IMPROVEMENT	C00LF8H-O.DWG	1
4	TAUNTON WWTF PH2 IMPROVEMENT	C00LF8H-R.DWG	1
5	TAUNTON WWTF PH2 IMPROVEMENT	C00LF8H-N.DWG	1
6	Customer Bill Of Material	LBS0031682-001_CUSTOMER_BOM.PDF	2
7	TAUNTON WWTF PH2 IMPROVEMENT	C00LF8H-E.DWG	1
8	MLO TOP ENTRY	C00LF8H-S001.DWG	1
9	ASM-3151, UNIT - 1F	C00LF8H-S002.DWG	1
10	ASM-3251, UNIT - 1K	C00LF8H-S003.DWG	1
11	ASM-3111, UNIT - 2D	C00LF8H-S004.DWG	1
12	ASM-3112, UNIT - 2H	C00LF8H-S005.DWG	1
13	ASM-3113, UNIT - 2M	C00LF8H-S006.DWG	1
14	ASM-3211, UNIT - 3D	C00LF8H-S007.DWG	1
15	ASM-3212, UNIT - 3H	C00LF8H-S008.DWG	1
16	ASM-3213, UNIT - 3M	C00LF8H-S009.DWG	1
17	ASM-3131, UNIT - 4D	C00LF8H-S010.DWG	1
18	ASM-3132, UNIT - 4H	C00LF8H-S011.DWG	1
19	ASM-3231, UNIT - 4M	C00LF8H-S012.DWG	1
20	ASM-3232, UNIT - 5D	C00LF8H-S013.DWG	1
21	RAB-3144, UNIT - 5G	C00LF8H-S014.DWG	2
22	RAB-3145, UNIT - 5K	C00LF8H-S015.DWG	2
23	RAB-3146, UNIT - 6C	C00LF8H-S016.DWG	2
24	RAB-3244, UNIT - 6F	C00LF8H-S017.DWG	2
25	RAB-3245, UNIT - 6J	C00LF8H-S018.DWG	2
26	RAB-3246, UNIT - 6M	C00LF8H-S019.DWG	2
27	DWP-9371, UNIT - 7B	C00LF8H-S020.DWG	1
28	DWP-9372, UNIT - 7D	C00LF8H-S021.DWG	1
29	DWP-9363, UNIT - 7F	C00LF8H-S022.DWG	1
30	DWP-9364, UNIT - 7H	C00LF8H-S023.DWG	1
31	DWP-9365, UNIT - 7K	C00LF8H-S024.DWG	1
32	DWP-9366, UNIT - 7M	C00LF8H-S025.DWG	1

User **Debora** **Fussell**	**Date** **9/6/2023** **8:30:50 AM**	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.		EATON Powering Business Worldwide
		D7580427X2K2		
		6MCC1	**Final Drawings**	
REVISION	DWG SIZE	G.O.	DWG	SHEET
3	**A**	**LBS0031682-001**	**C00LF8H-M.DOC**	1 of 1

Certified Production Test Report

Motor Control Centers

CERTIFICATION

Series 2100 Motor Control Centers are manufactured in compliance with UL 845, NEMA ICS 2, and Cutler-Hammer ISO 9000 certified Work Instructions for Inspection and Testing, as follows:

TEST	**PASSED**	**N/A**
DIELECTRIC: (POWER BUS @ 2.64KV, 1 SECOND) NEMA STANDARD	X	
MECHANICAL OPERATION OF DEVICES	X	
CONTROL WIRING CONTINUITY	X	
POLARITY OF INSTRUMENT TRANSFORMERS	X	
SEQUENCED PER SCHEMATICS	X	
VERIFICATION:	X	
EQUIPMENT/DEVICES VERIFICATION	X	
STRUCTURAL FIT, ALIGNMENT, OPERATION OF MOVING PARTS	X	
INSPECTION OF BUS CONNECTIONS	X	
WIRING CORRECT, NEATNESS, PROPER TERMINIATIONS	X	
FINISH, LABELS, TRIM	X	
Resistor and Transformer tap settings verified		X

Tester **Debora Fussell**	**Date** **09/06/2023**	CUTLER - HAMMER, 2900 DOC BENNETT ROAD, FAYETTEVILLE, NC		EATON Powering Business Worldwide
		This certifies that the above is based upon recorded factory tests made at this location.		
		6MCC1	**Certified Test Report**	
REVISION	DWG SIZE	G.O.	DWG	SHEET
1	**A**	**LBS0031682-001**	**C00LF8H-9**	1 of 1

REVISION STATUS		SHEET DESCRIPTION
SHEET	REV	
000	1	REVISION SHEET
001	1	FRONT VIEW; SECTIONS: 1F–3F
002	1	FRONT VIEW; SECTIONS: 4F–7F
003	1	POWER FLOW VIEW; SECTIONS: 1F–7F
004	1	TOP & FLOOR PLAN VIEWS; SECTIONS: 1F–7F
005	1	DETAIL VIEWS: SECTIONS: 1F–7F

REVISION HISTORY

REV	REVISION DESCRIPTION	BY	APPD	DATE
1	CREATED	TLL	FAY	6/1/2023

REVISION SHEET

NEG–ALT NUMBER: D7580427X2K2–C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
P.O. NUMBER: S121374090

Certified As-Built
This document accurately reflects the manufacturing details of this product when it shipped from the factory.

DFTR TLL	DATE 06/01/2023	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.	EATON
APPD FAY	DATE 06/01/2023	TITLE TAUNTON WWTF PH2 IMPROVEMENT 6MCC1	
PRODUCT CODE MCC	S.O. C00LF8H	TYPE FREEDOM+ MCC	OUTLINES
REVISION 1	DWG SIZE	G.O. LBS0031682–001	DWG C00LF8H–0 SHEET 000

CAGE CODE 380H0

COEFtBL_R6

SYSTEM DETAILS

SERVICE VOLTAGE: 480VAC
FREQUENCY: 60
SYSTEM: 3PH3W
SHORT-CIRCUIT-CURRENT RATING: 65000 AMPS RMS SYM. 600 VOLTS MAX
SERVICE FACTOR: 1.15
CONTROL VOLTAGE: 120VAC
CONTROL VOLTAGE SOURCE: IND CPT
WIRING CLASS: 1B+IIS

ENCLOSURE DETAILS

TYPE: NEMA 12 DUST TIGHT
CONFIGURATION: 16"D FRONT MT ONLY, 90"H
PAINT FINISH: GRAY (ANSI-61) EXTERIOR AND WHITE INTERIOR, EXTERIOR COAT
HORIZONTAL WIRE WAY: 9" HIGH, TOP & BOTTOM
BOTTOM PLATES
FRONT TO REAR BARRIERS BETWEEN EACH ENCLOSURE

BUS DETAILS

BRACING: 65,000 AMPS RMS SYMMETRICAL
HORIZONTAL AMPS: 600A
HORIZONTAL MATERIAL: COPPER
HORIZONTAL PLATING: TIN
MAXIMUM TEMPERATURE RISE: 50°C OVER 40°C AMBIENT
VERTICAL MATERIAL: COPPER
VERTICAL PLATING: TIN
VERTICAL BARRIER: LABYRINTH, ISOLATED/INSULATED WITH SHUTTERS, AND SUPPLIED WITH STEEL BOTTOM BARRIERS.
GROUND SIZE: 0.25" X 1.00"
GROUND MATERIAL: COPPER
GROUND PLATING: TIN
GROUND LOCATION: TOP
GROUND LUG PLACEMENT: INCOMING LINE
GROUND LUG SIZE: 2-#6-350KCMIL
GROUND LUG TYPE: SCREW
VERTICAL GROUND BUS LOCATED IN VERTICAL SECTION

CODES AND STANDARDS

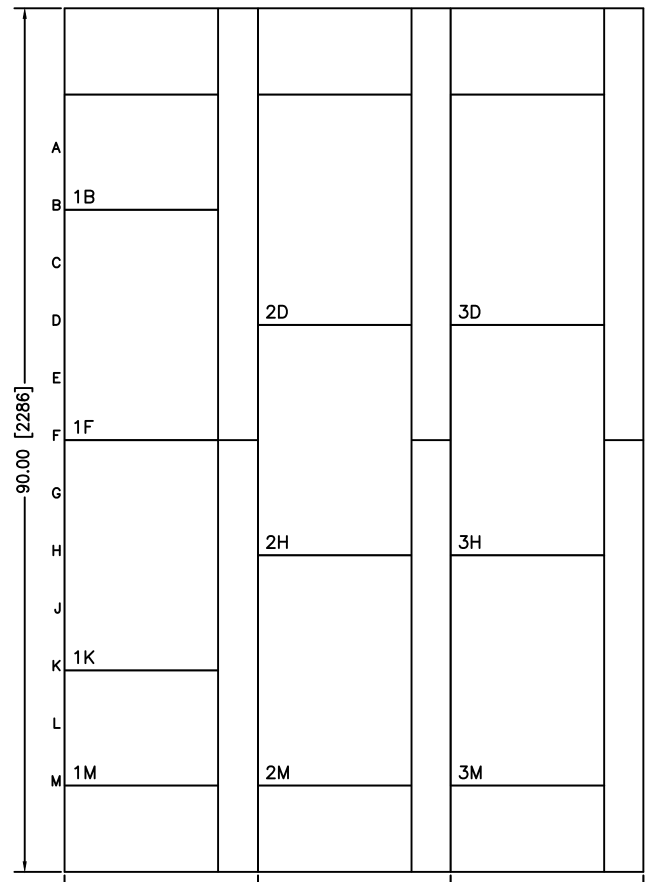
UL845, NEMA, NEC
SPECIAL CODES: UL
NEC ARTICLE 430, PART VIII, SECTIONS 92-98. NEMA STANDARD ICS 18,PART 1 AND UL STANDARD UL845, FILE# E47048MCC COMPLIES WITH UL845'S 2 METER RULE, WHEN BOTTOM OF MCC IS AT THE SAME LEVEL AS THE OPERATOR'S PLATFORM

WIRING AND CONTROL DETAILS

CONTROL WIRE - 16 AWG, RED, UL MTW - CSA TEW-AWM
POWER WIRE - BLACK, UL MTW - CSA TEW-AWM
TERMINAL BLOCKS - STANDARD PULL-APART
MOTOR OL PROTECTION: SOLID STATE, CLASS - 20 AMBIENT COMPENSATED.
MOTOR OL PROTECTION: STD SOLID STATE OVERLOAD
CONTROL WIRE HAS WIRE MARKERS AT EACH END
DEVICE TYPE: 10250T
INDICATING LIGHT TYPE: 6V XFMR
INDICATING BULB TYPE: LED

MISCELLANEOUS DETAILS

ALL DIMENSIONS ARE IN INCHES[MILLIMETERS], ALL WEIGHTS ARE IN POUNDS[KILOGRAMS] UNLESS INDICATED OTHERWISE.



SECTION NO:	1F	2F	3F
SECTION WIDTH:	20.156 [512]	20.078 [510]	20.078 [510]
DETAIL NUMBER:	10A30	10A30	10A30
SHIPPING SPLIT WIDTH:	60.31 [1532]		
SHIPPING SPLIT WEIGHT:	1845 [837]		

FRONT VIEW

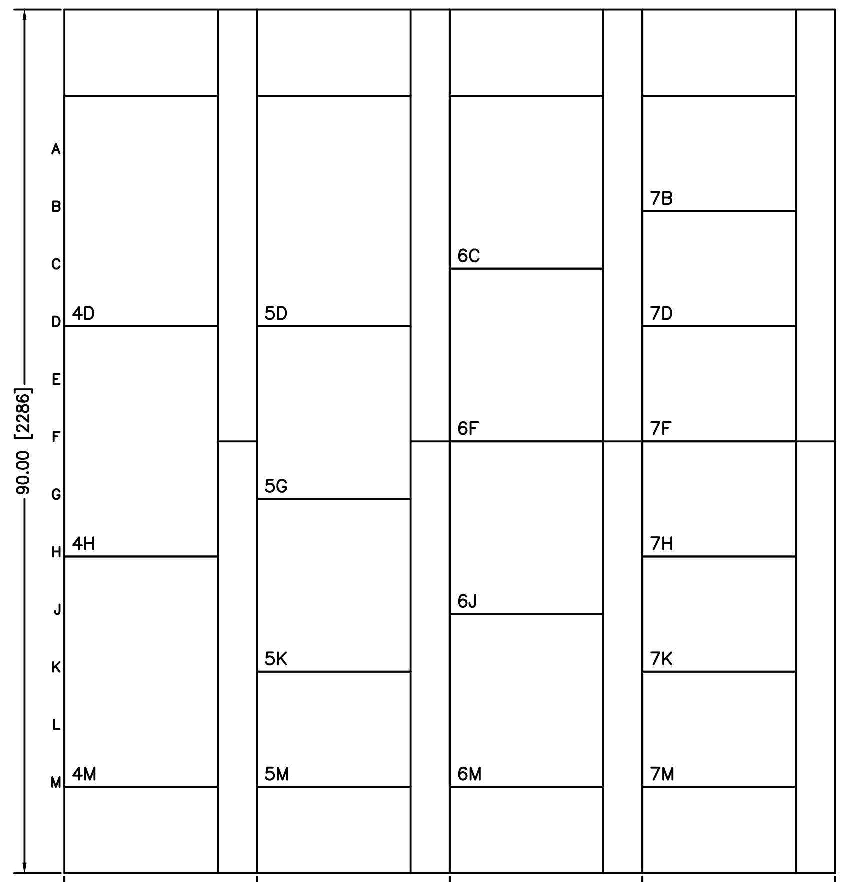
NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
P.O. NUMBER: S121374090

Certified As-Built
This document accurately reflects the manufacturing details of this product when it shipped from the factory.

CAGE CODE 380H0

DFTR TLL	DATE 06/01/2023	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.	EATON
APPD FAY	DATE 06/01/2023	TITLE TAUNTON WWTF PH2 IMPROVEMENT 6MCC1	
PRODUCT CODE MCC	S.O. COOLF8H	TYPE FREEDOM+ MCC	OUTLINES
REVISION 1	DWG SIZE	G.O. LBS0031682-001	DWG COOLF8H-0 SHEET 001

COEFtBL_R6



SECTION NO:	4F	5F	6F	7F
SECTION WIDTH:	20.078 [510]	20.078 [510]	20.078 [510]	20.078 [510]
DETAIL NUMBER:	10A30	10A30	10A30	10A30

SHIPPING SPLIT WIDTH: 80.31 [2040]
SHIPPING SPLIT WEIGHT: 2460 [1116]

FRONT VIEW

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
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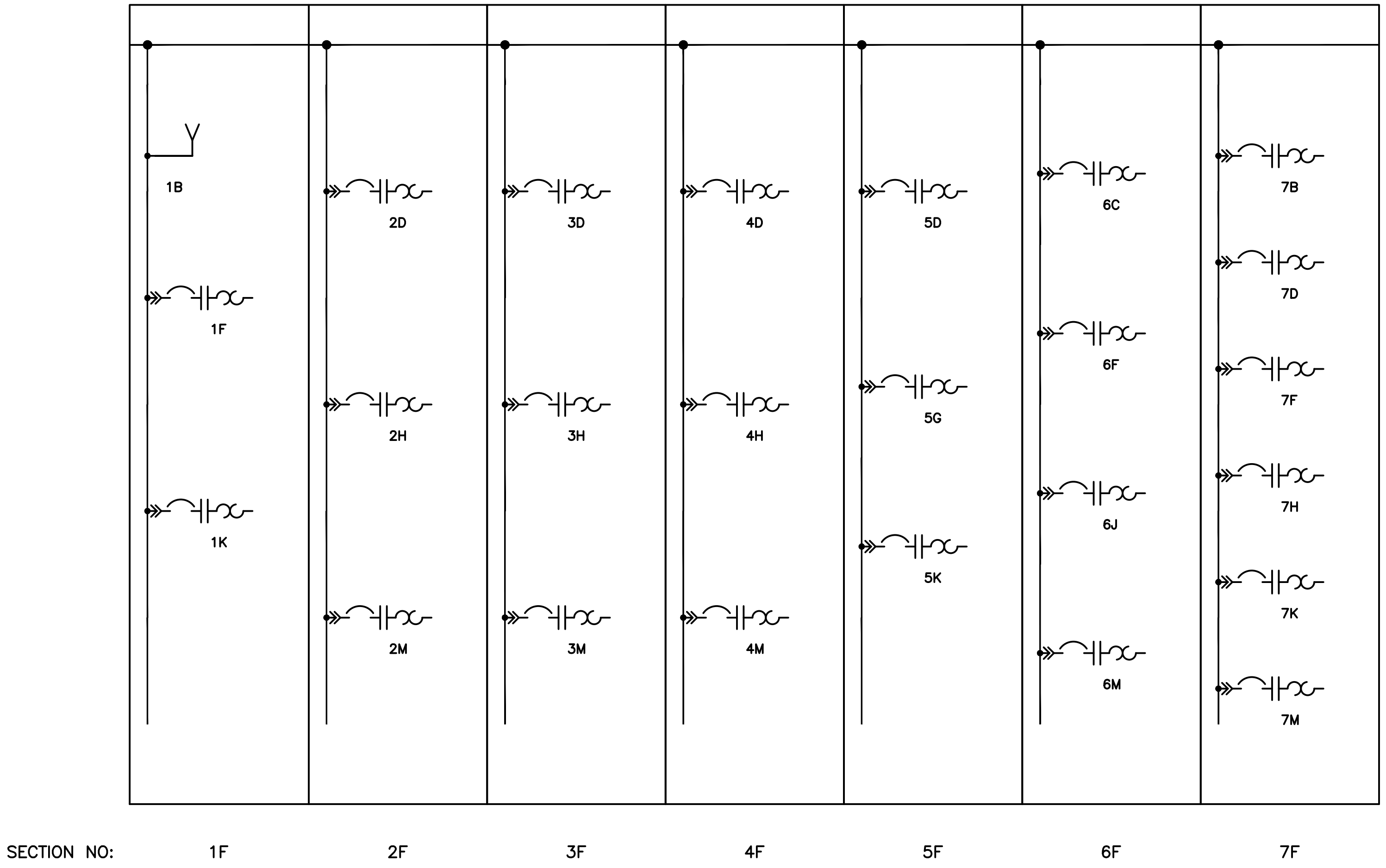
PRODUCT CODE MCC
S.O. C00LF8H
REVISION 1
DWG SIZE

EATON

TITLE TAUNTON WWTF PH2 IMPROVEMENT
6MCC1
TYPE FREEDOM+ MCC
OUTLINES
G.O. LBS0031682-001
DWG C00LF8H-0
SHEET 002



POWER FLOW VIEW

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
P.O. NUMBER: S121374090

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DATE 06/01/2023
PRODUCT CODE MCC
S.O. C00LF8H
REVISION 1
DWG SIZE

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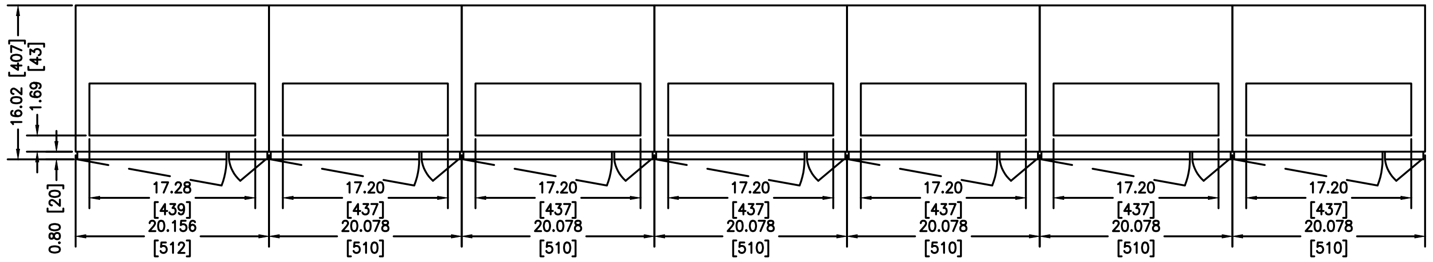
EATON

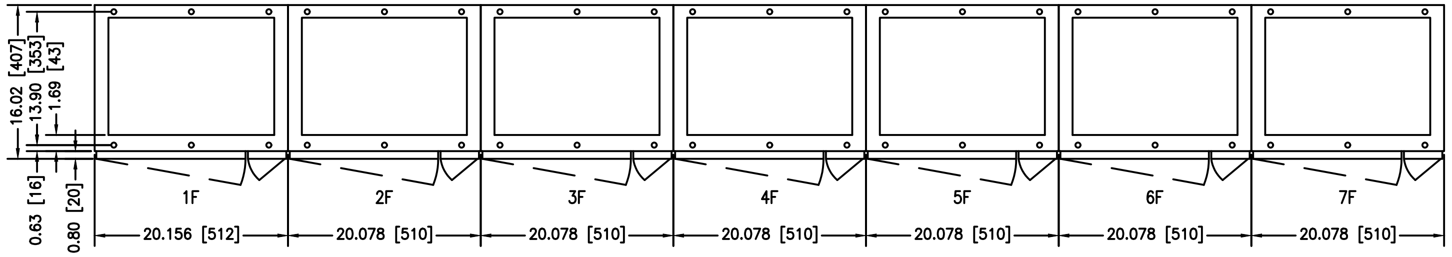
TITLE TAUNTON WWTF PH2 IMPROVEMENT
6MCC1

TYPE FREEDOM+ MCC
OUTLINES

G.O. LBS0031682-001
DWG C00LF8H-0
SHEET 003

COEFtBL_R6





SECTION WEIGHT:	615	615	615	615	615	615	615
DETAIL NUMBER:	10A30	10A30	10A30	10A30	10A30	10A30	10A30

TOP & FLOOR PLAN VIEWS

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
P.O. NUMBER: S121374090

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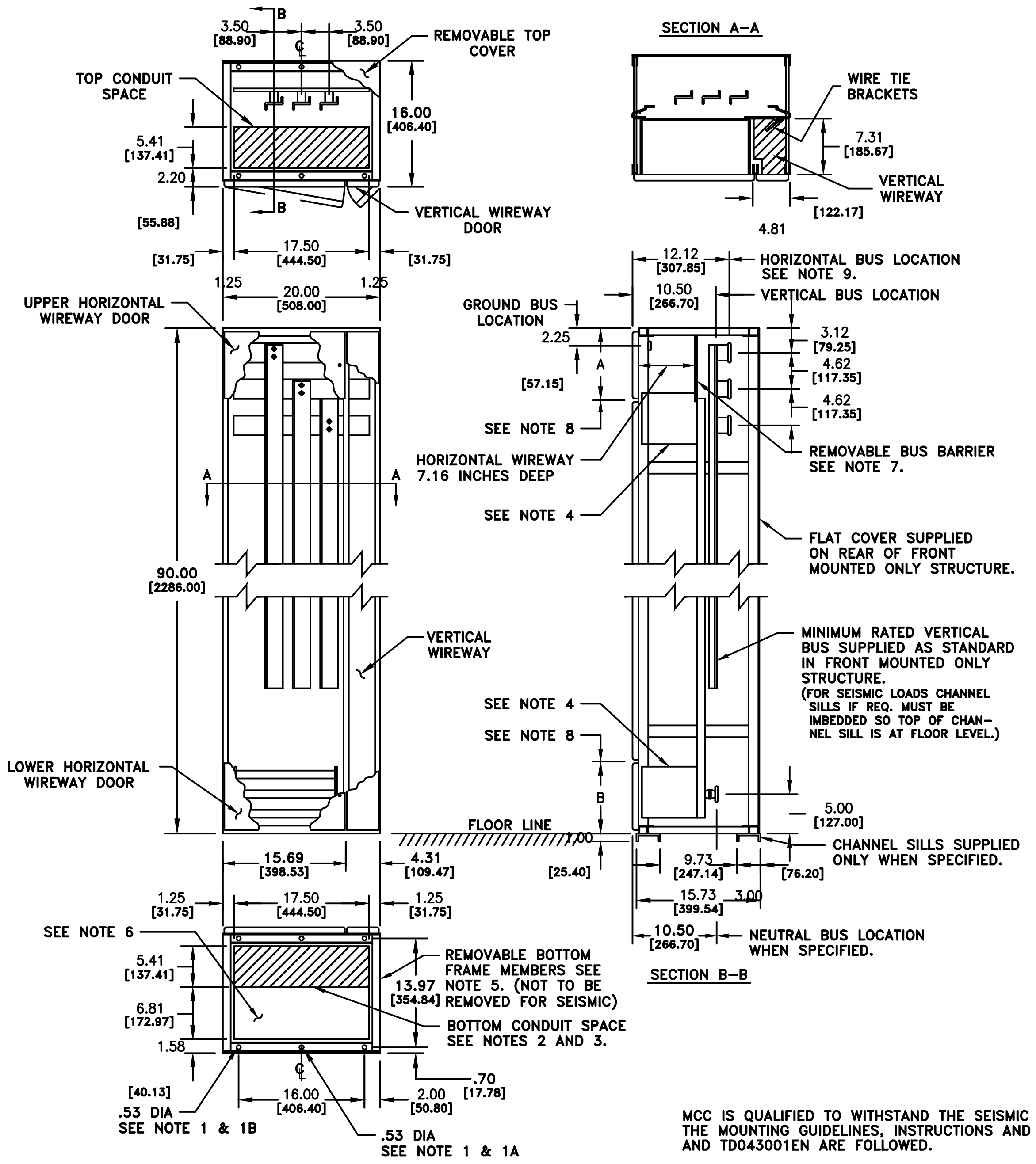
DATE 06/01/2023
PRODUCT CODE MCC
S.O. C00LF8H
REVISION 1
DWG SIZE

EATON

TITLE TAUNTON WWTF PH2 IMPROVEMENT
6MCC1
TYPE FREEDOM+ MCC
OUTLINES
G.O. LBS0031682-001
DWG C00LF8H-0
SHEET 004



NOTES:
1. MINIMUM LENGTH OF ANCHOR BOLT IS 2.00[50.8]. (.38–16 GRADE 5 TORQUED AT 31lb–ft[43.4Nm]).
   A. FOR NON SEISMIC, MOUNT WITH 2 CENTER BOLTS PER ENCLOSURE.
   B. FOR SEISMIC, MOUNT WITH MIN 4 CORNER BOLTS PER ENCLOSURE.
2. RECOMMENDED MAXIMUM CONDUIT HEIGHT ABOVE FLOOR LINE IS 3.50 INCHES.
3. MAXIMUM CONDUIT SPACE WITH CHANNEL SILLS IS 17.50 X 9.73 INCHES.
4. MASTER TERMINAL BLOCK (MTB) ASSEMBLY IS FURNISHED FOR TYPE 'C' WIRING ONLY. WHEN LOCATION IS NOT SPECIFIED THE MTB WILL BE SUPPLIED AT THE BOTTOM.
5. FOR MULTIPLE STRUCTURE ASSEMBLIES EITHER ONE OR BOTH OF THESE MEMBERS ARE REMOVED TO PROVIDE MAXIMUM UNRESTRICTED CONDUIT SPACE AT THE BOTTOM OF THE MCC. (MUST NOT BE REMOVED FOR SEISMIC REQ)
6. THIS CONDUIT SPACE IS NOT RECOMMENDED WHEN A NEUTRAL BUS IS REQUIRED. THE SPACE IS OTHERWISE AVAILABLE.
7. REAR HORIZONTAL BUS BARRIER IS NOT SUPPLIED IN FRONT MOUNTED ONLY STRUCTURE.
8. STANDARD HORIZONTAL WIREWAY ARRANGEMENT:
   WITHOUT MASTER TERMINAL BLOCK; A & B = 9 INCHES.
   WITH MASTER TERMINAL BLOCK AT BOTTOM; A & B = 9 INCHES.
   WITH MASTER TERMINAL BLOCK AT TOP;
      A = 15 INCHES, B = 3 INCHES (ALL CABLE MUST EXIT TOP).
9. HORIZONTAL BUS LOCATION DIMENSION IS TO FIRST BAR. MAXIMUM AMPACITY IS 1200A ALUMINUM OR 1400A COPPER BUS. NUMBER AND SIZE OF BARS DEPENDS ON AMPACITY RATING.

MCC IS QUALIFIED TO WITHSTAND THE SEISMIC LOADS SPECIFIED WITHIN THE UBC, CBC, AND IBC PROVIDED THE MOUNTING GUIDELINES, INSTRUCTIONS AND PROCEDURES IN DOCUMENTS 5A11213 OR 70–8722, AND TD043001EN ARE FOLLOWED.

DETAIL 10A30

DETAIL VIEWS

NEG–ALT NUMBER: D7580427X2K2–C000
ITEM NUMBER: 001
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DATE 06/01/2023
APPD FAY
DATE 06/01/2023
PRODUCT CODE MCC
S.O. C00LF8H
REVISION 1
DWG SIZE

TITLE TAUNTON WWTF PH2 IMPROVEMENT
6MCC1
TYPE FREEDOM+ MCC
OUTLINES
G.O. LBS0031682–001
DWG C00LF8H–0
SHEET 005

REVISION STATUS		SHEET DESCRIPTION
SHEET	REV	
000	1	REVISION SHEET
001	1	FRONT LAYOUT VIEW; SECTIONS: 1F–7F

REVISION HISTORY				
REV	REVISION DESCRIPTION	BY	APPD	DATE
1	CREATED	TLL	FAY	6/1/2023

REVISION SHEET

NEG–ALT NUMBER: D7580427X2K2–C000
ITEM NUMBER: 001
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LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
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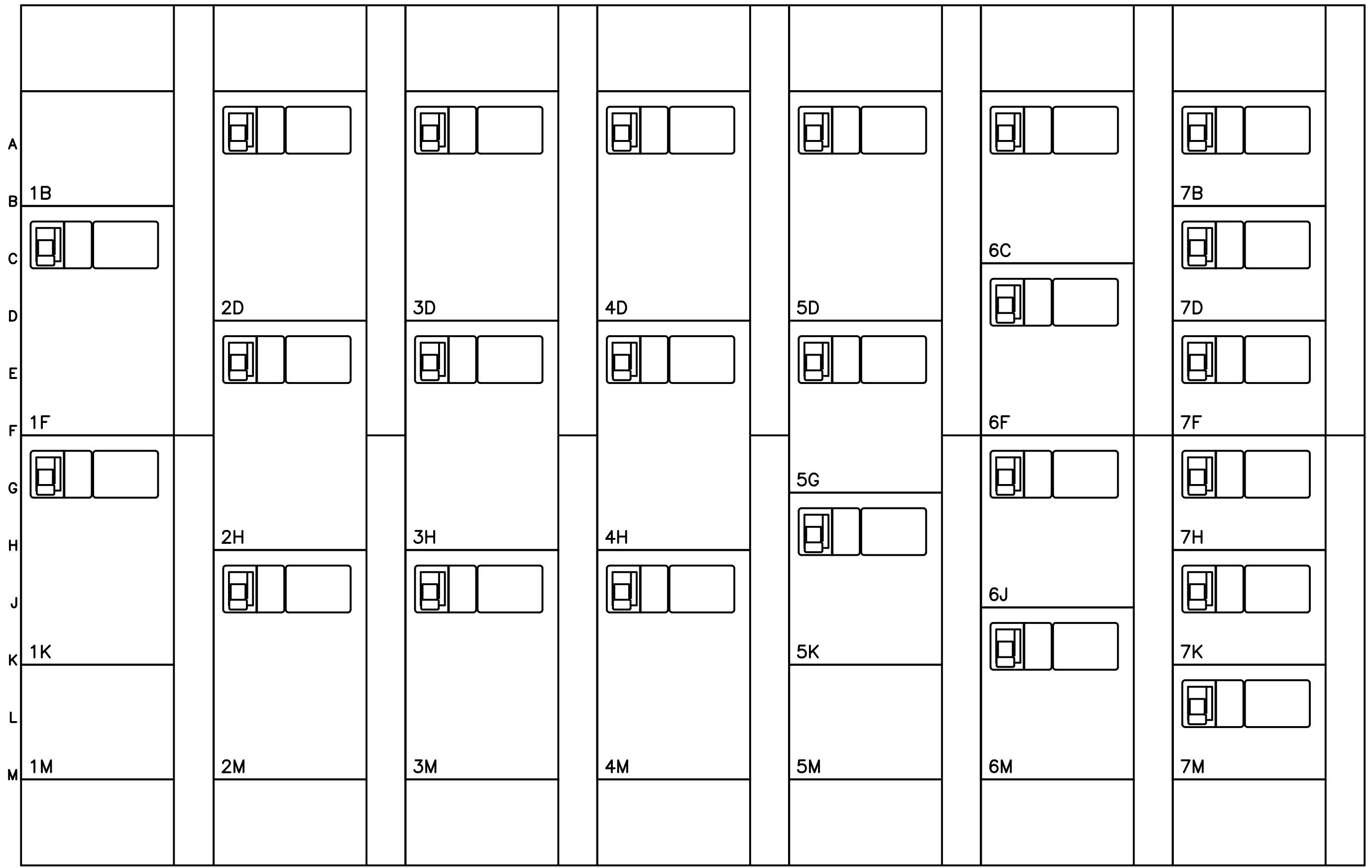
APPD FAY	DATE 06/01/2023	TITLE TAUNTON WWTF PH2 IMPROVEMENT 6MCC1	
PRODUCT CODE MCC	S.O. C00LF8H	TYPE FREEDOM+ MCC	OUTLINES
REVISION 1	DWG SIZE	G.O. LBS0031682–001	DWG C00LF8H–R SHEET 000

COEFtBL_R6



SECTION NO:	1F	2F	3F	4F	5F	6F	7F
SECTION WIDTH:	20.156 [512]	20.078 [510]	20.078 [510]	20.078 [510]	20.078 [510]	20.078 [510]	20.078 [510]

FRONT LAYOUT VIEW

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
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DATE 06/01/2023
PRODUCT CODE MCC
S.O. C00LF8H
REVISION 1
DWG SIZE

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TITLE TAUNTON WWTF PH2 IMPROVEMENT
6MCC1

TYPE FREEDOM+ MCC
OUTLINES

G.O. LBS0031682-001
DWG C00LF8H-R
SHEET 001

COEFtBL_R6

REVISION STATUS		SHEET DESCRIPTION
SHEET	REV	
000	1	REVISION SHEET
001	1	UNIT SCHEDULE; SECTIONS: 1F
002	1	UNIT SCHEDULE; SECTIONS:
003	1	UNIT SCHEDULE; SECTIONS: 2F
004	1	UNIT SCHEDULE; SECTIONS:
005	1	UNIT SCHEDULE; SECTIONS:
006	1	UNIT SCHEDULE; SECTIONS: 3F
007	1	UNIT SCHEDULE; SECTIONS:
008	1	UNIT SCHEDULE; SECTIONS:
009	1	UNIT SCHEDULE; SECTIONS: 4F
010	1	UNIT SCHEDULE; SECTIONS:
011	1	UNIT SCHEDULE; SECTIONS:
012	1	UNIT SCHEDULE; SECTIONS: 5F
013	1	UNIT SCHEDULE; SECTIONS:
014	1	UNIT SCHEDULE; SECTIONS: 6F
015	1	UNIT SCHEDULE; SECTIONS:
016	1	UNIT SCHEDULE; SECTIONS: 7F
017	1	UNIT SCHEDULE; SECTIONS:

REVISION HISTORY

REV	REVISION DESCRIPTION	BY	APPD	DATE
1	CREATED	TLL	FAY	6/1/2023

REVISION SHEET

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
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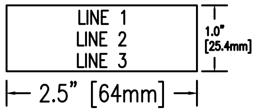
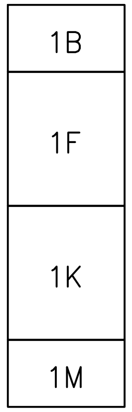
APPD FAY	DATE 06/01/2023	TITLE TAUNTON WWTF PH2 IMPROVEMENT 6MCC1	
PRODUCT CODE MCC	S.O. C00LF8H	TYPE FREEDOM+ MCC	SCHEDULES
REVISION 1	DWG SIZE	G.O. LBS0031682-001	DWG C00LF8H-N · SHEET 000

COEFtBL_R6

ID		DEVICE INFORMATION									PROTECTION INFO				UNIT DATA			TERMINATIONS					
SECTION NUMBER	CELL	CIRCUIT NAMEPLATE	DEVICE TYPE	DEVICE MOUNTING (SEE NOTES)	DEVICE SIZE	POLES	KAIC RATING (SEE NOTES)	BREAKER FRAME OR FUSE CLIP TYPE	RATING PLUG OR FUSE AMPS	BREAKER TRIP OR FUSE CLIP AMPS	STARTER SIZE	ACTUAL LOAD SIZE	FULL LOAD AMPS (SEE NOTES)	OVERLOAD	CPT SIZE	ADDITIONAL ACCESSORIES, FEATURES & NOTES	DEVICE SPACE REQ INCHES	CONTROL CABLE ENTRY DIRECTION	POWER CABLE ENTRY DIRECTION	TYPE (SEE NOTES)	PHASE SIZE	#PER PHASE	DETAILED DRAWING REFERENCE OR CATALOG NUMBER
1F			VERTICAL BUS		600A																		
1F	B		MAIN LUGS MLO	F													12		TOP	M	#4–350 KCMIL	2	
1F	F	ASM–3151	FREEDOM+ FVNR STARTER F206	D		3	65K	HMCP		50A (150–500)	2	15HP	21.00	9–45A	100VA	SIZE 1&2, FVNR–100VA TYPICAL, W/EXTRA 50VA EATON MINI ETM, 9999.9, 120VAC 60HZ, ELAPSED TIME TIMER, 405AR, SOLID STATE, ON DELAY, 0–10 SEC, MIN, HR, 120VAC TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, MIXER ON LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, SEAL LEAK/TEMP LIGHT, 120VAC, XFMR TYPE, LED BULB, GREEN, MIXER OFF LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, HIGH/MOTOR TEMP RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE PUSHBUTTON, MOMENTARY, BLACK, SEAL LEAK/RESET PUSHBUTTON, MOMENTARY, BLACK, OVERTEMP/RESET	24	EITHER	EITHER	M	#12–6 AWG	1	C00LF8H–S002





NAMEPLATE FEATURES
COLOR: BLACK / WHITE LETTERS
SECURED WITH SCREWS
CHARACTER HEIGHT: 0.1875" [5mm]
CHARACTERS PER LINE: 17 MAXIMUM
(LINE 2 MAX 15 CHARACTERS)
NAMEPLATE SECURED VIA SELF TAPPING SCREWS
NOT TO SCALE

NOTES:

TERMINATIONS
M = MECHANICAL CU/AL
C = COMPRESSION TYPE, 2 HOLE MOUNTING, COPPER

DEVICE MOUNTING
F = FIXED MOUNTED
D = DRAW-OUT MOUNTED
B = BOLTED IN

KAIC RATING
RMS SYMMETRICAL INTERRUPTING RATING AT MAXIMUM OF RATED VOLTAGE

FULL LOAD AMPERES & HEATER SIZE
THE FULL LOAD AMPS SHOWN ARE BASED ON STANDARD NEMA VALUES FOR REFERENCE ONLY
OVERLOAD TRIP DEVICES ARE NOT SET AT THE FACTORY
TRIP DEVICES MUST BE SET DURING COMMISSIONING OF EQUIPMENT

UNIT SCHEDULE

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
P.O. NUMBER: S121374090

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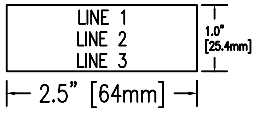
DATE 06/01/2023
PRODUCT CODE MCC
S.O. C00LF8H
REVISION 1
DWG SIZE

TITLE TAUNTON WWTF PH2 IMPROVEMENT
6MCC1
TYPE FREEDOM+ MCC
SCHEDULES
G.O. LBS0031682-001
DWG C00LF8H-N
SHEET 001

COEFtBL_R6

ID		DEVICE INFORMATION									PROTECTION INFO				UNIT DATA			TERMINATIONS					
SECTION NUMBER	CELL	CIRCUIT NAMEPLATE	DEVICE TYPE	DEVICE MOUNTING (SEE NOTES)	DEVICE SIZE	POLES	KAIC RATING (SEE NOTES)	BREAKER FRAME OR FUSE CLIP TYPE	RATING PLUG OR FUSE AMPS	BREAKER TRIP OR FUSE CLIP AMPS	STARTER SIZE	ACTUAL LOAD SIZE	FULL LOAD AMPS (SEE NOTES)	OVERLOAD	CPT SIZE	ADDITIONAL ACCESSORIES, FEATURES & NOTES	DEVICE SPACE REQ INCHES	CONTROL CABLE ENTRY DIRECTION	POWER CABLE ENTRY DIRECTION	TYPE (SEE NOTES)	PHASE SIZE	#PER PHASE	DETAILED DRAWING REFERENCE OR CATALOG NUMBER
1F	K	ASM-3251	FREEDOM+ FVNR STARTER F206	D		3	65K	HMCP		50A (150-500)	2	15HP	21.00	9-45A	100VA	SIZE 1&2, FVNR-100VA TYPICAL, W/EXTRA 50VA EATON MINI ETM, 9999.9, 120VAC 60HZ, ELAPSED TIME TIMER, 405AR, SOLID STATE, ON DELAY, 0-10 SEC, MIN, HR, 120VAC TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, MIXER ON LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, SEAL LEAK/TEMP LIGHT, 120VAC, XFMR TYPE, LED BULB, GREEN, MIXER OFF LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, HIGH/MOTOR TEMP RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE PUSHBUTTON, MOMENTARY, BLACK, SEAL LEAK/RESET PUSHBUTTON, MOMENTARY, BLACK, OVERTEMP/RESET	24	EITHER	EITHER	M	#12-6 AWG	1	C00LF8H-S003
1F	M		DOOR (FUTURE)														12						



NAMEPLATE FEATURES
COLOR: BLACK / WHITE LETTERS
SECURED WITH SCREWS
CHARACTER HEIGHT: 0.1875" [5mm]
CHARACTERS PER LINE: 17 MAXIMUM
(LINE 2 MAX 15 CHARACTERS)
NAMEPLATE SECURED VIA SELF TAPPING SCREWS
NOT TO SCALE

NOTES:

TERMINATIONS
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C = COMPRESSION TYPE, 2 HOLE MOUNTING, COPPER

DEVICE MOUNTING
F = FIXED MOUNTED
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KAIC RATING
RMS SYMMETRICAL INTERRUPTING RATING AT MAXIMUM OF RATED VOLTAGE

FULL LOAD AMPERES & HEATER SIZE
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VALUES FOR REFERENCE ONLY
OVERLOAD TRIP DEVICES ARE NOT SET AT THE FACTORY
TRIP DEVICES MUST BE SET DURING COMMISSIONING OF EQUIPMENT

UNIT SCHEDULE

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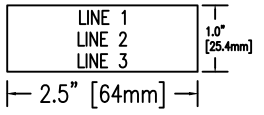
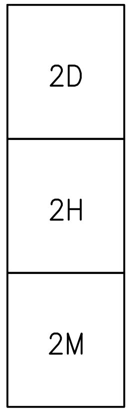
APPD FAY	DATE 06/01/2023	TITLE TAUNTON WWTF PH2 IMPROVEMENT 6MCC1	
PRODUCT CODE MCC	S.O. C00LF8H	TYPE FREEDOM+ MCC	SCHEDULES
REVISION 1	DWG SIZE	G.O. LBS0031682-001	DWG C00LF8H-N SHEET 002

COEFtBL_R6

ID		DEVICE INFORMATION									PROTECTION INFO				UNIT DATA			TERMINATIONS					
SECTION NUMBER	CELL	CIRCUIT NAMEPLATE	DEVICE TYPE	DEVICE MOUNTING (SEE NOTES)	DEVICE SIZE	POLES	KAIC RATING (SEE NOTES)	BREAKER FRAME OR FUSE CLIP TYPE	RATING PLUG OR FUSE AMPS	BREAKER TRIP OR FUSE CLIP AMPS	STARTER SIZE	ACTUAL LOAD SIZE	FULL LOAD AMPS (SEE NOTES)	OVERLOAD	CPT SIZE	ADDITIONAL ACCESSORIES, FEATURES & NOTES	DEVICE SPACE REQ INCHES	CONTROL CABLE ENTRY DIRECTION	POWER CABLE ENTRY DIRECTION	TYPE (SEE NOTES)	PHASE SIZE	#PER PHASE	DETAILED DRAWING REFERENCE OR CATALOG NUMBER
2F			VERTICAL BUS		600A																		
2F	D	ASM-3111	FREEDOM+ FVNR STARTER F206	D		3	65K	HMCPS		30A (90-300)	1	10HP	14.00	4-20A	100VA	SIZE 1&2, FVNR-100VA TYPICAL, W/EXTRA 50VA EATON MINI ETM, 9999.9, 120VAC 60HZ, ELAPSED TIME TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC TIMER, 405AR, SOLID STATE, ON DELAY, 0-10 SEC, MIN, HR, 120VAC TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, HIGH/MOTOR TEMP LIGHT, 120VAC, XFMR TYPE, LED BULB, GREEN, MIXER OFF LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, MIXER ON LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, SEAL LEAK/TEMP RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE PUSHBUTTON, MOMENTARY, BLACK, SEAL LEAK/RESET PUSHBUTTON, MOMENTARY, BLACK, OVERTEMP/RESET	24	EITHER	EITHER	M	#12-6 AWG	1	C00LF8H-S004





NAMEPLATE FEATURES
COLOR: BLACK / WHITE LETTERS
SECURED WITH SCREWS
CHARACTER HEIGHT: 0.1875" [5mm]
CHARACTERS PER LINE: 17 MAXIMUM
(LINE 2 MAX 15 CHARACTERS)
NAMEPLATE SECURED VIA SELF TAPPING SCREWS
NOT TO SCALE

NOTES:

TERMINATIONS
M = MECHANICAL CU/AL
C = COMPRESSION TYPE, 2 HOLE MOUNTING, COPPER

DEVICE MOUNTING
F = FIXED MOUNTED
D = DRAW-OUT MOUNTED
B = BOLTED IN

KAIC RATING
RMS SYMMETRICAL INTERRUPTING RATING AT MAXIMUM OF RATED VOLTAGE

FULL LOAD AMPERES & HEATER SIZE
THE FULL LOAD AMPS SHOWN ARE BASED ON STANDARD NEMA VALUES FOR REFERENCE ONLY
OVERLOAD TRIP DEVICES ARE NOT SET AT THE FACTORY
TRIP DEVICES MUST BE SET DURING COMMISSIONING OF EQUIPMENT

UNIT SCHEDULE

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
P.O. NUMBER: S121374090

Certified As-Built
This document accurately reflects the manufacturing details of this product when it shipped from the factory.

CAGE CODE 380H0

DFTR TLL
DATE 06/01/2023
APPD FAY
DATE 06/01/2023
PRODUCT CODE MCC
S.O. C00LF8H
REVISION 1
DWG SIZE

TITLE TAUNTON WWTF PH2 IMPROVEMENT
6MCC1
TYPE FREEDOM+ MCC
SCHEDULES
G.O. LBS0031682-001
DWG C00LF8H-N
SHEET 003

ID		DEVICE INFORMATION									PROTECTION INFO				UNIT DATA			TERMINATIONS					
SECTION NUMBER	CELL	CIRCUIT NAMEPLATE	DEVICE TYPE	DEVICE MOUNTING (SEE NOTES)	DEVICE SIZE	POLES	KAIC RATING (SEE NOTES)	BREAKER FRAME OR FUSE CLIP TYPE	RATING PLUG OR FUSE AMPS	BREAKER TRIP OR FUSE CLIP AMPS	STARTER SIZE	ACTUAL LOAD SIZE	FULL LOAD AMPS (SEE NOTES)	OVERLOAD	CPT SIZE	ADDITIONAL ACCESSORIES, FEATURES & NOTES	DEVICE SPACE REQ INCHES	CONTROL CABLE ENTRY DIRECTION	POWER CABLE ENTRY DIRECTION	TYPE (SEE NOTES)	PHASE SIZE	#PER PHASE	DETAILED DRAWING REFERENCE OR CATALOG NUMBER
2F	H	ASM–3112	FREEDOM+ FVNR STARTER F206	D		3	65K	HMCPS		30A (90–300)	1	10HP	14.00	4–20A	100VA	SIZE 1&2, FVNR–100VA TYPICAL, W/EXTRA 50VA EATON MINI ETM, 9999.9, 120VAC 60HZ, ELAPSED TIME TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC TIMER, 405AR, SOLID STATE, ON DELAY, 0–10 SEC, MIN, HR, 120VAC TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, HIGH/MOTOR TEMP LIGHT, 120VAC, XFMR TYPE, LED BULB, GREEN, MIXER OFF LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, MIXER ON LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, SEAL LEAK/TEMP RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE PUSHBUTTON, MOMENTARY, BLACK, SEAL LEAK/RESET PUSHBUTTON, MOMENTARY, BLACK, OVERTEMP/RESET	24	EITHER	EITHER	M	#12–6 AWG	1	COOLF8H–S005

LINE 1
LINE 2
LINE 3
1.0" [25.4mm]
2.5" [64mm]

NAMEPLATE FEATURES
COLOR: BLACK / WHITE LETTERS
SECURED WITH SCREWS
CHARACTER HEIGHT: 0.1875" [5mm]
CHARACTERS PER LINE: 17 MAXIMUM
(LINE 2 MAX 15 CHARACTERS)
NAMEPLATE SECURED VIA SELF TAPPING SCREWS
NOT TO SCALE

NOTES:

TERMINATIONS
M = MECHANICAL CU/AL
C = COMPRESSION TYPE, 2 HOLE MOUNTING, COPPER

DEVICE MOUNTING
F = FIXED MOUNTED
D = DRAW–OUT MOUNTED
B = BOLTED IN

KAIC RATING
RMS SYMMETRICAL INTERRUPTING RATING AT MAXIMUM OF RATED VOLTAGE

FULL LOAD AMPERES & HEATER SIZE
THE FULL LOAD AMPS SHOWN ARE BASED ON STANDARD NEMA VALUES FOR REFERENCE ONLY
OVERLOAD TRIP DEVICES ARE NOT SET AT THE FACTORY
TRIP DEVICES MUST BE SET DURING COMMISSIONING OF EQUIPMENT

UNIT SCHEDULE

NEG–ALT NUMBER: D7580427X2K2–C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
P.O. NUMBER: S121374090

Certified As-Built
This document accurately reflects the manufacturing details of this product when it shipped from the factory.

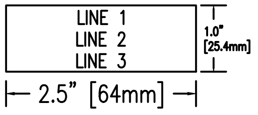
CAGE CODE 380H0

DFTR TLL
DATE 06/01/2023
APPD FAY
DATE 06/01/2023
PRODUCT CODE MCC
S.O. COOLF8H
REVISION 1
DWG SIZE

EATON

TITLE TAUNTON WWTF PH2 IMPROVEMENT
6MCC1
TYPE FREEDOM+ MCC
SCHEDULES
G.O. LBS0031682–001
DWG COOLF8H–N
SHEET 004

ID		DEVICE INFORMATION									PROTECTION INFO				UNIT DATA			TERMINATIONS					
SECTION NUMBER	CELL	CIRCUIT NAMEPLATE	DEVICE TYPE	DEVICE MOUNTING (SEE NOTES)	DEVICE SIZE	POLES	KAIC RATING (SEE NOTES)	BREAKER FRAME OR FUSE CLIP TYPE	RATING PLUG OR FUSE AMPS	BREAKER TRIP OR FUSE CLIP AMPS	STARTER SIZE	ACTUAL LOAD SIZE	FULL LOAD AMPS (SEE NOTES)	OVERLOAD	CPT SIZE	ADDITIONAL ACCESSORIES, FEATURES & NOTES	DEVICE SPACE REQ INCHES	CONTROL CABLE ENTRY DIRECTION	POWER CABLE ENTRY DIRECTION	TYPE (SEE NOTES)	PHASE SIZE	#PER PHASE	DETAILED DRAWING REFERENCE OR CATALOG NUMBER
2F	M	ASM-3113	FREEDOM+ FVNR STARTER F206	D		3	65K	HMCPS		30A (90-300)	1	10HP	14.00	4-20A	100VA	SIZE 1&2, FVNR-100VA TYPICAL, W/EXTRA 50VA EATON MINI ETM, 9999.9, 120VAC 60HZ, ELAPSED TIME TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC TIMER, 405AR, SOLID STATE, ON DELAY, 0-10 SEC, MIN, HR, 120VAC TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, HIGH/MOTOR TEMP LIGHT, 120VAC, XFMR TYPE, LED BULB, GREEN, MIXER OFF LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, MIXER ON LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, SEAL LEAK/TEMP RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE PUSHBUTTON, MOMENTARY, BLACK, SEAL LEAK/RESET PUSHBUTTON, MOMENTARY, BLACK, OVERTEMP/RESET	24	EITHER	EITHER	M	#12-6 AWG	1	C00LF8H-S006



NAMEPLATE FEATURES
COLOR: BLACK / WHITE LETTERS
SECURED WITH SCREWS
CHARACTER HEIGHT: 0.1875" [5mm]
CHARACTERS PER LINE: 17 MAXIMUM
(LINE 2 MAX 15 CHARACTERS)
NAMEPLATE SECURED VIA SELF TAPPING SCREWS
NOT TO SCALE

NOTES:

TERMINATIONS
M = MECHANICAL CU/AL
C = COMPRESSION TYPE, 2 HOLE MOUNTING, COPPER

DEVICE MOUNTING
F = FIXED MOUNTED
D = DRAW-OUT MOUNTED
B = BOLTED IN

KAIC RATING
RMS SYMMETRICAL INTERRUPTING RATING AT MAXIMUM OF RATED VOLTAGE

FULL LOAD AMPERES & HEATER SIZE
THE FULL LOAD AMPS SHOWN ARE BASED ON STANDARD NEMA VALUES FOR REFERENCE ONLY
OVERLOAD TRIP DEVICES ARE NOT SET AT THE FACTORY
TRIP DEVICES MUST BE SET DURING COMMISSIONING OF EQUIPMENT

UNIT SCHEDULE

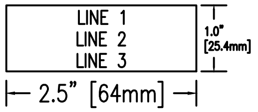
NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
P.O. NUMBER: S121374090

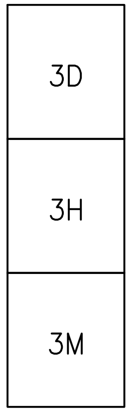
Certified As-Built
This document accurately reflects the manufacturing details of this product when it shipped from the factory.

CAGE CODE 380H0

DFTR TLL	DATE 06/01/2023	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.	EATON
APPD FAY	DATE 06/01/2023	TITLE TAUNTON WWTF PH2 IMPROVEMENT 6MCC1	
PRODUCT CODE MCC	S.O. C00LF8H	TYPE FREEDOM+ MCC	SCHEDULES
REVISION 1	DWG SIZE	G.O. LBS0031682-001	DWG C00LF8H-N SHEET 005

ID		DEVICE INFORMATION									PROTECTION INFO				UNIT DATA			TERMINATIONS					
SECTION NUMBER	CELL	CIRCUIT NAMEPLATE	DEVICE TYPE	DEVICE MOUNTING (SEE NOTES)	DEVICE SIZE	POLES	KAIC RATING (SEE NOTES)	BREAKER FRAME OR FUSE CLIP TYPE	RATING PLUG OR FUSE AMPS	BREAKER TRIP OR FUSE CLIP AMPS	STARTER SIZE	ACTUAL LOAD SIZE	FULL LOAD AMPS (SEE NOTES)	OVERLOAD	CPT SIZE	ADDITIONAL ACCESSORIES, FEATURES & NOTES	DEVICE SPACE REQ INCHES	CONTROL CABLE ENTRY DIRECTION	POWER CABLE ENTRY DIRECTION	TYPE (SEE NOTES)	PHASE SIZE	#PER PHASE	DETAILED DRAWING REFERENCE OR CATALOG NUMBER
3F			VERTICAL BUS		600A																		
3F	D	ASM–3211	FREEDOM+ FVNR STARTER F206	D		3	65K	HMCPS		30A (90–300)	1	10HP	14.00	4–20A	100VA	SIZE 1&2, FVNR–100VA TYPICAL, W/EXTRA 50VA EATON MINI ETM, 9999.9, 120VAC 60HZ, ELAPSED TIME TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC TIMER, 405AR, SOLID STATE, ON DELAY, 0–10 SEC, MIN, HR, 120VAC TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, HIGH/MOTOR TEMP LIGHT, 120VAC, XFMR TYPE, LED BULB, GREEN, MIXER OFF LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, MIXER ON LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, SEAL LEAK/TEMP RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE PUSHBUTTON, MOMENTARY, BLACK, SEAL LEAK/RESET PUSHBUTTON, MOMENTARY, BLACK, OVERTEMP/RESET	24	EITHER	EITHER	M	#12–6 AWG	1	C00LF8H–S007





NAMEPLATE FEATURES
COLOR: BLACK / WHITE LETTERS
SECURED WITH SCREWS
CHARACTER HEIGHT: 0.1875" [5mm]
CHARACTERS PER LINE: 17 MAXIMUM
(LINE 2 MAX 15 CHARACTERS)
NAMEPLATE SECURED VIA SELF TAPPING SCREWS
NOT TO SCALE

NOTES:

TERMINATIONS
M = MECHANICAL CU/AL
C = COMPRESSION TYPE, 2 HOLE MOUNTING, COPPER

DEVICE MOUNTING
F = FIXED MOUNTED
D = DRAW–OUT MOUNTED
B = BOLTED IN

KAIC RATING
RMS SYMMETRICAL INTERRUPTING RATING AT MAXIMUM OF RATED VOLTAGE

FULL LOAD AMPERES & HEATER SIZE
THE FULL LOAD AMPS SHOWN ARE BASED ON STANDARD NEMA VALUES FOR REFERENCE ONLY
OVERLOAD TRIP DEVICES ARE NOT SET AT THE FACTORY
TRIP DEVICES MUST BE SET DURING COMMISSIONING OF EQUIPMENT

UNIT SCHEDULE

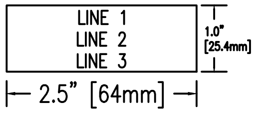
NEG–ALT NUMBER: D7580427X2K2–C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
P.O. NUMBER: S121374090

Certified As-Built
This document accurately reflects the manufacturing details of this product when it shipped from the factory.

CAGE CODE 380H0

DFTR TLL	DATE 06/01/2023	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.	EATON
APPD FAY	DATE 06/01/2023	TITLE TAUNTON WWTF PH2 IMPROVEMENT 6MCC1	
PRODUCT CODE MCC	S.O. C00LF8H	TYPE FREEDOM+ MCC	SCHEDULES
REVISION 1	DWG SIZE	G.O. LBS0031682–001	DWG C00LF8H–N SHEET 006

ID		DEVICE INFORMATION									PROTECTION INFO				UNIT DATA			TERMINATIONS					
SECTION NUMBER	CELL	CIRCUIT NAMEPLATE	DEVICE TYPE	DEVICE MOUNTING (SEE NOTES)	DEVICE SIZE	POLES	KAIC RATING (SEE NOTES)	BREAKER FRAME OR FUSE CLIP TYPE	RATING PLUG OR FUSE AMPS	BREAKER TRIP OR FUSE CLIP AMPS	STARTER SIZE	ACTUAL LOAD SIZE	FULL LOAD AMPS (SEE NOTES)	OVERLOAD	CPT SIZE	ADDITIONAL ACCESSORIES, FEATURES & NOTES	DEVICE SPACE REQ INCHES	CONTROL CABLE ENTRY DIRECTION	POWER CABLE ENTRY DIRECTION	TYPE (SEE NOTES)	PHASE SIZE	#PER PHASE	DETAILED DRAWING REFERENCE OR CATALOG NUMBER
3F	H	ASM-3212	FREEDOM+ FVNR STARTER F206	D		3	65K	HMCPS		30A (90-300)	1	10HP	14.00	4-20A	100VA	SIZE 1&2, FVNR-100VA TYPICAL, W/EXTRA 50VA EATON MINI ETM, 9999.9, 120VAC 60HZ, ELAPSED TIME TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC TIMER, 405AR, SOLID STATE, ON DELAY, 0-10 SEC, MIN, HR, 120VAC TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, HIGH/MOTOR TEMP LIGHT, 120VAC, XFMR TYPE, LED BULB, GREEN, MIXER OFF LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, MIXER ON LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, SEAL LEAK/TEMP RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE PUSHBUTTON, MOMENTARY, BLACK, SEAL LEAK/RESET PUSHBUTTON, MOMENTARY, BLACK, OVERTEMP/RESET	24	EITHER	EITHER	M	#12-6 AWG	1	C00LF8H-S008



NAMEPLATE FEATURES
COLOR: BLACK / WHITE LETTERS
SECURED WITH SCREWS
CHARACTER HEIGHT: 0.1875" [5mm]
CHARACTERS PER LINE: 17 MAXIMUM
(LINE 2 MAX 15 CHARACTERS)
NAMEPLATE SECURED VIA SELF TAPPING SCREWS
NOT TO SCALE

NOTES:

TERMINATIONS
M = MECHANICAL CU/AL
C = COMPRESSION TYPE, 2 HOLE MOUNTING, COPPER

DEVICE MOUNTING
F = FIXED MOUNTED
D = DRAW-OUT MOUNTED
B = BOLTED IN

KAIC RATING
RMS SYMMETRICAL INTERRUPTING RATING AT MAXIMUM OF RATED VOLTAGE

FULL LOAD AMPERES & HEATER SIZE
THE FULL LOAD AMPS SHOWN ARE BASED ON STANDARD NEMA VALUES FOR REFERENCE ONLY
OVERLOAD TRIP DEVICES ARE NOT SET AT THE FACTORY
TRIP DEVICES MUST BE SET DURING COMMISSIONING OF EQUIPMENT

UNIT SCHEDULE

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
P.O. NUMBER: S121374090

Certified As-Built
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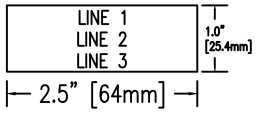
CAGE CODE 380H0

DFTR TLL
DATE 06/01/2023
APPD FAY
DATE 06/01/2023
PRODUCT CODE MCC
S.O. C00LF8H
REVISION 1
DWG SIZE

EATON

TITLE TAUNTON WWTF PH2 IMPROVEMENT
6MCC1
TYPE FREEDOM+ MCC
SCHEDULES
G.O. LBS0031682-001
DWG C00LF8H-N
SHEET 007

ID		DEVICE INFORMATION									PROTECTION INFO				UNIT DATA			TERMINATIONS					
SECTION NUMBER	CELL	CIRCUIT NAMEPLATE	DEVICE TYPE	DEVICE MOUNTING (SEE NOTES)	DEVICE SIZE	POLES	KAIC RATING (SEE NOTES)	BREAKER FRAME OR FUSE CLIP TYPE	RATING PLUG OR FUSE AMPS	BREAKER TRIP OR FUSE CLIP AMPS	STARTER SIZE	ACTUAL LOAD SIZE	FULL LOAD AMPS (SEE NOTES)	OVERLOAD	CPT SIZE	ADDITIONAL ACCESSORIES, FEATURES & NOTES	DEVICE SPACE REQ INCHES	CONTROL CABLE ENTRY DIRECTION	POWER CABLE ENTRY DIRECTION	TYPE (SEE NOTES)	PHASE SIZE	#PER PHASE	DETAILED DRAWING REFERENCE OR CATALOG NUMBER
3F	M	ASM-3213	FREEDOM+ FVNR STARTER F206	D		3	65K	HMCPS		30A (90-300)	1	10HP	14.00	4-20A	100VA	SIZE 1&2, FVNR-100VA TYPICAL, W/EXTRA 50VA EATON MINI ETM, 9999.9, 120VAC 60HZ, ELAPSED TIME TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC TIMER, 405AR, SOLID STATE, ON DELAY, 0-10 SEC, MIN, HR, 120VAC TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, HIGH/MOTOR TEMP LIGHT, 120VAC, XFMR TYPE, LED BULB, GREEN, MIXER OFF LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, MIXER ON LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, SEAL LEAK/TEMP RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE PUSHBUTTON, MOMENTARY, BLACK, SEAL LEAK/RESET PUSHBUTTON, MOMENTARY, BLACK, OVERTEMP/RESET	24	EITHER	EITHER	M	#12-6 AWG	1	C00LF8H-S009



NAMEPLATE FEATURES
COLOR: BLACK / WHITE LETTERS
SECURED WITH SCREWS
CHARACTER HEIGHT: 0.1875" [5mm]
CHARACTERS PER LINE: 17 MAXIMUM
(LINE 2 MAX 15 CHARACTERS)
NAMEPLATE SECURED VIA SELF TAPPING SCREWS
NOT TO SCALE

NOTES:

TERMINATIONS
M = MECHANICAL CU/AL
C = COMPRESSION TYPE, 2 HOLE MOUNTING, COPPER

DEVICE MOUNTING
F = FIXED MOUNTED
D = DRAW-OUT MOUNTED
B = BOLTED IN

KAIC RATING
RMS SYMMETRICAL INTERRUPTING RATING AT MAXIMUM OF RATED VOLTAGE

FULL LOAD AMPERES & HEATER SIZE
THE FULL LOAD AMPS SHOWN ARE BASED ON STANDARD NEMA VALUES FOR REFERENCE ONLY
OVERLOAD TRIP DEVICES ARE NOT SET AT THE FACTORY
TRIP DEVICES MUST BE SET DURING COMMISSIONING OF EQUIPMENT

UNIT SCHEDULE

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
P.O. NUMBER: S121374090

Certified As-Built
This document accurately reflects the manufacturing details of this product when it shipped from the factory.

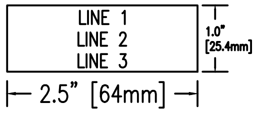
CAGE CODE 380H0

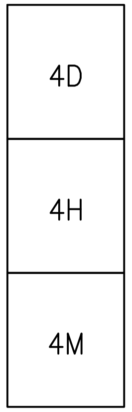
DFTR TLL
DATE 06/01/2023
APPD FAY
DATE 06/01/2023
PRODUCT CODE MCC
S.O. C00LF8H
REVISION 1
DWG SIZE

EATON

TITLE TAUNTON WWTF PH2 IMPROVEMENT
6MCC1
TYPE FREEDOM+ MCC
SCHEDULES
G.O. LBS0031682-001
DWG C00LF8H-N
SHEET 008

ID		DEVICE INFORMATION									PROTECTION INFO				UNIT DATA			TERMINATIONS					
SECTION NUMBER	CELL	CIRCUIT NAMEPLATE	DEVICE TYPE	DEVICE MOUNTING (SEE NOTES)	DEVICE SIZE	POLES	KAIC RATING (SEE NOTES)	BREAKER FRAME OR FUSE CLIP TYPE	RATING PLUG OR FUSE AMPS	BREAKER TRIP OR FUSE CLIP AMPS	STARTER SIZE	ACTUAL LOAD SIZE	FULL LOAD AMPS (SEE NOTES)	OVERLOAD	CPT SIZE	ADDITIONAL ACCESSORIES, FEATURES & NOTES	DEVICE SPACE REQ INCHES	CONTROL CABLE ENTRY DIRECTION	POWER CABLE ENTRY DIRECTION	TYPE (SEE NOTES)	PHASE SIZE	#PER PHASE	DETAILED DRAWING REFERENCE OR CATALOG NUMBER
4F			VERTICAL BUS		600A																		
4F	D	ASM-3131	FREEDOM+ FVNR STARTER F206	D		3	65K	HMCPS		30A (90-300)	1	10HP	14.00	4-20A	100VA	SIZE 1&2, FVNR-100VA TYPICAL, W/EXTRA 50VA EATON MINI ETM, 9999.9, 120VAC 60HZ, ELAPSED TIME TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC TIMER, 405AR, SOLID STATE, ON DELAY, 0-10 SEC, MIN, HR, 120VAC TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, HIGH/MOTOR TEMP LIGHT, 120VAC, XFMR TYPE, LED BULB, GREEN, MIXER OFF LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, MIXER ON LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, SEAL LEAK/TEMP RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE PUSHBUTTON, MOMENTARY, BLACK, SEAL LEAK/RESET PUSHBUTTON, MOMENTARY, BLACK, OVERTEMP/RESET	24	EITHER	EITHER	M	#12-6 AWG	1	C00LF8H-S010





NAMEPLATE FEATURES
COLOR: BLACK / WHITE LETTERS
SECURED WITH SCREWS
CHARACTER HEIGHT: 0.1875" [5mm]
CHARACTERS PER LINE: 17 MAXIMUM
(LINE 2 MAX 15 CHARACTERS)
NAMEPLATE SECURED VIA SELF TAPPING SCREWS
NOT TO SCALE

NOTES:

TERMINATIONS
M = MECHANICAL CU/AL
C = COMPRESSION TYPE, 2 HOLE MOUNTING, COPPER

DEVICE MOUNTING
F = FIXED MOUNTED
D = DRAW-OUT MOUNTED
B = BOLTED IN

KAIC RATING
RMS SYMMETRICAL INTERRUPTING RATING AT MAXIMUM OF RATED VOLTAGE

FULL LOAD AMPERES & HEATER SIZE
THE FULL LOAD AMPS SHOWN ARE BASED ON STANDARD NEMA
VALUES FOR REFERENCE ONLY
OVERLOAD TRIP DEVICES ARE NOT SET AT THE FACTORY
TRIP DEVICES MUST BE SET DURING COMMISSIONING OF EQUIPMENT

UNIT SCHEDULE

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
P.O. NUMBER: S121374090

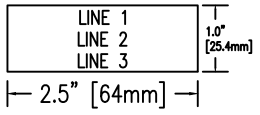
Certified As-Built
This document accurately reflects the manufacturing details of this product when it shipped from the factory.

CAGE CODE 380H0

DFTR TLL	DATE 06/01/2023	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.	EATON
APPD FAY	DATE 06/01/2023	TITLE TAUNTON WWTF PH2 IMPROVEMENT 6MCC1	
PRODUCT CODE MCC	S.O. C00LF8H	TYPE FREEDOM+ MCC	SCHEDULES
REVISION 1	DWG SIZE	G.O. LBS0031682-001	DWG C00LF8H-N SHEET 009

COEFtBL_R6

ID		DEVICE INFORMATION									PROTECTION INFO				UNIT DATA			TERMINATIONS					
SECTION NUMBER	CELL	CIRCUIT NAMEPLATE	DEVICE TYPE	DEVICE MOUNTING (SEE NOTES)	DEVICE SIZE	POLES	KAIC RATING (SEE NOTES)	BREAKER FRAME OR FUSE CLIP TYPE	RATING PLUG OR FUSE AMPS	BREAKER TRIP OR FUSE CLIP AMPS	STARTER SIZE	ACTUAL LOAD SIZE	FULL LOAD AMPS (SEE NOTES)	OVERLOAD	CPT SIZE	ADDITIONAL ACCESSORIES, FEATURES & NOTES	DEVICE SPACE REQ INCHES	CONTROL CABLE ENTRY DIRECTION	POWER CABLE ENTRY DIRECTION	TYPE (SEE NOTES)	PHASE SIZE	#PER PHASE	DETAILED DRAWING REFERENCE OR CATALOG NUMBER
4F	H	ASM-3132	FREEDOM+ FVNR STARTER F206	D		3	65K	HMCPS		30A (90-300)	1	10HP	14.00	4-20A	100VA	SIZE 1&2, FVNR-100VA TYPICAL, W/EXTRA 50VA EATON MINI ETM, 9999.9, 120VAC 60HZ, ELAPSED TIME TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC TIMER, 405AR, SOLID STATE, ON DELAY, 0-10 SEC, MIN, HR, 120VAC TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, HIGH/MOTOR TEMP LIGHT, 120VAC, XFMR TYPE, LED BULB, GREEN, MIXER OFF LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, MIXER ON LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, SEAL LEAK/TEMP RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE PUSHBUTTON, MOMENTARY, BLACK, SEAL LEAK/RESET PUSHBUTTON, MOMENTARY, BLACK, OVERTEMP/RESET	24	EITHER	EITHER	M	#12-6 AWG	1	COOLF8H-S011



NAMEPLATE FEATURES
COLOR: BLACK / WHITE LETTERS
SECURED WITH SCREWS
CHARACTER HEIGHT: 0.1875" [5mm]
CHARACTERS PER LINE: 17 MAXIMUM
(LINE 2 MAX 15 CHARACTERS)
NAMEPLATE SECURED VIA SELF TAPPING SCREWS
NOT TO SCALE

NOTES:

TERMINATIONS
M = MECHANICAL CU/AL
C = COMPRESSION TYPE, 2 HOLE MOUNTING, COPPER

DEVICE MOUNTING
F = FIXED MOUNTED
D = DRAW-OUT MOUNTED
B = BOLTED IN

KAIC RATING
RMS SYMMETRICAL INTERRUPTING RATING AT MAXIMUM OF RATED VOLTAGE

FULL LOAD AMPERES & HEATER SIZE
THE FULL LOAD AMPS SHOWN ARE BASED ON STANDARD NEMA VALUES FOR REFERENCE ONLY
OVERLOAD TRIP DEVICES ARE NOT SET AT THE FACTORY
TRIP DEVICES MUST BE SET DURING COMMISSIONING OF EQUIPMENT

UNIT SCHEDULE

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
P.O. NUMBER: S121374090

Certified As-Built
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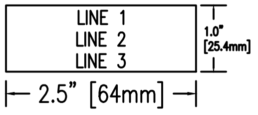
CAGE CODE 380H0

DFTR TLL
DATE 06/01/2023
APPD FAY
DATE 06/01/2023
PRODUCT CODE MCC
S.O. COOLF8H
REVISION 1
DWG SIZE

TITLE TAUNTON WWTF PH2 IMPROVEMENT
6MCC1
TYPE FREEDOM+ MCC
SCHEDULES
G.O. LBS0031682-001
DWG COOLF8H-N
SHEET 010

COEFtBL_R6

ID		DEVICE INFORMATION									PROTECTION INFO				UNIT DATA			TERMINATIONS					
SECTION NUMBER	CELL	CIRCUIT NAMEPLATE	DEVICE TYPE	DEVICE MOUNTING (SEE NOTES)	DEVICE SIZE	POLES	KAIC RATING (SEE NOTES)	BREAKER FRAME OR FUSE CLIP TYPE	RATING PLUG OR FUSE AMPS	BREAKER TRIP OR FUSE CLIP AMPS	STARTER SIZE	ACTUAL LOAD SIZE	FULL LOAD AMPS (SEE NOTES)	OVERLOAD	CPT SIZE	ADDITIONAL ACCESSORIES, FEATURES & NOTES	DEVICE SPACE REQ INCHES	CONTROL CABLE ENTRY DIRECTION	POWER CABLE ENTRY DIRECTION	TYPE (SEE NOTES)	PHASE SIZE	#PER PHASE	DETAILED DRAWING REFERENCE OR CATALOG NUMBER
4F	M	ASM-3231	FREEDOM+ FVNR STARTER F206	D		3	65K	HMCPS		30A (90-300)	1	10HP	14.00	4-20A	100VA	SIZE 1&2, FVNR-100VA TYPICAL, W/EXTRA 50VA EATON MINI ETM, 9999.9, 120VAC 60HZ, ELAPSED TIME TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC TIMER, 405AR, SOLID STATE, ON DELAY, 0-10 SEC, MIN, HR, 120VAC TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, HIGH/MOTOR TEMP LIGHT, 120VAC, XFMR TYPE, LED BULB, GREEN, MIXER OFF LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, MIXER ON LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, SEAL LEAK/TEMP RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE PUSHBUTTON, MOMENTARY, BLACK, SEAL LEAK/RESET PUSHBUTTON, MOMENTARY, BLACK, OVERTEMP/RESET	24	EITHER	EITHER	M	#12-6 AWG	1	COOLF8H-S012



NAMEPLATE FEATURES
COLOR: BLACK / WHITE LETTERS
SECURED WITH SCREWS
CHARACTER HEIGHT: 0.1875" [5mm]
CHARACTERS PER LINE: 17 MAXIMUM
(LINE 2 MAX 15 CHARACTERS)
NAMEPLATE SECURED VIA SELF TAPPING SCREWS
NOT TO SCALE

NOTES:

TERMINATIONS
M = MECHANICAL CU/AL
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DEVICE MOUNTING
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B = BOLTED IN

KAIC RATING
RMS SYMMETRICAL INTERRUPTING RATING AT MAXIMUM OF RATED VOLTAGE

FULL LOAD AMPERES & HEATER SIZE
THE FULL LOAD AMPS SHOWN ARE BASED ON STANDARD NEMA VALUES FOR REFERENCE ONLY
OVERLOAD TRIP DEVICES ARE NOT SET AT THE FACTORY
TRIP DEVICES MUST BE SET DURING COMMISSIONING OF EQUIPMENT

UNIT SCHEDULE

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
P.O. NUMBER: S121374090

Certified As-Built
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CAGE CODE 380H0

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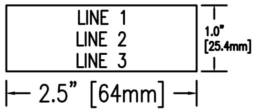
APPD FAY	DATE 06/01/2023	TITLE TAUNTON WWTF PH2 IMPROVEMENT 6MCC1	
PRODUCT CODE MCC	S.O. COOLF8H	TYPE FREEDOM+ MCC	SCHEDULES
REVISION 1	DWG SIZE	G.O. LBS0031682-001	DWG COOLF8H-N SHEET 011

ID		DEVICE INFORMATION									PROTECTION INFO				UNIT DATA			TERMINATIONS					
SECTION NUMBER	CELL	CIRCUIT NAMEPLATE	DEVICE TYPE	DEVICE MOUNTING (SEE NOTES)	DEVICE SIZE	POLES	KAIC RATING (SEE NOTES)	BREAKER FRAME OR FUSE CLIP TYPE	RATING PLUG OR FUSE AMPS	BREAKER TRIP OR FUSE CLIP AMPS	STARTER SIZE	ACTUAL LOAD SIZE	FULL LOAD AMPS (SEE NOTES)	OVERLOAD	CPT SIZE	ADDITIONAL ACCESSORIES, FEATURES & NOTES	DEVICE SPACE REQ INCHES	CONTROL CABLE ENTRY DIRECTION	POWER CABLE ENTRY DIRECTION	TYPE (SEE NOTES)	PHASE SIZE	#PER PHASE	DETAILED DRAWING REFERENCE OR CATALOG NUMBER
5F			VERTICAL BUS		600A																		
5F	D	ASM-3232	FREEDOM+ FVNR STARTER F206	D		3	65K	HMCPS		30A (90-300)	1	10HP	14.00	4-20A	100VA	SIZE 1&2, FVNR-100VA TYPICAL, W/EXTRA 50VA EATON MINI ETM, 9999.9, 120VAC 60HZ, ELAPSED TIME TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC TIMER, 405AR, SOLID STATE, ON DELAY, 0-10 SEC, MIN, HR, 120VAC TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, HIGH/MOTOR TEMP LIGHT, 120VAC, XFMR TYPE, LED BULB, GREEN, MIXER OFF LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, MIXER ON LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, SEAL LEAK/TEMP RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE PUSHBUTTON, MOMENTARY, BLACK, SEAL LEAK/RESET PUSHBUTTON, MOMENTARY, BLACK, OVERTEMP/RESET	24	EITHER	EITHER	M	#12-6 AWG	1	COOLF8H-S013



5D

5G

5K

5M

NAMEPLATE FEATURES
COLOR: BLACK / WHITE LETTERS
SECURED WITH SCREWS
CHARACTER HEIGHT: 0.1875" [5mm]
CHARACTERS PER LINE: 17 MAXIMUM
(LINE 2 MAX 15 CHARACTERS)
NAMEPLATE SECURED VIA SELF TAPPING SCREWS
NOT TO SCALE

NOTES:

TERMINATIONS
M = MECHANICAL CU/AL
C = COMPRESSION TYPE, 2 HOLE MOUNTING, COPPER

DEVICE MOUNTING
F = FIXED MOUNTED
D = DRAW-OUT MOUNTED
B = BOLTED IN

KAIC RATING
RMS SYMMETRICAL INTERRUPTING RATING AT MAXIMUM OF RATED VOLTAGE

FULL LOAD AMPERES & HEATER SIZE
THE FULL LOAD AMPS SHOWN ARE BASED ON STANDARD NEMA
VALUES FOR REFERENCE ONLY
OVERLOAD TRIP DEVICES ARE NOT SET AT THE FACTORY
TRIP DEVICES MUST BE SET DURING COMMISSIONING OF EQUIPMENT

UNIT SCHEDULE

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
P.O. NUMBER: S121374090

Certified As-Built
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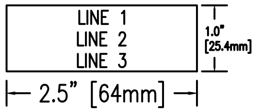
CAGE CODE 380H0

DFTR TLL	DATE 06/01/2023	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.	EATON
APPD FAY	DATE 06/01/2023	TITLE TAUNTON WWTF PH2 IMPROVEMENT 6MCC1	
PRODUCT CODE MCC	S.O. COOLF8H	TYPE FREEDOM+ MCC	SCHEDULES
REVISION 1	DWG SIZE	G.O. LBS0031682-001	DWG COOLF8H-N SHEET 012

COEFtBL_R6

ID		DEVICE INFORMATION									PROTECTION INFO				UNIT DATA			TERMINATIONS					
SECTION NUMBER	CELL	CIRCUIT NAMEPLATE	DEVICE TYPE	DEVICE MOUNTING (SEE NOTES)	DEVICE SIZE	POLES	KAIC RATING (SEE NOTES)	BREAKER FRAME OR FUSE CLIP TYPE	RATING PLUG OR FUSE AMPS	BREAKER TRIP OR FUSE CLIP AMPS	STARTER SIZE	ACTUAL LOAD SIZE	FULL LOAD AMPS (SEE NOTES)	OVERLOAD	CPT SIZE	ADDITIONAL ACCESSORIES, FEATURES & NOTES	DEVICE SPACE REQ INCHES	CONTROL CABLE ENTRY DIRECTION	POWER CABLE ENTRY DIRECTION	TYPE (SEE NOTES)	PHASE SIZE	#PER PHASE	DETAILED DRAWING REFERENCE OR CATALOG NUMBER
5F	G	RAB–3144	FREEDOM+ FVNR STARTER F206	D		3	65K	HMCPS		15A (45–150)	1	5HP	7.60	4–20A	100VA	SIZE 1&2, FVNR–100VA TYPICAL, W/EXTRA 50VA TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC TIMER, 405AR, SOLID STATE, ON DELAY, 0–10 SEC, MIN, HR, 120VAC LIGHT, 120VAC, XFMR TYPE, LED BULB RED, HIGH MOTOR TEMP LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, BLOWER ON LIGHT, 120VAC, XFMR TYPE, LED BULB, GREEN, BLOWER OFF RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE PUSHBUTTON, MOMENTARY, BLACK, OVERTEMP/RESET	18	EITHER	EITHER	M	#12–6 AWG	1	COOLF8H–S014
5F	K	RAB–3145	FREEDOM+ FVNR STARTER F206	D		3	65K	HMCPS		15A (45–150)	1	5HP	7.60	4–20A	100VA	SIZE 1&2, FVNR–100VA TYPICAL, W/EXTRA 50VA TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC TIMER, 405AR, SOLID STATE, ON DELAY, 0–10 SEC, MIN, HR, 120VAC LIGHT, 120VAC, XFMR TYPE, LED BULB RED, HIGH MOTOR TEMP LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, BLOWER ON LIGHT, 120VAC, XFMR TYPE, LED BULB, GREEN, BLOWER OFF RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE PUSHBUTTON, MOMENTARY, BLACK, OVERTEMP/RESET	18	EITHER	EITHER	M	#12–6 AWG	1	COOLF8H–S015
5F	M		DOOR (FUTURE)														12						



NAMEPLATE FEATURES
COLOR: BLACK / WHITE LETTERS
SECURED WITH SCREWS
CHARACTER HEIGHT: 0.1875" [5mm]
CHARACTERS PER LINE: 17 MAXIMUM
(LINE 2 MAX 15 CHARACTERS)
NAMEPLATE SECURED VIA SELF TAPPING SCREWS
NOT TO SCALE

NOTES:

TERMINATIONS
M = MECHANICAL CU/AL
C = COMPRESSION TYPE, 2 HOLE MOUNTING, COPPER

DEVICE MOUNTING
F = FIXED MOUNTED
D = DRAW–OUT MOUNTED
B = BOLTED IN

KAIC RATING
RMS SYMMETRICAL INTERRUPTING RATING AT MAXIMUM OF RATED VOLTAGE

FULL LOAD AMPERES & HEATER SIZE
THE FULL LOAD AMPS SHOWN ARE BASED ON STANDARD NEMA VALUES FOR REFERENCE ONLY
OVERLOAD TRIP DEVICES ARE NOT SET AT THE FACTORY
TRIP DEVICES MUST BE SET DURING COMMISSIONING OF EQUIPMENT

UNIT SCHEDULE

NEG–ALT NUMBER: D7580427X2K2–C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
P.O. NUMBER: S121374090

Certified As-Built
This document accurately reflects the manufacturing details of this product when it shipped from the factory.

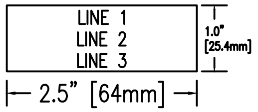
CAGE CODE 380H0

DFTR TLL
DATE 06/01/2023
APPD FAY
DATE 06/01/2023
PRODUCT CODE MCC
S.O. COOLF8H
REVISION 1
DWG SIZE

EATON

TITLE TAUNTON WWTF PH2 IMPROVEMENT
6MCC1
TYPE FREEDOM+ MCC
SCHEDULES
G.O. LBS0031682–001
DWG COOLF8H–N
SHEET 013

ID		DEVICE INFORMATION									PROTECTION INFO				UNIT DATA			TERMINATIONS					
SECTION NUMBER	CELL	CIRCUIT NAMEPLATE	DEVICE TYPE	DEVICE MOUNTING (SEE NOTES)	DEVICE SIZE	POLES	KAIC RATING (SEE NOTES)	BREAKER FRAME OR FUSE CLIP TYPE	RATING PLUG OR FUSE AMPS	BREAKER TRIP OR FUSE CLIP AMPS	STARTER SIZE	ACTUAL LOAD SIZE	FULL LOAD AMPS (SEE NOTES)	OVERLOAD	CPT SIZE	ADDITIONAL ACCESSORIES, FEATURES & NOTES	DEVICE SPACE REQ INCHES	CONTROL CABLE ENTRY DIRECTION	POWER CABLE ENTRY DIRECTION	TYPE (SEE NOTES)	PHASE SIZE	#PER PHASE	DETAILED DRAWING REFERENCE OR CATALOG NUMBER
6F			VERTICAL BUS		600A																		
6F	C	RAB-3146	FREEDOM+ FVNR STARTER F206	D		3	65K	HMCPS		15A (45-150)	1	5HP	7.60	4-20A	100VA	SIZE 1&2, FVNR-100VA TYPICAL, W/EXTRA 50VA TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC TIMER, 405AR, SOLID STATE, ON DELAY, 0-10 SEC, MIN, HR, 120VAC LIGHT, 120VAC, XFMR TYPE, LED BULB RED, HIGH MOTOR TEMP LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, BLOWER ON LIGHT, 120VAC, XFMR TYPE, LED BULB, GREEN, BLOWER OFF RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE PUSHBUTTON, MOMENTARY, BLACK, OVERTEMP/RESET	18	EITHER	EITHER	M	#12-6 AWG	1	C00LF8H-S016
6F	F	RAB-3244	FREEDOM+ FVNR STARTER F206	D		3	65K	HMCPS		15A (45-150)	1	5HP	7.60	4-20A	100VA	SIZE 1&2, FVNR-100VA TYPICAL, W/EXTRA 50VA TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC TIMER, 405AR, SOLID STATE, ON DELAY, 0-10 SEC, MIN, HR, 120VAC LIGHT, 120VAC, XFMR TYPE, LED BULB RED, HIGH MOTOR TEMP LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, BLOWER ON LIGHT, 120VAC, XFMR TYPE, LED BULB, GREEN, BLOWER OFF RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE PUSHBUTTON, MOMENTARY, BLACK, OVERTEMP/RESET	18	EITHER	EITHER	M	#12-6 AWG	1	C00LF8H-S017



6C
6F
6J
6M

NAMEPLATE FEATURES
COLOR: BLACK / WHITE LETTERS
SECURED WITH SCREWS
CHARACTER HEIGHT: 0.1875" [5mm]
CHARACTERS PER LINE: 17 MAXIMUM
(LINE 2 MAX 15 CHARACTERS)
NAMEPLATE SECURED VIA SELF TAPPING SCREWS
NOT TO SCALE

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UNIT SCHEDULE

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
P.O. NUMBER: S121374090

Certified As-Built
This document accurately reflects the manufacturing details of this product when it shipped from the factory.

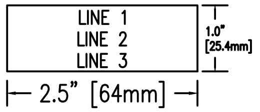
CAGE CODE 380H0

DFTR TLL
DATE 06/01/2023
APPD FAY
DATE 06/01/2023
PRODUCT CODE MCC
S.O. C00LF8H
REVISION 1
DWG SIZE

EATON

TITLE TAUNTON WWTF PH2 IMPROVEMENT
6MCC1
TYPE FREEDOM+ MCC
SCHEDULES
G.O. LBS0031682-001
DWG C00LF8H-N
SHEET 014

ID		DEVICE INFORMATION									PROTECTION INFO				UNIT DATA			TERMINATIONS					
SECTION NUMBER	CELL	CIRCUIT NAMEPLATE	DEVICE TYPE	DEVICE MOUNTING (SEE NOTES)	DEVICE SIZE	POLES	KAIC RATING (SEE NOTES)	BREAKER FRAME OR FUSE CLIP TYPE	RATING PLUG OR FUSE AMPS	BREAKER TRIP OR FUSE CLIP AMPS	STARTER SIZE	ACTUAL LOAD SIZE	FULL LOAD AMPS (SEE NOTES)	OVERLOAD	CPT SIZE	ADDITIONAL ACCESSORIES, FEATURES & NOTES	DEVICE SPACE REQ INCHES	CONTROL CABLE ENTRY DIRECTION	POWER CABLE ENTRY DIRECTION	TYPE (SEE NOTES)	PHASE SIZE	#PER PHASE	DETAILED DRAWING REFERENCE OR CATALOG NUMBER
6F	J	RAB-3245	FREEDOM+ FVNR STARTER F206	D		3	65K	HMCPS		15A (45-150)	1	5HP	7.60	4-20A	100VA	SIZE 1&2, FVNR-100VA TYPICAL, W/EXTRA 50VA TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC TIMER, 405AR, SOLID STATE, ON DELAY, 0-10 SEC, MIN, HR, 120VAC LIGHT, 120VAC, XFMR TYPE, LED BULB RED, HIGH MOTOR TEMP LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, BLOWER ON LIGHT, 120VAC, XFMR TYPE, LED BULB, GREEN, BLOWER OFF RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE PUSHBUTTON, MOMENTARY, BLACK, OVERTEMP/RESET	18	EITHER	EITHER	M	#12-6 AWG	1	COOLF8H-S018
6F	M	RAB-33246	FREEDOM+ FVNR STARTER F206	D		3	65K	HMCPS		15A (45-150)	1	5HP	7.60	4-20A	100VA	SIZE 1&2, FVNR-100VA TYPICAL, W/EXTRA 50VA TIMER, TMR6 (TRUE OFF DELAY), SOLID STATE, OFF DELAY, .05 SEC, 30 MIN, 120VAC TIMER, 405AR, SOLID STATE, ON DELAY, 0-10 SEC, MIN, HR, 120VAC LIGHT, 120VAC, XFMR TYPE, LED BULB RED, HIGH MOTOR TEMP LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, BLOWER ON LIGHT, 120VAC, XFMR TYPE, LED BULB, GREEN, BLOWER OFF RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE RELAY, D7, 120VAC, 10A, 2 POLE PUSHBUTTON, MOMENTARY, BLACK, OVERTEMP/RESET	18	EITHER	EITHER	M	#12-6 AWG	1	COOLF8H-S019



NAMEPLATE FEATURES
COLOR: BLACK / WHITE LETTERS
SECURED WITH SCREWS
CHARACTER HEIGHT: 0.1875" [5mm]
CHARACTERS PER LINE: 17 MAXIMUM
(LINE 2 MAX 15 CHARACTERS)
NAMEPLATE SECURED VIA SELF TAPPING SCREWS
NOT TO SCALE

NOTES:

TERMINATIONS
M = MECHANICAL CU/AL
C = COMPRESSION TYPE, 2 HOLE MOUNTING, COPPER

DEVICE MOUNTING
F = FIXED MOUNTED
D = DRAW-OUT MOUNTED
B = BOLTED IN

KAIC RATING
RMS SYMMETRICAL INTERRUPTING RATING AT MAXIMUM OF RATED VOLTAGE

FULL LOAD AMPERES & HEATER SIZE
THE FULL LOAD AMPS SHOWN ARE BASED ON STANDARD NEMA VALUES FOR REFERENCE ONLY
OVERLOAD TRIP DEVICES ARE NOT SET AT THE FACTORY
TRIP DEVICES MUST BE SET DURING COMMISSIONING OF EQUIPMENT

UNIT SCHEDULE

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
P.O. NUMBER: S121374090

Certified As-Built
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CAGE CODE 380H0

DFTR TLL DATE 06/01/2023
APPD FAY DATE 06/01/2023
PRODUCT CODE MCC
S.O. COOLF8H
REVISION 1
DWG SIZE

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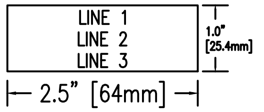
EATON

TITLE TAUNTON WWTF PH2 IMPROVEMENT
6MCC1
TYPE FREEDOM+ MCC
SCHEDULES
G.O. LBS0031682-001
DWG COOLF8H-N
SHEET 015

COEFtBL_R6

ID		DEVICE INFORMATION									PROTECTION INFO				UNIT DATA			TERMINATIONS					
SECTION NUMBER	CELL	CIRCUIT NAMEPLATE	DEVICE TYPE	DEVICE MOUNTING (SEE NOTES)	DEVICE SIZE	POLES	KAIC RATING (SEE NOTES)	BREAKER FRAME OR FUSE CLIP TYPE	RATING PLUG OR FUSE AMPS	BREAKER TRIP OR FUSE CLIP AMPS	STARTER SIZE	ACTUAL LOAD SIZE	FULL LOAD AMPS (SEE NOTES)	OVERLOAD	CPT SIZE	ADDITIONAL ACCESSORIES, FEATURES & NOTES	DEVICE SPACE REQ INCHES	CONTROL CABLE ENTRY DIRECTION	POWER CABLE ENTRY DIRECTION	TYPE (SEE NOTES)	PHASE SIZE	#PER PHASE	DETAILED DRAWING REFERENCE OR CATALOG NUMBER
7F			VERTICAL BUS		600A																		
7F	B	DWP-9371	FREEDOM+ FVNR STARTER F206	D		3	65K	HMCPS		15A (45-150)	1	5HP	7.60	4-20A	100VA	EATON MINI ETM, 9999.9, 120VAC 60HZ, ELAPSED TIME SIZE 1&2, FVNR-100VA TYPICAL, W/EXTRA 50VA LIGHT, 120VAC, XFMR TYPE, LED BULB, GREEN, PUMP OFF LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, PUMP ON	12	EITHER	EITHER	M	#12-6 AWG	1	C00LF8H-S020
7F	D	DWP-9372	FREEDOM+ FVNR STARTER F206	D		3	65K	HMCPS		15A (45-150)	1	5HP	7.60	4-20A	100VA	EATON MINI ETM, 9999.9, 120VAC 60HZ, ELAPSED TIME SIZE 1&2, FVNR-100VA TYPICAL, W/EXTRA 50VA LIGHT, 120VAC, XFMR TYPE, LED BULB, GREEN, PUMP OFF LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, PUMP ON	12	EITHER	EITHER	M	#12-6 AWG	1	C00LF8H-S021
7F	F	DWP-9363	FREEDOM+ FVNR STARTER F206	D		3	65K	HMCPS		15A (45-150)	1	5HP	7.60	4-20A	100VA	EATON MINI ETM, 9999.9, 120VAC 60HZ, ELAPSED TIME SIZE 1&2, FVNR-100VA TYPICAL, W/EXTRA 50VA LIGHT, 120VAC, XFMR TYPE, LED BULB, GREEN, PUMP OFF LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, PUMP ON	12	EITHER	EITHER	M	#12-6 AWG	1	C00LF8H-S022
7F	H	DWP-9364	FREEDOM+ FVNR STARTER F206	D		3	65K	HMCPS		15A (45-150)	1	5HP	7.60	4-20A	100VA	EATON MINI ETM, 9999.9, 120VAC 60HZ, ELAPSED TIME SIZE 1&2, FVNR-100VA TYPICAL, W/EXTRA 50VA LIGHT, 120VAC, XFMR TYPE, LED BULB, GREEN, PUMP OFF LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, PUMP ON	12	EITHER	EITHER	M	#12-6 AWG	1	C00LF8H-S023
7F	K	DWP-9365	FREEDOM+ FVNR STARTER F206	D		3	65K	HMCPS		15A (45-150)	1	5HP	7.60	4-20A	100VA	EATON MINI ETM, 9999.9, 120VAC 60HZ, ELAPSED TIME SIZE 1&2, FVNR-100VA TYPICAL, W/EXTRA 50VA LIGHT, 120VAC, XFMR TYPE, LED BULB, GREEN, PUMP OFF LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, PUMP ON	12	EITHER	EITHER	M	#12-6 AWG	1	C00LF8H-S024



NAMEPLATE FEATURES
COLOR: BLACK / WHITE LETTERS
SECURED WITH SCREWS
CHARACTER HEIGHT: 0.1875" [5mm]
CHARACTERS PER LINE: 17 MAXIMUM
(LINE 2 MAX 15 CHARACTERS)
NAMEPLATE SECURED VIA SELF TAPPING SCREWS
NOT TO SCALE

7B
7D
7F
7H
7K
7M

NOTES:

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DEVICE MOUNTING
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KAIC RATING
RMS SYMMETRICAL INTERRUPTING RATING AT MAXIMUM OF RATED VOLTAGE

FULL LOAD AMPERES & HEATER SIZE

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UNIT SCHEDULE

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
P.O. NUMBER: S121374090

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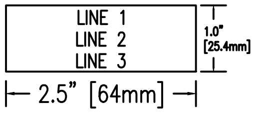
APPD FAY	DATE 06/01/2023	TITLE TAUNTON WWTF PH2 IMPROVEMENT 6MCC1			
PRODUCT CODE MCC	S.O. C00LF8H	TYPE FREEDOM+ MCC		SCHEDULES	
REVISION 1	DWG SIZE	G.O. LBS0031682-001	DWG C00LF8H-N		SHEET 016

COEFtBL_R6

ID		DEVICE INFORMATION									PROTECTION INFO				UNIT DATA			TERMINATIONS					
SECTION NUMBER	CELL	CIRCUIT NAMEPLATE	DEVICE TYPE	DEVICE MOUNTING (SEE NOTES)	DEVICE SIZE	POLES	KAIC RATING (SEE NOTES)	BREAKER FRAME OR FUSE CLIP TYPE	RATING PLUG OR FUSE AMPS	BREAKER TRIP OR FUSE CLIP AMPS	STARTER SIZE	ACTUAL LOAD SIZE	FULL LOAD AMPS (SEE NOTES)	OVERLOAD	CPT SIZE	ADDITIONAL ACCESSORIES, FEATURES & NOTES	DEVICE SPACE REQ INCHES	CONTROL CABLE ENTRY DIRECTION	POWER CABLE ENTRY DIRECTION	TYPE (SEE NOTES)	PHASE SIZE	#PER PHASE	DETAILED DRAWING REFERENCE OR CATALOG NUMBER
7F	M	DWP-9366	FREEDOM+ FVNR STARTER F206	D		3	65K	HMCPS		15A (45-150)	1	5HP	7.60	4-20A	100VA	EATON MINI ETM, 9999.9, 120VAC 60HZ, ELAPSED TIME SIZE 1&2, FVNR-100VA TYPICAL, W/EXTRA 50VA LIGHT, 120VAC, XFMR TYPE, LED BULB, GREEN, PUMP OFF LIGHT, 120VAC, XFMR TYPE, LED BULB, RED, PUMP ON	12	EITHER	EITHER	M	#12-6 AWG	1	C00LF8H-S025



NAMEPLATE FEATURES
COLOR: BLACK / WHITE LETTERS
SECURED WITH SCREWS
CHARACTER HEIGHT: 0.1875" [5mm]
CHARACTERS PER LINE: 17 MAXIMUM
(LINE 2 MAX 15 CHARACTERS)
NAMEPLATE SECURED VIA SELF TAPPING SCREWS
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FULL LOAD AMPERES & HEATER SIZE
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UNIT SCHEDULE

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
P.O. NUMBER: S121374090

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DATE 06/01/2023
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DATE 06/01/2023
PRODUCT CODE MCC
S.O. C00LF8H
REVISION 1
DWG SIZE

EATON

TITLE TAUNTON WWTF PH2 IMPROVEMENT
6MCC1
TYPE FREEDOM+ MCC
SCHEDULES
G.O. LBS0031682-001
DWG C00LF8H-N
SHEET 017

CUSTOMER BOM

TAUNTON WWTF PH2 IMPROVEMENT

MCC - Freedom+ MCC

GO-Item: LBS0031682-001
Material Information By: TERRENCE LADSON
Approved By: FAY
Generated: 06/02/2023
Manufacturing Location: Fayetteville

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET
TAUNTON MA 02780
P.O. NUMBER: S121374090

ISSUED FOR CONSTRUCTION - THE INFORMATION ON THIS DOCUMENT IS SUITABLE FOR USE IN ESTABLISHING FINAL INSTALLATION AND CONSTRUCTION DETAILS.

DFTR T.LADSON	**DATE** 06/02/2023	THE INFORMATION ON THIS DOCUMENT IS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT IS SUPPLIED.
APPD FAY	**DATE** 06/02/2023	**TITLE** TAUNTON WWTF PH2 IMPROVEMENT 6MCC1
S.O. C00LF8H	**TYPE** FREEDOM+ MCC	CUSTOMER BOM

PRODUCT CODE	CAGE CODE	REVISION		G.O.	DWG	SHEET
MCC	380H0	1	A	LBS0031682-001	CUSTOMER_BOM	1 OF 18

CONSOLIDATED PARTS

DEVICE ID	DESCRIPTION	PART NUMBER	QTY	MARKING
MS	ELECTRICAL INTERLOCK FREEDOM 1NO 1NC SIZE 1 OR 2	C320KGS3	18	
MS	ELECTRICAL INTERLOCK FREEDOM 1NO SIZE 1 OR 2	C320KGS1	6	
	.190 X.375 HEX WASHER HD SCREW	839A681H03	600	
	.190-32 X .500 HEX HEAD TR SCR	839A681H05	160	
	1/4-20 X .500 RH E/T SEMS	106A692G05	96	
	350 MCM LUG	4713A54H01	3	
	ABMM-A ABS ABS CABLE MOUNT	70801FA00A	24	
	BLANK DOOR 2X 15.56 WIDE	4701A93G02	2	
	BREAKER HMCP AMP FRAME	HMCP050K2C	2	
	BREAKER HMCP AMP FRAME	HMCPS015E0C	12	
	BREAKER HMCP AMP FRAME	HMCPS030H1C	10	
	C440 SSOL SUPPLEMENTAL CHART	PUB52394	2	
	CABLE TIE	4714A24H01	21	
	CAUTION LABEL: HAZARDOUS VOLTAGE, LIVE CIRCUITS	4714A02H01	25	
	CONTACT BLOCK 1NO	10250T53	30	
	CONTROL RELAY D7 2 POLE 120VAC	10-11108-32	72	
	CPT 100VA 440/480-95/125VAC 50/60HZ.	C0100E2AFB	24	
	CUSTOM DEVICE NAMEPLATE 1.8" X 0.58"	1428B04H11	126	
	DANGER - WARNING	4710A46H17	24	
	DEVICE NAMEPLATE ELAPSED TIME	30-45336	18	
	DEVICE PANEL 6 CUTOUT	1161D43H01	12	
	DEVICE PANEL 6 CUTOUT W/ETM CUTOUT - TOP CENTER	81-27811	12	
	DIVIDER PAN, FREEDOM+/FFG+AR MCC, STANDARD	17-25714	9	
	DOOR ASSEMBLY	39-48292-3	6	
	FREEDOM NEMA SIZE 1 120VAC, C440 SSOL (4-20A)	AN19CN0A5E020	22	
	FREEDOM NEMA SIZE 2 120VAC, C440 SSOL (9-45A)	AN19GN0A5E045	2	
	FREEDOM+ EMBLEM	478C642H52	1	
	GROUND BUS SPLICE KIT A CUTN	4702A70G26	1	
	INDICATING LIGHT LENS, GREEN	10250TC2N	24	
	INDICATING LIGHT LENS, RED	10250TC1N	54	

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET
TAUNTON MA 02780
P.O. NUMBER: S121374090

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APPD FAY	DATE 06/02/2023	TITLE TAUNTON WWTF PH2 IMPROVEMENT 6MCC1	
S.O. C00LF8H		TYPE FREEDOM+ MCC	CUSTOMER BOM

PRODUCT CODE	CAGE CODE	REVISION		G.O.	DWG	SHEET
MCC	380H0	1	A	LBS0031682-001	CUSTOMER_BOM	2 OF 18

CONSOLIDATED PARTS

DEVICE ID	DESCRIPTION	PART NUMBER	QTY	MARKING
	INDICATING LIGHT, TRANSFORMER TYPE, 120VAC W/O LED BULB	10250T181L	78	1005, 1113, 1112, 1108, 1107, 1106, 1103, 1102, 1101, 1097, 1096, 1095, 1094, 1089, 1088, 1087, 1114, 1117, 1118, 1119, 1150, 1149, 1146, 1145, 1142, 1141, 1138, 1086, 1137, 1133, 1129, 1128, 1127, 1124, 1123, 1122, 1134, 1081, 1080, 1079, 1038, 1033, 1032, 1031, 1030, 1025, 1024, 1039, 1023, 1016, 1015, 1014, 1013, 1008, 1007, 1006, 1022, 1153, 1040, 1046, 1078, 1073, 1072, 1071, 1070, 1065, 1064, 1041, 1063, 1057, 1056, 1055, 1054, 1049, 1048, 1047, 1062, 1154
	INSULATOR INCOMING LINE	1492C53H01	2	
	LABEL	4713A99H15	1	
	LABEL - NOTICE	4710A46H18	24	
	LABEL INCOMING LINE	1492C17H02	1	
	LABEL, UL, MCC UNIT LISTING	4714A26H22	25	
	LED BULB NATURAL LIGHT, USE WITH COLORED LENS	28-8310	78	
	MATE-N-LOK HSG, 2P CAP [CONNECTOR]	350777-1	12	
	MATE-N-LOK HSG, 2P PLUG [CONNECTOR]	350778-1	12	
	MATE-N-LOK TERMINAL PIN, #20-14 AWG WIRE RANGE	350547-1	24	
	MATE-N-LOK TERMINAL SOCKET, #20-14 AWG WIRE RANGE	350550-1	24	

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET
TAUNTON MA 02780
P.O. NUMBER: S121374090

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DFTR: T.LADSON	DATE: 06/02/2023			
APPD: FAY	DATE: 06/02/2023	TITLE: TAUNTON WWTF PH2 IMPROVEMENT 6MCC1		
S.O.: C00LF8H		TYPE: FREEDOM+ MCC	CUSTOMER BOM	

PRODUCT CODE	CAGE CODE	REVISION		G.O.	DWG	SHEET
MCC	380H0	1	A	LBS0031682-001	CUSTOMER_BOM	3 OF 18

CONSOLIDATED PARTS

DEVICE ID	DESCRIPTION	PART NUMBER	QTY	MARKING
	METER EATON MINI ETM ELAPSED TIME	3-2308-002A	24	1004, 1144, 1140, 1136, 1132, 1093, 1085, 1077, 1069, 1061, 1053, 1045, 1037, 1029, 1021, 1012, 1148, 1152
	NAME PLATE DANGER	4710A46H11	2	
	OFFSET PLATE 4 X 78	1161D16H01	7	
	OMS COMMON PLATFORM HANGER CP	50-43051	24	
	OVERLOAD HEATER CHART, FREEDOM SERIES	1491C79H03	2	
	PANDUIT LATCHING TIE	LC5-A-C8	120	
	PANDUIT WIRE TIE	PLT2I-M	24	
	PUSHBUTTON MOMENTARY BLACK	10250T111	30	1009, 1120, 1115, 1109, 1104, 1099, 1098, 1091, 1090, 1083, 1082, 1075, 1074, 1067, 1066, 1059, 1058, 1051, 1050, 1043, 1042, 1035, 1034, 1027, 1026, 1018, 1017, 1010, 1125, 1130
	SCREW LUG #6-350MCM FOR USE ON GROUND BUS	414A050H10	2	
	SHUTTER	99-4712-1	26	
	STANDARD DIN RAIL END STOP	XBAES35C	72	
	STANDARD DIN RAIL, 10.8"	800612-113-6	36	
	STEEL BOTTOM BARRIER FOR VERTICAL BUS	FV2A010H02	7	
	TERMINAL BLOCK 7 CIRCUIT SIDE MOUNTED PULL-APART	15220	120	
	TERMINAL BLOCK JUMPER	J15220	102	
	TEW STAB	4700A97G29	24	
	TIMER 405AR ON DELAY 0-10 SEC, MIN, HR 120VAC	10-11109-5	18	
	TIMER TMR6 (TRUE OFF DELAY) OFF DELAY 120VAC	10-11109-2	30	
	VERTICAL GROUND BUS ASSEMBLY, 300A, COPPER TIN, FMO	25-31363-1	7	
	WARNING LABEL: LINE SIDE ENERGIZED	4713A98H11	25	

NEG-ALT NUMBER: D7580427X2K2-C000
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LOCATION: 825 WEST WATER STREET
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APPD FAY	DATE 06/02/2023	TITLE TAUNTON WWTF PH2 IMPROVEMENT 6MCC1			
S.O. C00LF8H		TYPE FREEDOM+ MCC		CUSTOMER BOM	
PRODUCT CODE MCC	CAGE CODE 380H0	REVISION 1	A	G.O. LBS0031682-001	DWG CUSTOMER_BOM
SHEET 4 OF 18					

VERTICAL SECTION 1F

DEVICE ID	DESCRIPTION	PART NUMBER	QTY	MARKING
MS	ELECTRICAL INTERLOCK FREEDOM 1NO 1NC SIZE 1 OR 2	C320KGS3	2	
	.190 X.375 HEX WASHER HD SCREW	839A681H03	50	
	.190-32 X .500 HEX HEAD TR SCR	839A681H05	20	
	1/4-20 X .500 RH E/T SEMS	106A692G05	8	
	350 MCM LUG	4713A54H01	3	
	ABMM-A ABS ABS CABLE MOUNT	70801FA00A	2	
	BLANK DOOR 2X 15.56 WIDE	4701A93G02	1	
	BREAKER HMCP AMP FRAME	HMCP050K2C	2	
	C440 SSOL SUPPLEMENTAL CHART	PUB52394	1	
	CABLE TIE	4714A24H01	3	
	CAUTION LABEL: HAZARDOUS VOLTAGE, LIVE CIRCUITS	4714A02H01	3	
	CONTACT BLOCK 1NO	10250T53	4	
	CONTROL RELAY D7 2 POLE 120VAC	10-11108-32	8	
	CPT 100VA 440/480-95/125VAC 50/60HZ.	C0100E2AFB	2	
	CUSTOM DEVICE NAMEPLATE 1.8" X 0.58"	1428B04H11	14	
	DANGER - WARNING	4710A46H17	2	
	DEVICE NAMEPLATE ELAPSED TIME	30-45336	2	
	DEVICE PANEL 6 CUTOUT W/ETM CUTOUT - TOP CENTER	81-27811	2	
	DIVIDER PAN, FREEDOM+/FFG+AR MCC, STANDARD	17-25714	2	
	FREEDOM NEMA SIZE 2 120VAC, C440 SSOL (9-45A)	AN19GN0A5E045	2	
	FREEDOM+ EMBLEM	478C642H52	1	
	INDICATING LIGHT LENS, GREEN	10250TC2N	2	
	INDICATING LIGHT LENS, RED	10250TC1N	6	
	INDICATING LIGHT, TRANSFORMER TYPE, 120VAC W/O LED BULB	10250T181L	8	1005, 1006, 1007, 1008, 1013, 1014, 1015, 1016
	INSULATOR INCOMING LINE	1492C53H01	2	
	LABEL	4713A99H15	1	
	LABEL - NOTICE	4710A46H18	2	
	LABEL INCOMING LINE	1492C17H02	1	
	LABEL, UL, MCC UNIT LISTING	4714A26H22	3	
	LED BULB NATURAL LIGHT, USE WITH COLORED LENS	28-8310	8	
	MATE-N-LOK HSG, 2P CAP [CONNECTOR]	350777-1	2	
	MATE-N-LOK HSG, 2P PLUG [CONNECTOR]	350778-1	2	
	MATE-N-LOK TERMINAL PIN, #20-14 AWG WIRE RANGE	350547-1	4	
	MATE-N-LOK TERMINAL SOCKET, #20-14 AWG WIRE RANGE	350550-1	4	
	METER EATON MINI ETM ELAPSED TIME	3-2308-002A	2	1004, 1012
	NAME PLATE DANGER	4710A46H11	2	
	OFFSET PLATE 4 X 78	1161D16H01	1	
	OMS COMMON PLATFORM HANGER CP	50-43051	2	

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET
TAUNTON MA 02780
P.O. NUMBER: S121374090

ISSUED FOR CONSTRUCTION - THE INFORMATION ON THIS DOCUMENT IS SUITABLE FOR USE IN ESTABLISHING FINAL INSTALLATION AND CONSTRUCTION DETAILS.

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DFTR T.LADSON	DATE 06/02/2023		
APPD FAY	DATE 06/02/2023	TITLE TAUNTON WWTF PH2 IMPROVEMENT 6MCC1	
S.O. C00LF8H		TYPE FREEDOM+ MCC	CUSTOMER BOM

PRODUCT CODE	CAGE CODE	REVISION		G.O.	DWG	SHEET
MCC	380H0	1	A	LBS0031682-001	CUSTOMER_BOM	5 OF 18

VERTICAL SECTION 1F

DEVICE ID	DESCRIPTION	PART NUMBER	QTY	MARKING
	OVERLOAD HEATER CHART, FREEDOM SERIES	1491C79H03	1	
	PANDUIT LATCHING TIE	LC5-A-C8	10	
	PANDUIT WIRE TIE	PLT2I-M	2	
	PUSHBUTTON MOMENTARY BLACK	10250T111	4	1009, 1010, 1017, 1018
	SCREW LUG #6-350MCM FOR USE ON GROUND BUS	414A050H10	2	
	SHUTTER	99-4712-1	3	
	STANDARD DIN RAIL END STOP	XBAES35C	8	
	STANDARD DIN RAIL, 10.8"	800612-113-6	4	
	STEEL BOTTOM BARRIER FOR VERTICAL BUS	FV2A010H02	1	
	TERMINAL BLOCK 7 CIRCUIT SIDE MOUNTED PULL-APART	15220	12	
	TERMINAL BLOCK JUMPER	J15220	10	
	TEW STAB	4700A97G29	2	
	TIMER 405AR ON DELAY 0-10 SEC, MIN, HR 120VAC	10-11109-5	2	
	TIMER TMR6 (TRUE OFF DELAY) OFF DELAY 120VAC	10-11109-2	4	
	VERTICAL GROUND BUS ASSEMBLY, 300A, COPPER TIN, FMO	25-31363-1	1	
	WARNING LABEL: LINE SIDE ENERGIZED	4713A98H11	3	

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET
TAUNTON MA 02780
P.O. NUMBER: S121374090

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APPD FAY	**DATE** 06/02/2023	**TITLE** TAUNTON WWTF PH2 IMPROVEMENT 6MCC1	
S.O. C00LF8H		**TYPE** FREEDOM+ MCC	CUSTOMER BOM

PRODUCT CODE	CAGE CODE	REVISION		G.O.	DWG	SHEET
MCC	380H0	1	A	LBS0031682-001	CUSTOMER_BOM	6 OF 18

VERTICAL SECTION 2F

DEVICE ID	DESCRIPTION	PART NUMBER	QTY	MARKING
MS	ELECTRICAL INTERLOCK FREEDOM 1NO 1NC SIZE 1 OR 2	C320KGS3	3	
	.190 X.375 HEX WASHER HD SCREW	839A681H03	75	
	.190-32 X .500 HEX HEAD TR SCR	839A681H05	22	
	1/4-20 X .500 RH E/T SEMS	106A692G05	12	
	ABMM-A ABS ABS CABLE MOUNT	70801FA00A	3	
	BREAKER HMCP AMP FRAME	HMCPS030H1C	3	
	CABLE TIE	4714A24H01	3	
	CAUTION LABEL: HAZARDOUS VOLTAGE, LIVE CIRCUITS	4714A02H01	3	
	CONTACT BLOCK 1NO	10250T53	6	
	CONTROL RELAY D7 2 POLE 120VAC	10-11108-32	12	
	CPT 100VA 440/480-95/125VAC 50/60HZ.	C0100E2AFB	3	
	CUSTOM DEVICE NAMEPLATE 1.8" X 0.58"	1428B04H11	21	
	DANGER - WARNING	4710A46H17	3	
	DEVICE NAMEPLATE ELAPSED TIME	30-45336	3	
	DEVICE PANEL 6 CUTOUT W/ETM CUTOUT - TOP CENTER	81-27811	3	
	DIVIDER PAN, FREEDOM+/FFG+AR MCC, STANDARD	17-25714	1	
	FREEDOM NEMA SIZE 1 120VAC, C440 SSOL (4-20A)	AN19CN0A5E020	3	
	INDICATING LIGHT LENS, GREEN	10250TC2N	3	
	INDICATING LIGHT LENS, RED	10250TC1N	9	
	INDICATING LIGHT, TRANSFORMER TYPE, 120VAC W/O LED BULB	10250T181L	12	1022, 1023, 1024, 1025, 1030, 1031, 1032, 1033, 1038, 1039, 1040, 1041
	LABEL - NOTICE	4710A46H18	3	
	LABEL, UL, MCC UNIT LISTING	4714A26H22	3	
	LED BULB NATURAL LIGHT, USE WITH COLORED LENS	28-8310	12	
	MATE-N-LOK HSG, 2P CAP [CONNECTOR]	350777-1	3	
	MATE-N-LOK HSG, 2P PLUG [CONNECTOR]	350778-1	3	
	MATE-N-LOK TERMINAL PIN, #20-14 AWG WIRE RANGE	350547-1	6	
	MATE-N-LOK TERMINAL SOCKET, #20-14 AWG WIRE RANGE	350550-1	6	
	METER EATON MINI ETM ELAPSED TIME	3-2308-002A	3	1021, 1029, 1037
	OFFSET PLATE 4 X 78	1161D16H01	1	
	OMS COMMON PLATFORM HANGER CP	50-43051	3	
	PANDUIT LATCHING TIE	LC5-A-C8	15	
	PANDUIT WIRE TIE	PLT2I-M	3	
	PUSHBUTTON MOMENTARY BLACK	10250T111	6	1026, 1027, 1034, 1035, 1042, 1043
	SHUTTER	99-4712-1	3	

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET
TAUNTON MA 02780
P.O. NUMBER: S121374090

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APPD FAY	DATE 06/02/2023	TITLE TAUNTON WWTF PH2 IMPROVEMENT 6MCC1	
S.O. C00LF8H		TYPE FREEDOM+ MCC	CUSTOMER BOM

PRODUCT CODE	CAGE CODE	REVISION		G.O.	DWG	SHEET
MCC	380H0	1	A	LBS0031682-001	CUSTOMER_BOM	7 OF 18

VERTICAL SECTION 2F

DEVICE ID	DESCRIPTION	PART NUMBER	QTY	MARKING
	STANDARD DIN RAIL END STOP	XBAES35C	12	
	STANDARD DIN RAIL, 10.8"	800612-113-6	6	
	STEEL BOTTOM BARRIER FOR VERTICAL BUS	FV2A010H02	1	
	TERMINAL BLOCK 7 CIRCUIT SIDE MOUNTED PULL-APART	15220	18	
	TERMINAL BLOCK JUMPER	J15220	15	
	TEW STAB	4700A97G29	3	
	TIMER 405AR ON DELAY 0-10 SEC, MIN, HR 120VAC	10-11109-5	3	
	TIMER TMR6 (TRUE OFF DELAY) OFF DELAY 120VAC	10-11109-2	6	
	VERTICAL GROUND BUS ASSEMBLY, 300A, COPPER TIN, FMO	25-31363-1	1	
	WARNING LABEL: LINE SIDE ENERGIZED	4713A98H11	3	

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET
TAUNTON MA 02780
P.O. NUMBER: S121374090

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DFTR	DATE		
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APPD	**DATE**	**TITLE**	
FAY	06/02/2023	TAUNTON WWTF PH2 IMPROVEMENT 6MCC1	
S.O.		**TYPE**	
C00LF8H		FREEDOM+ MCC	CUSTOMER BOM

PRODUCT CODE	CAGE CODE	REVISION		G.O.	DWG	SHEET
MCC	380H0	1	A	LBS0031682-001	CUSTOMER_BOM	8 OF 18

VERTICAL SECTION 3F

DEVICE ID	DESCRIPTION	PART NUMBER	QTY	MARKING
MS	ELECTRICAL INTERLOCK FREEDOM 1NO 1NC SIZE 1 OR 2	C320KGS3	3	
	.190 X.375 HEX WASHER HD SCREW	839A681H03	75	
	.190-32 X .500 HEX HEAD TR SCR	839A681H05	22	
	1/4-20 X .500 RH E/T SEMS	106A692G05	12	
	ABMM-A ABS ABS CABLE MOUNT	70801FA00A	3	
	BREAKER HMCP AMP FRAME	HMCPS030H1C	3	
	CABLE TIE	4714A24H01	3	
	CAUTION LABEL: HAZARDOUS VOLTAGE, LIVE CIRCUITS	4714A02H01	3	
	CONTACT BLOCK 1NO	10250T53	6	
	CONTROL RELAY D7 2 POLE 120VAC	10-11108-32	12	
	CPT 100VA 440/480-95/125VAC 50/60HZ.	C0100E2AFB	3	
	CUSTOM DEVICE NAMEPLATE 1.8" X 0.58"	1428B04H11	21	
	DANGER - WARNING	4710A46H17	3	
	DEVICE NAMEPLATE ELAPSED TIME	30-45336	3	
	DEVICE PANEL 6 CUTOUT W/ETM CUTOUT - TOP CENTER	81-27811	3	
	DIVIDER PAN, FREEDOM+/FFG+AR MCC, STANDARD	17-25714	1	
	FREEDOM NEMA SIZE 1 120VAC, C440 SSOL (4-20A)	AN19CN0A5E020	3	
	INDICATING LIGHT LENS, GREEN	10250TC2N	3	
	INDICATING LIGHT LENS, RED	10250TC1N	9	
	INDICATING LIGHT, TRANSFORMER TYPE, 120VAC W/O LED BULB	10250T181L	12	1046, 1047, 1048, 1049, 1054, 1055, 1056, 1057, 1062, 1063, 1064, 1065
	LABEL - NOTICE	4710A46H18	3	
	LABEL, UL, MCC UNIT LISTING	4714A26H22	3	
	LED BULB NATURAL LIGHT, USE WITH COLORED LENS	28-8310	12	
	MATE-N-LOK HSG, 2P CAP [CONNECTOR]	350777-1	3	
	MATE-N-LOK HSG, 2P PLUG [CONNECTOR]	350778-1	3	
	MATE-N-LOK TERMINAL PIN, #20-14 AWG WIRE RANGE	350547-1	6	
	MATE-N-LOK TERMINAL SOCKET, #20-14 AWG WIRE RANGE	350550-1	6	
	METER EATON MINI ETM ELAPSED TIME	3-2308-002A	3	1045, 1053, 1061
	OFFSET PLATE 4 X 78	1161D16H01	1	
	OMS COMMON PLATFORM HANGER CP	50-43051	3	
	PANDUIT LATCHING TIE	LC5-A-C8	15	
	PANDUIT WIRE TIE	PLT2I-M	3	
	PUSHBUTTON MOMENTARY BLACK	10250T111	6	1050, 1051, 1058, 1059, 1066, 1067
	SHUTTER	99-4712-1	3	

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET
TAUNTON MA 02780
P.O. NUMBER: S121374090

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APPD: FAY	DATE: 06/02/2023	TITLE: TAUNTON WWTF PH2 IMPROVEMENT 6MCC1		
S.O.: C00LF8H		TYPE: FREEDOM+ MCC	CUSTOMER BOM	

PRODUCT CODE	CAGE CODE	REVISION		G.O.	DWG	SHEET
MCC	380H0	1	A	LBS0031682-001	CUSTOMER_BOM	9 OF 18

VERTICAL SECTION 3F

DEVICE ID	DESCRIPTION	PART NUMBER	QTY	MARKING
	STANDARD DIN RAIL END STOP	XBAES35C	12	
	STANDARD DIN RAIL, 10.8"	800612-113-6	6	
	STEEL BOTTOM BARRIER FOR VERTICAL BUS	FV2A010H02	1	
	TERMINAL BLOCK 7 CIRCUIT SIDE MOUNTED PULL-APART	15220	18	
	TERMINAL BLOCK JUMPER	J15220	15	
	TEW STAB	4700A97G29	3	
	TIMER 405AR ON DELAY 0-10 SEC, MIN, HR 120VAC	10-11109-5	3	
	TIMER TMR6 (TRUE OFF DELAY) OFF DELAY 120VAC	10-11109-2	6	
	VERTICAL GROUND BUS ASSEMBLY, 300A, COPPER TIN, FMO	25-31363-1	1	
	WARNING LABEL: LINE SIDE ENERGIZED	4713A98H11	3	

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET
TAUNTON MA 02780
P.O. NUMBER: S121374090

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APPD FAY	DATE 06/02/2023	TITLE TAUNTON WWTF PH2 IMPROVEMENT 6MCC1	
S.O. C00LF8H		TYPE FREEDOM+ MCC	CUSTOMER BOM

PRODUCT CODE	CAGE CODE	REVISION		G.O.	DWG	SHEET
MCC	380H0	1	A	LBS0031682-001	CUSTOMER_BOM	10 OF 18

VERTICAL SECTION 4F

DEVICE ID	DESCRIPTION	PART NUMBER	QTY	MARKING
MS	ELECTRICAL INTERLOCK FREEDOM 1NO 1NC SIZE 1 OR 2	C320KGS3	3	
	.190 X.375 HEX WASHER HD SCREW	839A681H03	75	
	.190-32 X .500 HEX HEAD TR SCR	839A681H05	22	
	1/4-20 X .500 RH E/T SEMS	106A692G05	12	
	ABMM-A ABS ABS CABLE MOUNT	70801FA00A	3	
	BREAKER HMCP AMP FRAME	HMCPS030H1C	3	
	CABLE TIE	4714A24H01	3	
	CAUTION LABEL: HAZARDOUS VOLTAGE, LIVE CIRCUITS	4714A02H01	3	
	CONTACT BLOCK 1NO	10250T53	6	
	CONTROL RELAY D7 2 POLE 120VAC	10-11108-32	12	
	CPT 100VA 440/480-95/125VAC 50/60HZ.	C0100E2AFB	3	
	CUSTOM DEVICE NAMEPLATE 1.8" X 0.58"	1428B04H11	21	
	DANGER - WARNING	4710A46H17	3	
	DEVICE NAMEPLATE ELAPSED TIME	30-45336	3	
	DEVICE PANEL 6 CUTOUT W/ETM CUTOUT - TOP CENTER	81-27811	3	
	DIVIDER PAN, FREEDOM+/FFG+AR MCC, STANDARD	17-25714	1	
	FREEDOM NEMA SIZE 1 120VAC, C440 SSOL (4-20A)	AN19CN0A5E020	3	
	GROUND BUS SPLICE KIT A CUTN	4702A70G26	1	
	INDICATING LIGHT LENS, GREEN	10250TC2N	3	
	INDICATING LIGHT LENS, RED	10250TC1N	9	
	INDICATING LIGHT, TRANSFORMER TYPE, 120VAC W/O LED BULB	10250T181L	12	1070, 1071, 1072, 1073, 1078, 1079, 1080, 1081, 1086, 1087, 1088, 1089
	LABEL - NOTICE	4710A46H18	3	
	LABEL, UL, MCC UNIT LISTING	4714A26H22	3	
	LED BULB NATURAL LIGHT, USE WITH COLORED LENS	28-8310	12	
	MATE-N-LOK HSG, 2P CAP [CONNECTOR]	350777-1	3	
	MATE-N-LOK HSG, 2P PLUG [CONNECTOR]	350778-1	3	
	MATE-N-LOK TERMINAL PIN, #20-14 AWG WIRE RANGE	350547-1	6	
	MATE-N-LOK TERMINAL SOCKET, #20-14 AWG WIRE RANGE	350550-1	6	
	METER EATON MINI ETM ELAPSED TIME	3-2308-002A	3	1069, 1077, 1085
	OFFSET PLATE 4 X 78	1161D16H01	1	
	OMS COMMON PLATFORM HANGER CP	50-43051	3	
	PANDUIT LATCHING TIE	LC5-A-C8	15	
	PANDUIT WIRE TIE	PLT2I-M	3	
	PUSHBUTTON MOMENTARY BLACK	10250T111	6	1074, 1075, 1082, 1083, 1090, 1091

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET
TAUNTON MA 02780
P.O. NUMBER: S121374090

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APPD FAY	**DATE** 06/02/2023	**TITLE** TAUNTON WWTF PH2 IMPROVEMENT 6MCC1	
S.O. C00LF8H		**TYPE** FREEDOM+ MCC	CUSTOMER BOM

PRODUCT CODE	CAGE CODE	REVISION		G.O.	DWG	SHEET
MCC	380H0	1	A	LBS0031682-001	CUSTOMER_BOM	11 OF 18

VERTICAL SECTION 4F

DEVICE ID	DESCRIPTION	PART NUMBER	QTY	MARKING
	SHUTTER	99-4712-1	3	
	STANDARD DIN RAIL END STOP	XBAES35C	12	
	STANDARD DIN RAIL, 10.8"	800612-113-6	6	
	STEEL BOTTOM BARRIER FOR VERTICAL BUS	FV2A010H02	1	
	TERMINAL BLOCK 7 CIRCUIT SIDE MOUNTED PULL-APART	15220	18	
	TERMINAL BLOCK JUMPER	J15220	15	
	TEW STAB	4700A97G29	3	
	TIMER 405AR ON DELAY 0-10 SEC, MIN, HR 120VAC	10-11109-5	3	
	TIMER TMR6 (TRUE OFF DELAY) OFF DELAY 120VAC	10-11109-2	6	
	VERTICAL GROUND BUS ASSEMBLY, 300A, COPPER TIN, FMO	25-31363-1	1	
	WARNING LABEL: LINE SIDE ENERGIZED	4713A98H11	3	

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET
TAUNTON MA 02780
P.O. NUMBER: S121374090

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APPD FAY	**DATE** 06/02/2023	**TITLE** TAUNTON WWTF PH2 IMPROVEMENT 6MCC1	
S.O. C00LF8H		**TYPE** FREEDOM+ MCC	CUSTOMER BOM

PRODUCT CODE	**CAGE CODE**	**REVISION**		**G.O.**	**DWG**	**SHEET**
MCC	380H0	1	A	LBS0031682-001	CUSTOMER_BOM	12 OF 18

VERTICAL SECTION 5F

DEVICE ID	DESCRIPTION	PART NUMBER	QTY	MARKING
MS	ELECTRICAL INTERLOCK FREEDOM 1NO 1NC SIZE 1 OR 2	C320KGS3	1	
MS	ELECTRICAL INTERLOCK FREEDOM 1NO SIZE 1 OR 2	C320KGS1	2	
	.190 X.375 HEX WASHER HD SCREW	839A681H03	75	
	.190-32 X .500 HEX HEAD TR SCR	839A681H05	22	
	1/4-20 X .500 RH E/T SEMS	106A692G05	12	
	ABMM-A ABS ABS CABLE MOUNT	70801FA00A	3	
	BLANK DOOR 2X 15.56 WIDE	4701A93G02	1	
	BREAKER HMCP AMP FRAME	HMCPS015E0C	2	
	BREAKER HMCP AMP FRAME	HMCPS030H1C	1	
	CABLE TIE	4714A24H01	3	
	CAUTION LABEL: HAZARDOUS VOLTAGE, LIVE CIRCUITS	4714A02H01	3	
	CONTACT BLOCK 1NO	10250T53	4	
	CONTROL RELAY D7 2 POLE 120VAC	10-11108-32	12	
	CPT 100VA 440/480-95/125VAC 50/60HZ.	C0100E2AFB	3	
	CUSTOM DEVICE NAMEPLATE 1.8" X 0.58"	1428B04H11	15	
	DANGER - WARNING	4710A46H17	3	
	DEVICE NAMEPLATE ELAPSED TIME	30-45336	1	
	DEVICE PANEL 6 CUTOUT	1161D43H01	2	
	DEVICE PANEL 6 CUTOUT W/ETM CUTOUT - TOP CENTER	81-27811	1	
	DIVIDER PAN, FREEDOM+/FFG+AR MCC, STANDARD	17-25714	2	
	FREEDOM NEMA SIZE 1 120VAC, C440 SSOL (4-20A)	AN19CN0A5E020	3	
	INDICATING LIGHT LENS, GREEN	10250TC2N	3	
	INDICATING LIGHT LENS, RED	10250TC1N	7	
	INDICATING LIGHT, TRANSFORMER TYPE, 120VAC W/O LED BULB	10250T181L	10	1094, 1095, 1096, 1097, 1101, 1102, 1103, 1106, 1107, 1108
	LABEL - NOTICE	4710A46H18	3	
	LABEL, UL, MCC UNIT LISTING	4714A26H22	3	
	LED BULB NATURAL LIGHT, USE WITH COLORED LENS	28-8310	10	
	MATE-N-LOK HSG, 2P CAP [CONNECTOR]	350777-1	1	
	MATE-N-LOK HSG, 2P PLUG [CONNECTOR]	350778-1	1	
	MATE-N-LOK TERMINAL PIN, #20-14 AWG WIRE RANGE	350547-1	2	
	MATE-N-LOK TERMINAL SOCKET, #20-14 AWG WIRE RANGE	350550-1	2	
	METER EATON MINI ETM ELAPSED TIME	3-2308-002A	3	1093
	OFFSET PLATE 4 X 78	1161D16H01	1	
	OMS COMMON PLATFORM HANGER CP	50-43051	3	
	PANDUIT LATCHING TIE	LC5-A-C8	15	
	PANDUIT WIRE TIE	PLT2I-M	3	
	PUSHBUTTON MOMENTARY BLACK	10250T111	4	1098, 1099, 1104, 1109

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET
TAUNTON MA 02780
P.O. NUMBER: S121374090

ISSUED FOR CONSTRUCTION - THE INFORMATION ON THIS DOCUMENT IS SUITABLE FOR USE IN ESTABLISHING FINAL INSTALLATION AND CONSTRUCTION DETAILS.

DFTR	DATE	
T.LADSON	06/02/2023	THE INFORMATION ON THIS DOCUMENT IS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT IS SUPPLIED.

APPD	DATE	TITLE
FAY	06/02/2023	TAUNTON WWTF PH2 IMPROVEMENT 6MCC1

S.O.	TYPE	
C00LF8H	FREEDOM+ MCC	CUSTOMER BOM

PRODUCT CODE	CAGE CODE	REVISION		G.O.	DWG	SHEET
MCC	380H0	1	A	LBS0031682-001	CUSTOMER_BOM	13 OF 18

VERTICAL SECTION 5F

DEVICE ID	DESCRIPTION	PART NUMBER	QTY	MARKING
	SHUTTER	99-4712-1	4	
	STANDARD DIN RAIL END STOP	XBAES35C	12	
	STANDARD DIN RAIL, 10.8"	800612-113-6	6	
	STEEL BOTTOM BARRIER FOR VERTICAL BUS	FV2A010H02	1	
	TERMINAL BLOCK 7 CIRCUIT SIDE MOUNTED PULL-APART	15220	16	
	TERMINAL BLOCK JUMPER	J15220	15	
	TEW STAB	4700A97G29	3	
	TIMER 405AR ON DELAY 0-10 SEC, MIN, HR 120VAC	10-11109-5	3	
	TIMER TMR6 (TRUE OFF DELAY) OFF DELAY 120VAC	10-11109-2	4	
	VERTICAL GROUND BUS ASSEMBLY, 300A, COPPER TIN, FMO	25-31363-1	1	
	WARNING LABEL: LINE SIDE ENERGIZED	4713A98H11	3	

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET
TAUNTON MA 02780
P.O. NUMBER: S121374090

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APPD FAY	DATE 06/02/2023	TITLE TAUNTON WWTF PH2 IMPROVEMENT 6MCC1				
S.O. C00LF8H		TYPE FREEDOM+ MCC	CUSTOMER BOM			
PRODUCT CODE MCC	CAGE CODE 380H0	REVISION 1	A	G.O. LBS0031682-001	DWG CUSTOMER_BOM	SHEET 14 OF 18

VERTICAL SECTION 6F

DEVICE ID	DESCRIPTION	PART NUMBER	QTY	MARKING
MS	ELECTRICAL INTERLOCK FREEDOM 1NO SIZE 1 OR 2	C320KGS1	4	
	.190 X.375 HEX WASHER HD SCREW	839A681H03	100	
	.190-32 X .500 HEX HEAD TR SCR	839A681H05	24	
	1/4-20 X .500 RH E/T SEMS	106A692G05	16	
	ABMM-A ABS ABS CABLE MOUNT	70801FA00A	4	
	BREAKER HMCP AMP FRAME	HMCPS015E0C	4	
	CABLE TIE	4714A24H01	3	
	CAUTION LABEL: HAZARDOUS VOLTAGE, LIVE CIRCUITS	4714A02H01	4	
	CONTACT BLOCK 1NO	10250T53	4	
	CONTROL RELAY D7 2 POLE 120VAC	10-11108-32	16	
	CPT 100VA 440/480-95/125VAC 50/60HZ.	C0100E2AFB	4	
	CUSTOM DEVICE NAMEPLATE 1.8" X 0.58"	1428B04H11	16	
	DANGER - WARNING	4710A46H17	4	
	DEVICE PANEL 6 CUTOUT	1161D43H01	4	
	DIVIDER PAN, FREEDOM+/FFG+AR MCC, STANDARD	17-25714	1	
	FREEDOM NEMA SIZE 1 120VAC, C440 SSOL (4-20A)	AN19CN0A5E020	4	
	INDICATING LIGHT LENS, GREEN	10250TC2N	4	
	INDICATING LIGHT LENS, RED	10250TC1N	8	
	INDICATING LIGHT, TRANSFORMER TYPE, 120VAC W/O LED BULB	10250T181L	12	1112, 1113, 1114, 1117, 1118, 1119, 1122, 1123, 1124, 1127, 1128, 1129
	LABEL - NOTICE	4710A46H18	4	
	LABEL, UL, MCC UNIT LISTING	4714A26H22	4	
	LED BULB NATURAL LIGHT, USE WITH COLORED LENS	28-8310	12	
	METER EATON MINI ETM ELAPSED TIME	3-2308-002A	4	
	OFFSET PLATE 4 X 78	1161D16H01	1	
	OMS COMMON PLATFORM HANGER CP	50-43051	4	
	PANDUIT LATCHING TIE	LC5-A-C8	20	
	PANDUIT WIRE TIE	PLT2I-M	4	
	PUSHBUTTON MOMENTARY BLACK	10250T111	4	1115, 1120, 1125, 1130
	SHUTTER	99-4712-1	4	
	STANDARD DIN RAIL END STOP	XBAES35C	16	
	STANDARD DIN RAIL, 10.8"	800612-113-6	8	
	STEEL BOTTOM BARRIER FOR VERTICAL BUS	FV2A010H02	1	
	TERMINAL BLOCK 7 CIRCUIT SIDE MOUNTED PULL-APART	15220	20	
	TERMINAL BLOCK JUMPER	J15220	20	
	TEW STAB	4700A97G29	4	
	TIMER 405AR ON DELAY 0-10 SEC, MIN, HR 120VAC	10-11109-5	4	

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET
TAUNTON MA 02780
P.O. NUMBER: S121374090

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DFTR: T.LADSON
DATE: 06/02/2023

APPD: FAY
DATE: 06/02/2023

EATON

TITLE: TAUNTON WWTF PH2 IMPROVEMENT
6MCC1

S.O.: C00LF8H
TYPE: FREEDOM+ MCC
CUSTOMER BOM

PRODUCT CODE	CAGE CODE	REVISION		G.O.	DWG	SHEET
MCC	380H0	1	A	LBS0031682-001	CUSTOMER_BOM	15 OF 18

VERTICAL SECTION 6F

DEVICE ID	DESCRIPTION	PART NUMBER	QTY	MARKING
	TIMER TMR6 (TRUE OFF DELAY) OFF DELAY 120VAC	10-11109-2	4	
	VERTICAL GROUND BUS ASSEMBLY, 300A, COPPER TIN, FMO	25-31363-1	1	
	WARNING LABEL: LINE SIDE ENERGIZED	4713A98H11	4	

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET
TAUNTON MA 02780
P.O. NUMBER: S121374090

ISSUED FOR CONSTRUCTION - THE INFORMATION ON THIS DOCUMENT IS SUITABLE FOR USE IN ESTABLISHING FINAL INSTALLATION AND CONSTRUCTION DETAILS.

DFTR T.LADSON	**DATE** 06/02/2023	THE INFORMATION ON THIS DOCUMENT IS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT IS SUPPLIED.	EATON	
APPD FAY	**DATE** 06/02/2023	**TITLE** TAUNTON WWTF PH2 IMPROVEMENT 6MCC1		
S.O. C00LF8H		**TYPE** FREEDOM+ MCC	CUSTOMER BOM	

PRODUCT CODE	CAGE CODE	REVISION		G.O.	DWG	SHEET
MCC	380H0	1	A	LBS0031682-001	CUSTOMER_BOM	16 OF 18

VERTICAL SECTION 7F

DEVICE ID	DESCRIPTION	PART NUMBER	QTY	MARKING
MS	ELECTRICAL INTERLOCK FREEDOM 1NO 1NC SIZE 1 OR 2	C320KGS3	6	
	.190 X.375 HEX WASHER HD SCREW	839A681H03	150	
	.190-32 X .500 HEX HEAD TR SCR	839A681H05	28	
	1/4-20 X .500 RH E/T SEMS	106A692G05	24	
	ABMM-A ABS ABS CABLE MOUNT	70801FA00A	6	
	BREAKER HMCP AMP FRAME	HMCPS015E0C	6	
	C440 SSOL SUPPLEMENTAL CHART	PUB52394	1	
	CABLE TIE	4714A24H01	3	
	CAUTION LABEL: HAZARDOUS VOLTAGE, LIVE CIRCUITS	4714A02H01	6	
	CPT 100VA 440/480-95/125VAC 50/60HZ.	C0100E2AFB	6	
	CUSTOM DEVICE NAMEPLATE 1.8" X 0.58"	1428B04H11	18	
	DANGER - WARNING	4710A46H17	6	
	DEVICE NAMEPLATE ELAPSED TIME	30-45336	6	
	DEVICE PANEL 6 CUTOUT	1161D43H01	6	
	DIVIDER PAN, FREEDOM+/FFG+AR MCC, STANDARD	17-25714	1	
	DOOR ASSEMBLY	39-48292-3	6	
	FREEDOM NEMA SIZE 1 120VAC, C440 SSOL (4-20A)	AN19CN0A5E020	6	
	INDICATING LIGHT LENS, GREEN	10250TC2N	6	
	INDICATING LIGHT LENS, RED	10250TC1N	6	
	INDICATING LIGHT, TRANSFORMER TYPE, 120VAC W/O LED BULB	10250T181L	12	1133, 1134, 1137, 1138, 1141, 1142, 1145, 1146, 1149, 1150, 1153, 1154
	LABEL - NOTICE	4710A46H18	6	
	LABEL, UL, MCC UNIT LISTING	4714A26H22	6	
	LED BULB NATURAL LIGHT, USE WITH COLORED LENS	28-8310	12	
	METER EATON MINI ETM ELAPSED TIME	3-2308-002A	6	1132, 1136, 1140, 1144, 1148, 1152
	OFFSET PLATE 4 X 78	1161D16H01	1	
	OMS COMMON PLATFORM HANGER CP	50-43051	6	
	OVERLOAD HEATER CHART, FREEDOM SERIES	1491C79H03	1	
	PANDUIT LATCHING TIE	LC5-A-C8	30	
	PANDUIT WIRE TIE	PLT2I-M	6	
	SHUTTER	99-4712-1	6	
	STEEL BOTTOM BARRIER FOR VERTICAL BUS	FV2A010H02	1	
	TERMINAL BLOCK 7 CIRCUIT SIDE MOUNTED PULL-APART	15220	18	
	TERMINAL BLOCK JUMPER	J15220	12	
	TEW STAB	4700A97G29	6	
	VERTICAL GROUND BUS ASSEMBLY, 300A, COPPER TIN, FMO	25-31363-1	1	

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET
TAUNTON MA 02780
P.O. NUMBER: S121374090

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APPD FAY	DATE 06/02/2023	TITLE TAUNTON WWTF PH2 IMPROVEMENT 6MCC1
S.O. C00LF8H	TYPE FREEDOM+ MCC	CUSTOMER BOM

PRODUCT CODE	CAGE CODE	REVISION		G.O.	DWG	SHEET
MCC	380H0	1	A	LBS0031682-001	CUSTOMER_BOM	17 OF 18

VERTICAL SECTION 7F

DEVICE ID	DESCRIPTION	PART NUMBER	QTY	MARKING
	WARNING LABEL: LINE SIDE ENERGIZED	4713A98H11	6	

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET
TAUNTON MA 02780
P.O. NUMBER: S121374090

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APPD FAY	DATE 06/02/2023	TITLE TAUNTON WWTF PH2 IMPROVEMENT 6MCC1	
S.O. C00LF8H		TYPE FREEDOM+ MCC	CUSTOMER BOM

PRODUCT CODE	CAGE CODE	REVISION		G.O.	DWG	SHEET
MCC	380H0	1	A	LBS0031682-001	CUSTOMER_BOM	18 OF 18

REVISION STATUS		SHEET DESCRIPTION
SHEET	REV	
000	1	REVISION HISTORY
001	1	LEGEND; ABBREVIATIONS, STANDARDS & SYMBOLS

REVISION HISTORY				
REV	REVISION DESCRIPTION	BY	APPD	DATE
1	NEW DRAWING	TLL	FAY	6/1/2023

NEG-ALT NUMBER: D7580427X2K2-C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
P.O. NUMBER: S121374090

Certified As-Built
This document accurately reflects the manufacturing details of this product when it shipped from the factory.

CAGE CODE 380H0

DFTR TLL	DATE 06/01/2023	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.		EATON
APPD FAY	DATE 06/01/2023	TITLE TAUNTON WWTF PH2 IMPROVEMENT 6MCC1		
PRODUCT CODE MCC	S.O. C00LF8H	TYPE FREEDOM+ MCC		LEGEND
REVISION 1	DWG SIZE	G.O. LBS0031682-001	DWG C00LF8H-E	SHEET 000

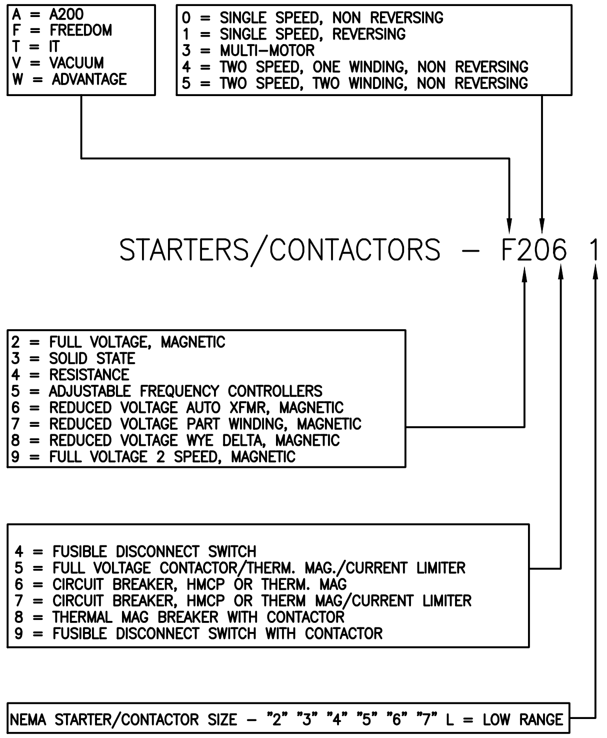
COEFtBL_R6

ABBREVIATIONS

GENERAL

MS	MOTOR STARTER
FLA	FULL LOAD AMPS
KW	KILOWATTS
CPT	CONTROL POWER TRANSFORMER
CT	CURRENT TRANSFORMER
AFD	ADJUSTABLE FREQUENCY DRIVE
VFD	VARIABLE FREQUENCY DRIVE
CB	CIRCUIT BREAKER
BKR	BREAKER
FDR	FEEDER
SVM	SYSTEM VOLTAGE MONITOR
DS	DISCONNECT SWITCH

DEVICE DESIGNATION



A = A200
F = FREEDOM
T = IT
V = VACUUM
W = ADVANTAGE

0 = SINGLE SPEED, NON REVERSING
1 = SINGLE SPEED, REVERSING
3 = MULTI–MOTOR
4 = TWO SPEED, ONE WINDING, NON REVERSING
5 = TWO SPEED, TWO WINDING, NON REVERSING

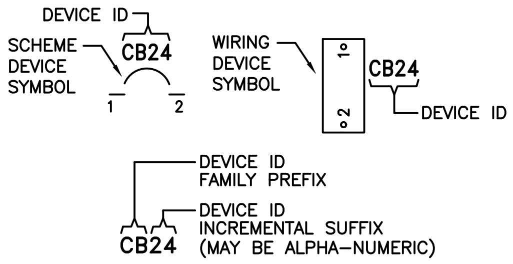
STARTERS/CONTACTORS – F206 1

2 = FULL VOLTAGE, MAGNETIC
3 = SOLID STATE
4 = RESISTANCE
5 = ADJUSTABLE FREQUENCY CONTROLLERS
6 = REDUCED VOLTAGE AUTO XFMR, MAGNETIC
7 = REDUCED VOLTAGE PART WINDING, MAGNETIC
8 = REDUCED VOLTAGE WYE DELTA, MAGNETIC
9 = FULL VOLTAGE 2 SPEED, MAGNETIC

4 = FUSIBLE DISCONNECT SWITCH
5 = FULL VOLTAGE CONTACTOR/THERM. MAG./CURRENT LIMITER
6 = CIRCUIT BREAKER, HMCP OR THERM. MAG
7 = CIRCUIT BREAKER, HMCP OR THERM MAG/CURRENT LIMITER
8 = THERMAL MAG BREAKER WITH CONTACTOR
9 = FUSIBLE DISCONNECT SWITCH WITH CONTACTOR

NEMA STARTER/CONTACTOR SIZE – "2" "3" "4" "5" "6" "7" L = LOW RANGE

DEVICE IDENTIFICATION



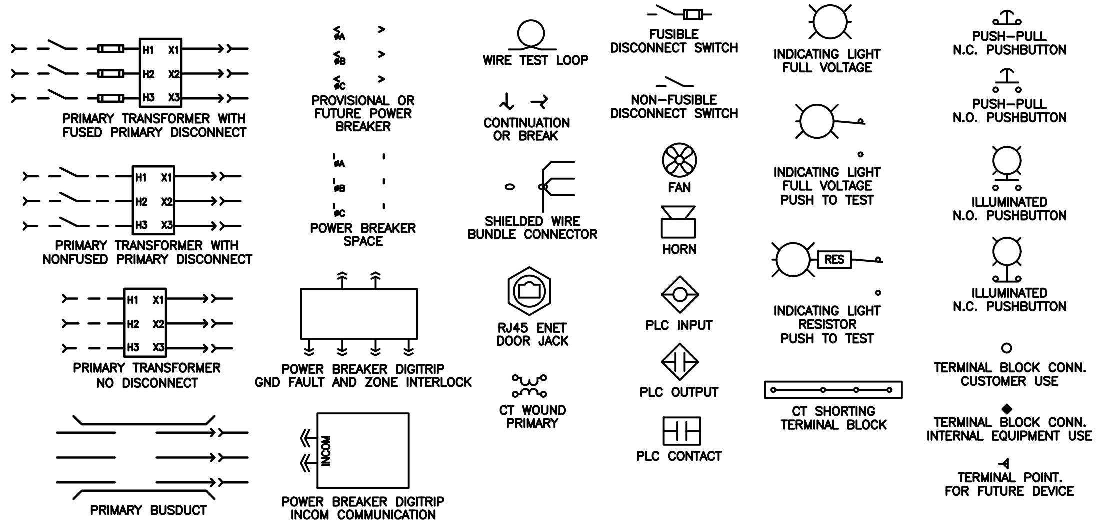
DEVICE ID FAMILY PREFIX DEFINITION

ANN	ANNUNCIATOR
ATX	AUTOTRANSFORMER
BUS	BUS
C	CONTACTOR
CAP	CAPACITOR – POWER
CB	BREAKER
COM	COMMUNICATION
CPT	CPT
CR	RELAY
CT	CURRENT TRANSFORMER
CTD	CAPACITOR TRIP DEVICE
D	DIODE
DS	SWITCH – DISCONNECT
FAN	FUSE – MV POWER
FU	FUSE AND FUSE BLOCK & HOLDER
GFR	GROUND FAULT OPTION
GRD	GROUND BUS
GRF	GROUND FAULT RELAY AND MONITOR
GRS	GROUND FAULT SENSOR
HTR	HEATER
JMP	JUMPER
K	KEY INTERLOCK
LOR	RELAY – LOCKOUT
LS	SWITCH, LIMIT
LT	LIGHT
MISC	MISC COMPONENTS
MS	STARTER
MT	METER
OL	OVERLOAD RELAY
PB	PUSHBUTTON
PDB	POWER DIST BLOCK
PLC	PLC
POT	POTENTIOMETER
PR	RELAY – PROTECTIVE
PS	POWER SUPPLY/CONVERTERS/CONDITIONING
PT	POTENTIAL TRANSFORMER
REC	RECEPTACLE
RES	RESISTOR – POWER
SS	SWITCH, SELECTOR
STB	STAB
SU	SURGE SUPPRESSOR
T	REACTOR
TB	TERMINAL BLOCK
TERM	TERMINAL
TR	RELAY – TIMING
TS	SWITCH, TEST
TS	THERMOSTAT
TX	DISTRIBUTION TRANSFORMER
VFD	AFD (ADJUST. FREQ. DRIVE)
XD	TRANSDUCER

NEMA / IEEE CONFORMANCE STATEMENT PERTAINING TO GRAPHIC SYMBOLS FOR ELECTRICAL DRAWINGS:

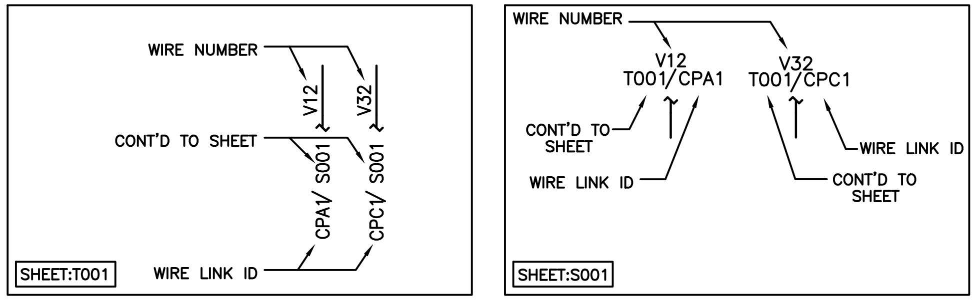
IT IS EATON'S PRACTICE TO CONFORM TO STANDARDS ESTABLISHED BY THE NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA). IF NEMA DOESN'T HAVE A PARTICULAR SYMBOL OR IF IT IS NOT SHOWN IN THE THIS DOCUMENTATION, REFER TO THE AMERICAN NATIONAL STANDARDS (ANSI Y32.2, IEEE STD 315).

NONSTANDARD SYMBOLS



SCHEMATIC WIRE LINK (SIGNAL CROSS REF) DEFINITION

WIRE LINK OR SIGNAL CROSS REFERENCE SYMBOLS TIE SPLIT OR BROKEN WIRE SEGMENTS TOGETHER THAT SPAN DIFFERENT LOCATIONS WITHIN A SHEET OR ACROSS DIFFERENT SHEETS.

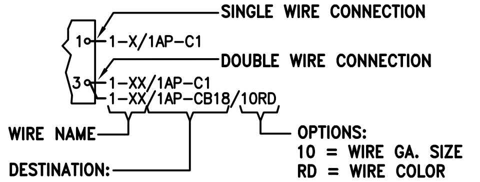


THE WIRE LINK ID IS UNIQUE FOR PAIRED WIRE LINK SYMBOLS.

PAIRED WIRE LINK SYMBOLS WILL HAVE THE SAME WIRE NUMBER.

WIRE REFERENCE TAG ID

FORMAT: WIRE NAME / DESTINATION / OPTIONS



DESTINATION:
1AP = ZONE LOCATION
CB18 = DEVICE IDENTIFICATION

OPTIONS:
10 = WIRE GA. SIZE
RD = WIRE COLOR

WIRE COLOR DEFINITIONS

BK = BLACK
BL = BLUE
BN = BROWN
GN = GREEN
GY = GRAY
OR = ORANGE
RD = RED
TN = TAN
VT = VIOLET
WT = WHITE
YL = YELLOW

WIRE SIZE DEFINITIONS

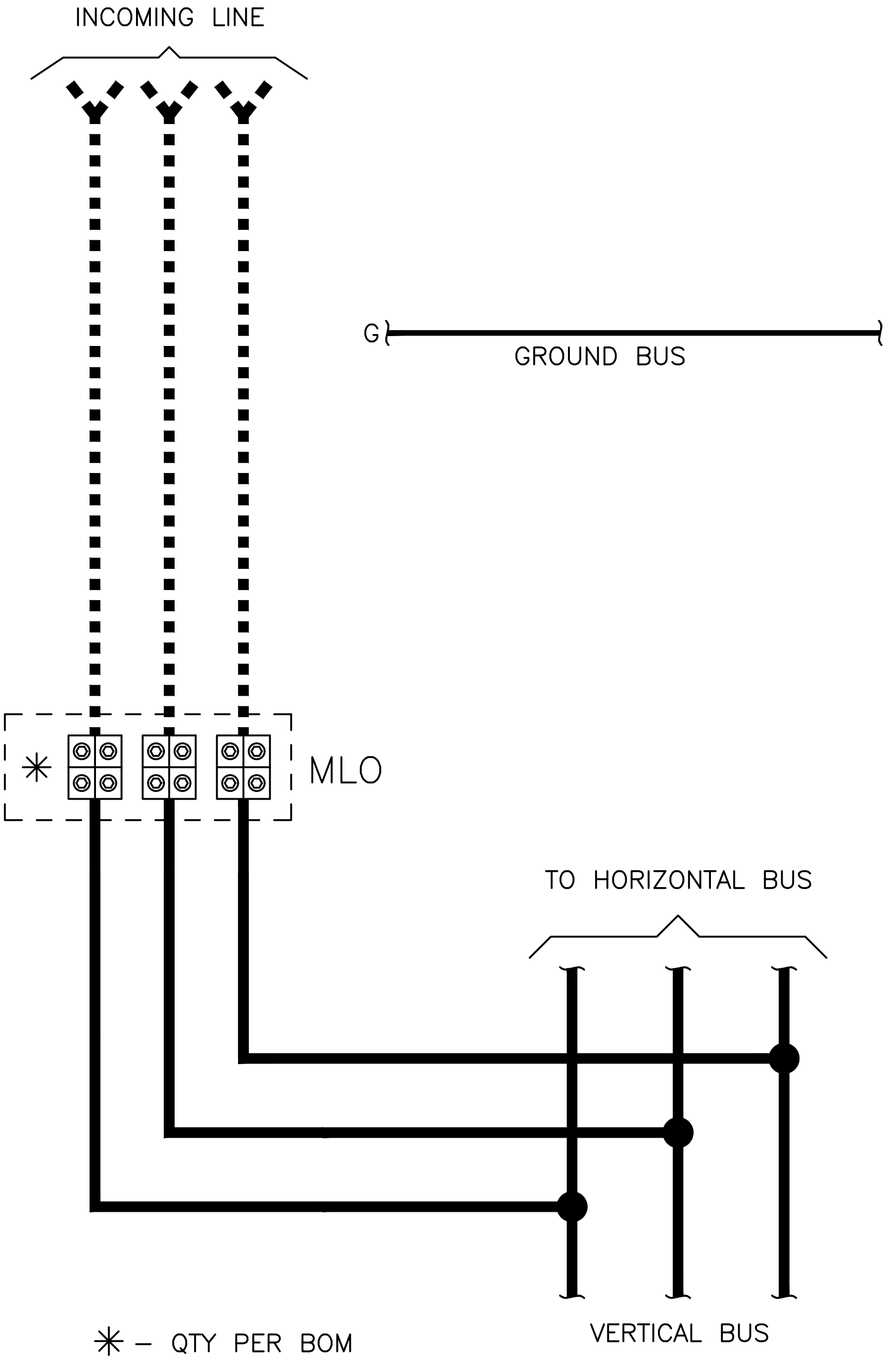
16 = 16awg
14 = 14awg
12 = 12awg
10 = 10awg
8 = 8awg
6 = 6awg
4 = 4awg
2 = 2awg
1 = 1awg
1/0 = 1/0awg
2/0 = 2/0awg
4/0 = 4/0awg
500 = 500kcmil

NEG–ALT NUMBER: D7580427X2K2–C000
ITEM NUMBER: 001
CUSTOMER: WATERMARK ELECTRIC
LOCATION: 825 WEST WATER STREET TAUNTON MA 02780
P.O. NUMBER: S121374090

Certified As-Built
This document accurately reflects the manufacturing details of this product when it shipped from the factory.

DFTR TLL	DATE 06/01/2023	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.	EATON
APPD FAY	DATE 06/01/2023	TITLE TAUNTON WWTF PH2 IMPROVEMENT 6MCC1	
PRODUCT CODE MCC	S.O. C00LF8H	TYPE FREEDOM+ MCC	LEGEND
REVISION 1	DWG SIZE	G.O. LBS0031682–001	DWG C00LF8H–E SHEET 001

CAGE CODE
380H0



EATON

TITLE
MLO TOP ENTRY

TYPE
FREEDOM+ MCC
SCHEMATIC

G.O.
LBS0031682

DWG
C00LF8H-S001

SHEET
1 OF 1

DFTR
SVU
DATE
05/31/23

APPD
FAY
DATE
05/31/23

APPD
DATE

REVISION
1

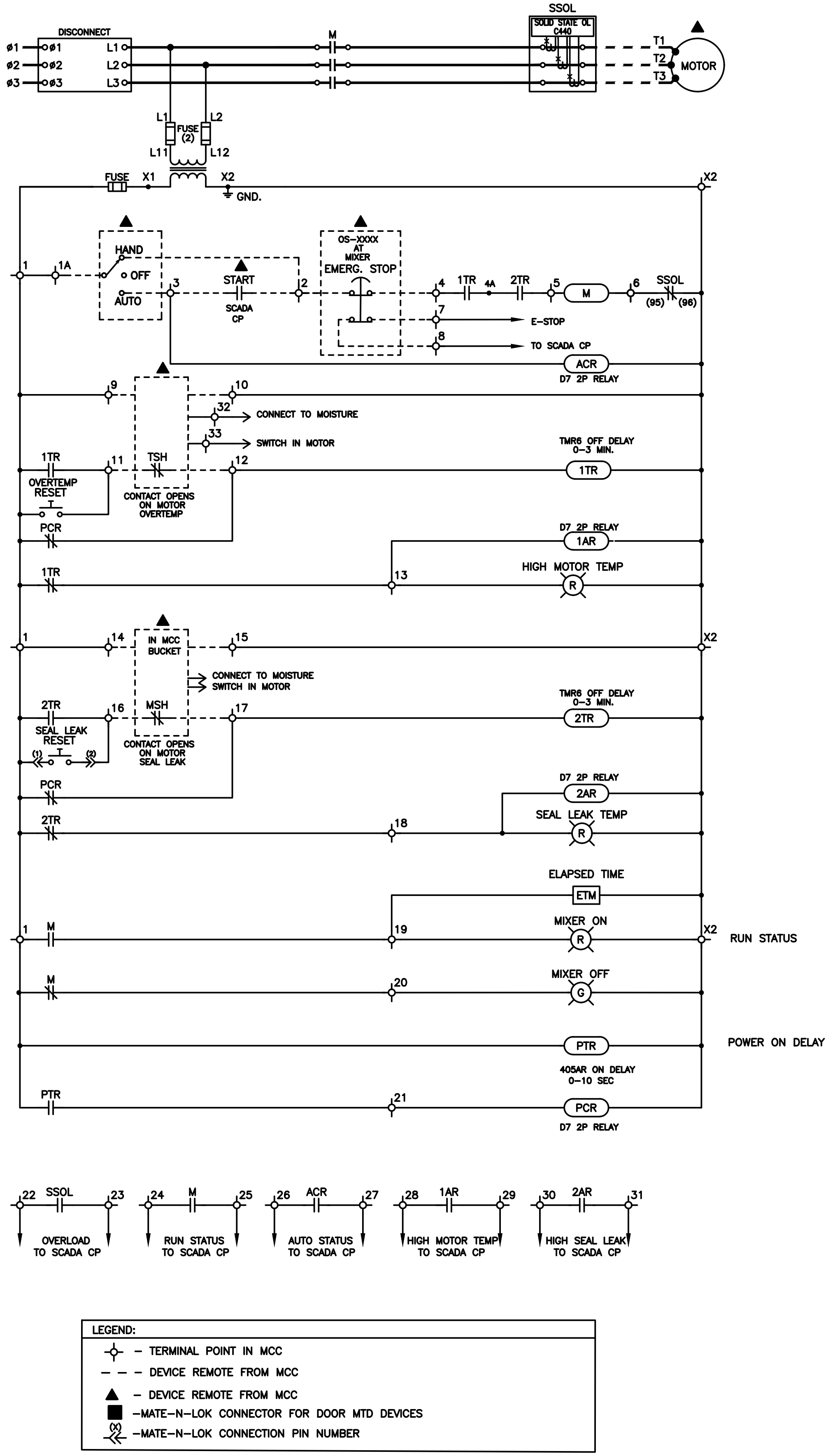
DWG SIZE
A

PRODUCT CODE
CF

FEDERAL ID NO

REVISION
1

FILE: C00LF8H-S001.DWG



EATON

TITLE ASM-3151, UNIT - 1F
15 HP,FVNR Starter Size 2 W C440 OL , 6MCC1

TYPE SCHEMATIC
FREEDOM+ MCC

G.O. LBS0031682

DWG C00LF8H-S002

SHEET 1 OF 2

DFTR SVU

DATE 5/31/2023

APPD FAY

DATE 5/31/2023

APPD

DATE

DWG SIZE A

REVISION 1

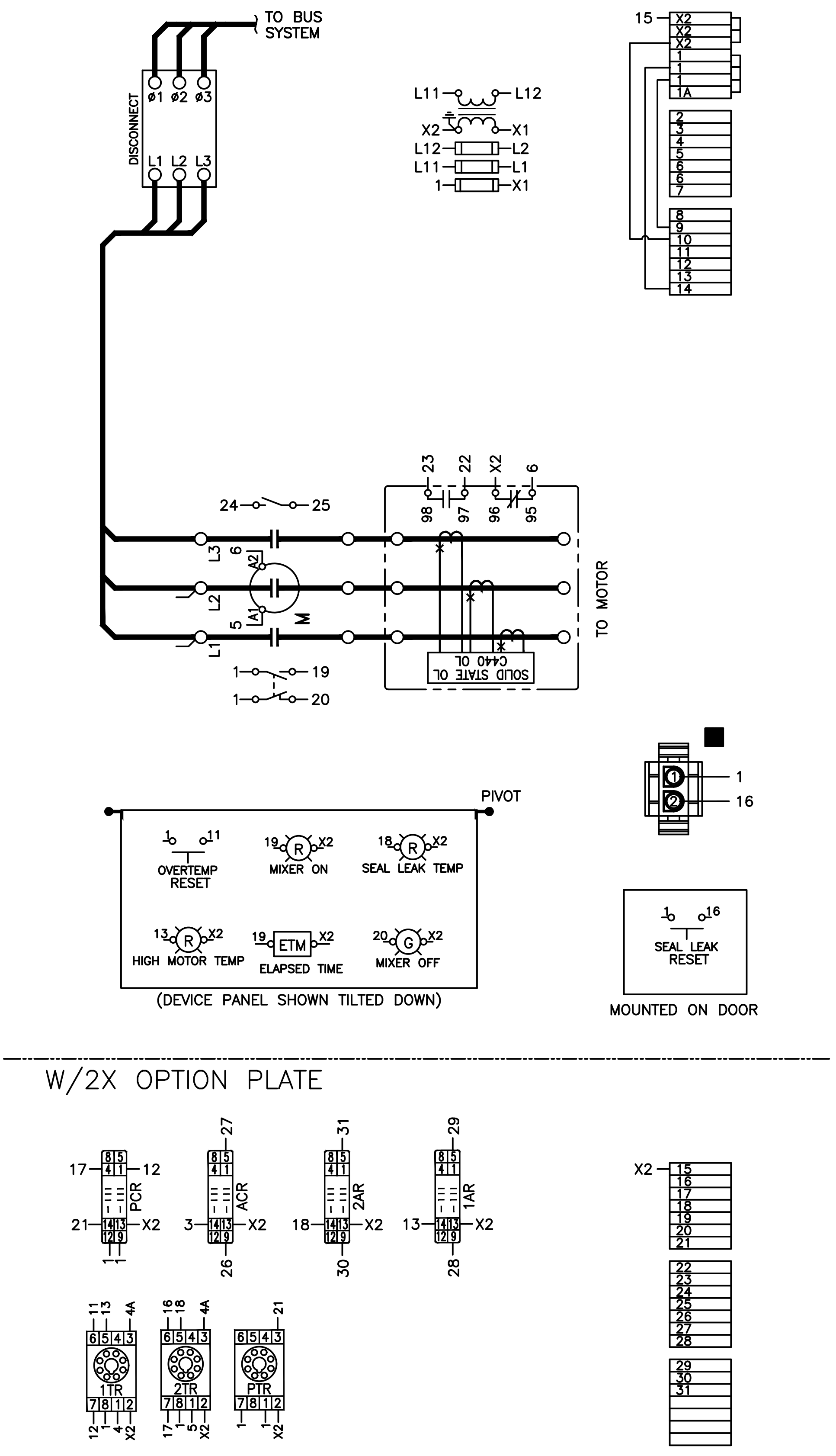
PRODUCT CODE CF

FEDERAL ID NO

REVISION

1

FILE: C00LF8H-S002.DWG



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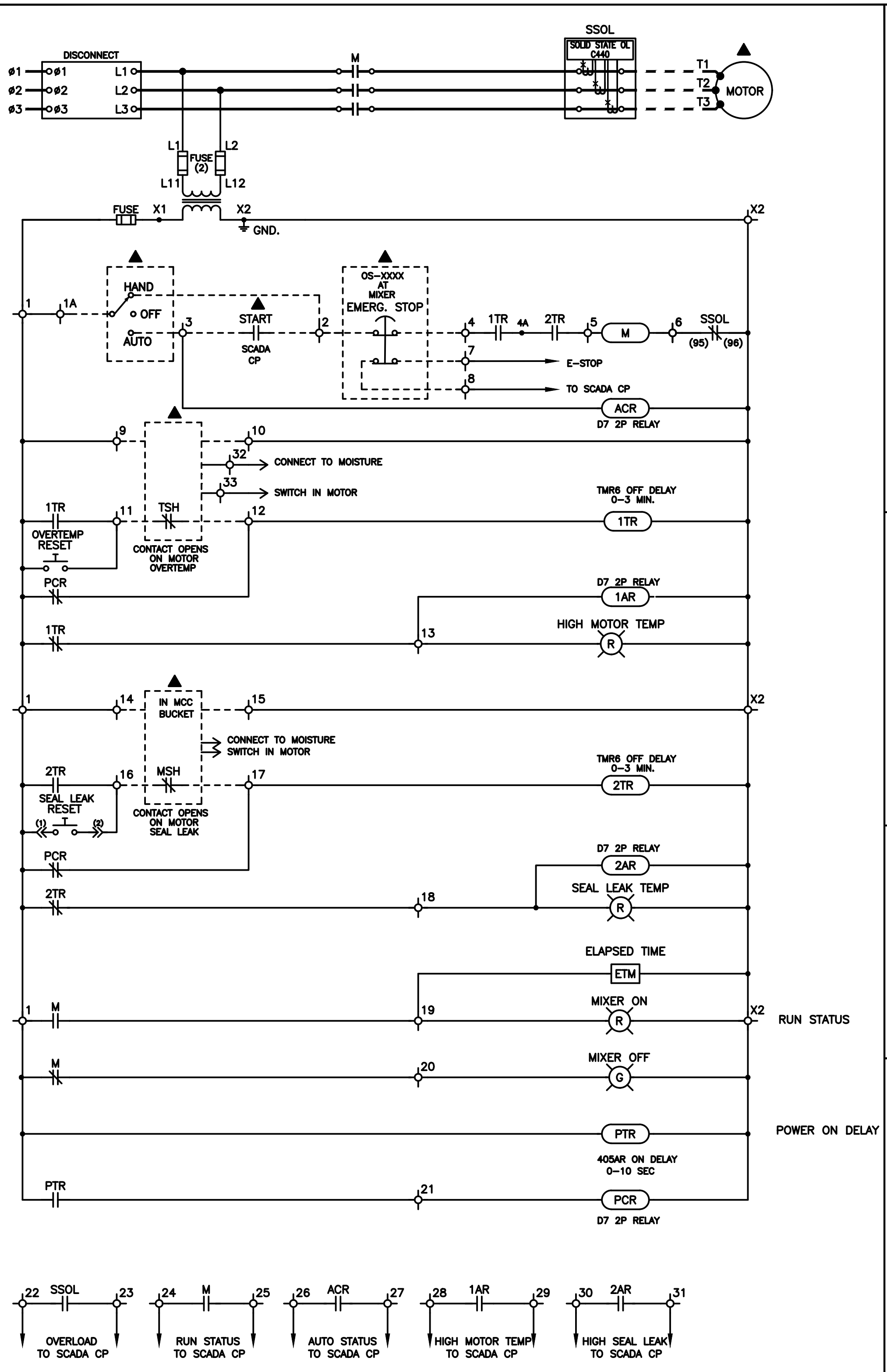
EATON

DFTR SVU	DATE 5/31/2023	TITLE ASM-3151, UNIT - 1F 15 HP,FVNR Starter Size 2 W C440 OL , 6MCC1
APPD FAY	DATE 5/31/2023	
APPD	DATE	TYPE FREEDOM+ MCC · CONNECTION
FEDERAL ID NO	PRODUCT CODE CF	REVISION 1 · DWG SIZE A · G.O. LBS0031682 · DWG C00LF8H-S002 · SHEET 2 OF 2

REVISION

1

FILE: C00LF8H-S002.DWG



LEGEND:

-ф- – TERMINAL POINT IN MCC

– – – – DEVICE REMOTE FROM MCC

▲ – DEVICE REMOTE FROM MCC

■ –MATE-N-LOK CONNECTOR FOR DOOR MTD DEVICES

(X)≪ –MATE-N-LOK CONNECTION PIN NUMBER

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EATON

TITLE ASM-3251, UNIT – 1K
15 HP,FVNR Starter Size 2 W C440 OL , 6MCC1

TYPE FREEDOM+ MCC
SCHEMATIC

G.O. LBS0031682

DWG C00LF8H-S003

SHEET 1 OF 2

DATE 5/31/2023
DFTR SVU

DATE 5/31/2023
APPD FAY

DATE
APPD

DWG SIZE A

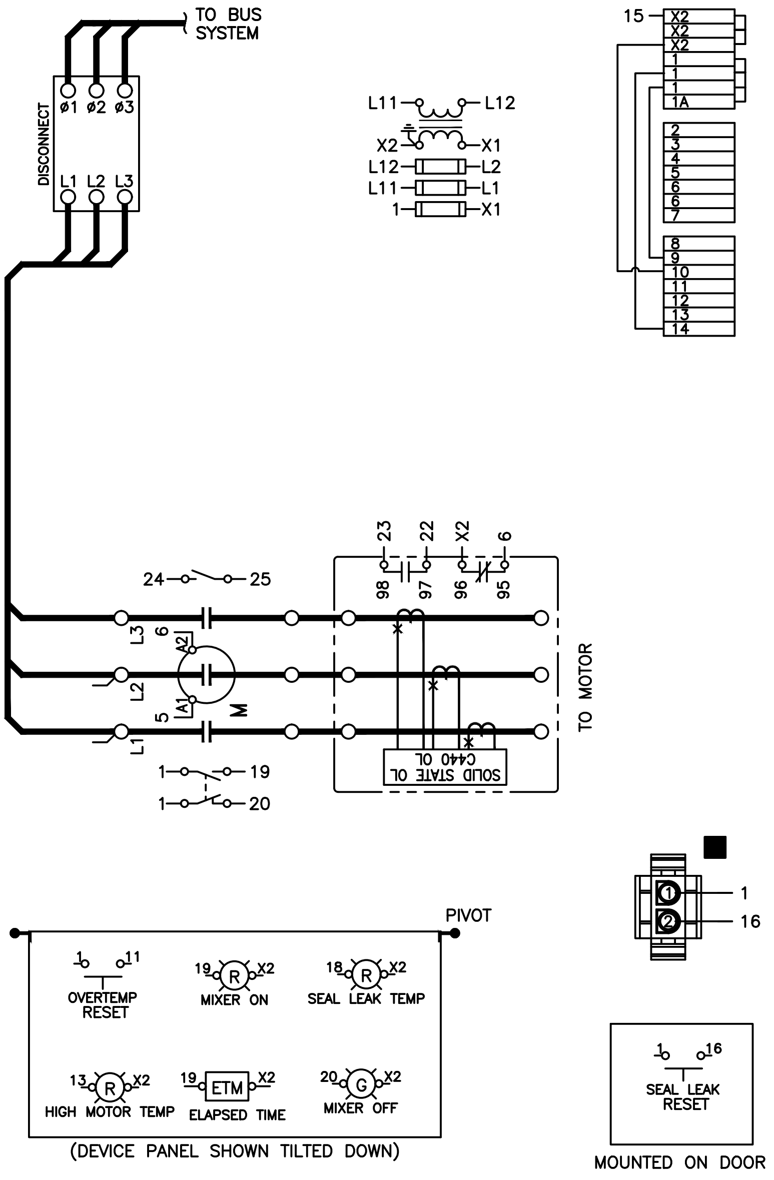
REVISION 1

PRODUCT CODE CF

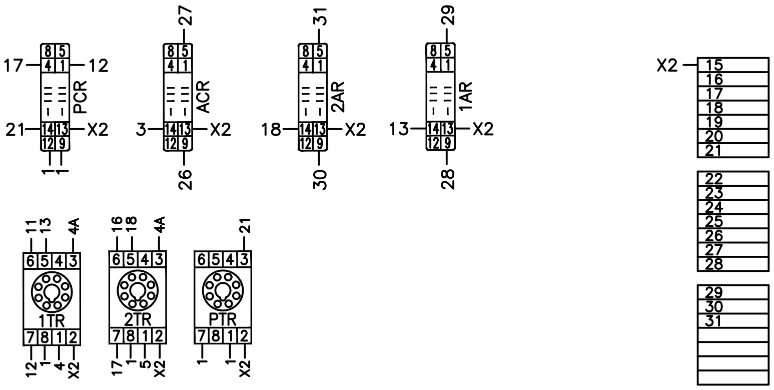
FEDERAL ID NO

REVISION
1

FILE: C00LF8H-S003.DWG



W/2X OPTION PLATE



THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE WHICH IT WAS SUPPLIED.

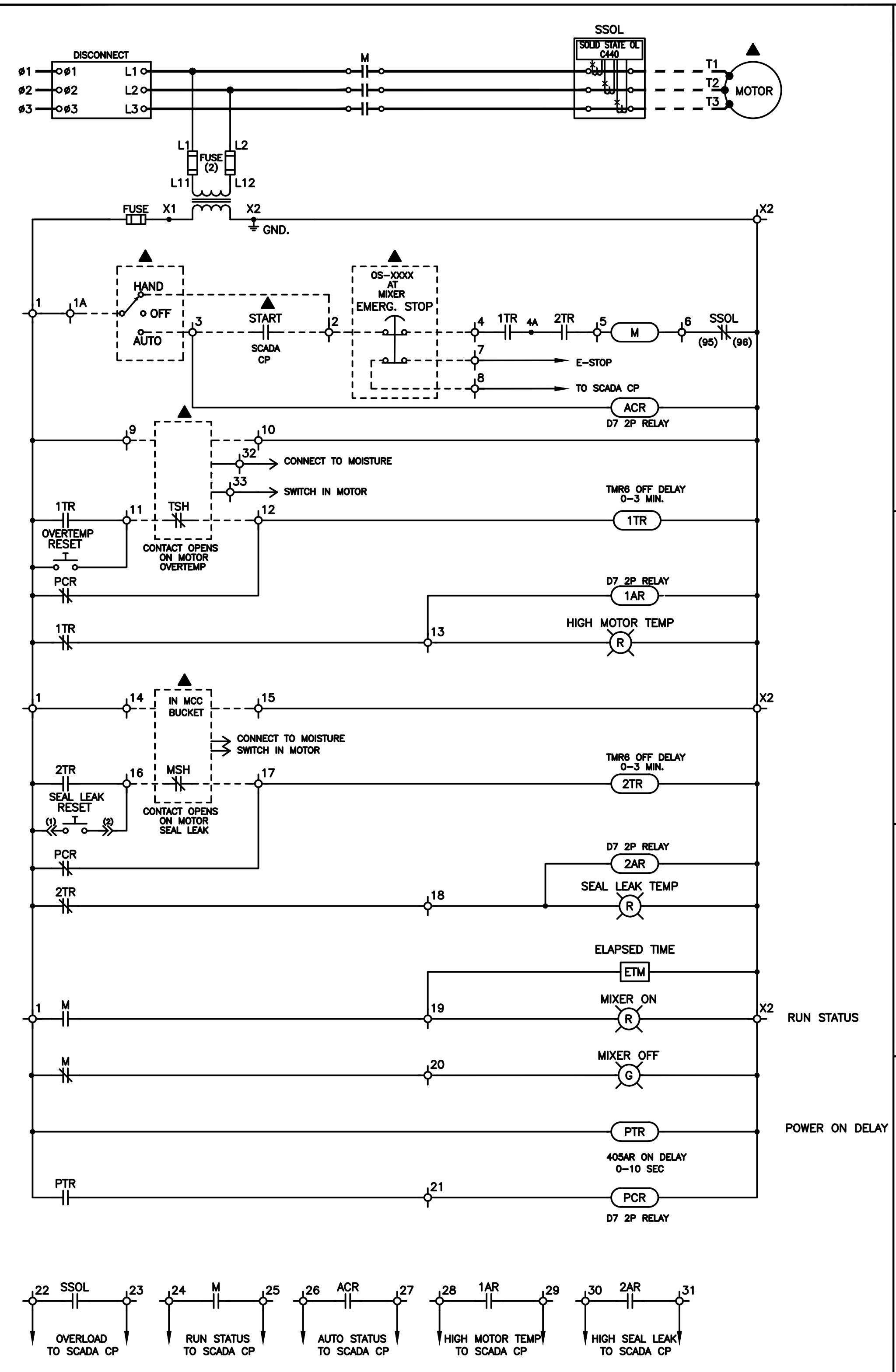
EATON

TITLE	ASM-3251, UNIT - 1K 15 HP,FVNR Starter Size 2 W C440 OL , 6MCC1
TYPE	FREEDOM+ MCC CONNECTION
G.O.	LBS0031682
DWG	C00LF8H-S003
SHEET	2 OF 2
DATE	5/31/2023
DFTR	SVU
DATE	5/31/2023
APPD	FAY
DATE	
APPD	
DWG SIZE	A
REVISION	1
PRODUCT CODE	CF
FEDERAL ID NO	

REVISION

1

FILE: C00LF8H-S003.DWG



LEGEND:

- -⌖- – TERMINAL POINT IN MCC
- – – – DEVICE REMOTE FROM MCC
- ▲ – DEVICE REMOTE FROM MCC
- ■ –MATE–N–LOK CONNECTOR FOR DOOR MTD DEVICES
- (X)≪ –MATE–N–LOK CONNECTION PIN NUMBER

EATON

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TITLE
ASM-3111, UNIT - 2D
10 HP,FVNR Starter Size 1 W C440 OL , 6MCC1

TYPE
FREEDOM+ MCC
SCHEMATIC

G.O.
LBS0031682

DWG
C00LF8H-S004

SHEET
1 OF 2

DFTR SVU	DATE 5/31/2023	
APPD FAY	DATE 5/31/2023	
APPD	DATE	

REVISION
1

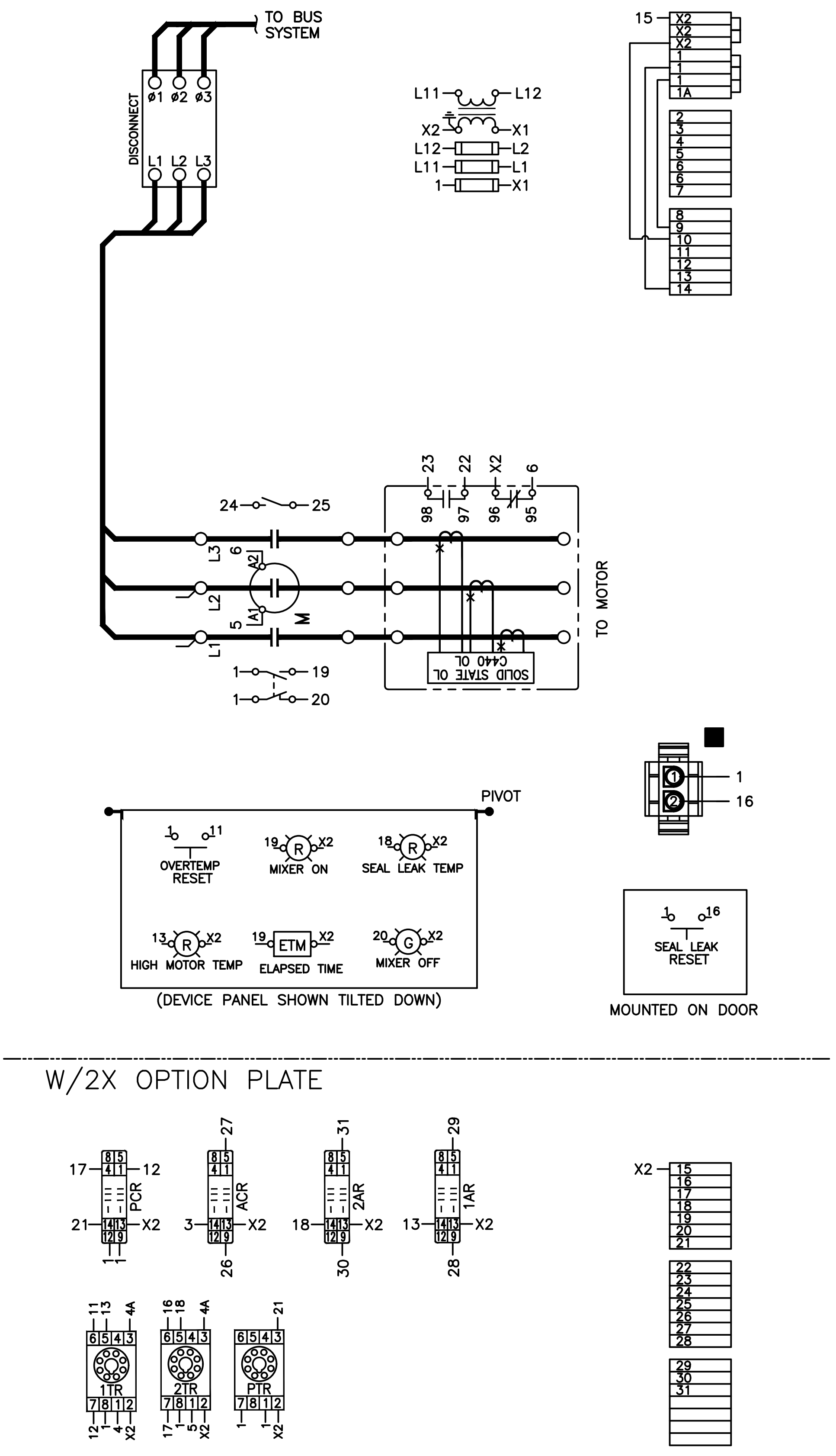
DWG SIZE
A

PRODUCT CODE
CF

FEDERAL ID NO

REVISION
1

FILE: C00LF8H-S004.DWG



THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE WHICH IT WAS SUPPLIED.

EATON

TITLE ASM-3111, UNIT – 2D
10 HP,FVNR Starter Size 1 W C440 OL , 6MCC1

TYPE FREEDOM+ MCC CONNECTION

G.O. LBS0031682

DWG C00LF8H-S004

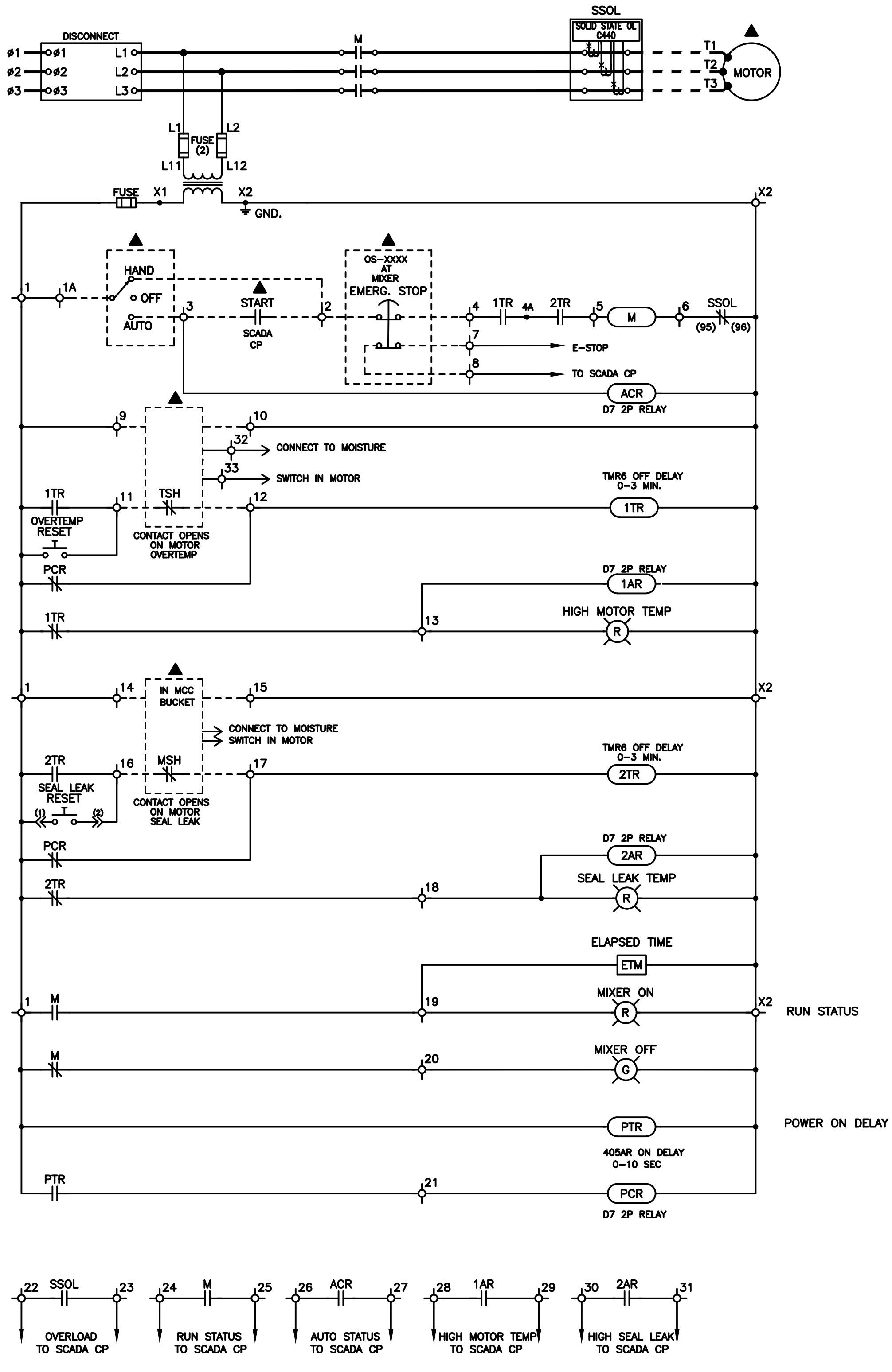
SHEET 2 OF 2

DFTR SVU	DATE 5/31/2023	
APPD FAY	DATE 5/31/2023	
APPD	DATE	
REVISION 1	DWG SIZE A	
FEDERAL ID NO	PRODUCT CODE CF	

REVISION

1

FILE: C00LF8H-S004.DWG



LEGEND:

- -⌖- – TERMINAL POINT IN MCC
- – – – DEVICE REMOTE FROM MCC
- ▲ – DEVICE REMOTE FROM MCC
- ■ –MATE–N–LOK CONNECTOR FOR DOOR MTD DEVICES
- (X) –MATE–N–LOK CONNECTION PIN NUMBER

E·T·N

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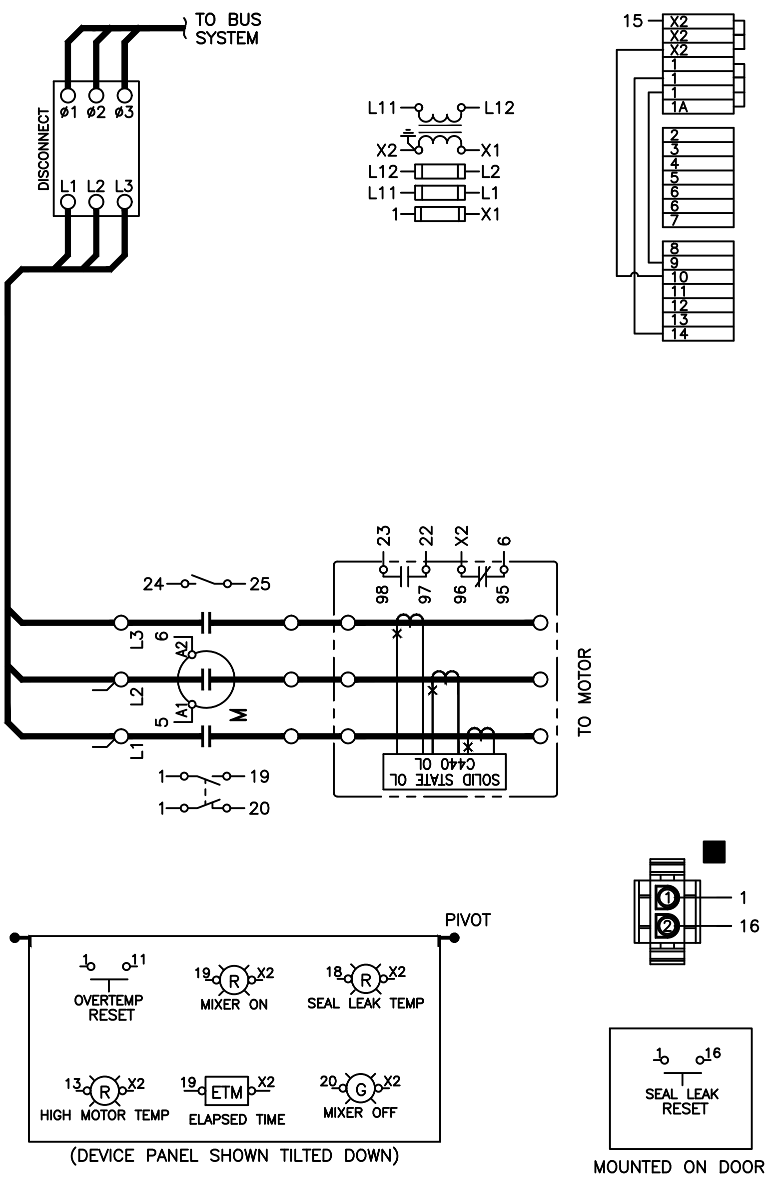
TITLE	ASM–3112, UNIT – 2H 10 HP,FVNR Starter Size 1 W C440 OL , 6MCC1
TYPE	SCHEMATIC FREEDOM+ MCC
G.O.	LBS0031682
DWG	C00LF8H-S005
SHEET	1 OF 2
DFTR	SVU
DATE	5/31/2023
APPD	FAY
DATE	5/31/2023
APPD	
DATE	
DWG SIZE	A
REVISION	1
PRODUCT CODE	CF
FEDERAL ID NO	

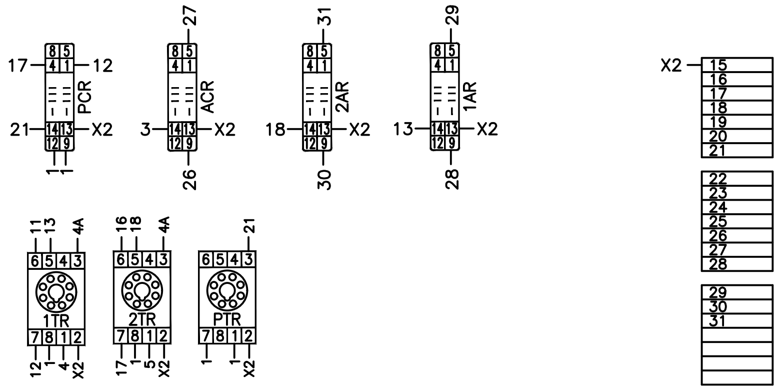
REVISION

1

FILE: C00LF8H–S005.DWG



W/2X OPTION PLATE



EATON

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TITLE ASM-3112, UNIT - 2H
10 HP,FVNR Starter Size 1 W C440 OL , 6MCC1

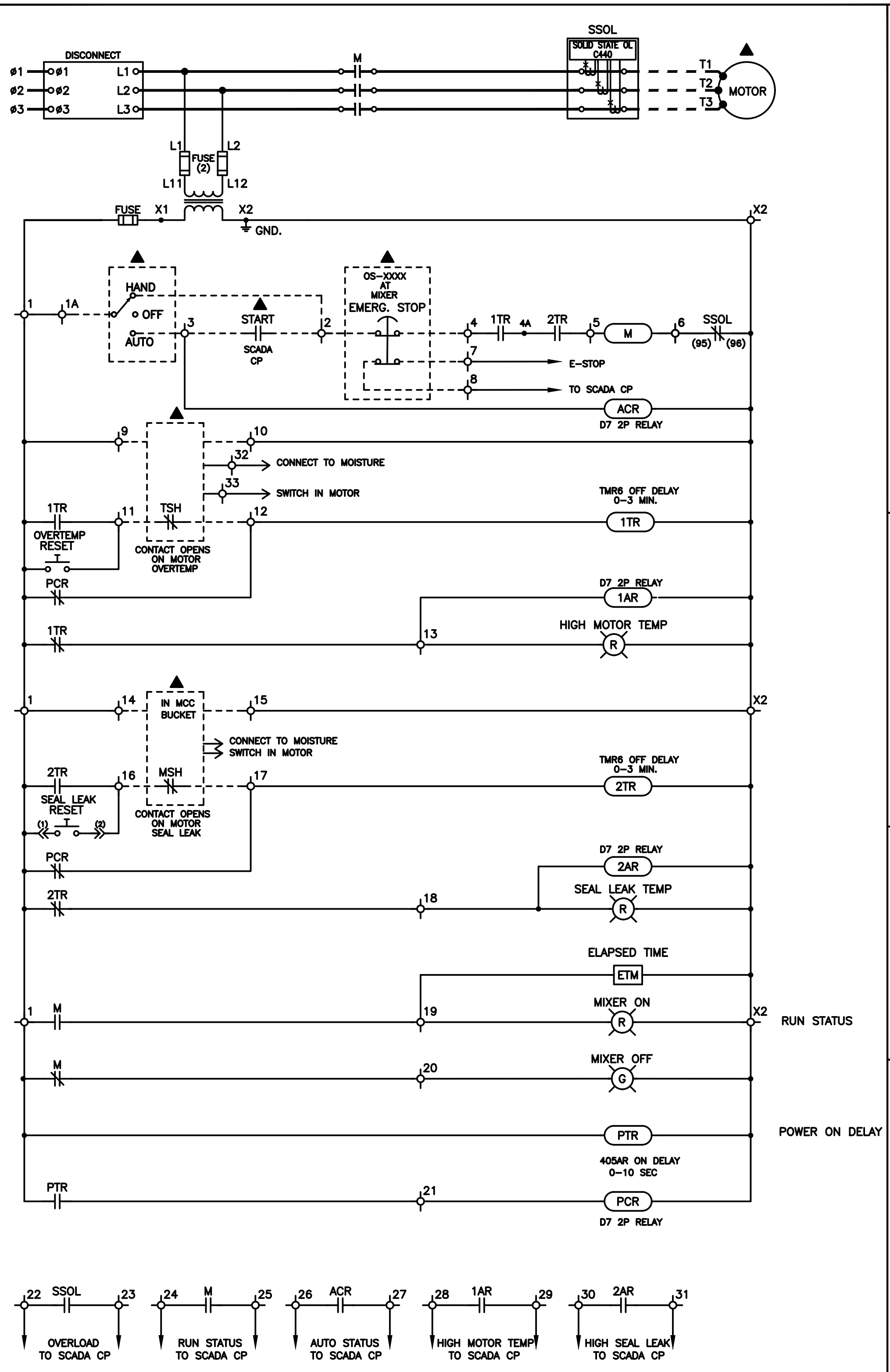
TYPE FREEDOM+ MCC
CONNECTION

G.O. LBS0031682
DWG C00LF8H-S005
SHEET 2 OF 2

DFTR SVU	DATE 5/31/2023		
APPD FAY	DATE 5/31/2023		
APPD	DATE		
REVISION 1	DWG SIZE A		
PRODUCT CODE CF			
FEDERAL ID NO			

REVISION
1

FILE: C00LF8H-S005.DWG



LEGEND:

-⌖- – TERMINAL POINT IN MCC
– – – – DEVICE REMOTE FROM MCC
▲ – DEVICE REMOTE FROM MCC
■ –MATE–N–LOK CONNECTOR FOR DOOR MTD DEVICES
(X) ≪ –MATE–N–LOK CONNECTION PIN NUMBER

EATON

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TITLE ASM–3113, UNIT – 2M
10 HP,FVNR Starter Size 1 W C440 OL , 6MCC1

TYPE FREEDOM+ MCC
SCHEMATIC

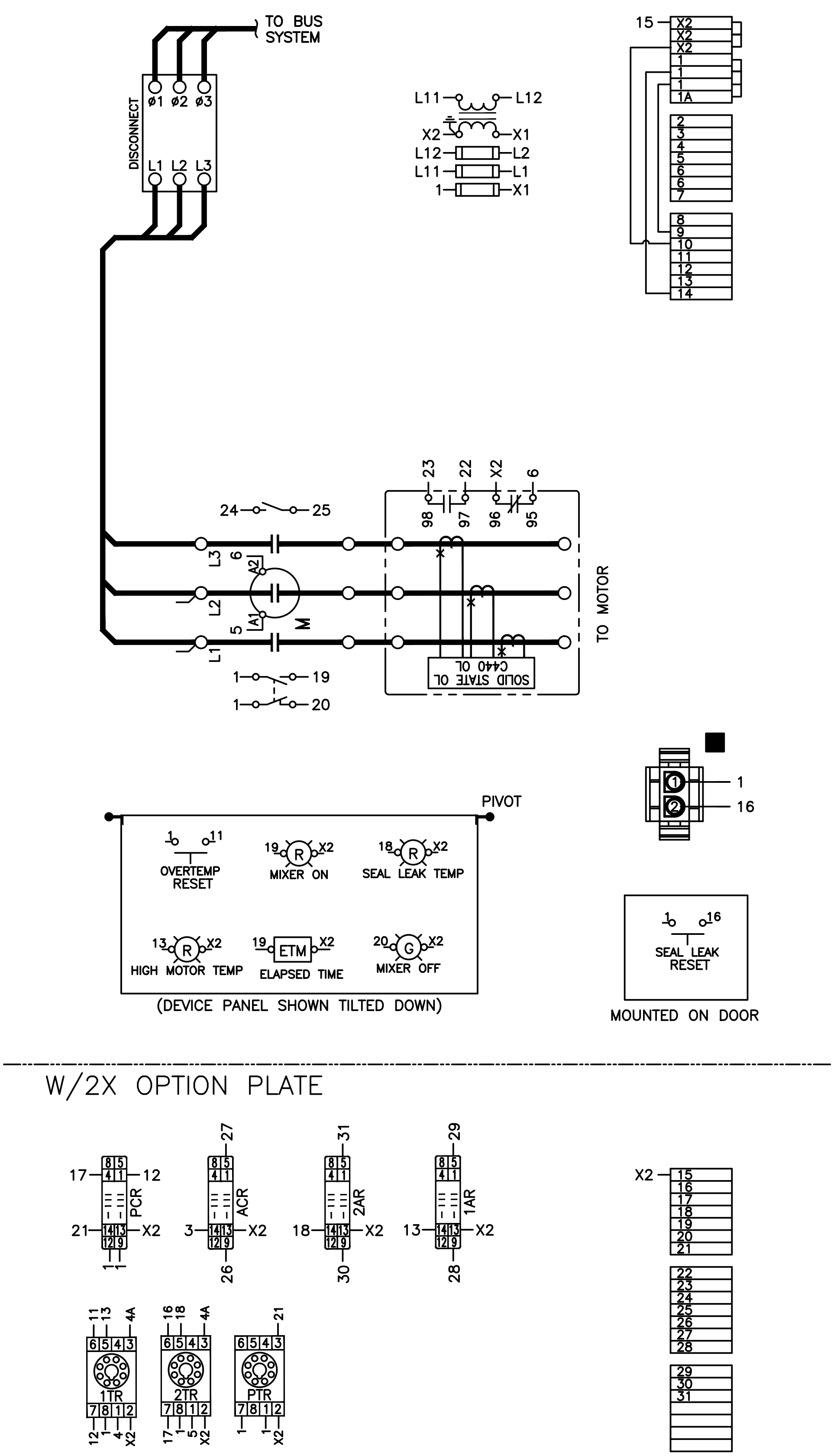
G.O. LBS0031682
DWG C00LF8H-S006
SHEET 1 OF 2

DFTR SVU
DATE 5/31/2023
APPD FAY
DATE 5/31/2023
APPD
DATE

REVISION 1
DWG SIZE A
PRODUCT CODE CF
FEDERAL ID NO

REVISION
1

FILE: C00LF8H-S006.DWG



EATON

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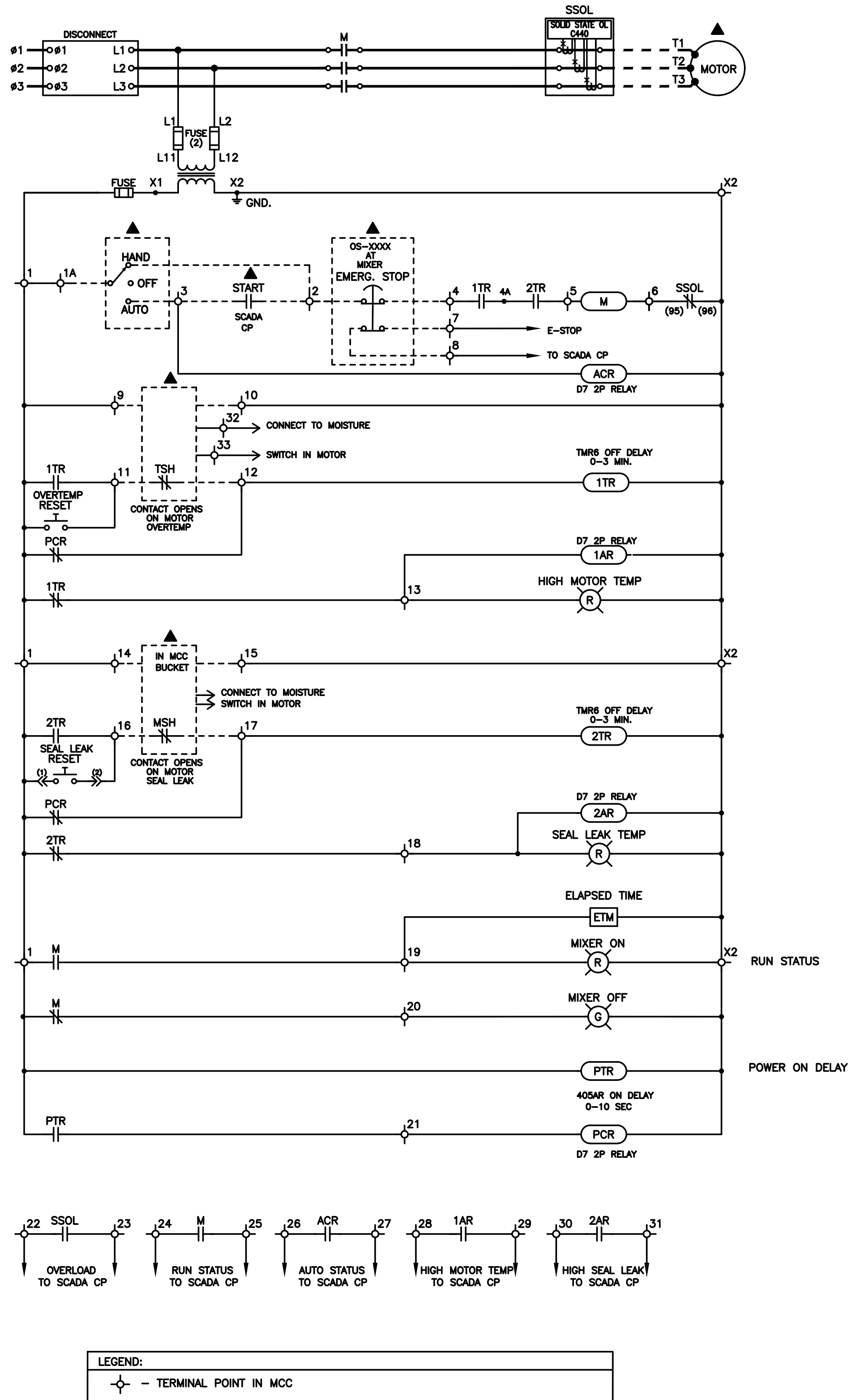
DFTR SVU	DATE 5/31/2023	
APPD FAY	DATE 5/31/2023	TITLE ASM-3113, UNIT - 2M 10 HP,FVNR Starter Size 1 W C440 OL , 6MCC1
APPD	DATE	TYPE FREEDOM+ MCC — CONNECTION
REVISION 1	DWG SIZE A	G.O. LBS0031682 — DWG C00LF8H-S006 — SHEET 2 OF 2
FEDERAL ID NO	PRODUCT CODE CF	

REVISION 1

FILE: C00LF8H-S006.DWG



LEGEND:

- -⌖- – TERMINAL POINT IN MCC
- – – – DEVICE REMOTE FROM MCC
- ▲ – DEVICE REMOTE FROM MCC
- ■ –MATE–N–LOK CONNECTOR FOR DOOR MTD DEVICES
- ≪(X) –MATE–N–LOK CONNECTION PIN NUMBER

EATON

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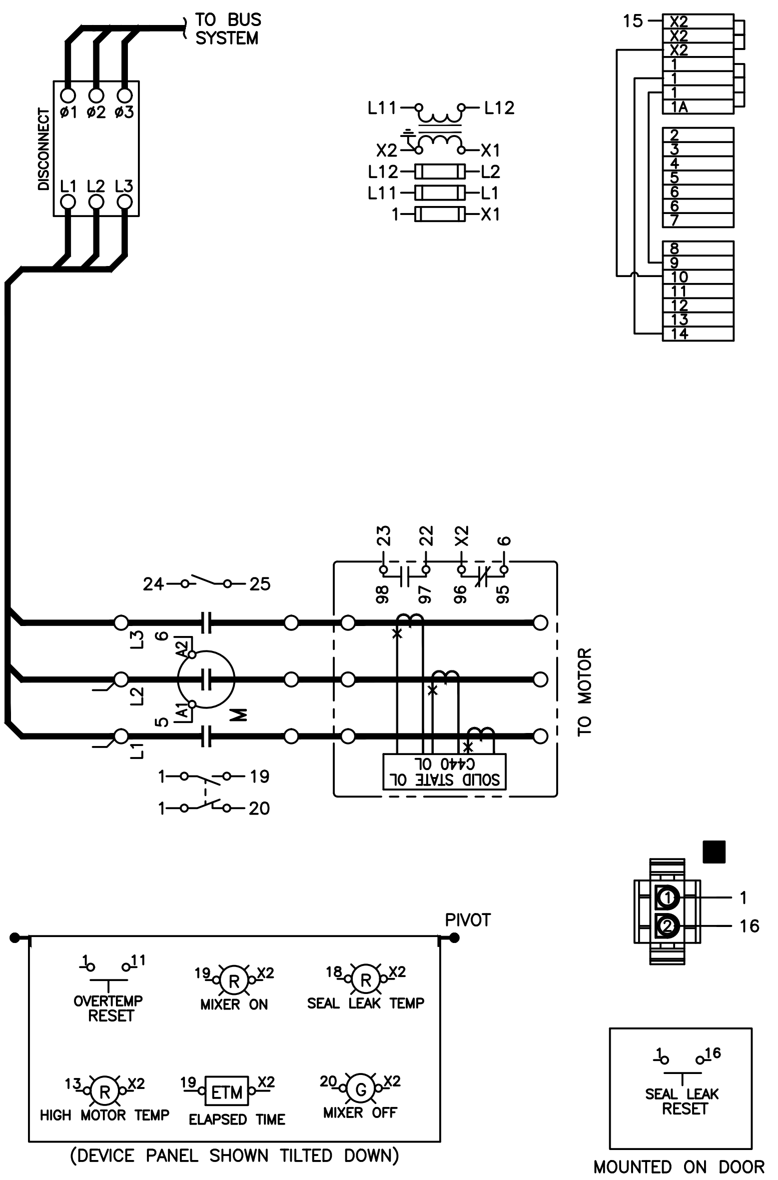
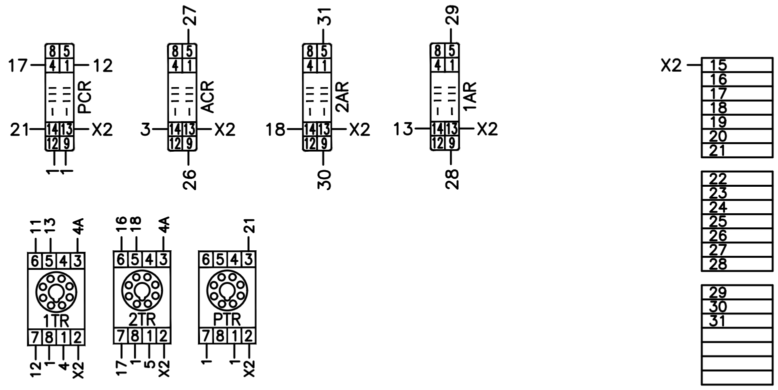
TITLE	ASM-3211, UNIT - 3D 10 HP,FVNR Starter Size 1 W C440 OL , 6MCC1
TYPE	FREEDOM+ MCC SCHEMATIC
G.O.	LBS0031682
DWG	C00LF8H-S007
SHEET	1 OF 2
DFTR	SVU
DATE	5/31/2023
APPD	FAY
DATE	5/31/2023
APPD	
DATE	
DWG SIZE	A
REVISION	1
PRODUCT CODE	CF
FEDERAL ID NO	

REVISION 1

FILE: C00LF8H-S007.DWG



W/2X OPTION PLATE



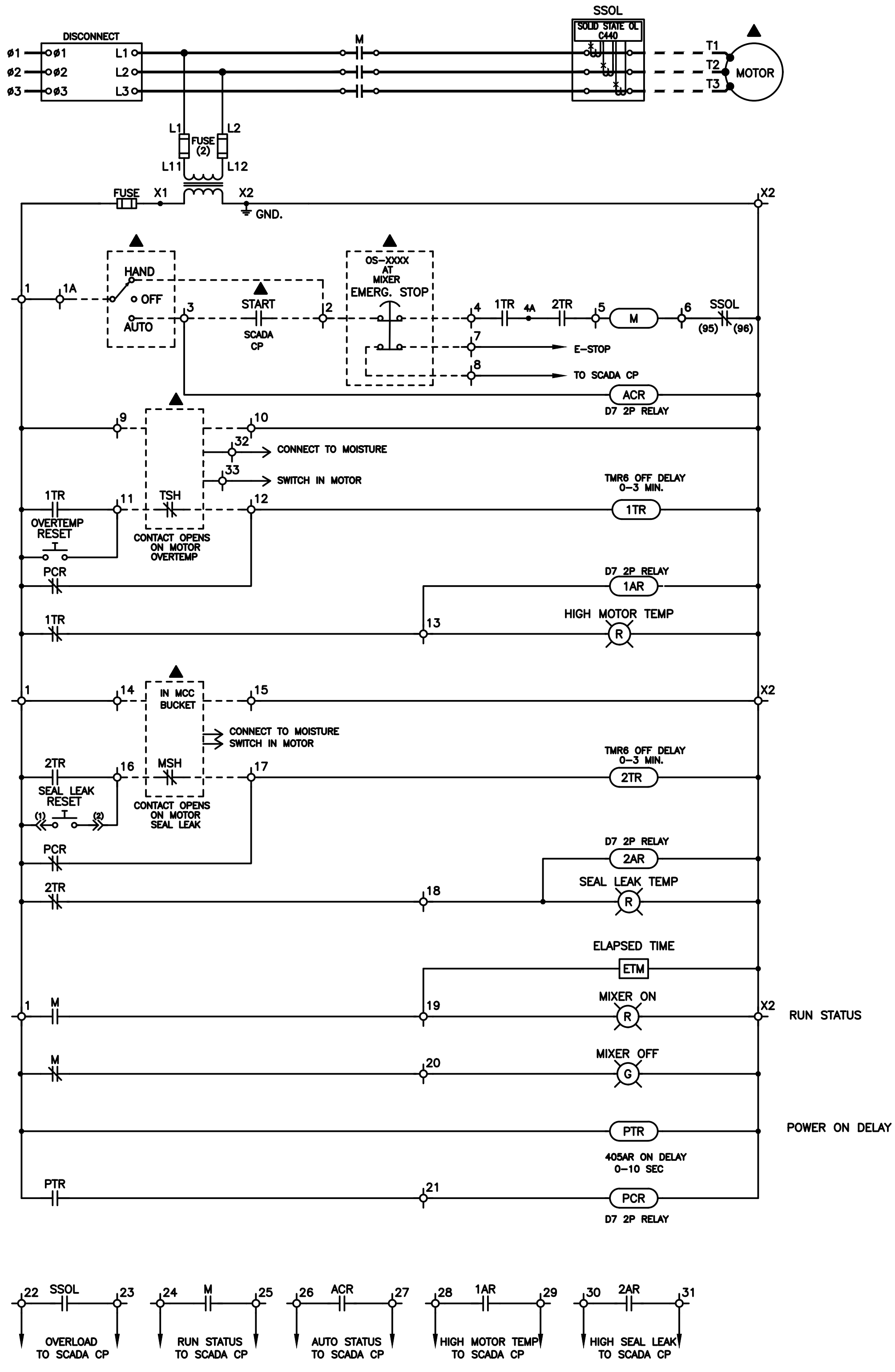
THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE WHICH IT WAS SUPPLIED.

EATON

TITLE	ASM-3211, UNIT - 3D 10 HP,FVNR Starter Size 1 W C440 OL , 6MCC1
TYPE	FREEDOM+ MCC CONNECTION
G.O.	LBS0031682
DWG	C00LF8H-S007
SHEET	2 OF 2
DFTR	SVU
DATE	5/31/2023
APPD	FAY
DATE	5/31/2023
APPD	
DATE	
REVISION	1
DWG SIZE	A
PRODUCT CODE	CF
FEDERAL ID NO	

REVISION
1

FILE: C00LF8H-S007.DWG



LEGEND:
- ⌖ – TERMINAL POINT IN MCC
- – – – DEVICE REMOTE FROM MCC
- ▲ – DEVICE REMOTE FROM MCC
- ■ –MATE–N–LOK CONNECTOR FOR DOOR MTD DEVICES
- (X)≪ –MATE–N–LOK CONNECTION PIN NUMBER

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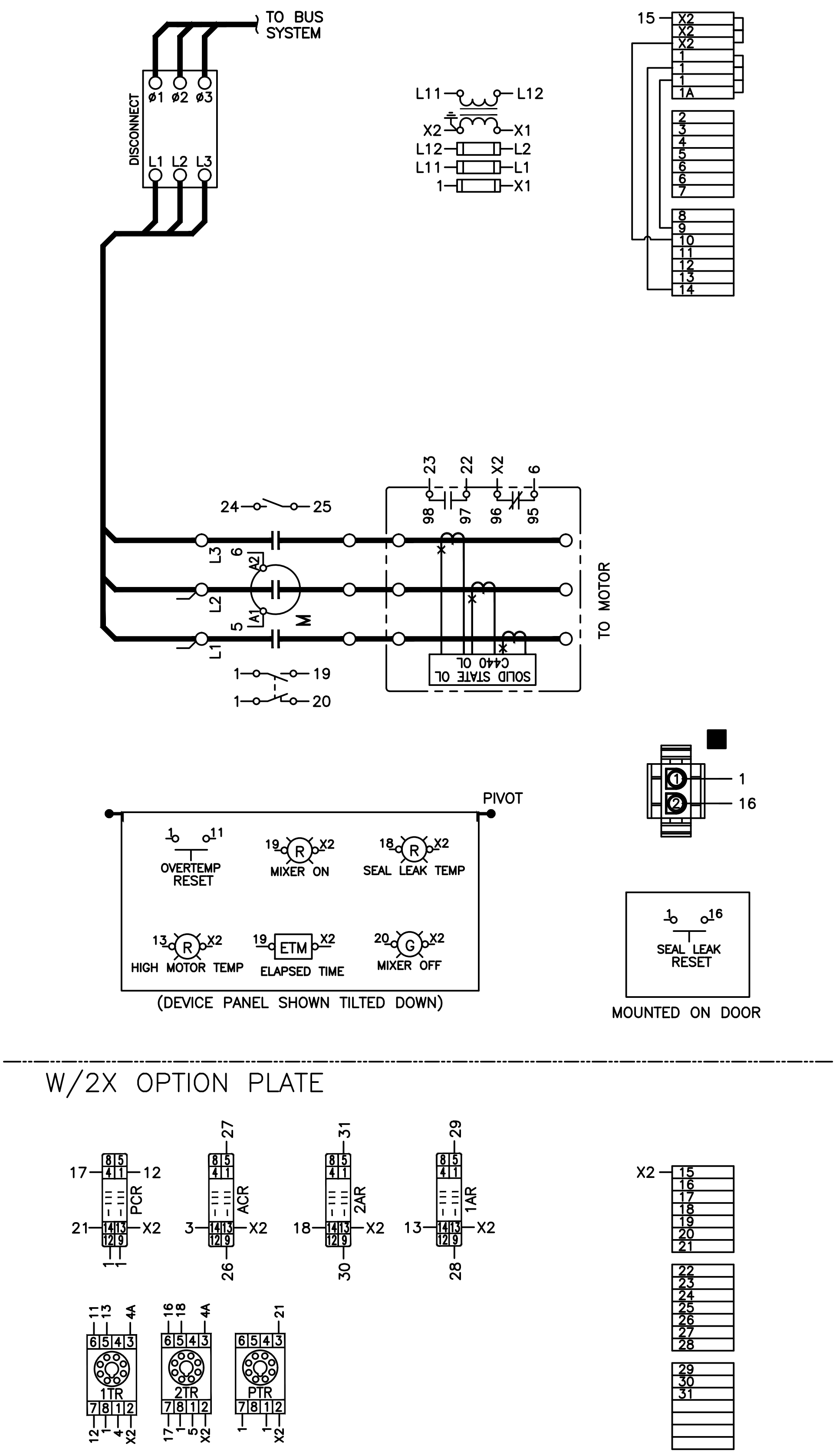
EATON

TITLE	ASM-3212, UNIT – 3H 10 HP,FVNR Starter Size 1 W C440 OL , 6MCC1
TYPE	FREEDOM+ MCC
	SCHEMATIC
G.O.	LBS0031682
DWG	C00LF8H-S008
SHEET	1 OF 2
DFTR	SVU
DATE	5/31/2023
APPD	FAY
DATE	5/31/2023
APPD	
DATE	
DWG SIZE	A
REVISION	1
PRODUCT CODE	CF
FEDERAL ID NO	

REVISION
1

FILE: C00LF8H-S008.DWG



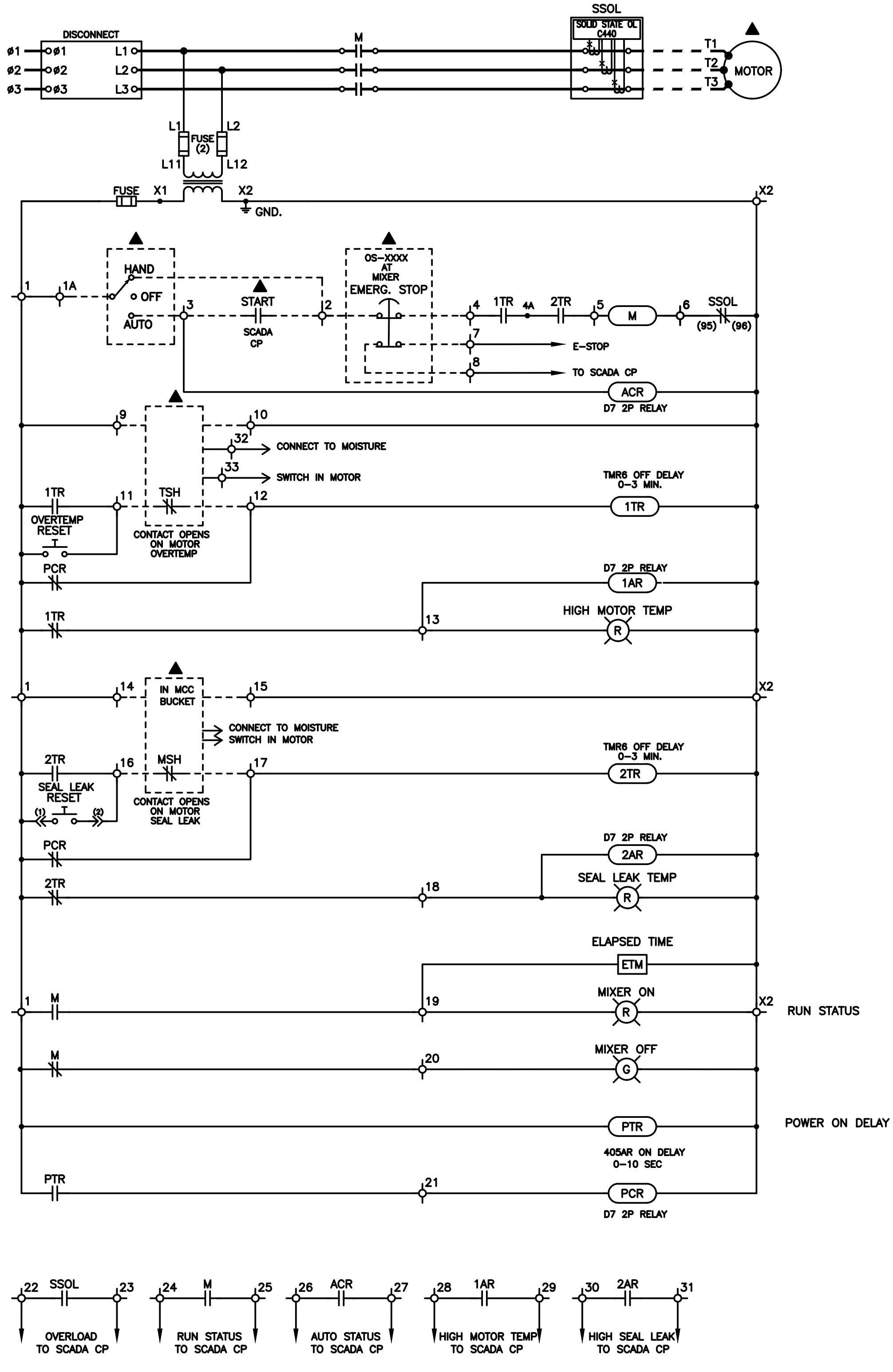
THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE WHICH IT WAS SUPPLIED.

DFTR SVU	DATE 5/31/2023	
APPD FAY	DATE 5/31/2023	TITLE ASM-3212, UNIT - 3H 10 HP,FVNR Starter Size 1 W C440 OL , 6MCC1
APPD	DATE	TYPE FREEDOM+ MCC — CONNECTION
REVISION 1	DWG SIZE A	G.O. LBS0031682 — DWG C00LF8H-S008 — SHEET 2 OF 2
FEDERAL ID NO	PRODUCT CODE CF	

REVISION

1

FILE: C00LF8H-S008.DWG



LEGEND:
- ⌖ – TERMINAL POINT IN MCC
- – – – DEVICE REMOTE FROM MCC
- ▲ – DEVICE REMOTE FROM MCC
- ■ –MATE–N–LOK CONNECTOR FOR DOOR MTD DEVICES
- ⪡ (X) –MATE–N–LOK CONNECTION PIN NUMBER

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EATON

TITLE ASM–3213, UNIT – 3M
10 HP,FVNR Starter Size 1 W C440 OL , 6MCC1

TYPE SCHEMATIC
FREEDOM+ MCC

DWG C00LF8H-S009
SHEET 1 OF 2

G.O. LBS0031682

DATE 5/31/2023
DFTR SVU

DATE 5/31/2023
APPD FAY

DATE
APPD

DWG SIZE A

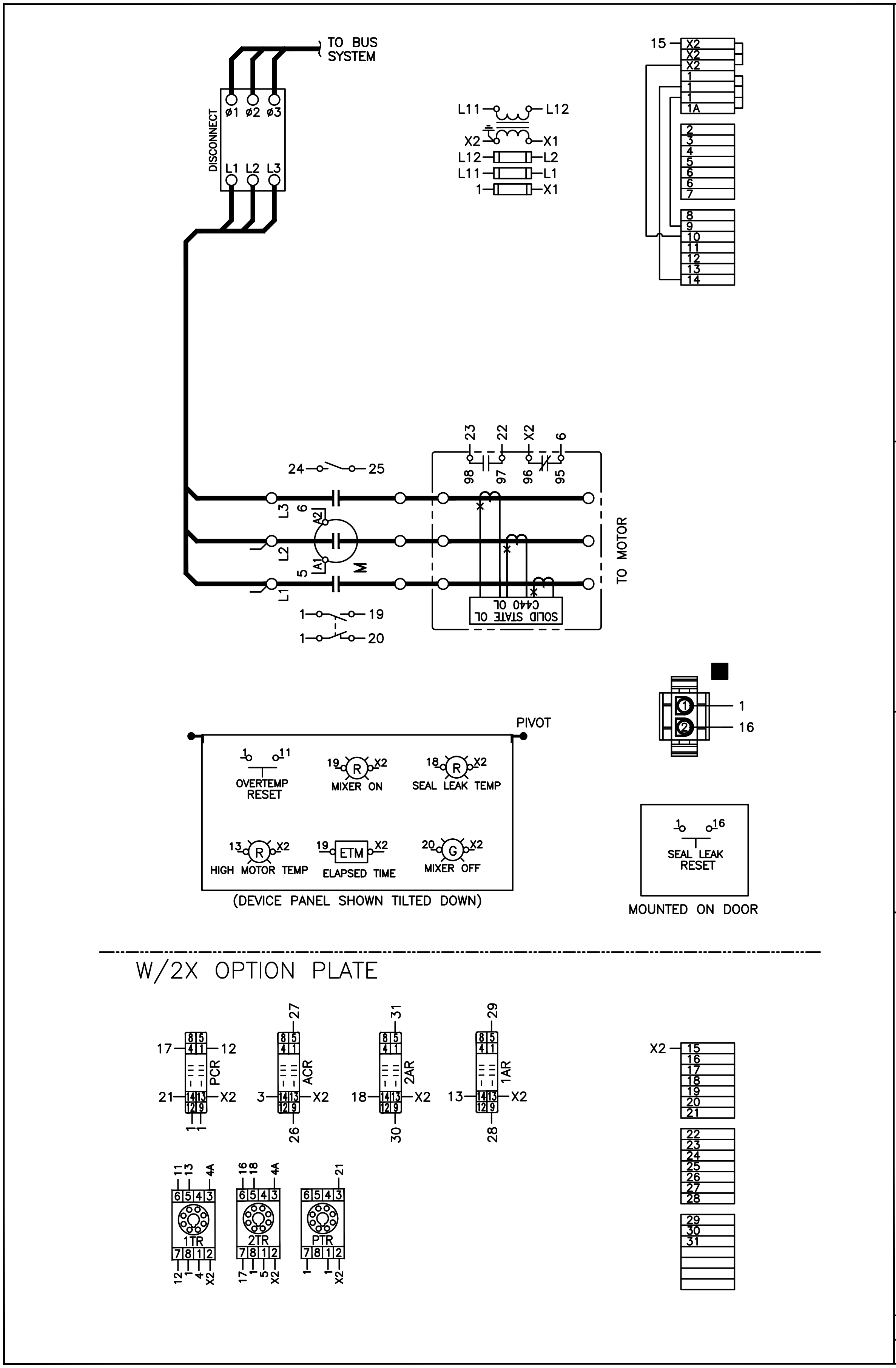
REVISION 1

PRODUCT CODE CF

FEDERAL ID NO

REVISION
1

FILE: C00LF8H–S009.DWG



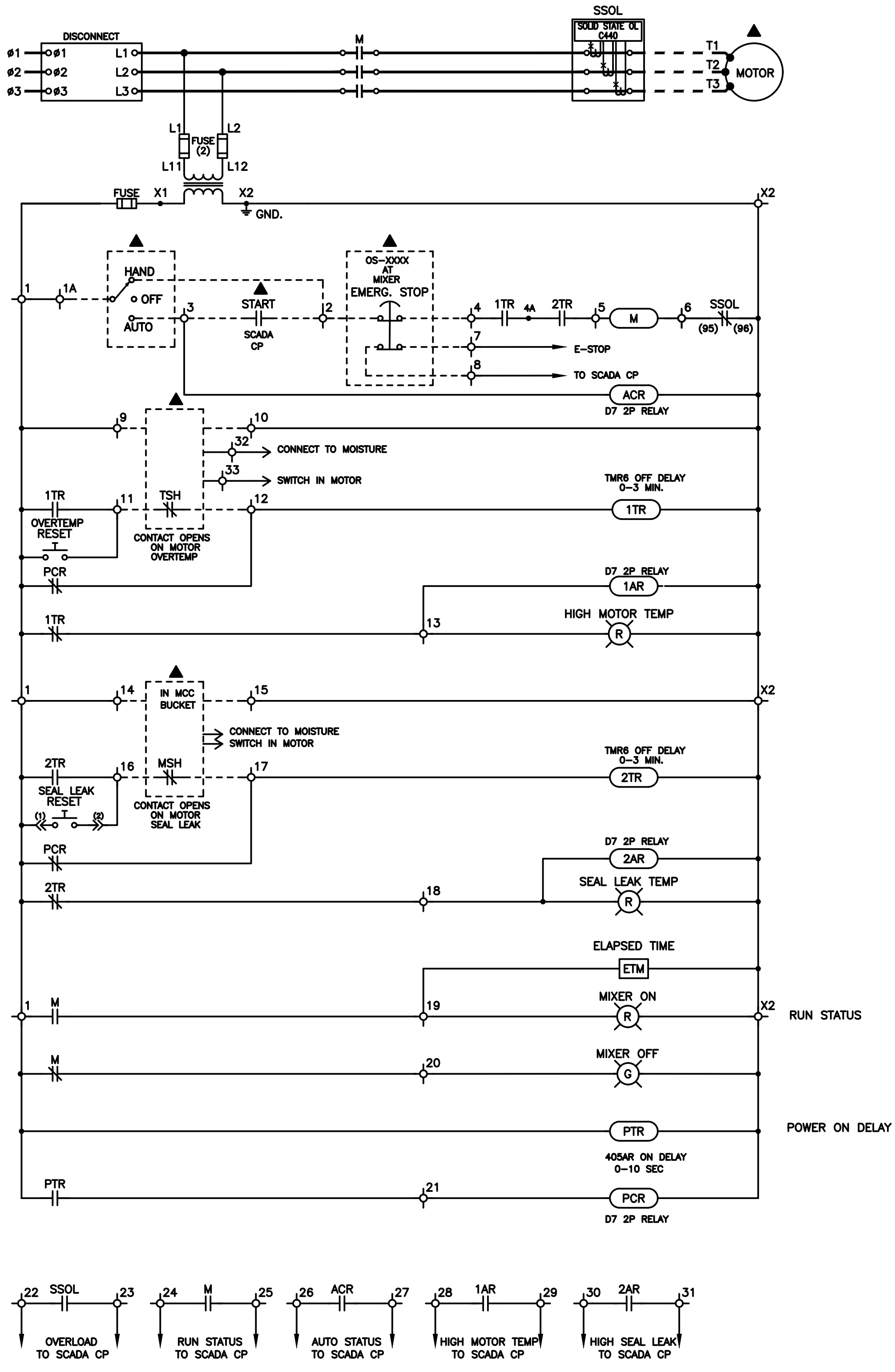
THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE WHICH IT WAS SUPPLIED.

EATON

TITLE	ASM-3213, UNIT - 3M 10 HP,FVNR Starter Size 1 W C440 OL , 6MCC1
TYPE	FREEDOM+ MCC CONNECTION
G.O.	LBS0031682
DWG	C00LF8H-S009
SHEET	2 OF 2
DFTR	SVU
DATE	5/31/2023
APPD	FAY
DATE	5/31/2023
APPD	
DATE	
DWG SIZE	A
REVISION	1
PRODUCT CODE	CF
FEDERAL ID NO	

REVISION
1

FILE: C00LF8H-S009.DWG



LEGEND:

- ⌖ – TERMINAL POINT IN MCC
- – – – DEVICE REMOTE FROM MCC
- ▲ – DEVICE REMOTE FROM MCC
- ■ –MATE-N-LOK CONNECTOR FOR DOOR MTD DEVICES
- (X) –MATE-N-LOK CONNECTION PIN NUMBER

EATON

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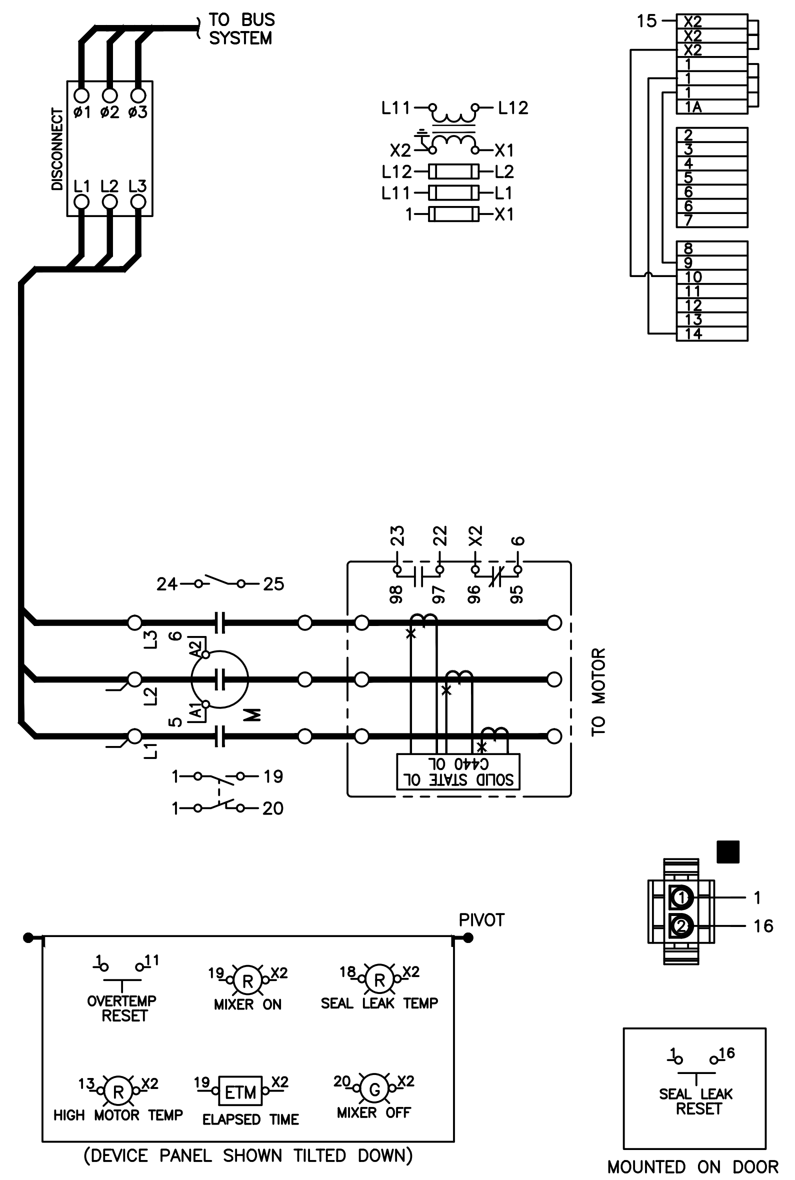
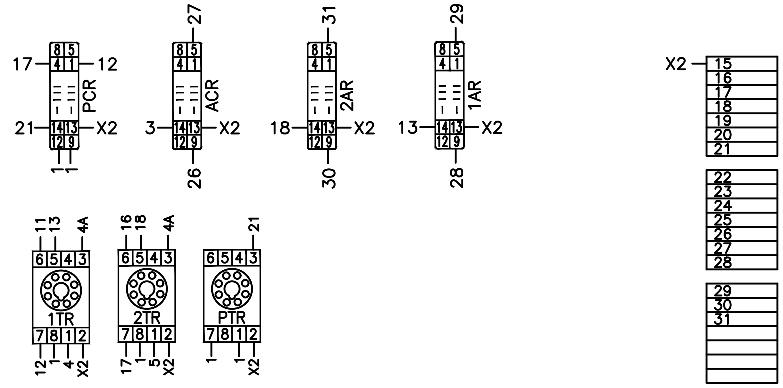
TITLE	ASM-3131, UNIT – 4D 10 HP,FVNR Starter Size 1 W C440 OL , 6MCC1
TYPE	SCHEMATIC FREEDOM+ MCC
G.O.	LBS0031682
DWG	C00LF8H-S010
SHEET	1 OF 2
DFTR	SVU
DATE	5/31/2023
APPD	FAY
DATE	5/31/2023
APPD	
DATE	
DWG SIZE	A
REVISION	1
PRODUCT CODE	CF
FEDERAL ID NO	

REVISION
1

FILE: C00LF8H-S010.DWG



W/2X OPTION PLATE



THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE WHICH IT WAS SUPPLIED.

TITLE
ASM-3131, UNIT - 4D
10 HP,FVNR Starter Size 1 W C440 OL , 6MCC1

TYPE
FREEDOM+ MCC

CONNECTION

SHEET
2 OF 2

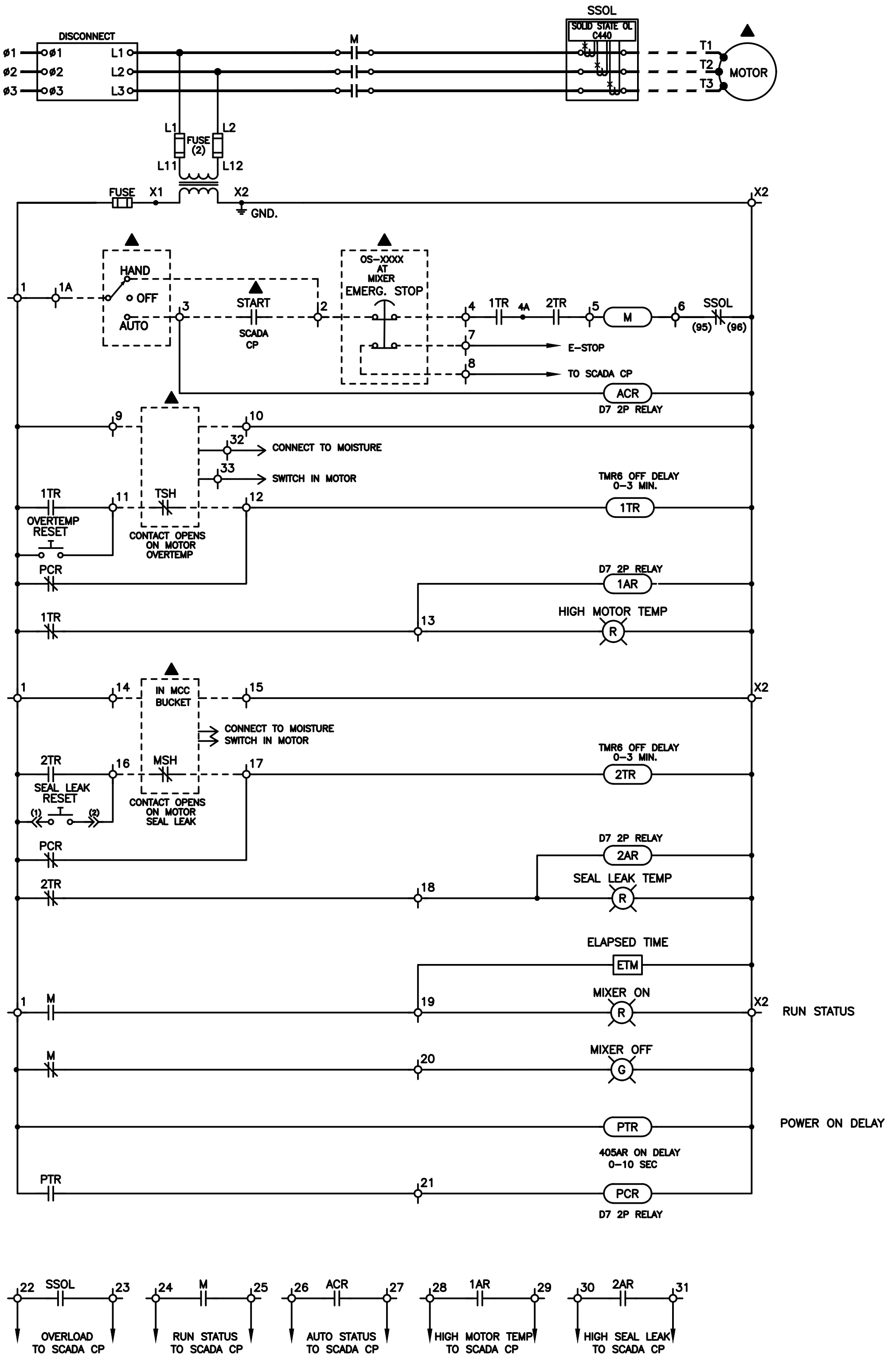
DWG
C00LF8H-S010

G.O.
LBS0031682

DFTR SVU	DATE 5/31/2023		
APPD FAY	DATE 5/31/2023		
APPD	DATE		
REVISION 1	DWG SIZE A		
FEDERAL ID NO	PRODUCT CODE CF		

1	REVISION

FILE: C00LF8H-S010.DWG



LEGEND:

- -⌖- – TERMINAL POINT IN MCC
- – – – DEVICE REMOTE FROM MCC
- ▲ – DEVICE REMOTE FROM MCC
- ■ –MATE-N-LOK CONNECTOR FOR DOOR MTD DEVICES
- (X) ≪ –MATE-N-LOK CONNECTION PIN NUMBER

THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE WHICH IT WAS SUPPLIED.

TITLE
ASM-3132, UNIT - 4H
10 HP,FVNR Starter Size 1 W C440 OL , 6MCC1

TYPE
SCHEMATIC
FREEDOM+ MCC

SHEET
1 OF 2

DWG
C00LF8H-S011

G.O.
LBS0031682

DFTR	DATE
SVU	5/31/2023

APPD	DATE
FAY	5/31/2023

APPD	DATE

DWG SIZE A

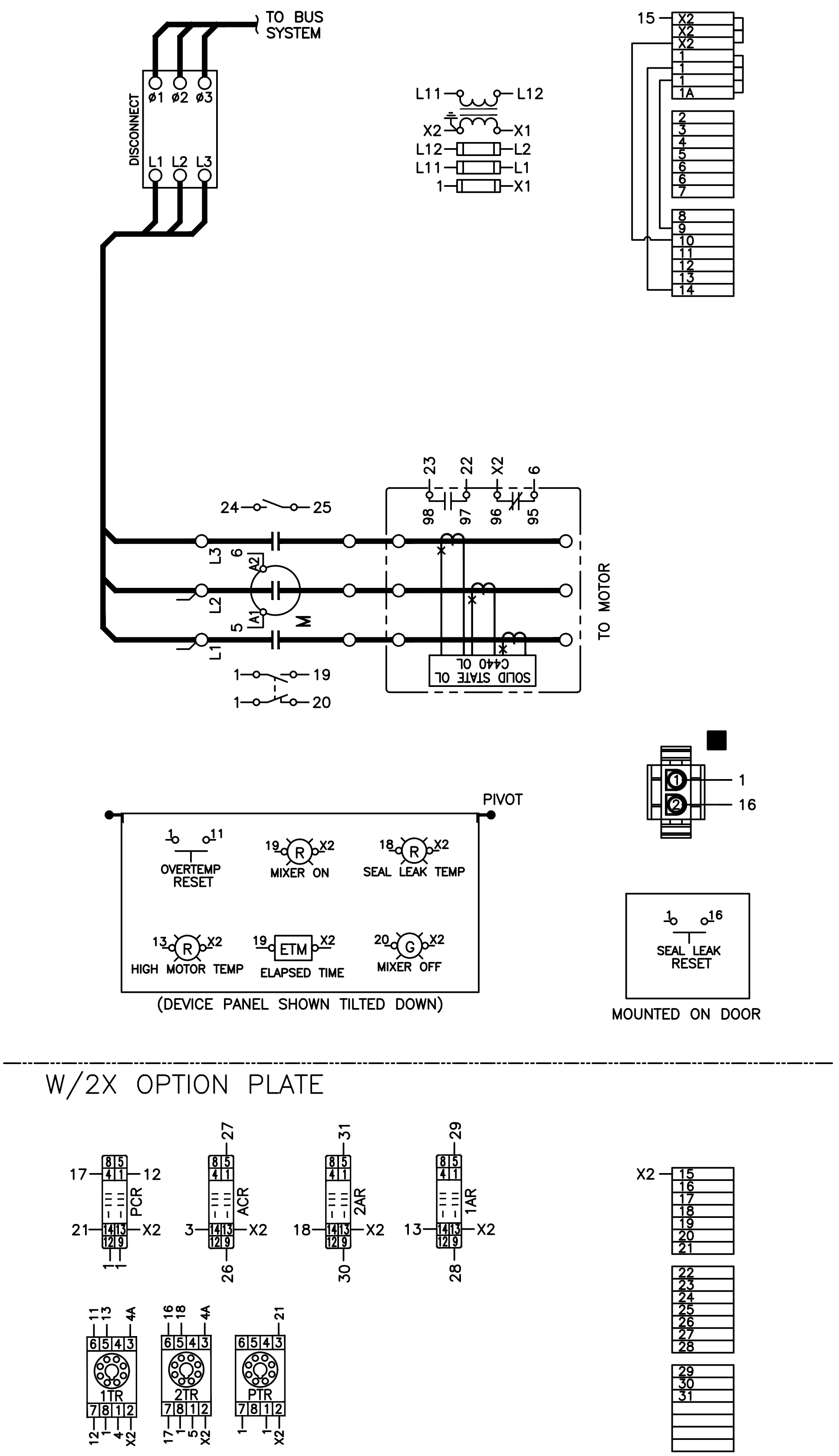
REVISION 1

PRODUCT CODE CF

FEDERAL ID NO

REVISION
1

FILE: C00LF8H-S011.DWG



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EAT·N

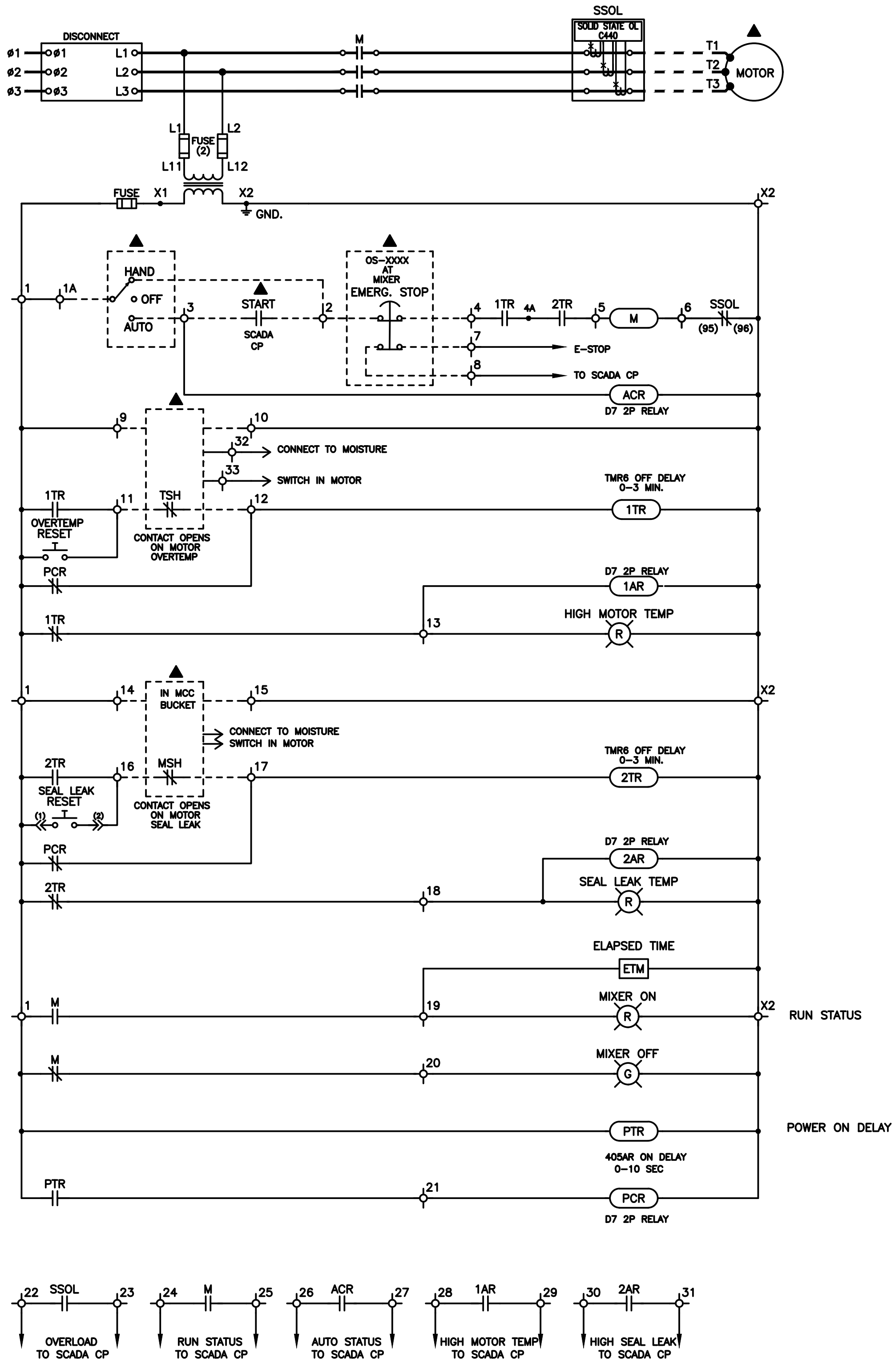
TITLE
ASM-3132, UNIT - 4H
10 HP,FVNR Starter Size 1 W C440 OL , 6MCC1

TYPE
FREEDOM+ MCC
CONNECTION

DATE 5/31/2023	DATE 5/31/2023	DATE	G.O. LBS0031682	DWG C00LF8H-S011
DFTR SVU	APPD FAY	APPD	DWG SIZE A	SHEET 2 OF 2
			REVISION 1	
			PRODUCT CODE CF	
			FEDERAL ID NO	

REVISION
1

FILE: C00LF8H-S011.DWG



LEGEND:

-⌖- – TERMINAL POINT IN MCC

— — — – DEVICE REMOTE FROM MCC

▲ – DEVICE REMOTE FROM MCC

■ –MATE-N-LOK CONNECTOR FOR DOOR MTD DEVICES

(X) –MATE-N-LOK CONNECTION PIN NUMBER

EATON

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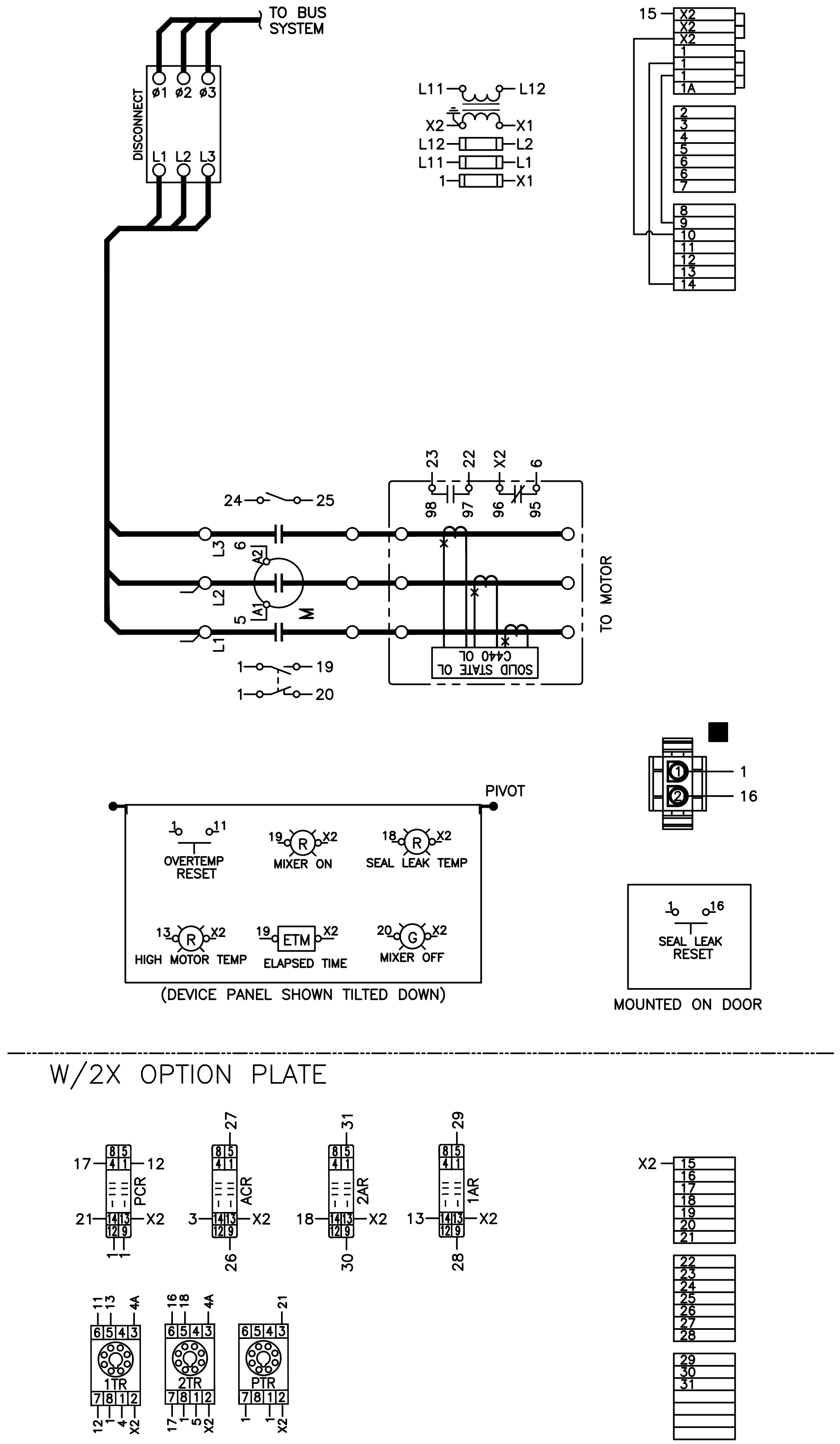
TITLE	ASM-3231, UNIT – 4M 10 HP,FVNR Starter Size 1 W C440 OL , 6MCC1
TYPE	SCHEMATIC FREEDOM+ MCC
G.O.	LBS0031682
DWG	C00LF8H-S012
SHEET	1 OF 2
DFTR	SVU
DATE	5/31/2023
APPD	FAY
DATE	5/31/2023
APPD	
DATE	
DWG SIZE	A
REVISION	1
PRODUCT CODE	CF
FEDERAL ID NO	

REVISION

1

FILE: C00LF8H-S012.DWG



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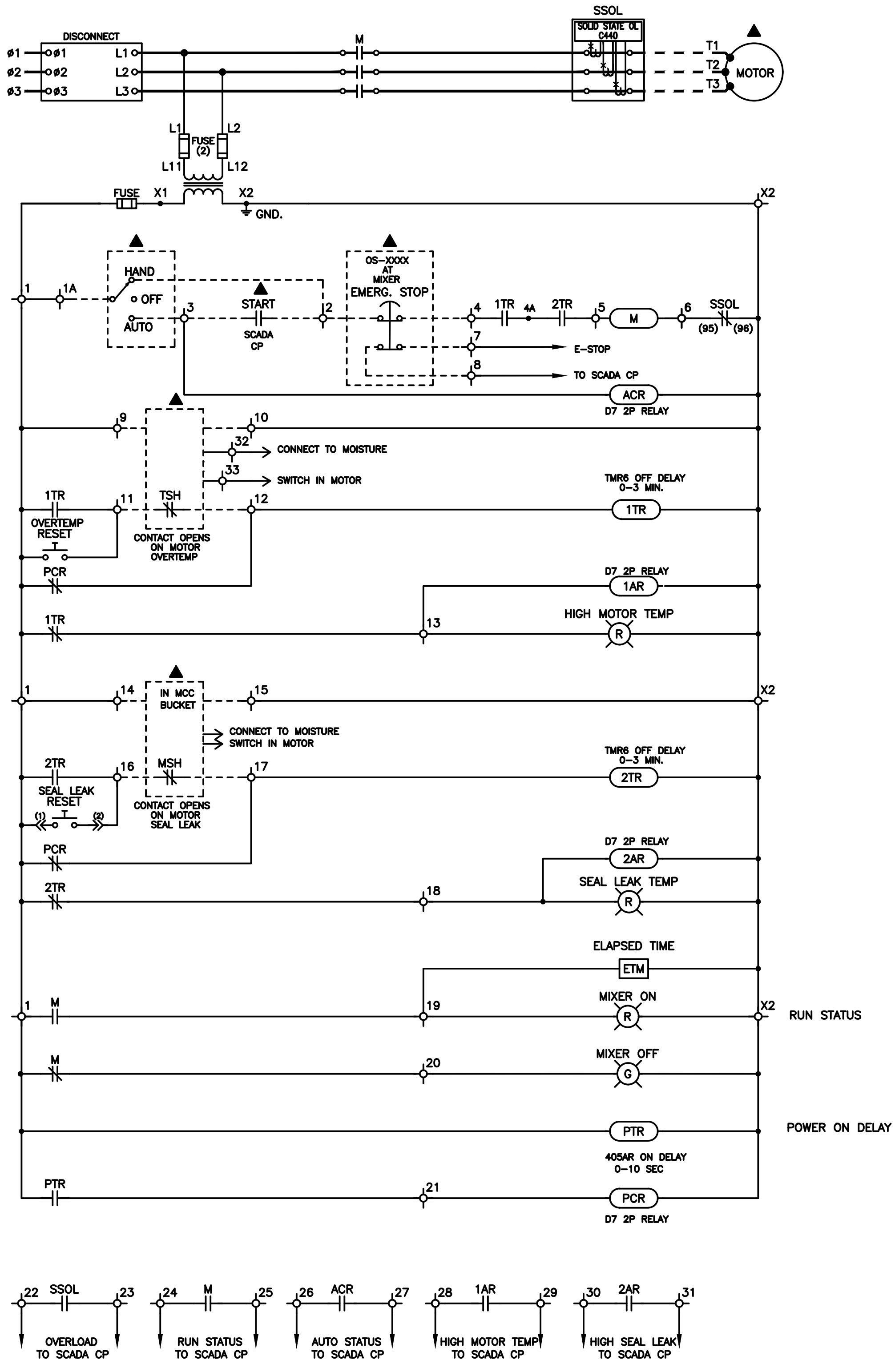
EATON

DFTR SVU	DATE 5/31/2023	TITLE ASM-3231, UNIT – 4M 10 HP,FVNR Starter Size 1 W C440 OL , 6MCC1	
APPD FAY	DATE 5/31/2023		
APPD	DATE	TYPE FREEDOM+ MCC	CONNECTION
FEDERAL ID NO	PRODUCT CODE CF	REVISION 1	DWG SIZE A
G.O. LBS0031682	DWG C00LF8H-S012	SHEET 2 OF 2	

REVISION
1

FILE: C00LF8H-S012.DWG



LEGEND:

-⌖- – TERMINAL POINT IN MCC
– – – DEVICE REMOTE FROM MCC
▲ – DEVICE REMOTE FROM MCC
■ –MATE–N–LOK CONNECTOR FOR DOOR MTD DEVICES
(X)≪ –MATE–N–LOK CONNECTION PIN NUMBER

EATON

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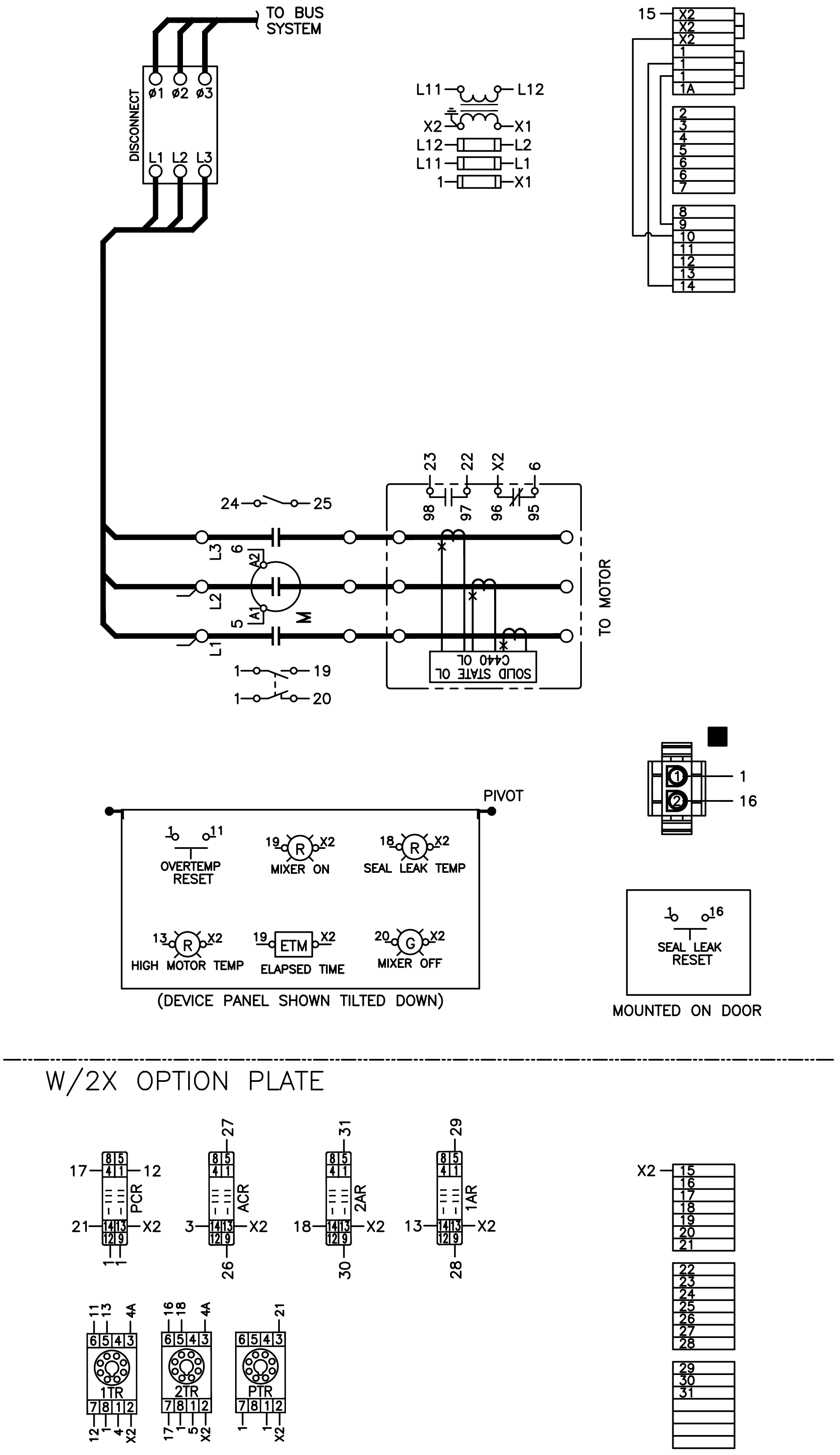
TITLE	ASM-3232, UNIT - 5D 10 HP,FVNR Starter Size 1 W C440 OL , 6MCC1	TYPE	SCHEMATIC
TYPE	FREEDOM+ MCC	DWG	C00LF8H-S013
G.O.	LBS0031682	SHEET	1 OF 2
DFTR	SVU	DATE	5/31/2023
APPD	FAY	DATE	5/31/2023
APPD		DATE	
REVISION	1	DWG SIZE	A
PRODUCT CODE	CF	FEDERAL ID NO	

REVISION
1

FILE: C00LF8H-S013.DWG



EATON

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TITLE
ASM-3232, UNIT – 5D
10 HP,FVNR Starter Size 1 W C440 OL , 6MCC1

TYPE
FREEDOM+ MCC
CONNECTION

G.O.
LBS0031682

DWG
C00LF8H-S013

SHEET
2 OF 2

DFTR
SVU

DATE
5/31/2023

APPD
FAY

DATE
5/31/2023

APPD

DATE

REVISION
1

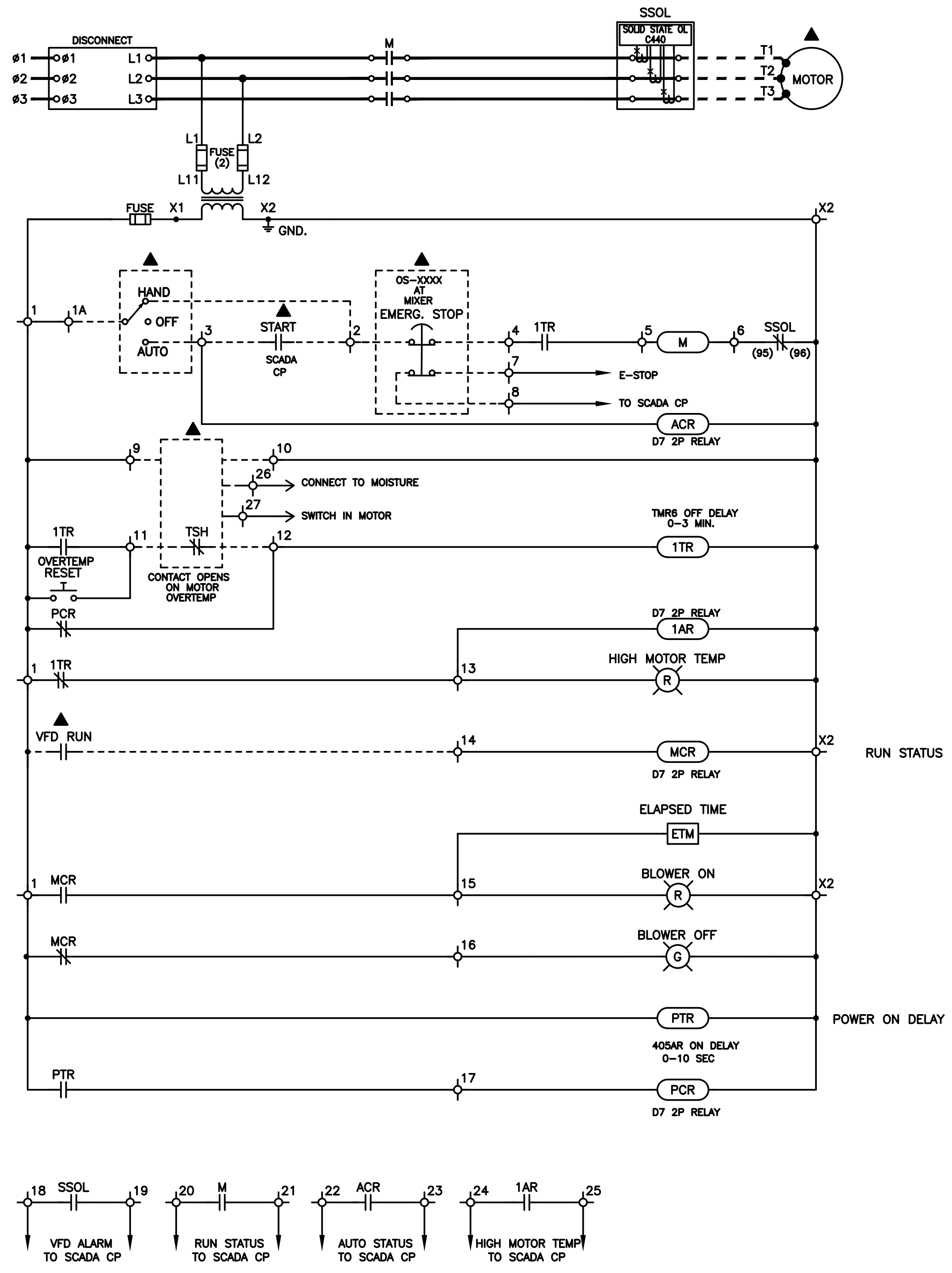
DWG SIZE
A

FEDERAL ID NO

PRODUCT CODE
CF

REVISION
1

FILE: C00LF8H-S013.DWG



LEGEND:

-⌖- – TERMINAL POINT IN MCC

– – – – DEVICE REMOTE FROM MCC

▲ – DEVICE REMOTE FROM MCC

EATON

TITLE
RAB-3144, UNIT - 5G
5 HP,FVNR Starter Size 1 W C440 OL , 6MCC1

TYPE
FREEDOM+ MCC
SCHEMATIC

G.O.
LBS0031682

DWG
C00LF8H-S014

SHEET
1 OF 2

DATE 5/31/2023	DATE 5/31/2023	DATE
DFTR SVU	APPD FAY	APPD

DWG SIZE
A

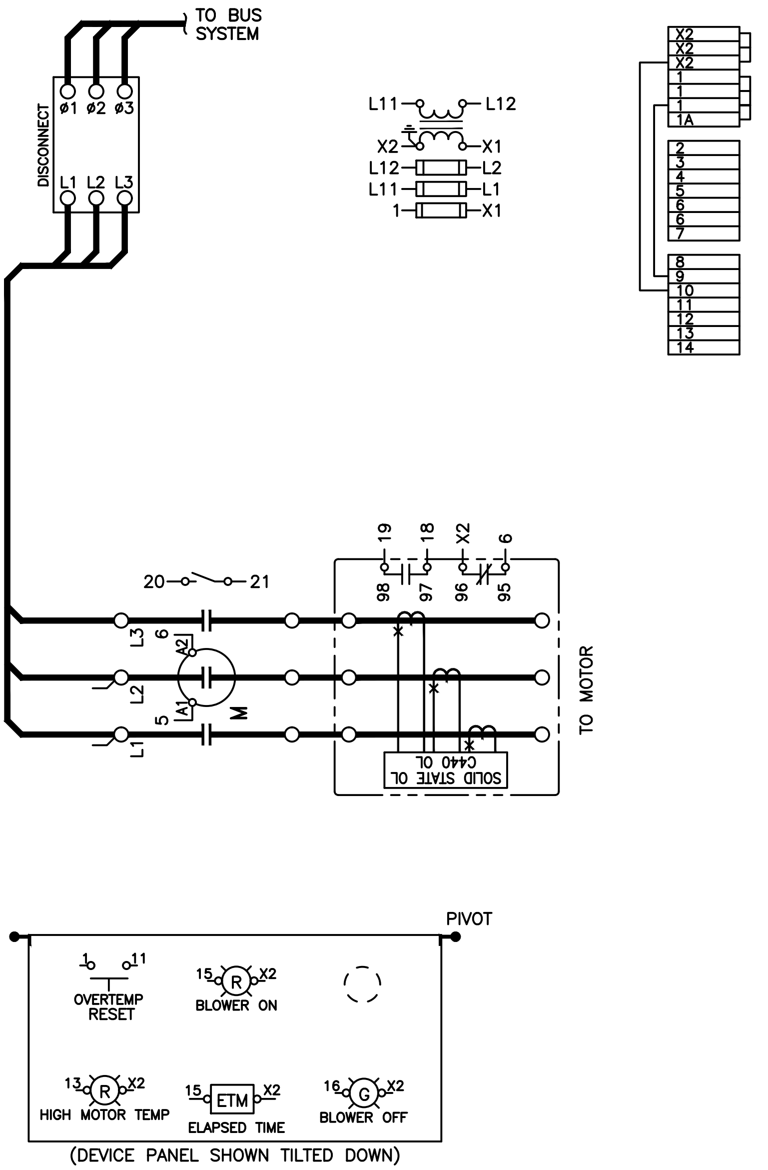
REVISION
1

PRODUCT CODE
CF

FEDERAL ID NO

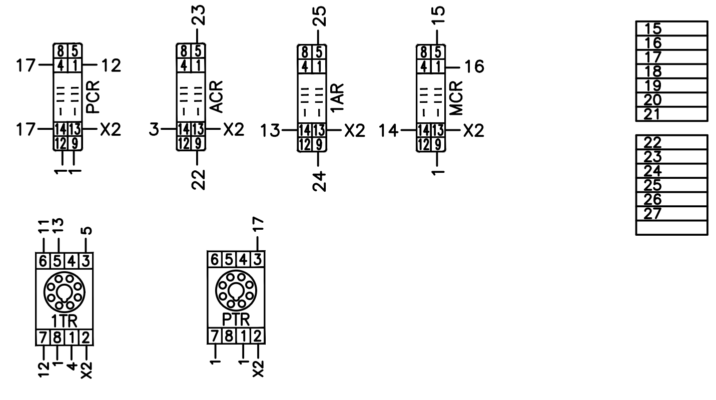
1 REVISION

FILE: C00LF8H-S014.DWG



(DEVICE PANEL SHOWN TILTED DOWN)

W/1X OPTION PLATE



EATON

TITLE RAB-3144, UNIT - 5G
5 HP,FVNR Starter Size 1 W C440 OL , 6MCC1

TYPE FREEDOM+ MCC

CONNECTION

SHEET 2 OF 2

DWG C00LF8H-S014

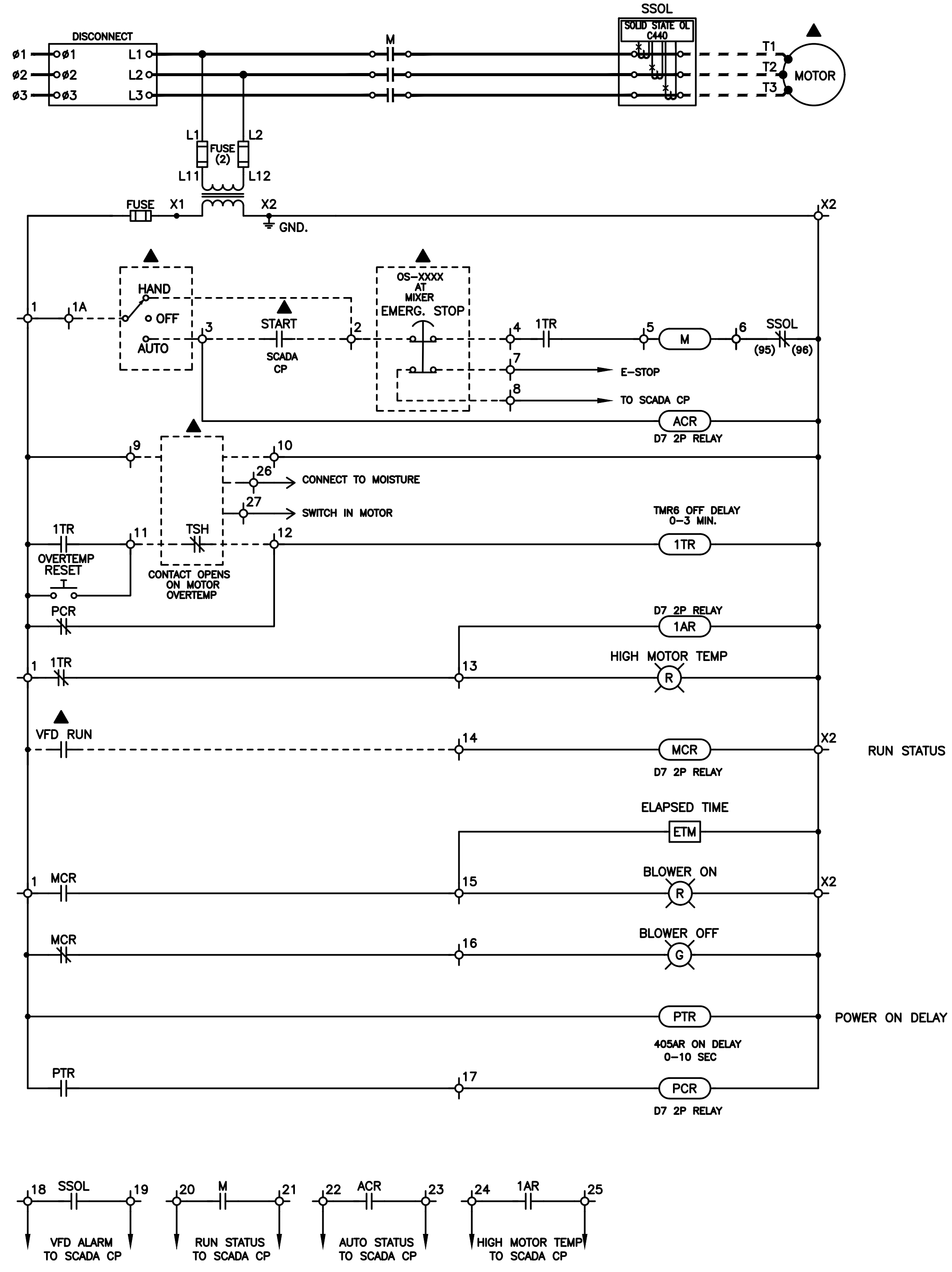
G.O. LBS0031682

DFTR SVU DATE 5/31/2023
APPD FAY DATE 5/31/2023
APPD DATE

DWG SIZE A
REVISION 1
PRODUCT CODE CF
FEDERAL ID NO

1 REVISION

FILE: C00LF8H-S014.DWG



LEGEND:

- ⌖ – TERMINAL POINT IN MCC
- — — – DEVICE REMOTE FROM MCC
- ▲ – DEVICE REMOTE FROM MCC

EATON

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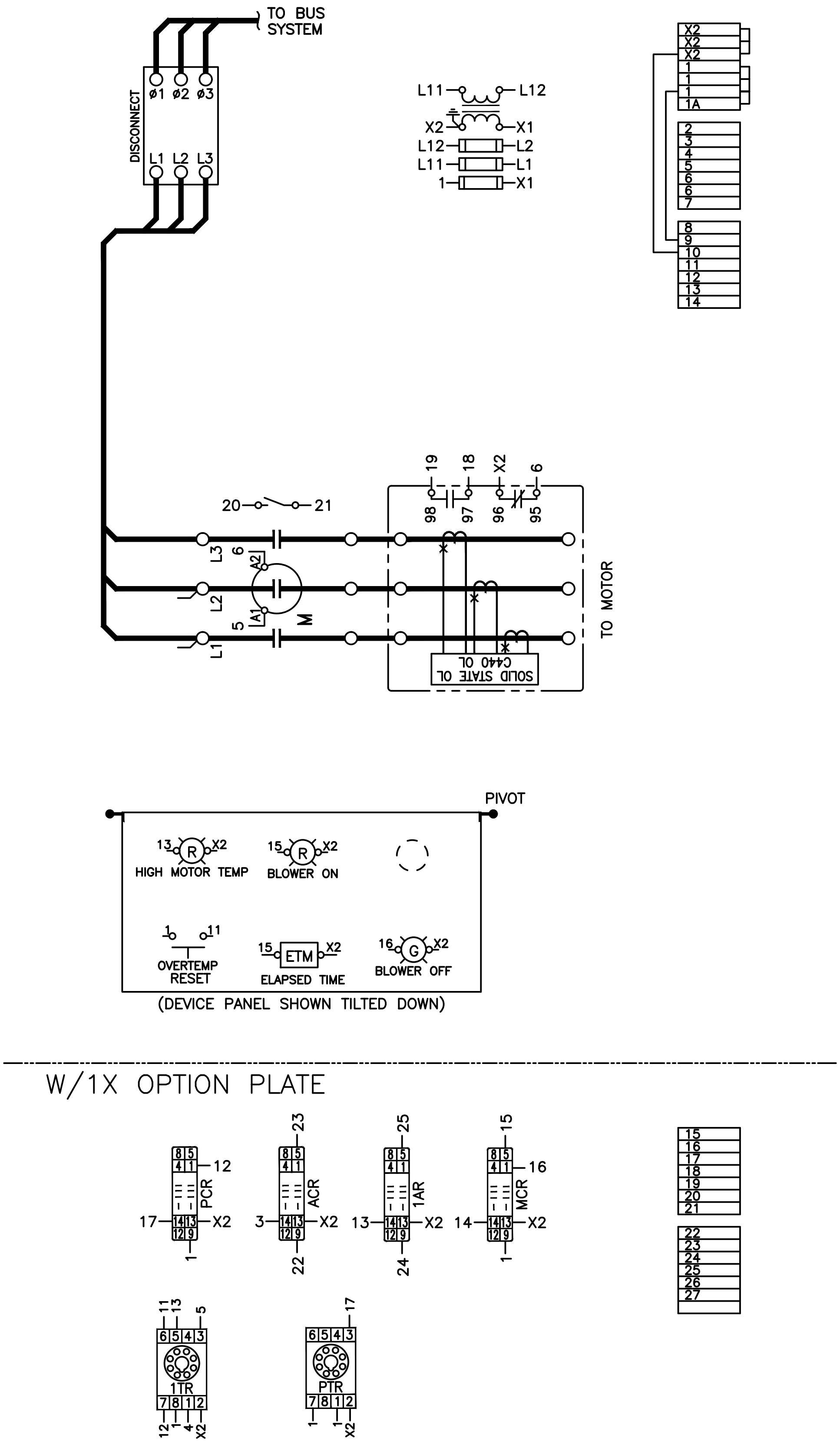
DFTR SVU	DATE 5/31/2023	TITLE RAB-3145, UNIT - 5K 5 HP,FVNR Starter Size 1 W C440 OL , 6MCC1	
APPD FAY	DATE 5/31/2023		
APPD	DATE	TYPE FREEDOM+ MCC	SCHEMATIC
FEDERAL ID NO	PRODUCT CODE CF	REVISION 2	DWG SIZE A
G.O. LBS0031682	DWG C00LF8H-S015	SHEET 1 OF 2	

REVISION	
1	
2	REVISE TO CHANGE PCP RERLAY CONTACTS 9/5/2023 TLL

FILE: C00LF8H-S015.DWG



EATON

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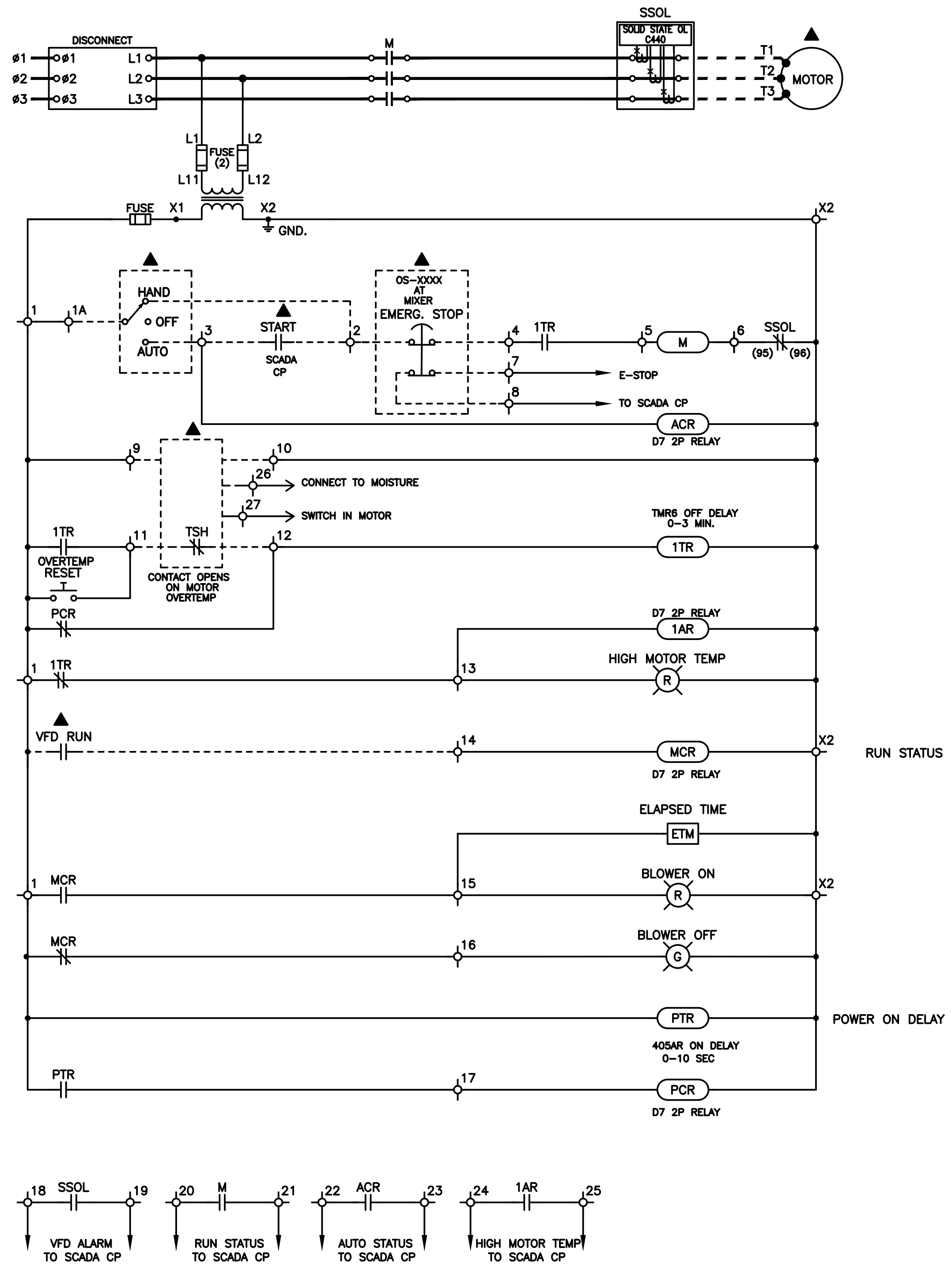
TITLE	RAB-3145, UNIT – 5K 5 HP,FVNR Starter Size 1 W C440 OL , 6MCC1			
TYPE	FREEDOM+ MCC	CONNECTION		
G.O.	LBS0031682	DWG	C00LF8H-S015	SHEET 2 OF 2
DFTR SVU	DATE 5/31/2023			
APPD FAY	DATE 5/31/2023			
APPD	DATE			
REVISION 2	DWG SIZE A			
FEDERAL ID NO	PRODUCT CODE CF			

REVISION	
1	
2	REVISE TO CHANGE PCP RERLAY CONTACTS 9/5/2023 TLL

FILE: C00LF8H-S015.DWG



LEGEND:

-⌖- – TERMINAL POINT IN MCC

— — – DEVICE REMOTE FROM MCC

▲ – DEVICE REMOTE FROM MCC

EATON

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TITLE RAB-3146, UNIT - 6C
5 HP,FVNR Starter Size 1 W C440 OL , 6MCC1

TYPE FREEDOM+ MCC

SCHEMATIC

G.O. LBS0031682

DWG C00LF8H-S016

SHEET 1 OF 2

DATE 5/31/2023	DATE 5/31/2023	DATE
DFTR SVU	APPD FAY	APPD

DWG SIZE A

REVISION 1

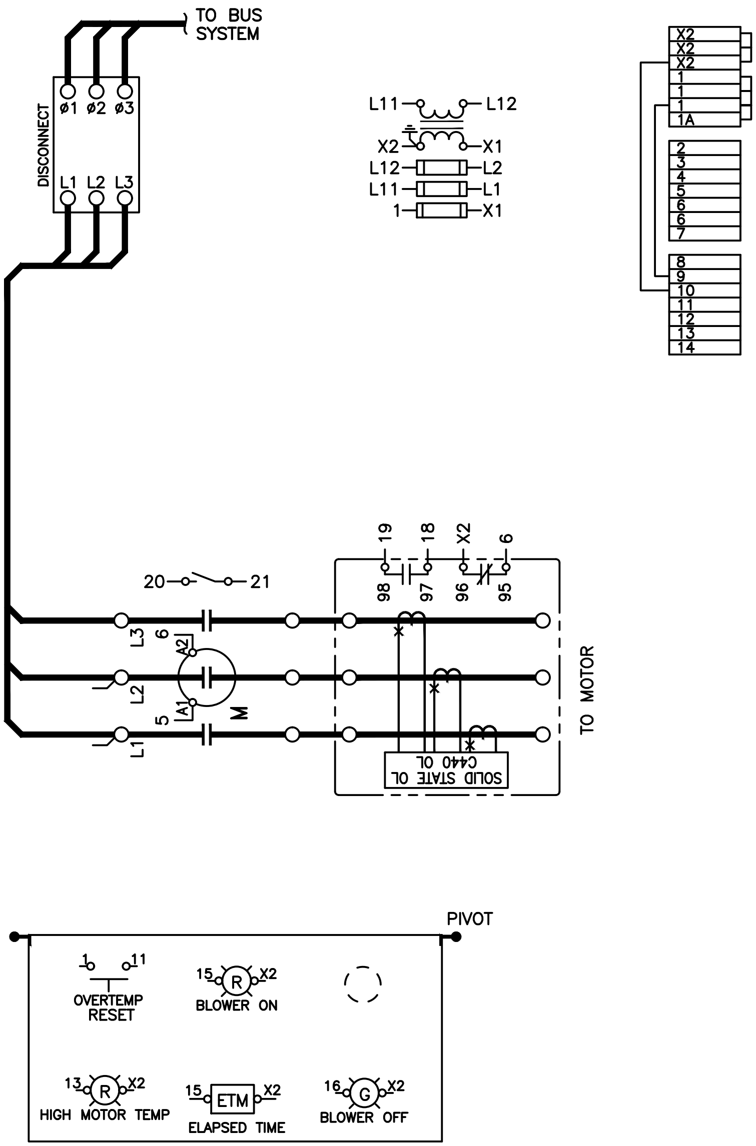
PRODUCT CODE CF

FEDERAL ID NO

REVISION

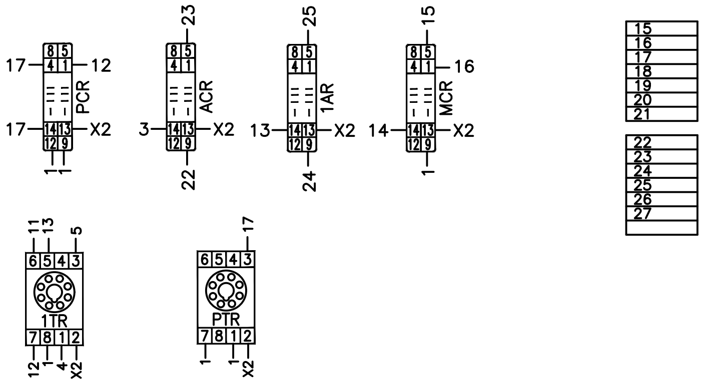
1

FILE: C00LF8H-S016.DWG



(DEVICE PANEL SHOWN TILTED DOWN)

W/1X OPTION PLATE



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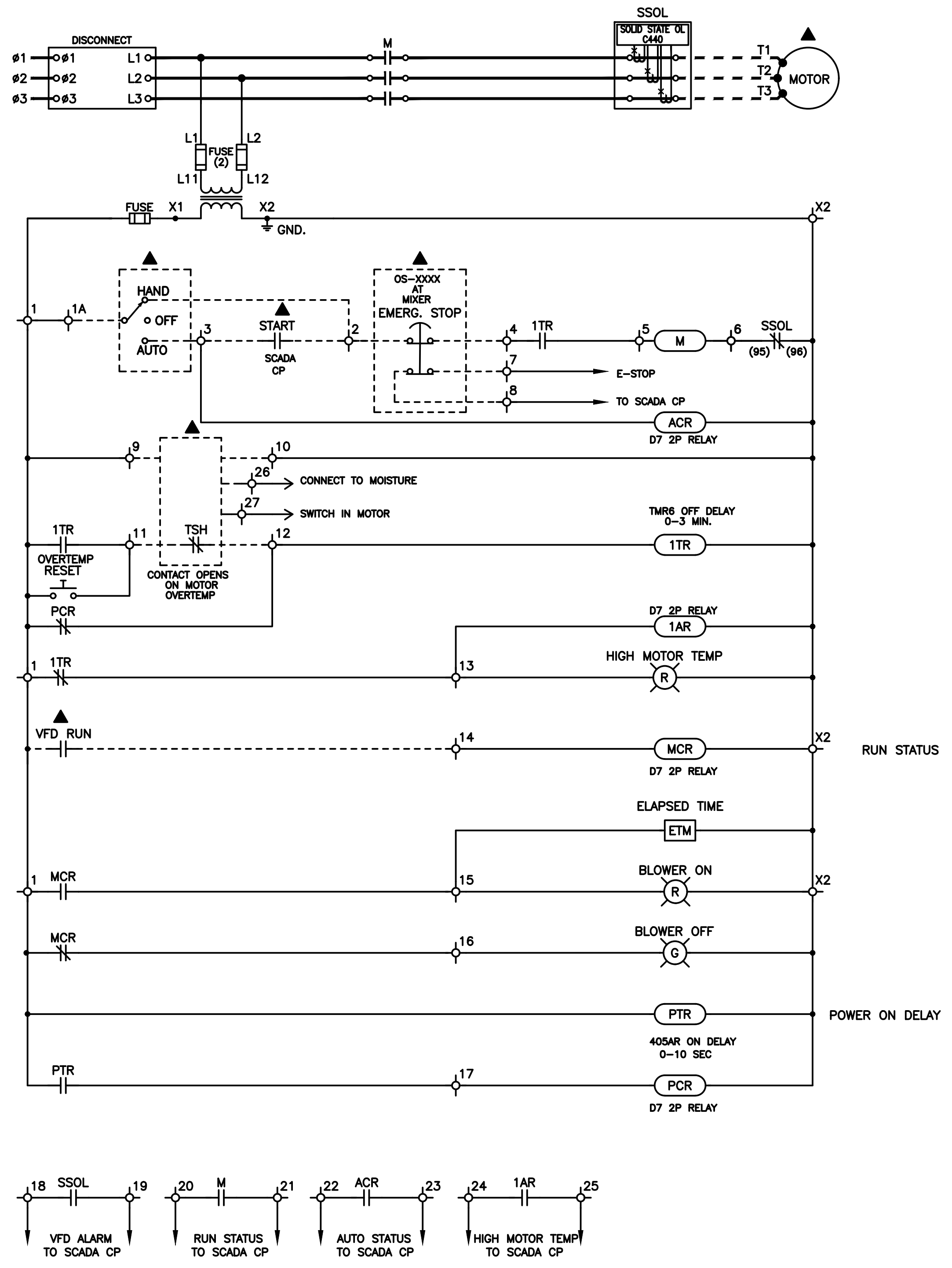
EATON

	DFTR SVU	DATE 5/31/2023		
	APPD FAY	DATE 5/31/2023	TITLE RAB-3146, UNIT - 6C 5 HP,FVNR Starter Size 1 W C440 OL , 6MCC1	
	APPD	DATE	TYPE FREEDOM+ MCC	CONNECTION
FEDERAL ID NO	PRODUCT CODE CF	REVISION 1	DWG SIZE A	G.O. LBS0031682	DWG C00LF8H-S016	SHEET 2 OF 2

REVISION 1



LEGEND:

-⌖- – TERMINAL POINT IN MCC

— — – DEVICE REMOTE FROM MCC

▲ – DEVICE REMOTE FROM MCC

TITLE RAB-3244, UNIT - 6F
5 HP,FVNR Starter Size 1 W C440 OL , 6MCC1

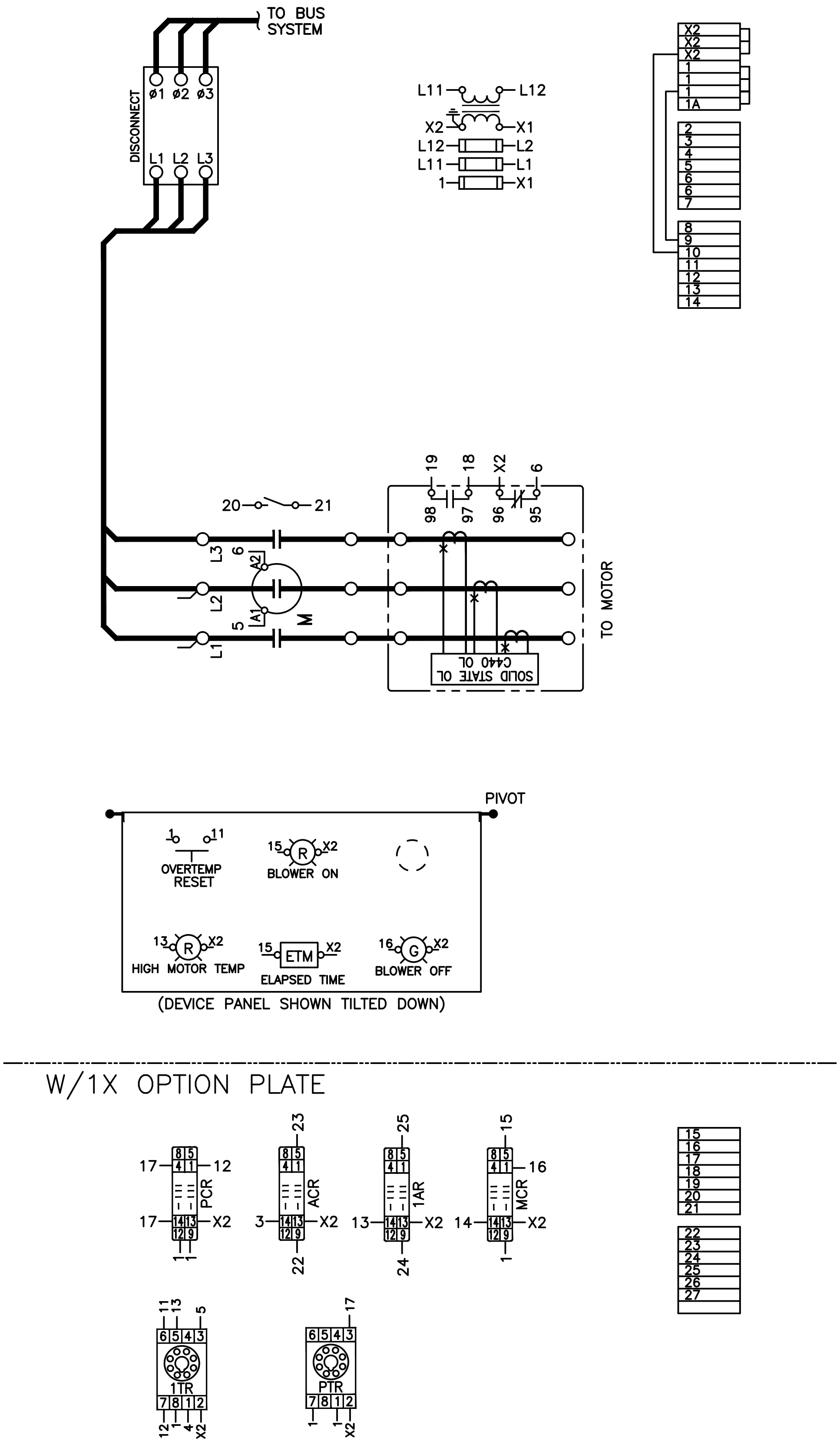
TYPE FREEDOM+ MCC
SCHEMATIC

G.O. LBS0031682
DWG C00LF8H-S017
SHEET 1 OF 2

DFTR SVU	DATE 5/31/2023	DWG SIZE A	REVISION 1	PRODUCT CODE CF	FEDERAL ID NO
APPD FAY	DATE 5/31/2023				
APPD	DATE				

REVISION
1

FILE: C00LF8H-S017.DWG



DFTR SVU
DATE 5/31/2023
APPD FAY
DATE 5/31/2023
APPD
DATE

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EATON

TITLE RAB-3244, UNIT - 6F
5 HP,FVNR Starter Size 1 W C440 OL , 6MCC1

TYPE FREEDOM+ MCC

CONNECTION

G.O. LBS0031682

DWG C00LF8H-S017

SHEET 2 OF 2

DWG SIZE A

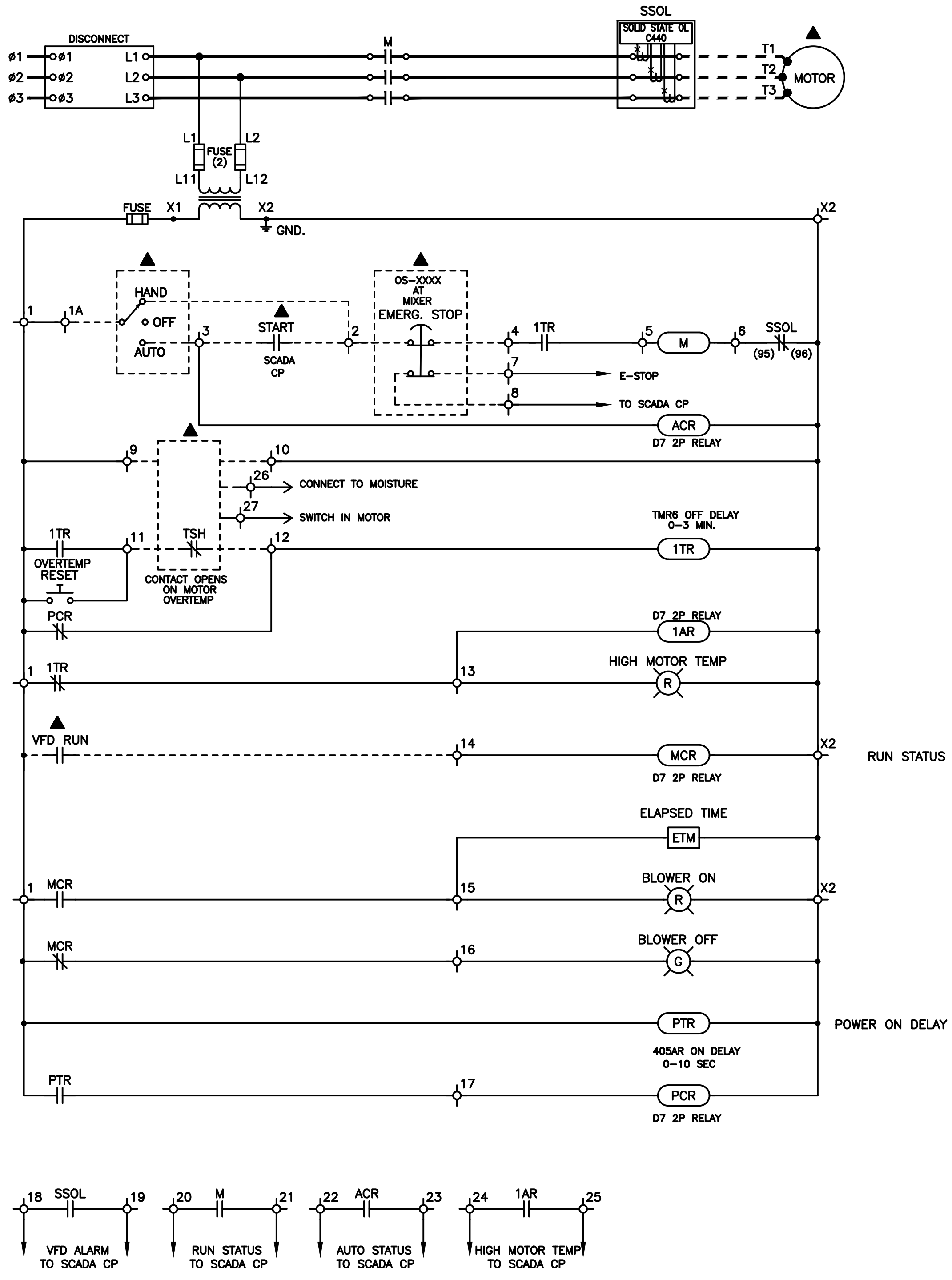
REVISION 1

PRODUCT CODE CF

FEDERAL ID NO

REVISION
1

FILE: C00LF8H-S017.DWG



LEGEND:

-⌖- – TERMINAL POINT IN MCC

– – – – DEVICE REMOTE FROM MCC

▲ – DEVICE REMOTE FROM MCC

EATON

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TITLE
RAB-3245, UNIT - 6J
5 HP,FVNR Starter Size 1 W C440 OL , 6MCC1

TYPE
FREEDOM+ MCC
SCHEMATIC

DWG
C00LF8H-S018

SHEET
1 OF 2

G.O.
LBS0031682

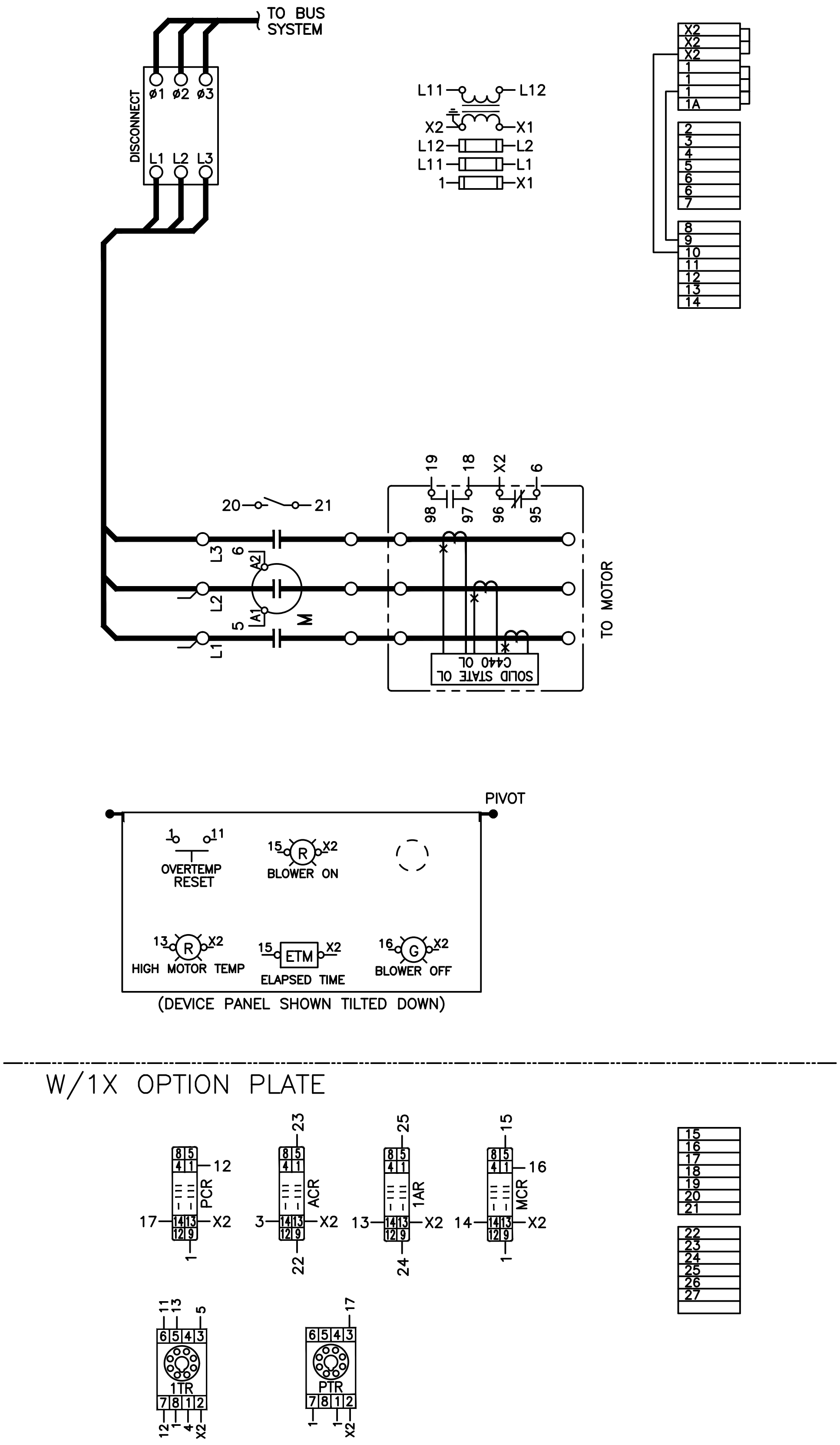
DATE 5/31/2023	DFTR SVU		
DATE 5/31/2023	APPD FAY		
DATE	APPD		
DWG SIZE A	REVISION 2	PRODUCT CODE CF	FEDERAL ID NO

REVISION

1

2 REVISE TO CHANGE PCP RERLAY CONTACTS 9/5/2023 TLL

FILE: C00LF8H-S018.DWG



EATON

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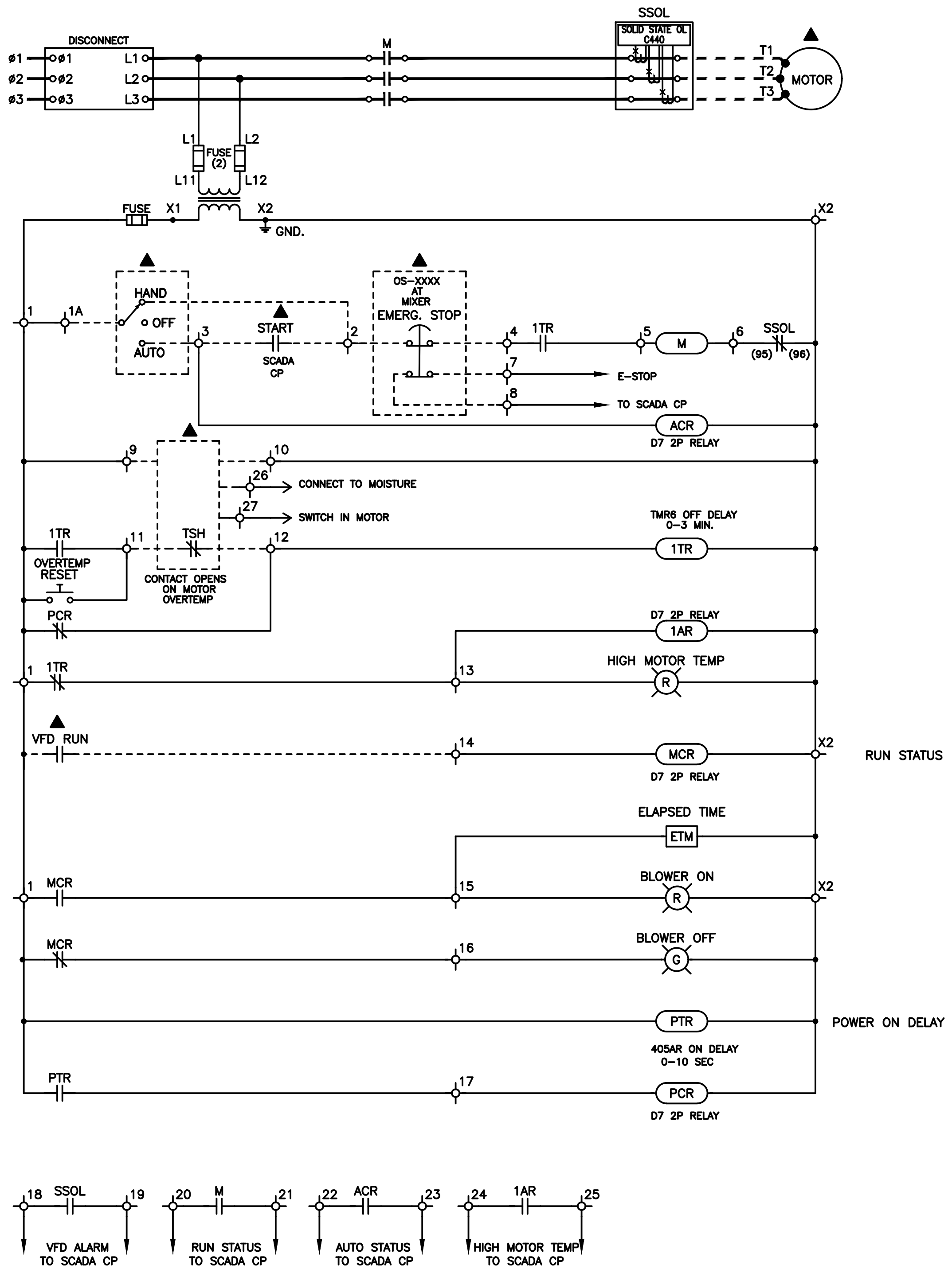
TITLE	RAB-3245, UNIT – 6J 5 HP,FVNR Starter Size 1 W C440 OL , 6MCC1
TYPE	FREEDOM+ MCC
	CONNECTION
G.O.	LBS0031682
DWG	C00LF8H-S018
SHEET	2 OF 2
DFTR	SVU
DATE	5/31/2023
APPD	FAY
DATE	5/31/2023
APPD	
DATE	
DWG SIZE	A
REVISION	2
PRODUCT CODE	CF
FEDERAL ID NO	

REVISION

1	
2	REVISE TO CHANGE PCP RERLAY CONTACTS 9/5/2023 TLL

FILE: C00LF8H-S018.DWG



LEGEND:

-◇- – TERMINAL POINT IN MCC

– – – – DEVICE REMOTE FROM MCC

▲ – DEVICE REMOTE FROM MCC

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EATON

TITLE RAB-3246, UNIT – 6M
5 HP,FVNR Starter Size 1 W C440 OL , 6MCC1

TYPE FREEDOM+ MCC
SCHEMATIC

G.O. LBS0031682

DWG C00LF8H-S019

SHEET 1 OF 2

DATE 5/31/2023
DATE 5/31/2023
DATE

DWG SIZE A

DFTR SVU
APPD FAY
APPD

REVISION 2

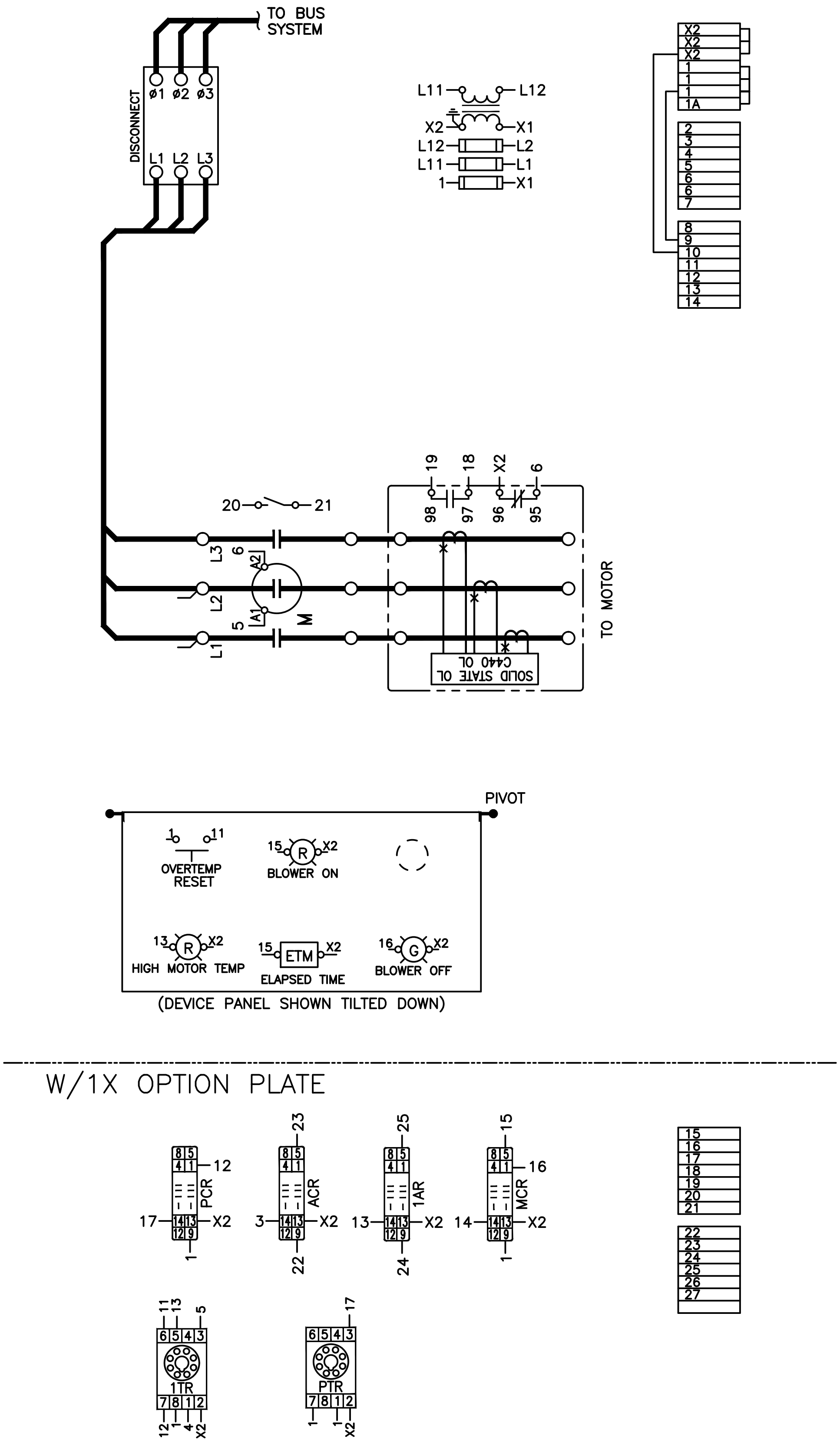
PRODUCT CODE CF

FEDERAL ID NO

2 REVISE TO
CHANGE PCP
RERLAY CONTACTS
9/5/2023 TLL

1 REVISION

FILE: C00LF8H-S019.DWG



THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE WHICH IT WAS SUPPLIED.

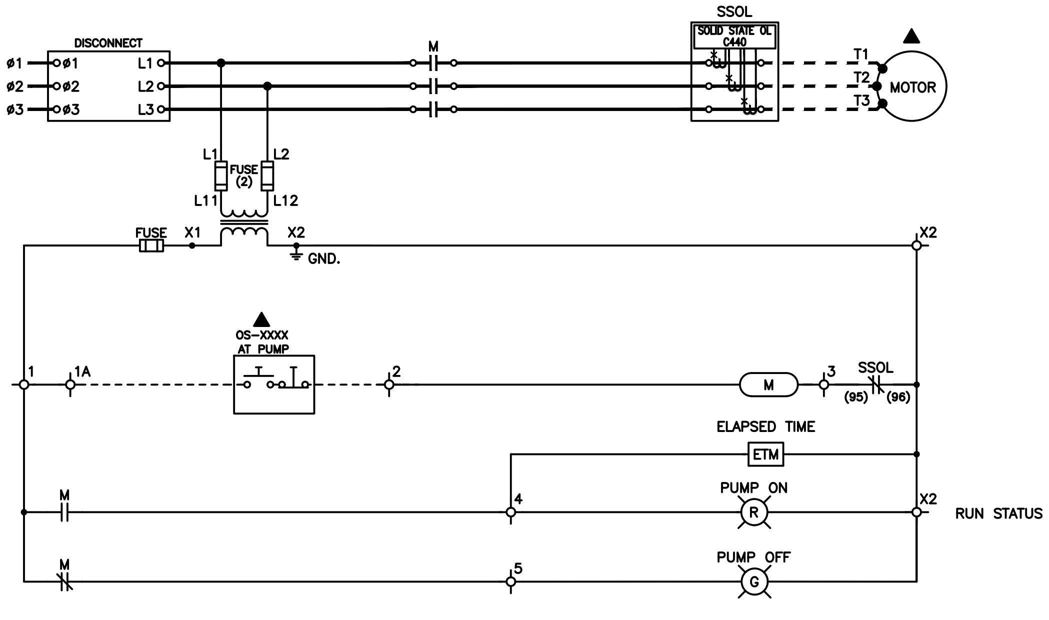
DFTR SVU	DATE 5/31/2023	TITLE RAB-3246, UNIT – 6M 5 HP,FVNR Starter Size 1 W C440 OL , 6MCC1	EATON
APPD FAY	DATE 5/31/2023		
APPD	DATE	TYPE FREEDOM+ MCC	CONNECTION
FEDERAL ID NO	PRODUCT CODE CF	REVISION 2	DWG SIZE A
G.O. LBS0031682	DWG C00LF8H-S019	SHEET 2 OF 2	

REVISION

1

2 REVISE TO CHANGE PCP RERLAY CONTACTS 9/5/2023 TLL

FILE: C00LF8H-S019.DWG



LEGEND:

-⌖- – TERMINAL POINT IN MCC

— — – DEVICE REMOTE FROM MCC

▲ – DEVICE REMOTE FROM MCC

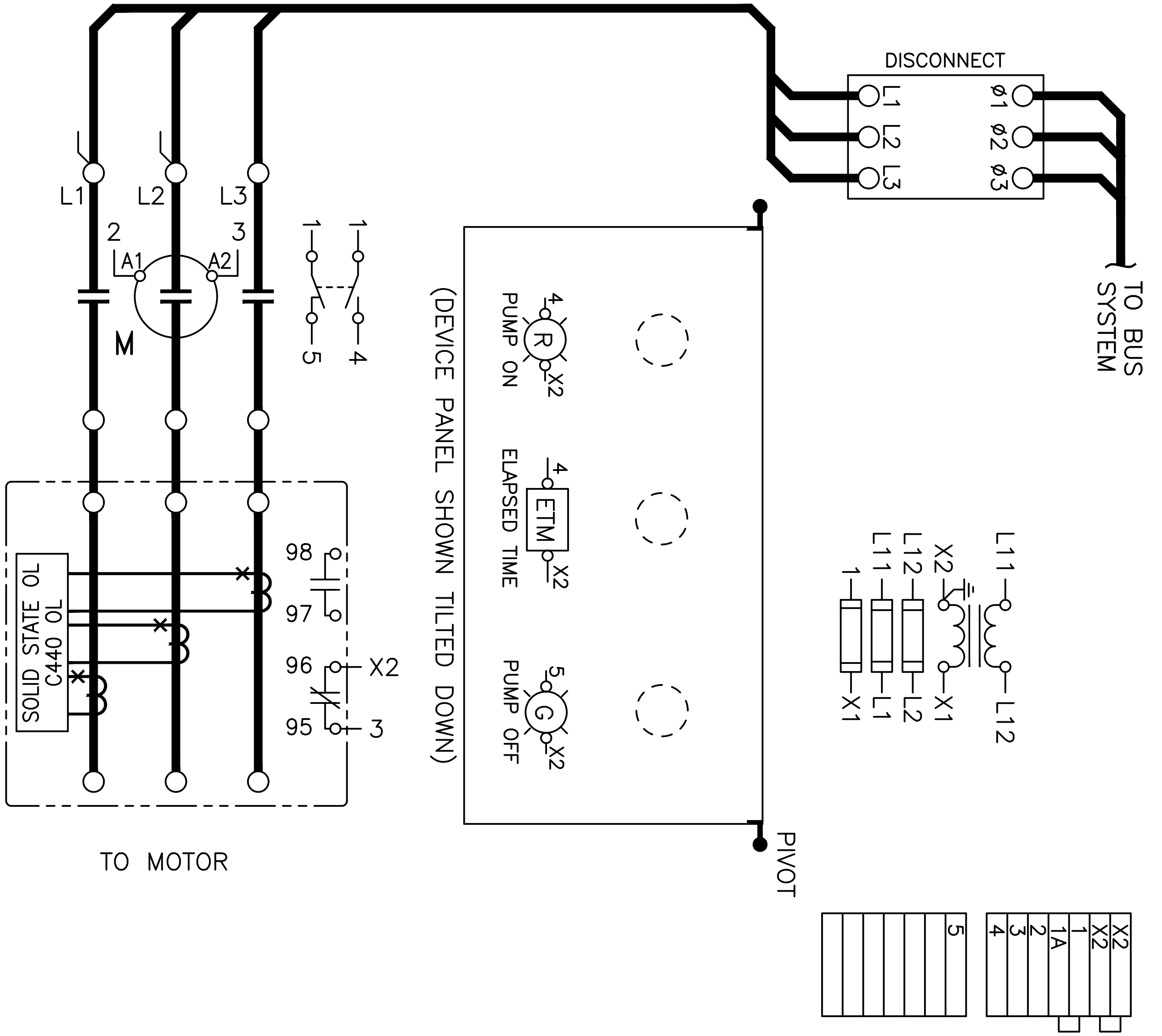
EATON

TITLE	DWP-9371, UNIT – 7B 5 HP,FVNR Starter Size 1 W C440 OL , 6MCC1
TYPE	SCHEMATIC FREEDOM+ MCC
G.O.	LBS0031682
DWG	C00LF8H-S020
SHEET	1 OF 2
DFTR	SVU
DATE	5/31/2023
APPD	FAY
DATE	5/31/2023
APPD	
DATE	
DWG SIZE	A
REVISION	1
PRODUCT CODE	CF
FEDERAL ID NO	

REVISION

1

FILE: C00LF8H-S020.DWG



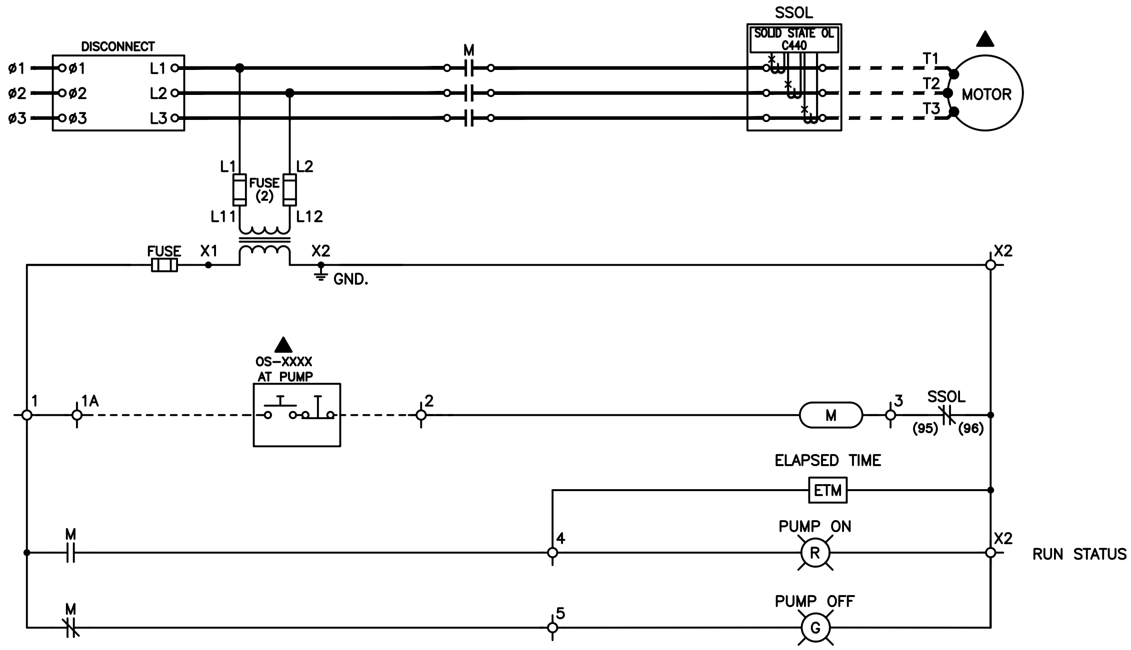
DFTR SVU	DATE 5/31/2023	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE WHICH IT WAS SUPPLIED.		EATON	
APPD FAY	DATE 5/31/2023	TITLE DWP-9371, UNIT – 7B 5 HP,FVNR Starter Size 1 W C440 OL , 6MCC1			
APPD	DATE	TYPE FREEDOM+ MCC		CONNECTION	
REVISION 1	DWG SIZE A	G.O. LBS0031682	DWG C00LF8H-S020		SHEET 2 OF 2

FEDERAL ID NO

PRODUCT CODE
CF

REVISION
1

FILE: C00LF8H-S020.DWG



LEGEND:

-ф- – TERMINAL POINT IN MCC

– – – DEVICE REMOTE FROM MCC

▲ – DEVICE REMOTE FROM MCC

THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE WHICH IT WAS SUPPLIED.

EATON

TITLE
DWP-9372, UNIT – 7D
5 HP,FVNR Starter Size 1 W C440 OL , 6MCC1

TYPE
FREEDOM+ MCC
SCHEMATIC

G.O.
LBS0031682

DWG
C00LF8H-S021

SHEET
1 OF 2

DATE
5/31/2023

DFTR
SVU

DATE
5/31/2023

APPD
FAY

DATE

APPD

DWG SIZE
A

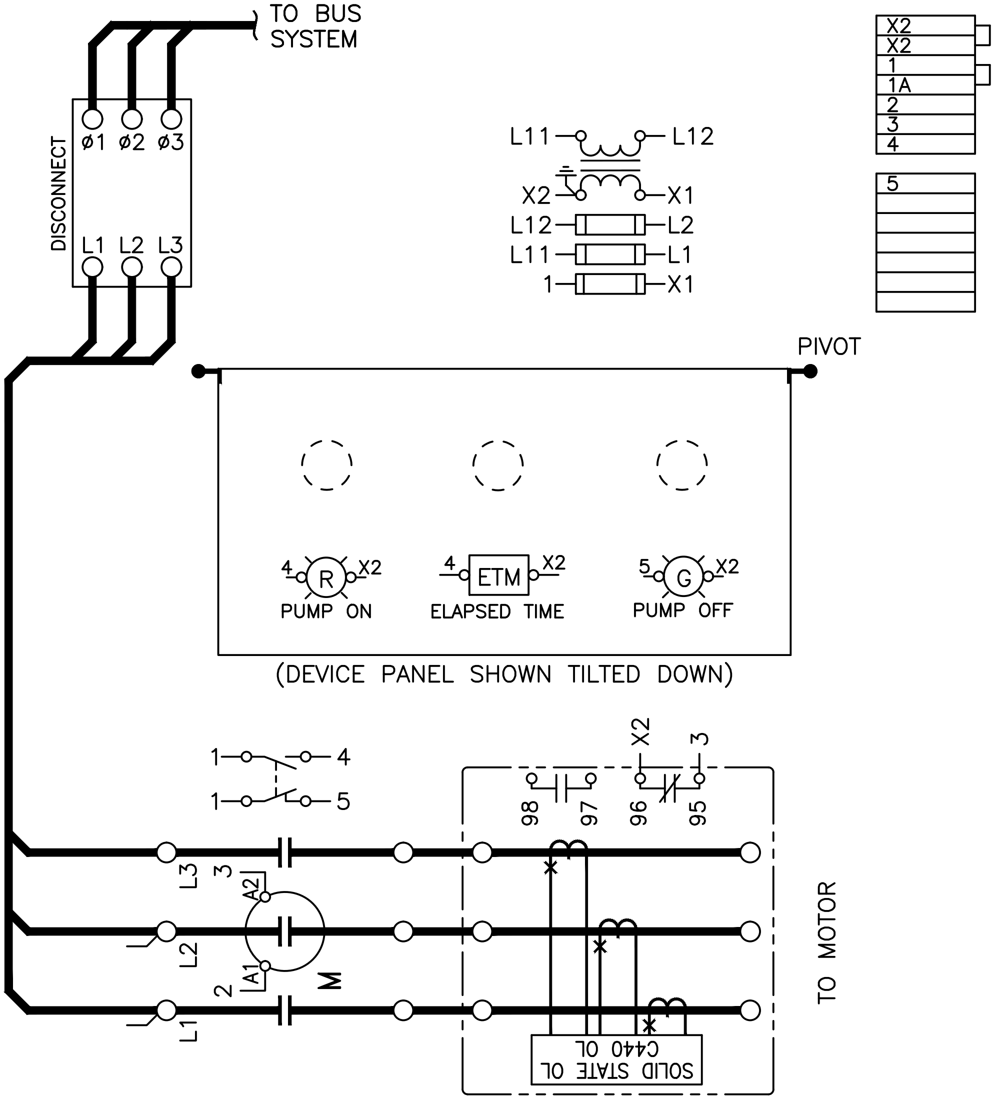
REVISION
1

PRODUCT CODE
CF

FEDERAL ID NO

REVISION
1

FILE: C00LF8H-S021.DWG



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EATON

TITLE
DWP-9372, UNIT – 7D
5 HP,FVNR Starter Size 1 W C440 OL , 6MCC1

TYPE
FREEDOM+ MCC
CONNECTION

G.O.
LBS0031682

DWG
C00LF8H-S021

SHEET
2 OF 2

DFTR SVU
DATE 5/31/2023

APPD FAY
DATE 5/31/2023

APPD
DATE

DWG SIZE A

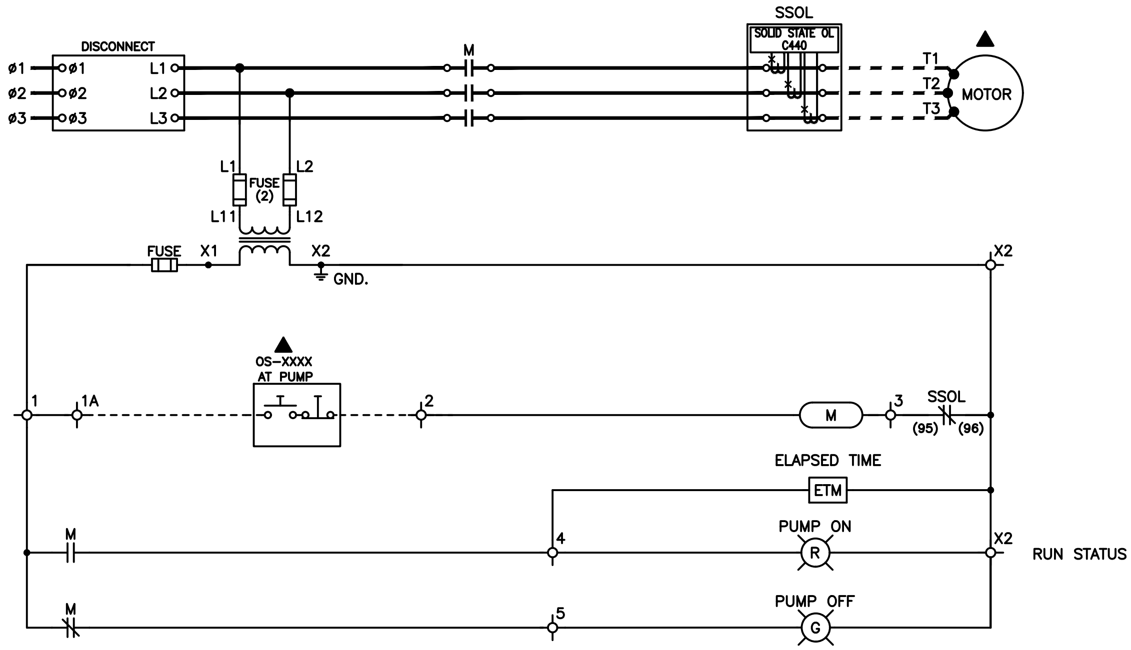
REVISION 1

PRODUCT CODE CF

FEDERAL ID NO

1 REVISION

FILE: C00LF8H-S021.DWG



LEGEND:

-⌖- – TERMINAL POINT IN MCC

— — – DEVICE REMOTE FROM MCC

▲ – DEVICE REMOTE FROM MCC

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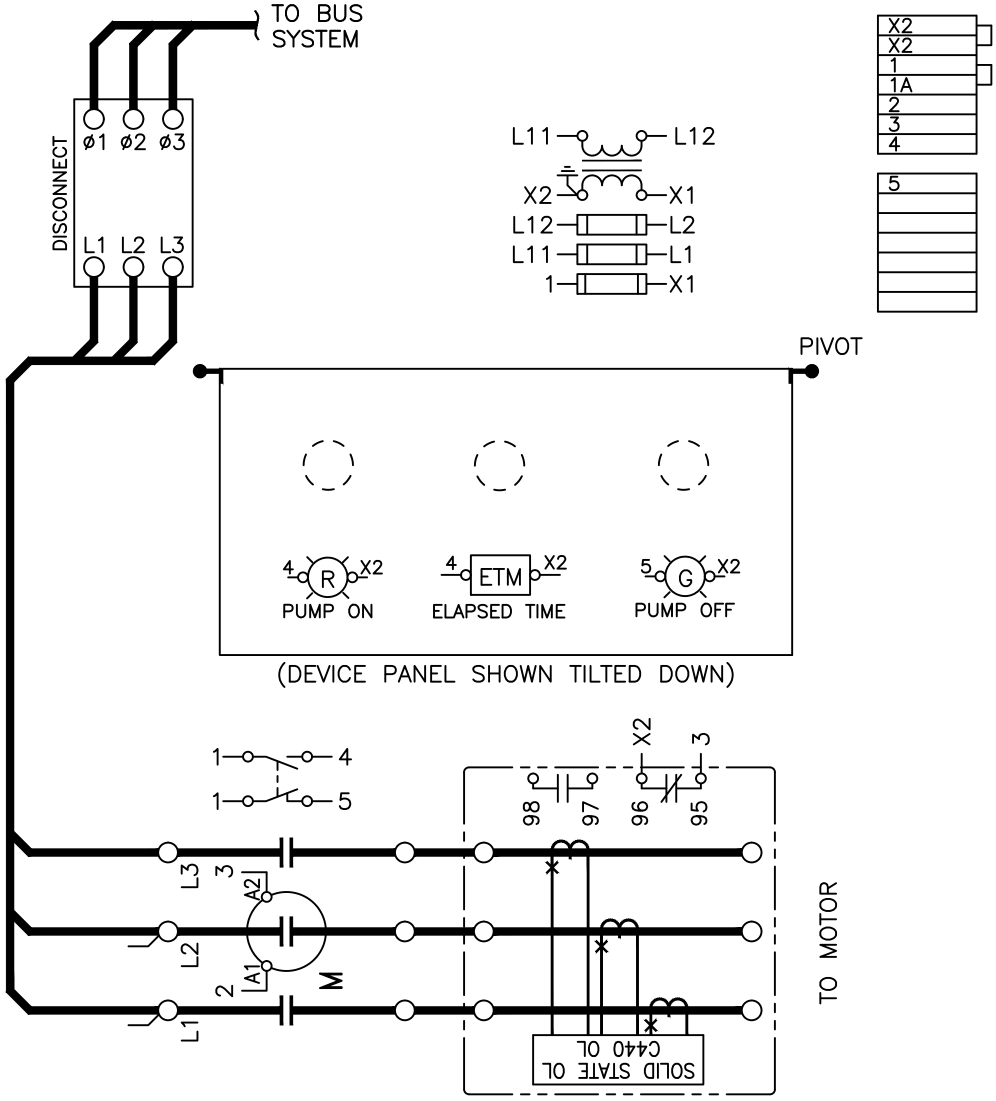
TITLE	DWP-9363, UNIT – 7F 5 HP,FVNR Starter Size 1 W C440 OL , 6MCC1
TYPE	FREEDOM+ MCC
	SCHEMATIC
G.O.	LBS0031682
DWG	C00LF8H-S022
SHEET	1 OF 2
DFTR	SVU
DATE	5/31/2023
APPD	FAY
DATE	5/31/2023
APPD	
DATE	
DWG SIZE	A
REVISION	1
PRODUCT CODE	CF
FEDERAL ID NO	

REVISION

1

FILE: C00LF8H-S022.DWG



EATON

TITLE DWP-9363, UNIT - 7F
5 HP,FVNR Starter Size 1 W C440 OL , 6MCC1

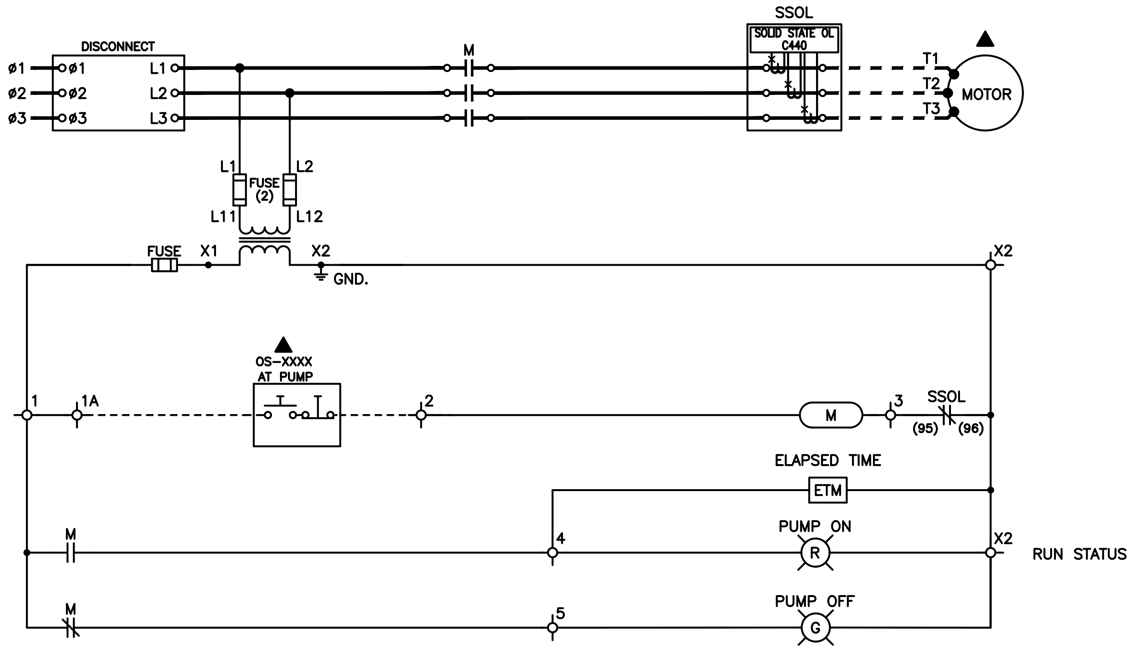
TYPE FREEDOM+ MCC
CONNECTION

G.O. LBS0031682
DWG C00LF8H-S022
SHEET 2 OF 2

DFTR SVU
DATE 5/31/2023
APPD FAY
DATE 5/31/2023
APPD
DATE
DWG SIZE A
REVISION 1
PRODUCT CODE CF
FEDERAL ID NO

1 REVISION

FILE: C00LF8H-S022.DWG



LEGEND:

- ⌖ – TERMINAL POINT IN MCC
- — — – DEVICE REMOTE FROM MCC
- ▲ – DEVICE REMOTE FROM MCC

EATON

TITLE DWP-9364, UNIT – 7H
5 HP,FVNR Starter Size 1 W C440 OL , 6MCC1

TYPE FREEDOM+ MCC
SCHEMATIC

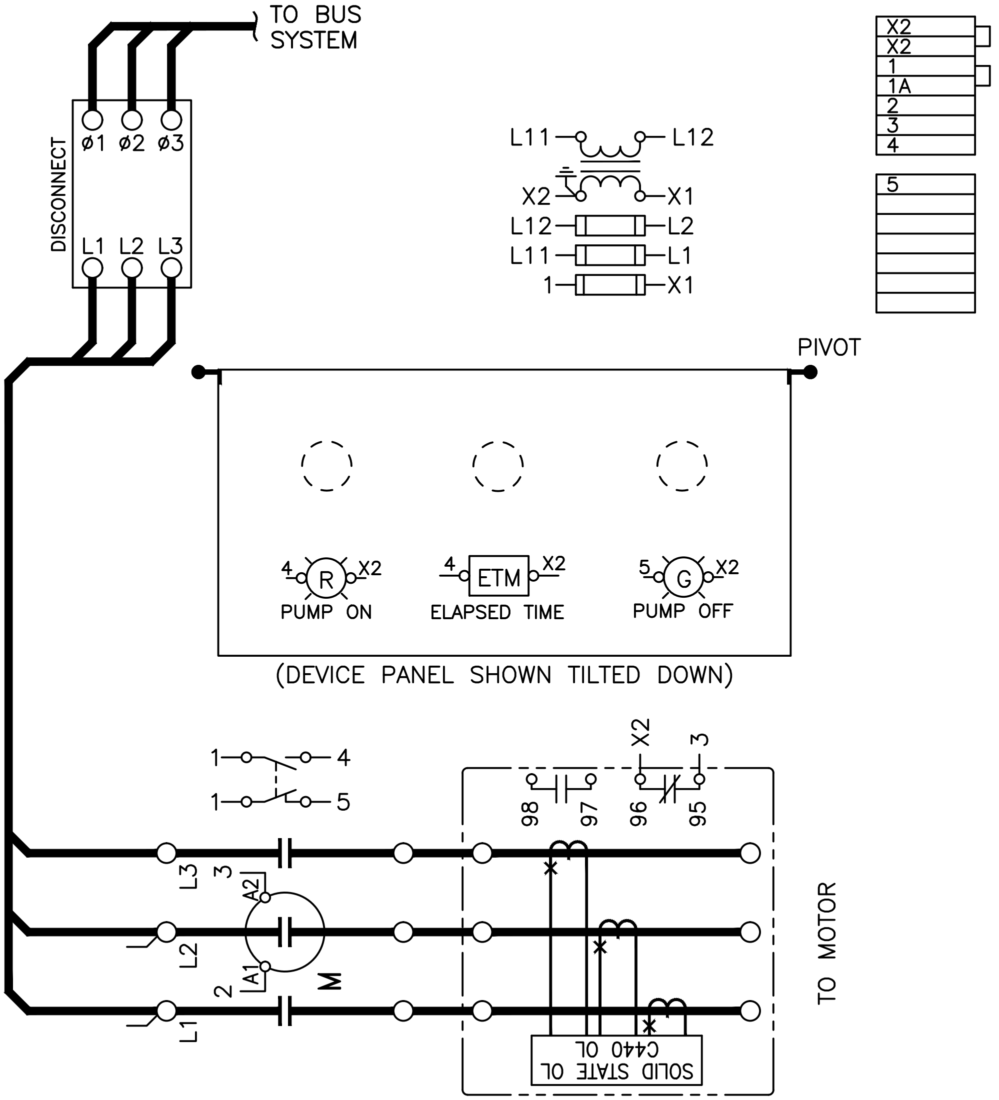
G.O. LBS0031682
DWG C00LF8H-S023
SHEET 1 OF 2

DATE 5/31/2023
DFTR SVU
DATE 5/31/2023
APPD FAY
DATE
APPD

DWG SIZE A
REVISION 1
PRODUCT CODE CF
FEDERAL ID NO

REVISION
1

FILE: C00LF8H-S023.DWG



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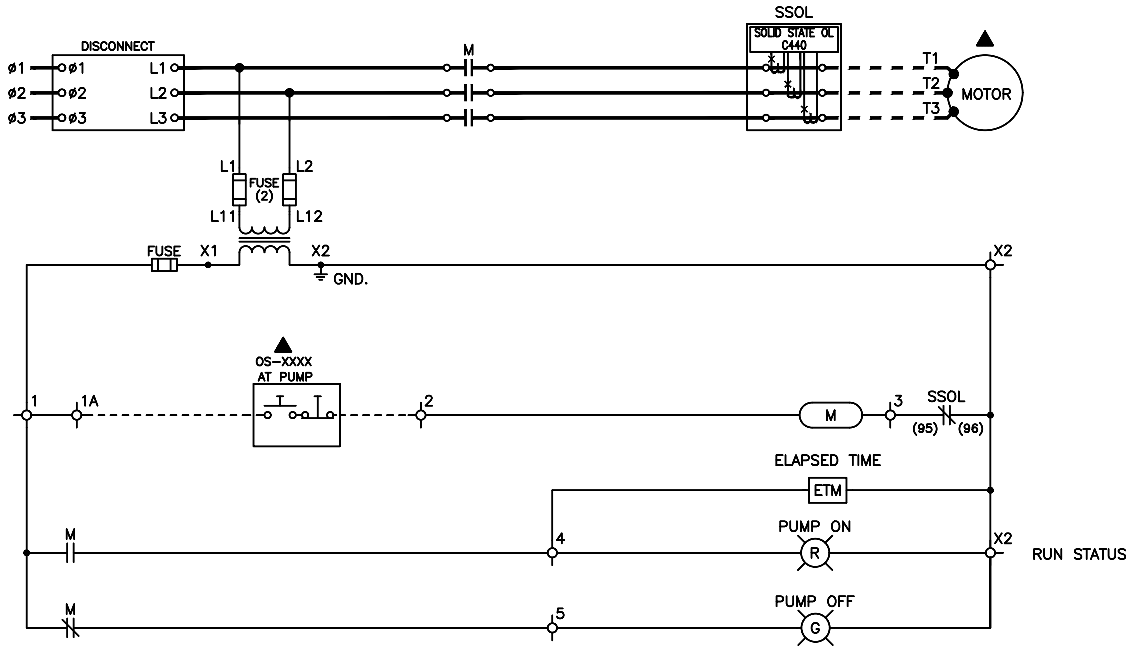
EATON

TITLE	DWP-9364, UNIT - 7H 5 HP,FVNR Starter Size 1 W C440 OL , 6MCC1
TYPE	FREEDOM+ MCC CONNECTION
G.O.	LBS0031682
DWG	C00LF8H-S023
SHEET	2 OF 2
DFTR	SVU
DATE	5/31/2023
APPD	FAY
DATE	5/31/2023
APPD	
DATE	
DWG SIZE	A
REVISION	1
PRODUCT CODE	CF
FEDERAL ID NO	

REVISION

1

FILE: C00LF8H-S023.DWG



LEGEND:

-⌖- – TERMINAL POINT IN MCC

– – – DEVICE REMOTE FROM MCC

▲ – DEVICE REMOTE FROM MCC

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EATON

TITLE
DWP-9365, UNIT - 7K
5 HP,FVNR Starter Size 1 W C440 OL , 6MCC1

TYPE
FREEDOM+ MCC
SCHEMATIC

G.O.
LBS0031682

DWG
C00LF8H-S024

SHEET
1 OF 2

DFTR
SVU
DATE
5/31/2023

APPD
FAY
DATE
5/31/2023

APPD
DATE

DWG SIZE
A

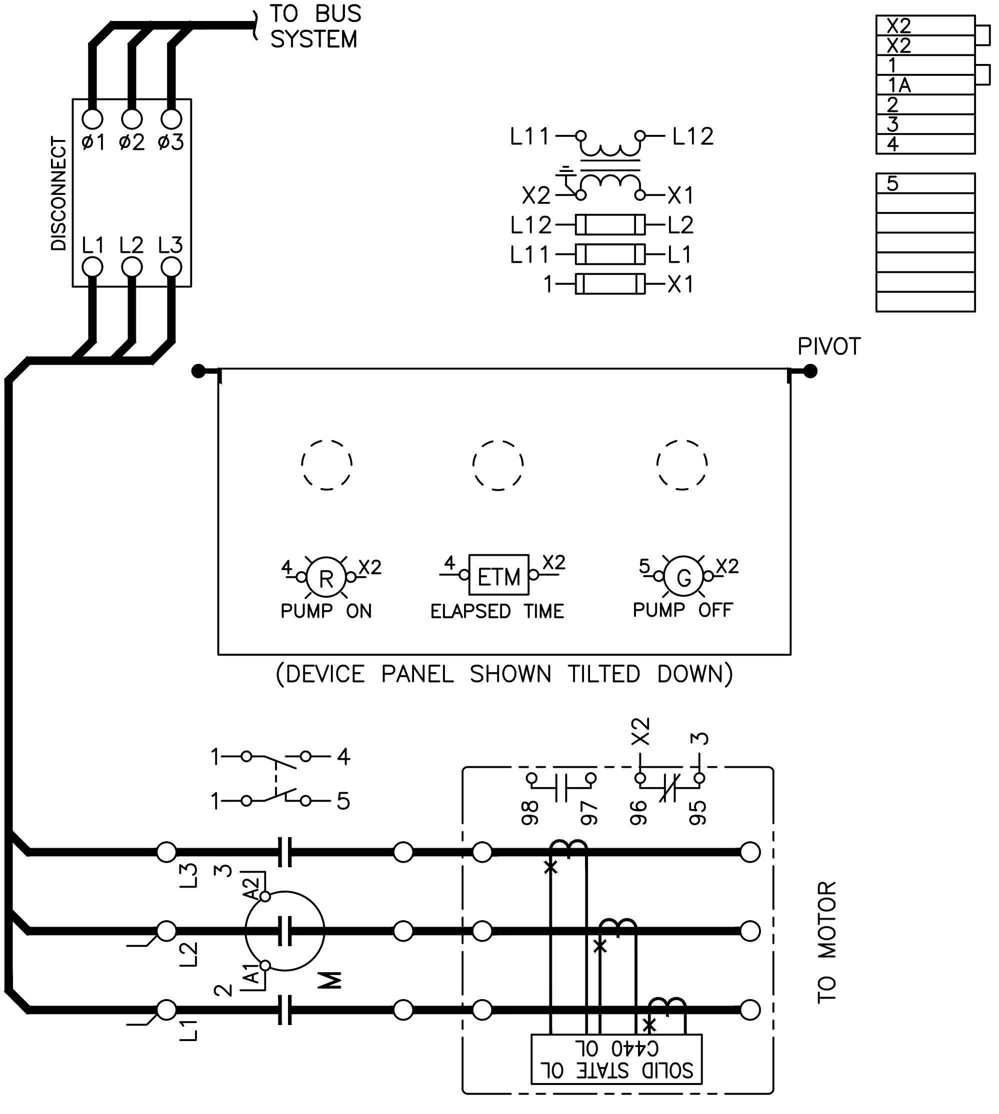
REVISION
1

PRODUCT CODE
CF

FEDERAL ID NO

REVISION
1

FILE: C00LF8H-S024.DWG



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EATON

TITLE DWP-9365, UNIT - 7K
5 HP,FVNR Starter Size 1 W C440 OL , 6MCC1

TYPE FREEDOM+ MCC
CONNECTION

G.O. LBS0031682
DWG C00LF8H-S024
SHEET 2 OF 2

DFTR SVU
DATE 5/31/2023
APPD FAY
DATE 5/31/2023
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REVISION 1
DWG SIZE A
PRODUCT CODE CF
FEDERAL ID NO

1 REVISION

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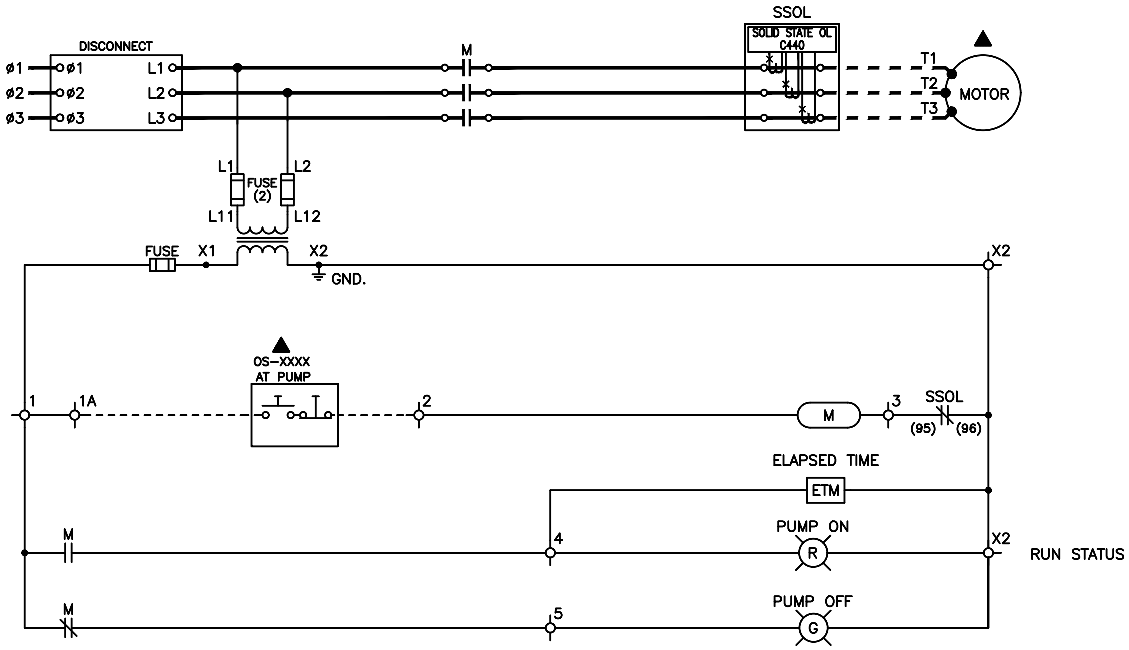

LEGEND:

-○- – TERMINAL POINT IN MCC

— — – DEVICE REMOTE FROM MCC

▲ – DEVICE REMOTE FROM MCC

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EATON

TITLE
DWP-9366, UNIT – 7M
5 HP,FVNR Starter Size 1 W C440 OL , 6MCC1

TYPE
FREEDOM+ MCC
SCHEMATIC

G.O.
LBS0031682

DWG
C00LF8H-S025

SHEET
1 OF 2

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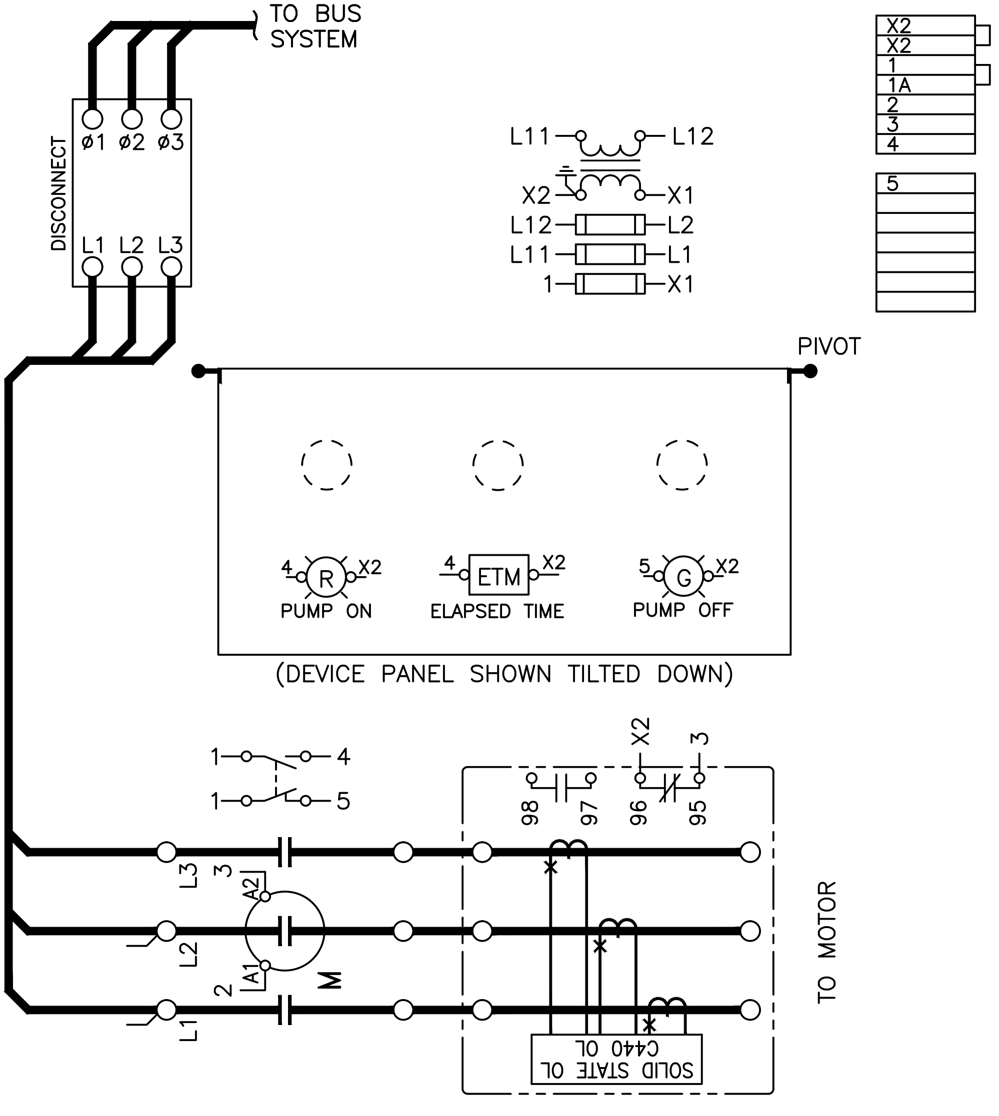

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FILE: C00LF8H-S025.DWG

Powering Business Worldwide

Instruction Data

Instruction Booklet **IM04302004E**

Effective April 2019
Supersedes September 2016

Freedom motor control center installation and maintenance manual

Contents

This electrical control equipment is designed to be installed, operated, and maintained by adequately trained workmen. These instructions do not cover all details, variations, or combinations of the equipment, its storage, delivery, installation, check-out, safe operation,or maintenance. Care must be exercised to comply with local, state, and national regulations, as well as safety practices, for this class of equipment. The maximum short circuit capability of the equipment should not be exceeded by connection to a source with higher capacity. If maintenance or troubleshooting assistance is required,contact your nearest Eaton sales office.

Powering Business Worldwide

Part 1. General information

The motor control center

The Eaton Freedom motor control center (MCC) may be joined to existing Five Star, Series 2100, and Advantage installations using the splice bar kits common to both. Units designed for the Freedom MCC can be mounted in Five Star Series and Series 2100 sections, but the opposite is not recommended, because Five Star and Series 2100 units may lack terminal blocks and sufficient interrupting capacity. The Freedom MCC may be joined to existing Eaton Freedom Unitrol and F10 Unitrol MCCs with a special splice bar kit, but units are not interchangeable

Control center nomenclature

The numbers shown in parentheses in the following text refer to the balloon legends in **Figure 2**.

The Eaton Freedom MCC consists of one or more totally enclosed, dead front, free standing structural assemblies 90 inches high which are compartmentalized to house individual control units. (2) With control units mounted in the front side only, the structure may be 16 or 21 inches deep. For mounting units back-to-back, the structure is 21 inches deep. Steel covers (7) enclose the structure at the top, sides and at the rear of front-mounted-only structures.

A vertical bus system installed in each vertical section is connected to the horizontal bus to feed the individual control units. The vertical bus is isolated by a full height barrier. (6) An optional labyrinth barrier provides both isolation and insulation. An automatic shutter is included with the labyrinth barrier system to cover the stab openings for each control unit.

At the top of each section, a door provides ready access to the top horizontal wireway (11) and ground bus. The horizontal wireway is isolated from the bus systems by steel barriers which can be removed for installation and maintenance operations. Adequate space is provided for control wiring and top cable entry.

At the bottom of each section, a door (18) provides ready access to the bottom horizontal wireway, and neutral bus (if provided). The bottom of each section is completely open to provide unrestricted bottom entry of cable and conduit. Channel sills may be installed across the bottom of the control center if specified, and an optional bottom plate may also be specified.

A vertical wireway 8 inches deep, extending the full 90 inch height of the control center is located to the right of each unit compartment. This wireway is covered by two hinged doors (15) and contains cable supports to secure wire bundle sand cables. The vertical wireway joins the horizontal wireway at the top and bottom to provide unobstructed space for interwiring.

Each vertical section provides space to mount up to six controller units (2) with a minimum height of 12 inches, in increments of six inches, for a total of 72 inches of usable space. Controllers through NEMA® Size 5 are drawout type (except reduced-voltage starters). These drawout unit assemblies are a completely self-contained package consisting of a steel enclosure, operating handle and electrical components. The drawout assembly slides into this compartment on guide rails (11) to provide easy withdrawal and reinsertion and to ensure precise alignment of the unit stabs with the vertical bus. Each drawout unit is held in place by a single quarter-turn latch (4) which can only been gaged when the unit stabs are fully mated with the vertical bus. Each unit has a separate door, (1) held closed by a minimum of two quarter-turn fasteners.

The operating handle on the controller unit (3) moves vertically. In the ON or TRIPPED positions,the handle interlocks with the unit door to prevent its opening. In this position, authorized personnel can open the door by turning the defeater mechanism screw. (21) With the unit door open and the operating handle in the ON position, another interlock to the divider pan prevents removal of the unit. This same interlock prevents insertion of the unit unless the handle mechanism is in the OFF position. To ensure that units are not energized accidentally or by unauthorized personnel, the handle mechanism can be padlocked in the OFF position. Space for a minimum of three padlocks is provided on each handle. The device panel (5) is mounted on the drawout unit. It will accommodate up to six pilot devices. The overload reset button is mounted on the unit door.

Figure 1. Nameplate

Ratings

Each Freedom MCC has a rating nameplate attached to the door of the top horizontal wireway of the primary section. See **Figure 1** and **Figure 2**. This nameplate shows the general order number under which the motor control center was built and its continuous electrical ratings, in terms of incoming line voltage, phases, and frequency, and ampere ratings of the horizontal bus and the vertical bus for each section. In addition, this nameplate shows the passive short-circuit (withstand) rating of the horizontal and vertical bus system. The active short-circuit (interrupting) ratings of the main and unit short-circuit protective devices are shown on labels attached to the inside of each unit. Before installing a motor control center, calculate and record the fault current available at the incoming line terminals. Verify that the short-circuit with standard short-circuit interrupting ratings of the units in the motor control center are appropriate for the fault current available.

Qualified personnel

Individuals who install, operate, or maintain MCCs must be trained and authorized to operate the equipment associated with the installation and maintenance of an MCC, as well as the operation of the equipment that receives its power from controller units in the MCC. Such individuals must be trained in the proper procedures with respect to disconnecting and locking OFF power to the MCC and wearing personal protective equipment, which includes arc flash, insulating, and shielding materials, and also use insulated tools and test equipment, following established safety procedures as outlined in the National Electrical Safety Code (ANSI C2) and Electrical Equipment Maintenance (NFPA 70E).

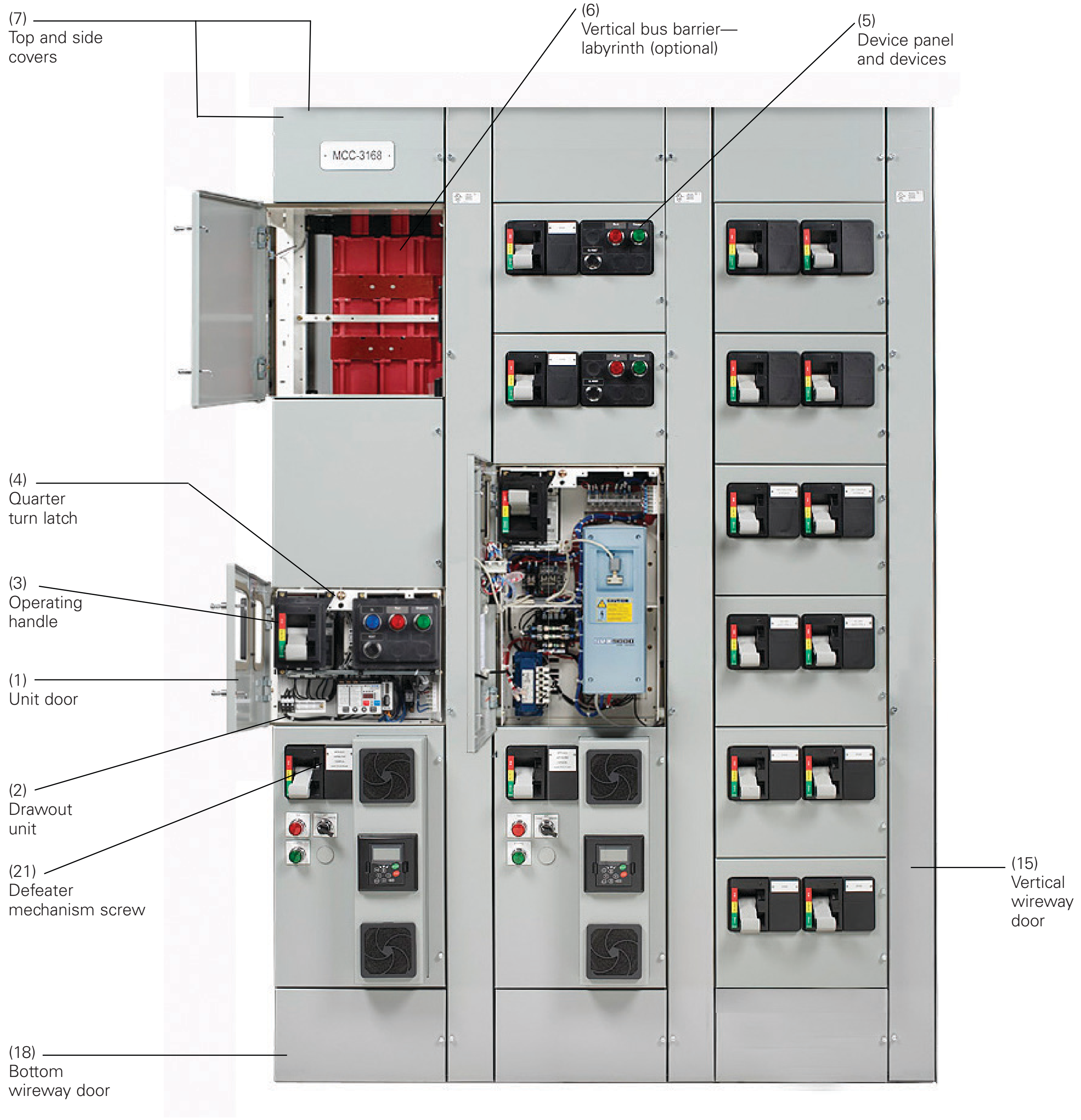


Figure 2. Motor control center nomenclature

Part 2. Receiving, handling, and storage

⚠ WARNING

MCC—HEAVY EQUIPMENT STATEMENT

THIS MCC CAN WEIGH IN EXCESS OF 2,000 POUNDS. REFER TO SHIPPING MANIFESTS FOR EXACT WEIGHT OF EQUIPMENT. TO PREVENT SERIOUS INJURY OR DEATH, OR EQUIPMENT DAMAGE, FROM UNINTENDED MOVEMENT OF EQUIPMENT DURING TRANSPORT, INSTALLATION OR ANY OTHER OPERATIONS, ENSURE THAT (1) ONLY MATERIAL HANDLING EQUIPMENT OF ADEQUATE CAPACITY AND RATING FOR THE LOAD INVOLVED IS USED; (2) ONLY QUALIFIED PERSONNEL ARE INVOLVED; AND (3) ALL LIFTING/BRACING SHIPPING LABELS AND MARKINGS INSTRUCTIONS SHIPPED WITH THE MCC MUST BE FOLLOWED.

Receiving

Before and after unloading the motor control center, inspect each section and unit exterior for evidence of damage that may have been incurred during shipment. If there is any indication that the control center has been mishandled or shipped on its back or side, remove the drawout units and make a complete inspection of the internal structure, bus bars, insulators, and unit components for possible hidden damage. Report any damage found to the carrier at once.

Handling

The following guidelines are provided to help avoid personal injury and equipment damage during handling, and to facilitate moving the motor control center at the job site.

General hints

1. Handle the motor control center with care to avoid damage to components and to the enclosure or its paint finish.
2. Keep the motor control center in an upright position.
3. Ensure that the moving means has the capacity to handle the weight of the motor control center.
4. The control center should remain secured to the shipping skid until the motor control center is in its final location.
5. Exercise care during any movement and placement operations to prevent falling or unintentional rolling or tipping.
6. Lifting angles for handling by overhead crane are bolted to the top of each shipping section. Handling by overhead crane is preferable, but when crane facilities are not available, the motor control center can be positioned with a fork-lift truck or by using rollers under the shipping skid.

Overhead crane

1. See **Figure 3** for recommended lifting configuration.
2. Select or adjust the rigging lengths to compensate for any unequal weight distribution, and to maintain the motor control center in an upright position.
3. To reduce tension on the rigging and the compressive load on the lifting angles, do not allow the angle between the lifting cables and vertical to exceed 45 degrees. Use slings with safety hooks or shackles. **Do not pass ropes or cables through lifting angle holes.**

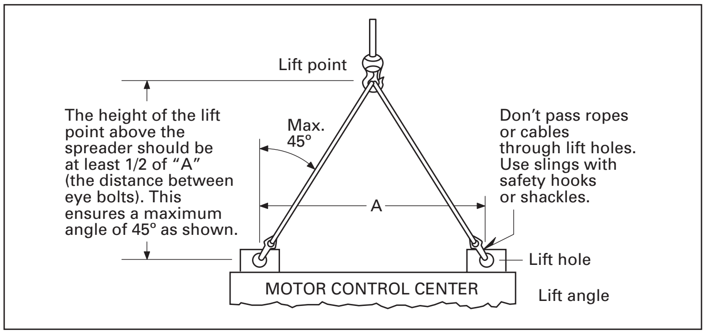


Figure 3. Correct use of lifting angle

4. After removing the lifting angles, replace the mounting hardware to prevent the entrance of dirt, etc.

Fork-lift truck

Motor control centers are normally top and front heavy. Balance the load carefully, and steady, as necessary, while moving. Always use a **safety strap when handling with a fork-lift**.

Rollers

Rod or pipe rollers, with the aid of pinch bars, provide a simple method of moving the motor control center on one floor level, if there is no significant incline. Roll the motor control center slowly, and steady the load to prevent tipping.

Storage

When an motor control center cannot be installed and placed into operation immediately upon receipt, take steps to prevent damage by condensation or harsh environmental conditions. If the motor control center cannot be installed in its final location, store it in a clean, dry, ventilated building, heated to prevent condensation, and protected from dirt, dust, water, and mechanical damage. When storage conditions are less than ideal, install temporary electrical heating, typically in the form of light bulbs, totaling 150 watts per section, hung in the vertical wireway, or by applying power to self-contained space heaters that the motor control center may be equipped with. Remove all loose packing and flammable materials before energizing any of the heating elements.

Part 3. Installing control center sections

General

Freedom FlashGard™ motor control centers (MCCs) are designed for installation in accordance with both the National Electrical Code® (NEC®), NFPA 70, and the National Electrical Safety Code (NESC), ANSI C2.

⚠ CAUTION

IF WORK IS INVOLVED IN CONNECTING THE CONTROL CENTER WITH EXISTING EQUIPMENT, ENSURE THAT INCOMING POWER IS DISCONNECTED BEFORE WORK BEGINS. DISCONNECTING MEANS SHOULD BE LOCKED OUT AND/OR TAGGED OUT OF SERVICE. WHERE IT IS NOT FEASIBLE TO DE-ENERGIZE THE SYSTEM, THE FOLLOWING PRECAUTIONS SHOULD BE TAKEN:

Persons working near exposed parts that are or may be energized should be instructed and should use practices (including appropriate personal protective equipment, which includes arc flash, insulating, and shielding materials, and insulated tools and test equipment in accordance with the NFPA 70E).

E. Persons working on exposed parts that are or may be energized should, in addition, be qualified persons who have been trained to work on energized circuits.

Installation

1. Before any installation work begins, consult all drawings furnished by Eaton, as well as all applicable contract drawings for the installation. Give particular attention to the physical location of units in the control center and their relation to existing or planned conduit, busways, etc. Provide for future conduit entrance prior to control center installation.
2. Locate the control center in the area shown on the building floor plans. If in a wet location or outside of the building, protect the control center from water entering or accumulation within the enclosure. Recommended clearances or working spaces are as follows:
   a. Clearance from walls (where not rear accessible)—a minimum of 1/2 inch for indoor and 6 inches for outdoor or wet locations.
   b. Clearance from front of MCC (working space)—minimum of 3 feet for control centers without exposed live parts. See NEC 110.13.
   c. For arc resistant MCCs up to 2500 A horizontal bus, there are no restrictions on the clearance above the MCC top plate. Standard Freedom MCC rules apply for conduit, cable trays, and wiring.

Note: This working space should not be used for storage and should have adequate lighting.

3. Since MCCs are assembled at the factory on smooth and level surfaces to ensure correct alignment of all parts, MCCs should be securely mounted on a level surface. The foundation furnished by the purchaser must be true and level, or the bottom frames must be shimmed to support the entire base in a true plane. It is recommended that leveled channel sills under both the front and rear of the control center be used to provide this level base. Drill and tap the channel sills for mounting bolts in accordance with the applicable floor plan drawing and then either install the MCC level with, or on top of, the finished floor. If sills are grouted in concrete, the mounting bolts should be screwed in place and remain until the concrete has hardened.
4. For bottom entry, position the MCC so that the conduit stubs or floor openings are located in the shaded areas shown on the MCC floor plan drawings (refer to **page 27** and **page 28** for floor plan dimensions). The shaded areas represent the open space available for conduit entry through the bottom of each section. A shaded area may be restricted if large controllers or auto-transformers are mounted in the bottom of the sections. If optional bottom plates are supplied, the plates may be removed and drilled for conduit entry.
5. Install the MCC in its final position, progressively leveling each section and bolting the frames together if they are separated. If necessary, secure the MCC to walls or other supporting surfaces. Do not depend on wooden plugs driven into holes in masonry, concrete, plaster, or similar materials. See NEC 110.13.
6. If two or more shipping sections are to be joined into an integral assembly or a shipping section is to be joined to an existing section, refer to paragraphs below before proceeding with the installation.
7. Ground and bond the MCC as follows:
   a. MCCs used as service equipment for a grounded system or as an incoming line section for a separately derived, previously grounded system:
      1. Run a grounding electrode conductor (ground wire) having a size in accordance with NEC 250.94 from the grounding electrode to the MCC ground bus or ground terminal provided. See also NEC 250.92(A) and 92(B).
      2. If the system is grounded at any point ahead of the MCC, the grounded conductor must be run to the MCC in accordance with NEC 250, and connected to the ground bus terminal.
      3. Do not make any connections to ground on the load side of any neutral disconnecting line or any sensor used for ground-fault protection. Do not connect outgoing grounding conductors to the neutral.

   b. MCCs used as service equipment for an ungrounded system or as an incoming line section for a separately derived, previously ungrounded system:
      1. Run a grounding electrode conductor (ground wire) having a size in accordance with NEC 250.94 from the grounding electrode to the MCC ground bus terminal. See NEC 250.92(A) and 92(B).

   c. MCCs not used as service equipment nor as an incoming line section for a separately derived system, and used on either a grounded or ungrounded system:
      1. Ground the MCC ground bus by means of equipment grounding conductors having a size in accordance with NEC 250.95 or by bonding to the raceway enclosing the main supply conductors in accordance with NEC 250.92(B).
8. When all wiring and adjustments are complete, close all unit and wireway doors.
9. In damp indoor locations, shield the MCC to prevent moisture and water from entering and accumulating.
10. Unless the MCC has been designed for unusual service conditions, it should not be located where it will be exposed to ambient temperatures above 40 °C (104 °F), corrosive or explosive fumes, dust, vapors, dripping or standing water, abnormal vibration, shock, or tilting.

Joining compatible sections

If two more shipping sections are to be joined into an integral assembly, or a section added to an existing installation, splicing of horizontal bus, ground bus, neutral bus, and joining of the adjacent vertical sections must be planned with the installation.

1. Remove the side sheets from adjacent vertical sections to be joined. (These sheets will have been removed from factory-assembled sections.)
2. The horizontal bus splice plates and connection hardware will be shipped with the MCC attached to one end of shipping section. Refer to **Figure 4**.
3. This method provides the most convenient access to the bolts, and eliminates the need to remove the horizontal bus barriers in that structure. Should the existing bus be oxidized, sand lightly with a fine aluminum oxide paper.

⚠ CAUTION

DO NOT USE EMERY CLOTH OR ANY ABRASIVE CONTAINING METAL.

4. Remove the upper horizontal wireway door from the structure on the right side of the left-hand (LH) section, and remove the two-piece wireway barrier to provide access to the ends of the bus in that section.
5. Move the section into place, aligning the upright structural channels and bottom channels. Alignment of the section with floor sills and foundation provisions will be facilitated by removing the bottom horizontal wireway doors. Using the “U” or “Z” type frame clamps provided, clamp adjacent front upright channels together at the top, bottom, and approximate center of the vertical structure. “U” or “Z” clamp placements must be placed 4 inches (101.6 mm) above or below the drawout unit—1/4 turn latch and unit interlock feature on the cover control module; see details on **page 28** bottom left-hand corner. This operation will be facilitated by removing the vertical wireway doors from the left-hand structure and one or more drawout units from the right-hand structure. See **Part 9, page 20**.
6. If rear access is available, “U” or “Z” clamps should also be used to clamp the rear upright channels together. In front-mounted-only structures, this will require removal of the adjacent back sheets. In a back-to-back-mounted structure, remove the vertical wireway doors and one or more drawout units as above.
7. Secure the sections to the floor sills or mounting bolts as provided for the installation.
8. Bolt the horizontal bus splice plates to the bus in the left-hand structure, torquing all bus splice bolts to 360 pound-inches (30 pound-feet). See **Figure 5**.
9. Replace all units, bus barriers, and doors.
10. If joining a new arc resistant section to the end of an existing arc resistant lineup, remove the 4-inch end section and add new arc resistant sections with new 4-inch arc section to the end of the lineup.

Joining incompatible sections

Joining a Freedom MCC to other equipment, such as Type W and 11-300 control centers, will usually involve a transition section installed between the two varieties of equipment. This transition section will be detailed on drawings provided by Eaton and the applicable contract drawings. If provided separately, it should be installed first. Review the overall installation task to determine whether the transition section should be attached to the existing equipment or to the Freedom FlashGard section, before it is moved into place, and select the sequence that will provide best access to bus splicing and joining of the structures.

Figure 4. Splice plates attached to right-hand section

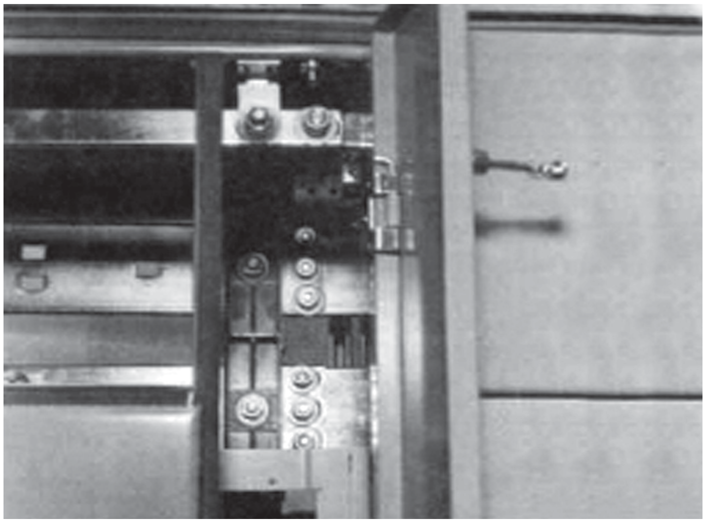


Figure 5. Access to left-hand splice plate connections

Splice plates

Each splice plate kit consists of short pieces of bus bar the same width as the main horizontal bus of the MCC the kit is shipped with, four bolts per phase, and appropriate quantities of related hardware. For a single bus bar per phase, the hardware is used as shown in **Figure 6** for either 16- or 21-inch deep enclosures. Each splice plate is punched with rectangular holes to accept a square shank carriage bolt that will not rotate as the nut is tightened.

Where the MCC is built with two horizontal bus bars per phase, the splice plates are installed as shown in **Figure 7**. The top edge of **Figure 7** through **Figure 10** represents the back side of the MCC. The top portion of each of these figures applies to 21-inch deep enclosures and the lower portion to 16-inch deep enclosures. Note that for all but the single-bar per phase (**Figure 6**) installation, the 16-inch deep enclosures require the use of a nut plate that is mounted with the same carriage bolt used to attach the horizontal bus bars to the channel-shaped insulators. Install these nut plates before mounting the splice plates. Tighten the splice plate bolts with a driving torque of 360 pound-inches (30 pound-feet).

Type 3R enclosures

Where the MCC is supplied in a Type 3R enclosure for an outdoor application, apply roof splice caps at each shipping block junction to maintain the enclosure integrity.

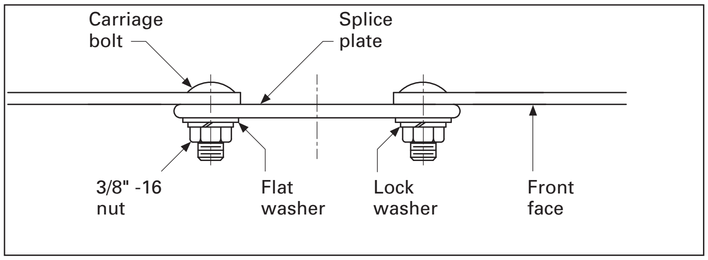


Figure 6. Single-bar splice kit

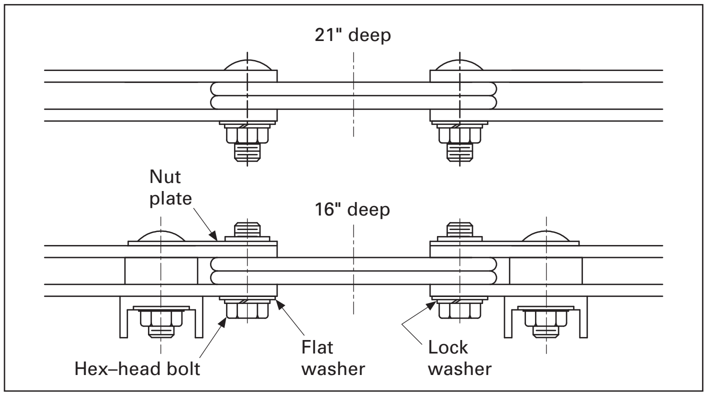


Figure 7. Double-bar splice kit

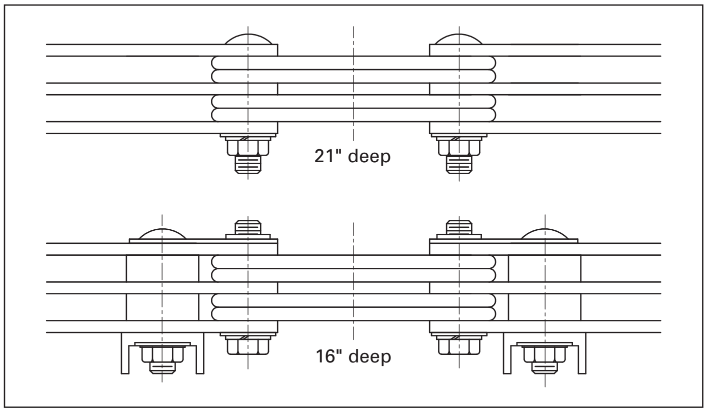


Figure 8. Triple-bar splice kit

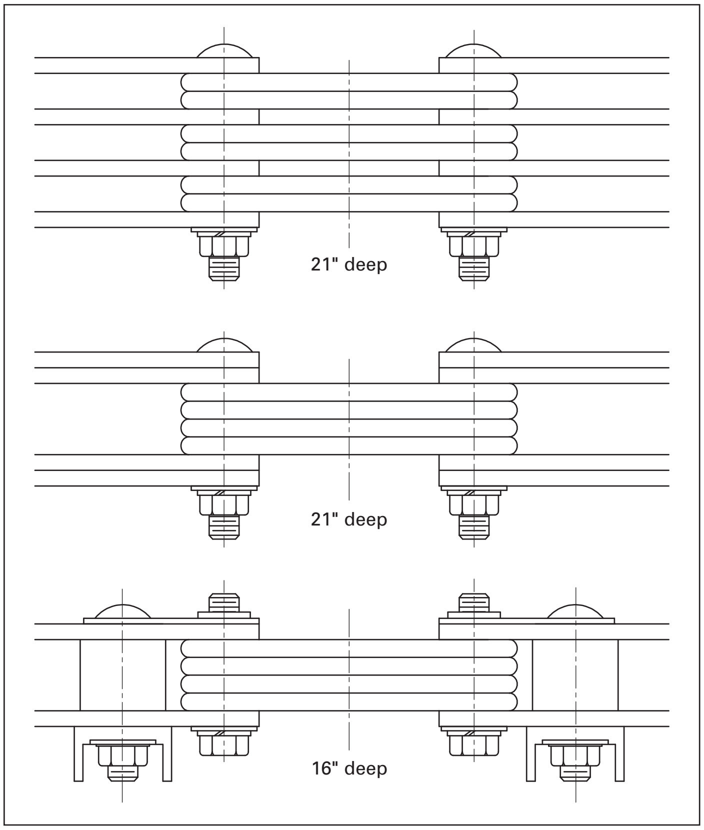


Figure 9. Quadruple-bar splice kits

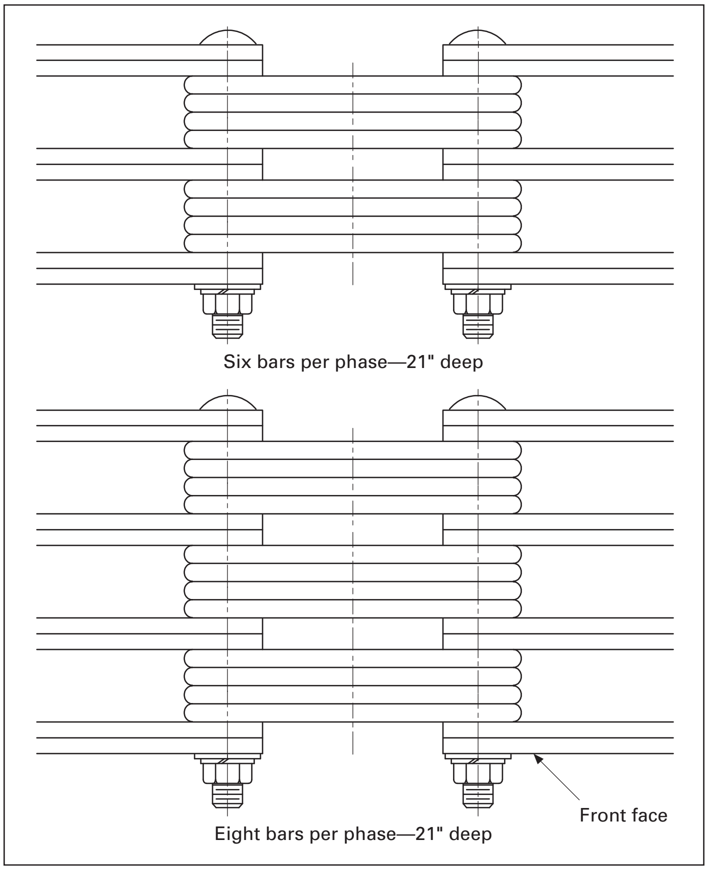


Figure 10. Six- and eight-bar splice kits

Joining to a Freedom FlashGard, Freedom Unitrol, or F10 Unitrol

Consult the assembly instruction supplied with every Freedom MCC set up for splice to Freedom FlashGard, Freedom Unitrol, or F10 Unitrol.

⚠ WARNING

SPECIFIC SAFETY NOTE FOR INSTALLING AND REMOVING MCC UNITS—RECOMMEND THE USE OF NEW ACCESSORY.

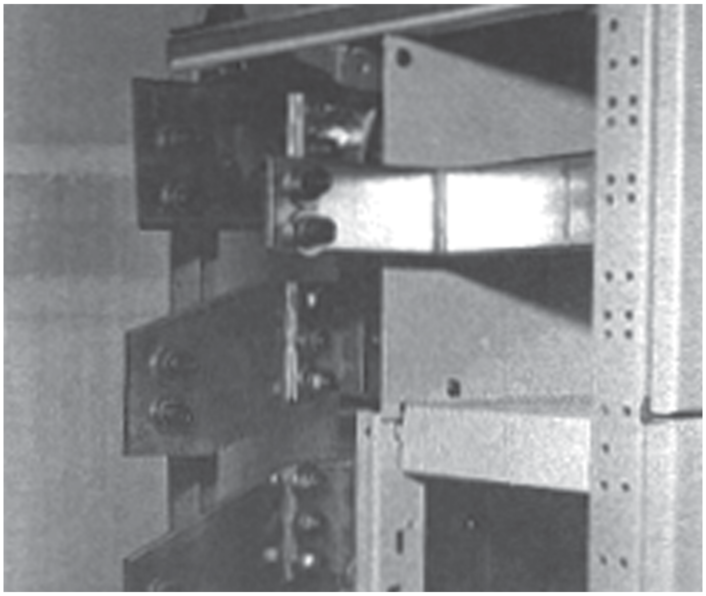


Figure 11. Splice plates attached to Freedom horizontal bus and ground bus at top

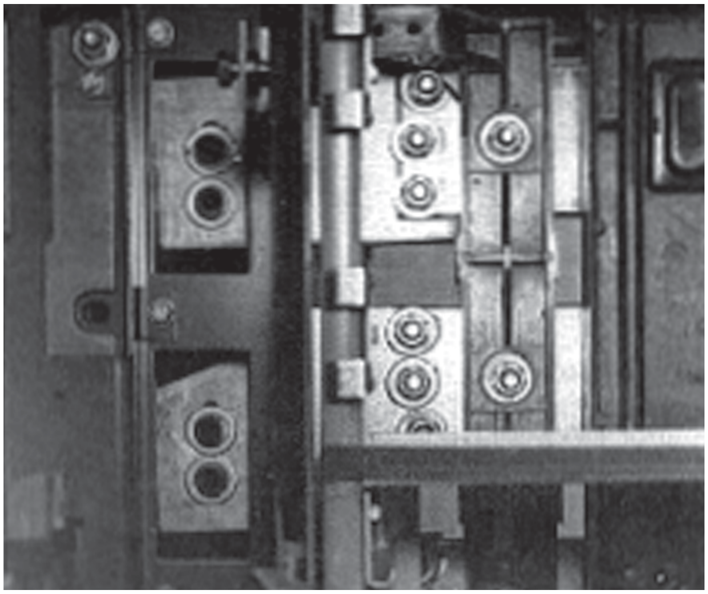


Figure 12. Horizontal bus splice Freedom Unitrol on left, Freedom on right

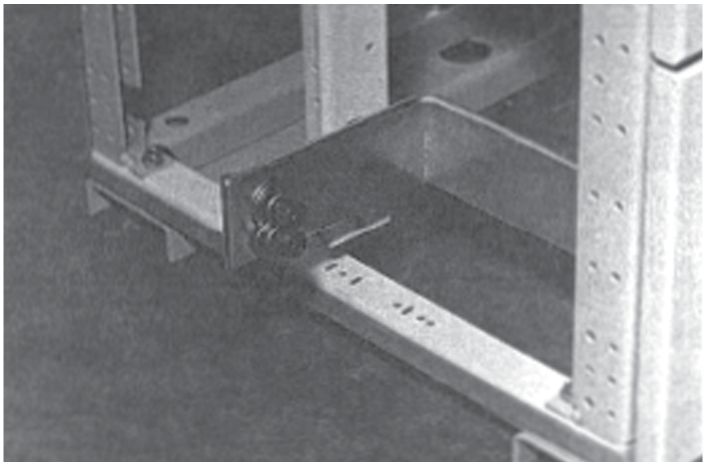


Figure 13. Splice plate attached to Freedom FlashGard ground bus at bottom

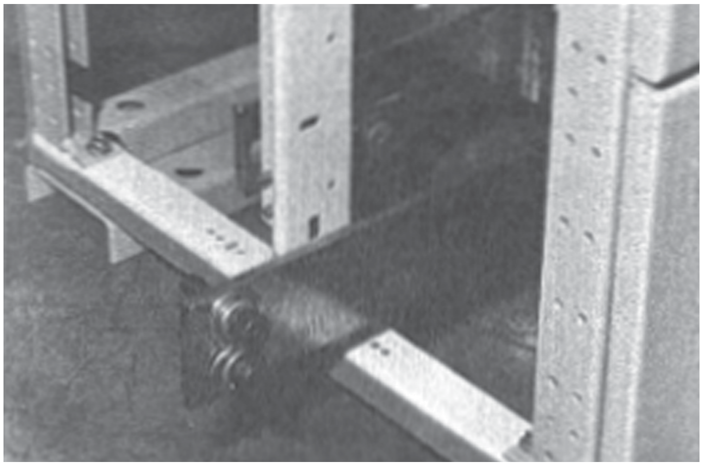


Figure 14. Splice plate attached to Freedom FlashGard neutral bus

Part 4. Installing conduit and wiring

Conduit

Install conduit in such a manner as to prevent water from entering and accumulating in the conduit or the enclosure. Eliminate sags in conduit. Have the conduit enter the motor control center (MCC) in the areas designated for conduit entry on the plan views. See **page 27** and **page 28** of this booklet and outline drawings shipped with the MCC. Keeping conduit within the shaded areas shown in the plan views will avoid cable interference with structural members and live bus. See **Part 12**.

For arc resistant MCCs, use conduit in top or bottom MCC locations as shown on **page 27** and **page 28** of this booklet. Do not alter the front, sides, or back of arc resistant MCCs.

Wiring

Install the line and load conductors sized in accordance with the NEC. **Use copper wire only for control terminations. Use copper wire only for power terminations unless they are marked "CU/AL."** Use conductors with a temperature rating of 167 °F (75 °C) or higher, but regardless of the insulation temperature rating, select the wire size on the basis of 167 °F (75 °C) wire ampacity. Using a higher temperature wire ampacity table often results in a smaller cross-section of copper available for carrying heat away from terminals.

Install insulated wire and cable at a temperature sufficiently warm to prevent the insulation from cracking or splitting.

When more than one conduit is run from a common source or to a common load, be sure to have each conduit carry conductors from each phase and the same number of conductors per phase. If the phase conductors are not distributed uniformly, eddy currents will be generated in the steel between the conduits.

Locate conductors within the MCC to avoid physical damage and to avoid overheating. Secure incoming power lines in a manner adequate to withstand the forces that will act to separate the conductors under short-circuit conditions. Use the cable ties furnished in both horizontal and vertical wireways to support the load and interconnection wire. Use a shielded communications cable inside of flexible metal conduit to protect very low voltage signals transmitted to or from a computer or programmable controller.

Lugs furnished with the MCC and its components are for Class B and Class C stranding. Verify the compatibility of wire size, type, and stranding with the lugs furnished. Where they are not compatible, change the wire or lugs accordingly. If crimp lugs are used, crimp with the tools recommended by the manufacturer.

Use care in stripping insulation to avoid nicking or ringing the metal. All field wiring to control units should be made in accordance with the wiring drawings that are furnished with the control center. Load and control wiring can be brought in through the upper and/or lower horizontal wireways. Determine the type of wiring installed in the control center (NEMA Type B or C) and proceed per the following appropriate paragraph.

The phase sequence of the power circuit load terminals (top-to-bottom: T1, T2, T3) in units mounted on the rear side of the MCC is opposite to that of the load terminals in units mounted on the front side of a back-to-back MCC. To obtain the same direction of rotation for a motor connected to a rear-mounted unit as for one connected to a front-mounted unit, re-label the terminals in the rear-mounted unit: T3, T2, T1, and wire accordingly. Refer to the warning sticker supplied with rear-side units. When making power connections to the starter terminals, be sure to leave sufficient slack in the wires so that the unit can be withdrawn to the detent position for maintenance. See **Table 8**.

NEMA Type B wiring

Each control unit is factory assembled with devices inter-wired within the unit. In addition, all control wiring is carried to unit terminal blocks mounted on the right-hand side of the unit. See **Figure 15**. Bring the field wiring of control wires from a horizontal wireway into the vertical wireway on the right-hand side of the applicable control unit and terminate them at the unit terminal blocks.

Bring load wiring from the vertical wireway, under the bottom right-hand side of the unit, to terminations within the unit. If optional load terminals are provided, terminate load wires to load terminals located adjacent to the vertical wireway. To gain access to these terminals, place tool between right-hand wrapper side and wireway post as shown in **Figure 17**.

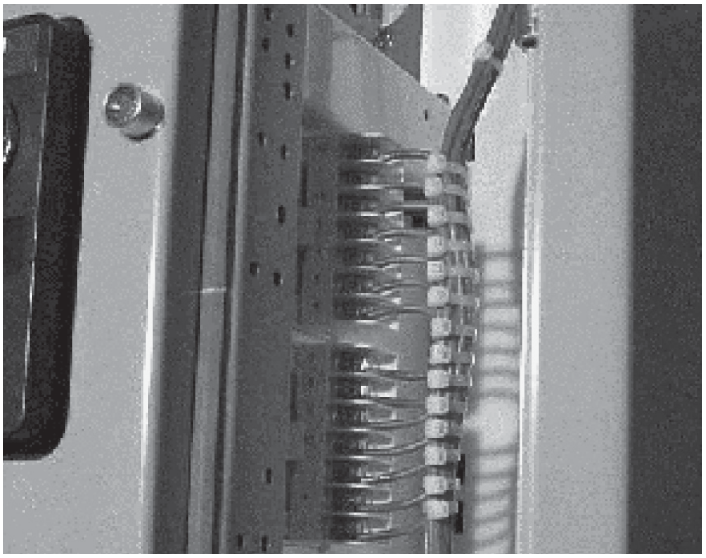


Figure 15. Unit terminal blocks

Engaging pull-apart terminal blocks

The male portion of the pull-apart terminal block is located in a plastic bag tied to the pivot rod inside the unit. This terminal block can be wired outside of the vertical wireway. To engage the terminal block, align the fingers of the male connector with the slot at the back of the female portion of the terminal block. Then rotate the male portion forward and to the left into the female portion of the terminal block. Each male portion of the pull-apart terminal block has two cavities adjacent to the center terminal screw to accept the blade of an electrician's screwdriver used to cam the block into and out of engagement. Each male portion also has a rear slot that can engage the edge of the unit frame where it can be mounted for ease in troubleshooting.

Figure 16. Pull-apart terminal blocks

NEMA Type C wiring

Each control unit is factory assembled with devices inter-wired within the unit. In addition, all control wiring is carried to unit terminal blocks on the side of the unit and from these unit blocks, along with load wiring through Size 3, to master terminal blocks located at the top or bottom of the structure. See **Figure 17**. Master terminal blocks can be either fixed or drawout mounted. In the drawout design, the terminal blocks are rack mounted to permit withdrawal of the entire assembly for ease of wiring during installation and maintenance. Bring field wiring from the horizontal wireway to the master terminal blocks except for load wiring larger than Size 3. These latter load wires should be carried into the vertical wireway and under the bottom right-hand side of the unit to terminations within the unit.

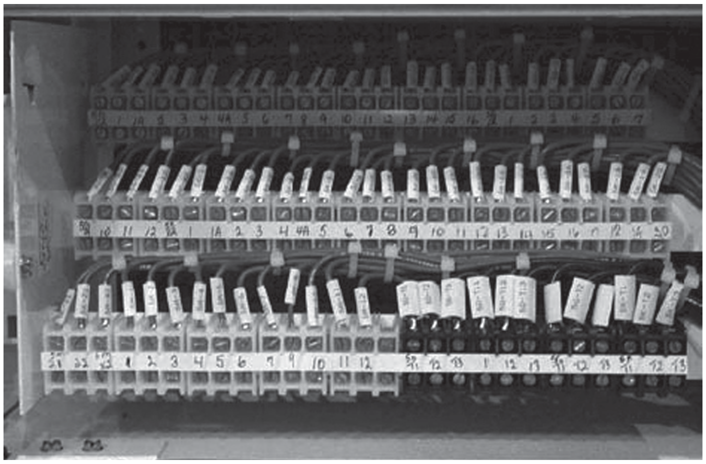


Figure 17. Master terminal block

Part 5. Incoming line connections

Overcurrent protection

All ungrounded conductors in a motor control center (MCC) installation require some form of overcurrent protection in order to comply with Section 240.20 of the NEC. Such overcurrent protection for the incoming lines to the MCC is in the form of fuses or a circuit breaker located at the transformer secondary that supplies the MCC. The conductors from the transformer secondary constitute the feeder to the MCC, and the "10-foot rule" and the "25-foot rule" of NEC, 240.21 apply. These latter exceptions to the general rule allow the disconnect means and overcurrent protection to be located in the MCC, provided the feeder taps from the transformer are sufficiently short and other requirements are met.

A circuit breaker or a circuit interrupter combined with fuses controlling the power to the entire MCC may provide the overcurrent protection required as described above or may be a supplementary disconnect (isolation) means. See **Figure 18**, **Figure 19**, and **Figure 20**.

When the MCC has a main disconnect, bring the incoming lines (the feeders) to the line terminals of the circuit breaker or circuit interrupter. The load side of the circuit breaker or the load side of the fuses associated with the circuit interrupter has already been connected to the MCC bus bar distribution system. In the case of main disconnects rated 400 A or less, this load connection is made by stab connections to vertical bus bars that connect to the horizontal bus distribution system. See **Figure 18**.

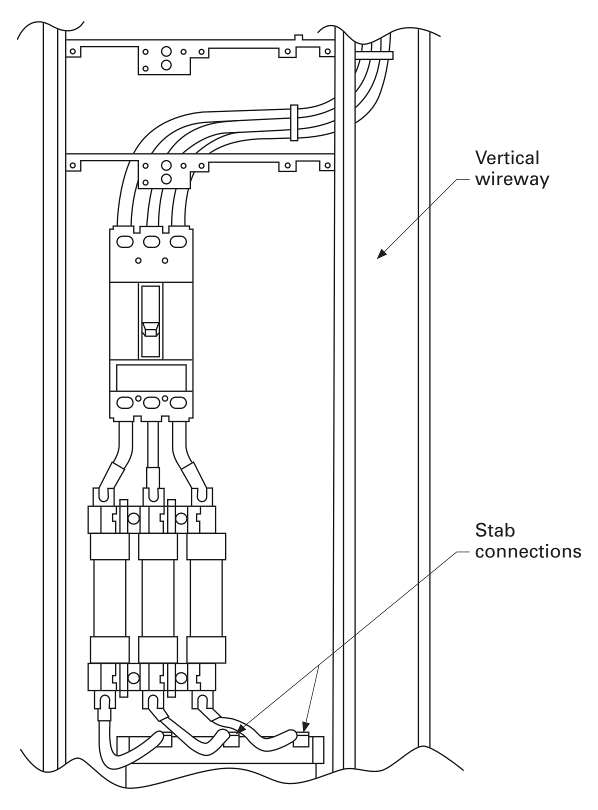
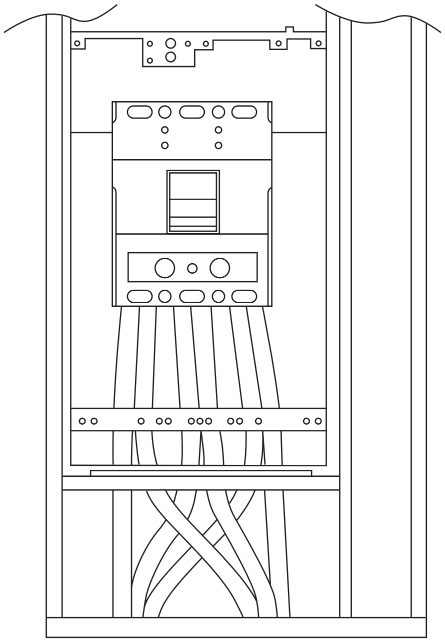


Figure 18. Main disconnect with stab load connections overcurrent protection to be located in the MCC, provided the feeder taps from the transformer are sufficiently short and other requirements are met



Note that with reverse feed, the bottom terminals of the circuit breaker are still energized when the circuit breaker is turned off!

Figure 19. Main circuit breaker with reverse feed

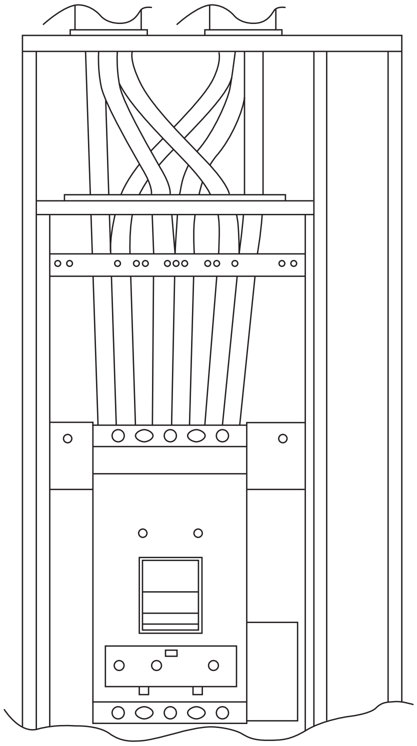


Figure 20. Main circuit breaker

Incoming line lugs

Where the overcurrent protection for the MCC is at a remote location, the MCC feeder lines are connected to incoming line lugs attached to the bus bar distribution system. See **Figure 21**. For high-ampere rated horizontal bus bar systems, the incoming line lugs are mounted on vertical risers that connect to the horizontal bus bars. See **Figure 22**.

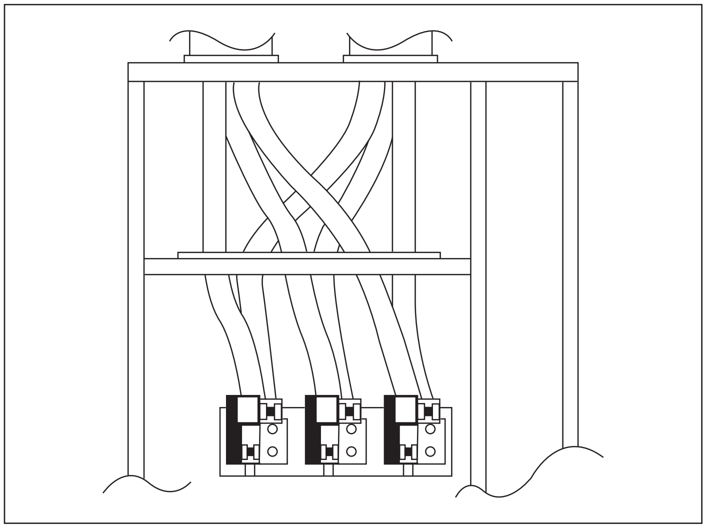


Figure 21. Incoming line lug connections

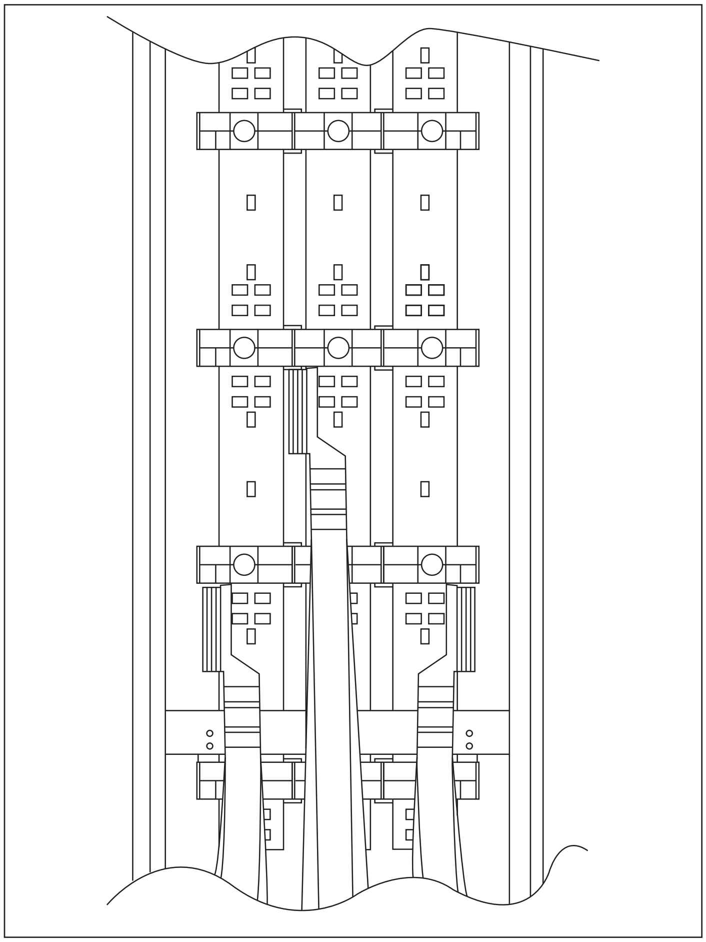


Figure 22. Incoming line compartment, 2000 A

Short-circuit bracing

All incoming lines to either incoming line lugs or to main disconnects must be braced to withstand the mechanical forces created by a high fault current. With the remainder of a Freedom MCC rated for not less than 65,000 A (rms symmetrical), the installing electrician needs to anchor the cables at the incoming line connections sufficiently and tighten the lugs correctly.

Each incoming line compartment is equipped with two-piece sheet steel brackets that form a cable bracing support bracket that is approximately 9 inches from the conduit entry point, for both top- and bottom-feed applications. Use the bracket and appropriate lashing material to tie the cables securely together if bundled or to hold apart when they are required to be separated. See **Figure 23**, which shows the two-part mounting/bracing bracket, in a top entry incoming lug configuration.

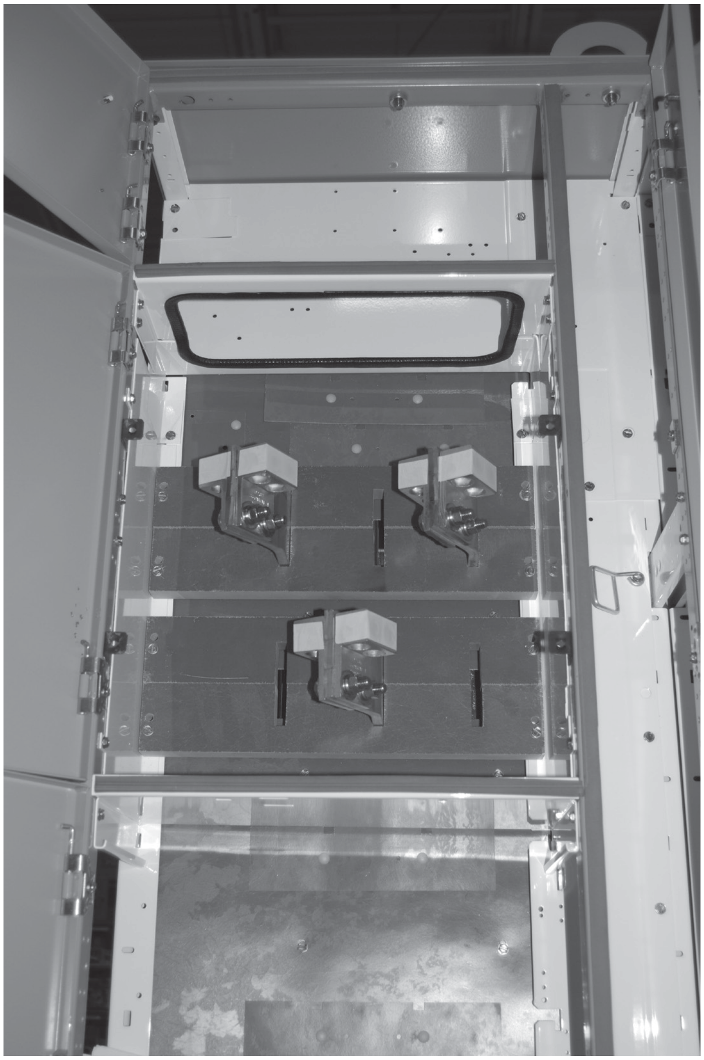


Figure 23. Incoming line compartment showing two-piece support bracket, with opening for cables

Making connection

⚠ CAUTION

ALL INCOMING LINE COMPARTMENTS PRESENT AN OBVIOUS HAZARD WHEN THE DOOR IS OPENED OR COVERS ARE REMOVED WITH POWER ON. WHEN WORKING IN THIS AREA, THE INCOMING FEEDER SHOULD BE DE-ENERGIZED.

Before beginning work on incoming line connections, refer to all drawings furnished by Eaton, as well as all applicable contract drawings for the particular installation.

Depending on the location, size, and type of the incoming arrangement, remove one or more horizontal and vertical wireway doors, and selected units to provide complete access. See **Part 9**, **page 20** for unit removal instructions.

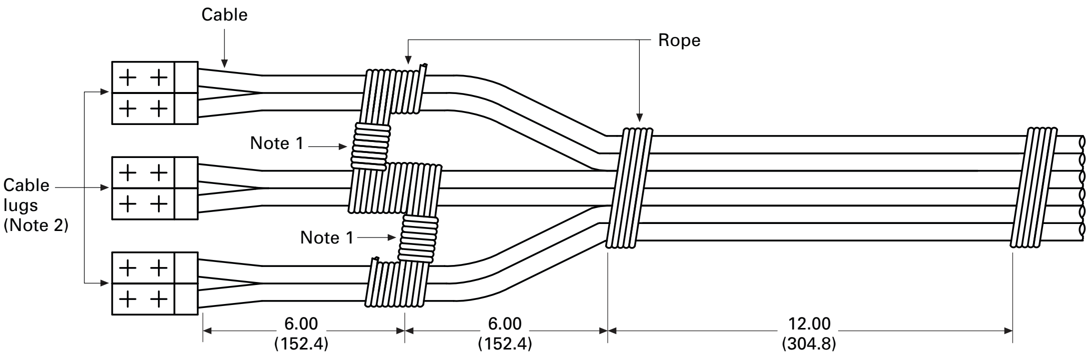
For top entry, the top cover plates are easily removed for drilling or punching operations.

MCC with a Magnum™ or a main lug only incoming line (Figure 21) section—cable bracing/lashing for top- and bottom-feed arrangements

1. All cable must be terminated with two-hole mounted compression or mechanical set-screw type lugs.
2. All non-current-limiting circuit breakers rated above 42 kA and with circuits rated for 800 A and below require cable lashing per **Figure 24**.
3. Circuit breaker rated 42 kA and below require no cable lashing.
4. No cable lashing is required for current-limiting circuit breakers.
5. No cable lashing is required for circuits using more than four (4) cables of 500 kcmil or larger size wire per phase, regardless of short circuit rating.

Rope requirements:

- 3/8" diameter
- Nylon, twisted
- Size = #12
- 3 strand
- Tensile strength = 3340 lb (1515 kg)
- Working load = 278 lb (126 kg)



Instructions:
1. Route cable as close together as possible.
2. Wrap rope around the cable 6 in (152.4 mm) from lugs (see Note 1).
3. The second wrap is to be applied 6 in (152.4 mm) from the first wrap.
4. After the second wrap, the cables should be wrapped at 12 in (304.8 mm) increments to the entry or exit point of the switchgear.
5. Verify that each set contains 5 loops and that all ropes are pulled as tight as possible.

Note 1: The goal is to bundle all cables together in one bundle, but near the lug landings, so the bundles may need to separate. In this case, the rope between cables should be wrapped to provide support.

Note 2: The center pole cable lugs are shown in-line with outer poles; **Figure 22** shows lugs with center pole offset either leading or lagging outer poles, depending on top or bottom feed cables. The six-inch dimension shown in these arrangements is from the closed lug, which is the center pole for top entry and outer poles for bottom entry as shown in **Figure 22**.

Figure 24. Cable lashing installation instructions

Part 6. Overcurrent protection devices

Device selection

Articles 240 and 430 of the NEC contain the rules for selecting fuses, circuit breakers, and overload relays by type and by voltage and ampere rating. Follow these rules for feeder circuits, and the instructions attached to the inside of the left-most vertical wireway door, for motor branch circuits. Select and install overload relay current elements (heaters) based on the motor service factor and full-load current. Ambient-compensated overload relays are used in motor control centers (MCCs) to offset the temperature gradient that occurs from top to bottom in a loaded vertical section.

Heaters must be installed in the starter overload relay assemblies before the starter is energized.

C306 thermal overload relays (Figure 25)

C306 overload relays are provided on Freedom starters. Four sizes are available for overload protection up to 114 A. Features include:

- Selectable manual or automatic reset operation
- Interchangeable heater packs adjustable ±24% to match motor FLA and calibrated for use with 1.0 and 1.15 service factor motors. Heater packs for 32 A overload relay will mount in 75 A overload relay—useful in derating applications such as jogging
- Class 10 or 20 heater packs (**Figure 25**). Use Class 10 heaters with fusible or thermal-magnetic breaker disconnects only
- Bimetallic, ambient-compensated operated. Trip-free mechanism
- Electrically isolated NO and NC contacts (pull RESET button to test)
- Overload trip indication
- Single-phase protection
- UL® listed, CSA® certified, and NEMA compliant

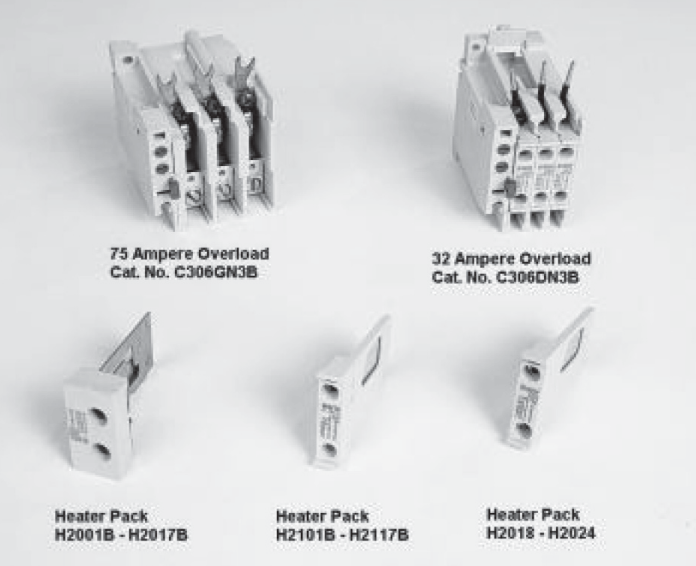


Figure 25. C306 thermal overload relay and heater pack

C306 overload relay setting

FLA Dial Adjustment—For motors having a 1.15 service factor, rotate the FLA adjustment dial to correspond to the motor's FLA rating. Estimate the dial position when the motor FLA falls between two letter values as shown in **Figure 26**.

For motors having a 1.0 service factor, rotate the FLA dial one-half position counterclockwise (CCW).

Manual/Automatic Reset—The overload relay is factory set "M" for manual reset operation as shown in **Figure 26**. For automatic reset operation, turn the reset adjustment dial to the "A" position. Automatic reset is not intended for two-wire devices.

Test For Trip Indication—To test overload relay for trip indication when in manual reset, pull out the blue reset button. An orange flag will appear indicating that the device has tripped. Push reset button to reset.

⚠ WARNING

TO PROVIDE CONTINUED PROTECTION AGAINST FIRE OR SHOCK HAZARD, THE COMPLETE OVERLOAD RELAY MUST BE REPLACED IF BURNOUT OF THE HEATER ELEMENT OCCURS.

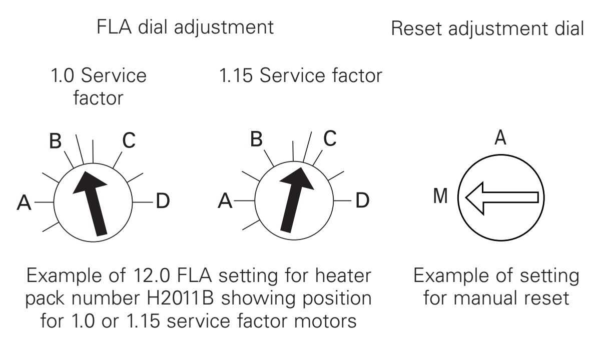


Figure 26. Overload relay settings

Current transformers

When current transformers are used with overload relays, the current through the overload relay heater is related to the motor full-load by the inverse of the current transformer ratio.

⚠ WARNING

DO NOT EVER REMOVE HEATERS FROM SIZE 5 AND LARGER STARTERS TO CHECK UNIT OPERATION. THESE STARTERS USE CURRENT TRANSFORMERS TO DROP THE CURRENT TO THE RANGE OF THE SIZE 1 OVERLOAD RELAY. OPERATION WITH HEATERS REMOVED WILL NOT INTERRUPT VOLTAGE TO THE MOTOR AND WILL GENERATE DANGEROUS VOLTAGES IN THE OPEN SECONDARY OF THE CURRENT TRANSFORMER.

Motor circuit protector (HMCP)

After installation of the control center, each MCP must be adjusted to actual motor full-load amperes (FLA) so that it will trip at any current that exceeds starting inrush. This setting provides low-level fault protection. The first half-cycle inrush will vary with the motor characteristics. Motors with locked-rotor currents of 6 times motor full-load amperes will usually require an instantaneous magnetic setting of 7 to 11 times motor full-load amperes to prevent tripping when starting.

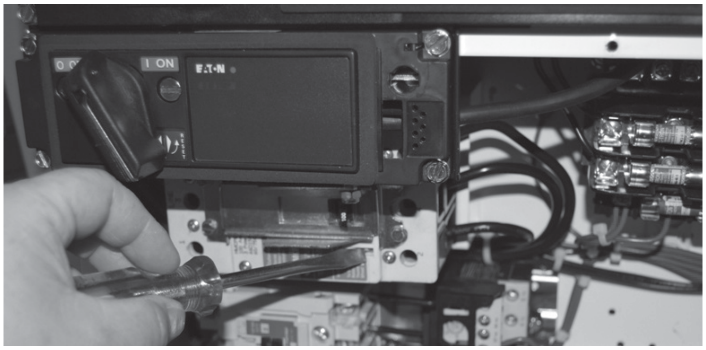


Figure 27. HMCP magnetic adjustment

A cam to accept a small narrow-blade electrician's screwdriver is near the lower left corner and around that are eight lettered adjustment points, calibrated in trip amperes. See **Figure 27**. Adjustment should never exceed 13 times FLA, which is in accordance with NEC requirements for magnetic-trip-only breakers. **Adjustment should be made as follows:**

1. Obtain FLA from motor nameplate.
2. Multiply FLA by 13.
3. Set the cam to the highest trip setting that does not exceed the calculated figure of Item 2. This is the maximum setting that should be used.
4. Depress and turn the screwdriver adjustment counterclockwise one setting at a time, until the breaker trips in starting and then adjust upward one setting position. This will ensure that the circuit will open instantly on any current above the motor inrush, usually 7 to 11 times FLA.

The PUSH-TO-TRIP button checks the tripping function and is used to periodically exercise the breaker operating mechanism. The button is designed to be operated by using a small screwdriver.

Once the breaker has tripped, apply force when moving the unit operating handle from the TRIPPED to the RESET position, which is slightly passed the OFF position

Freedom MCCs are supplied with Type HMCP motor circuit protectors having an interrupting rating to match the short-circuit withstand rating of the bus bar system. For HMCPs in 225 A, 400 A, and 600 A frame sizes, the magnetic-trip adjustment is set for each pole. A three-pole HMCP has three trip settings to adjust. Place all three poles at the same setting.

Current limiters for use with type HMCP and FD breakers

The addition of the current limiter provides interrupting capacity above the range handled by the HMCP in motor starters or by FD thermal-magnetic feeder breakers.

Each HMCP or FD breaker rated up to 150 A has its own current limiter to provide coordinated protection against faults up to 100,000 A, rms symmetrical.

Built-in trip indicators in each phase immediately show when a fault has blown the current limiter and tripped the circuit breaker. This provides protection against single phasing. **After interrupting a fault, the current limiter will require replacement.** After the fault has been cleared, the current limiter is replaced by the removal of three screws. The breaker can then be reset to provide for subsequent high overcurrent protection.

Type HMCP and FD circuit breakers with terminal end covers

Circuit breakers installed in units connected to 600 V distribution systems require a terminal end cap to be installed on the line side. Replace the terminal end cap when replacing circuit breakers in such units.

Part 7. Overload relay heater selection

Heater selection and installation

Heaters should be selected on the basis of the actual full load current and service factor as shown on the motor nameplate or in the motor manufacturer's published literature.

When motor and overload relay are in the same ambient and the service factor of the motor is 1.15 to 1.25, select heaters and set **FLA** adjustment dial from the heater application table. **If the service factor of the motor is 1.0, or there is no service factor shown, rotate the FLA adjustment dial counterclockwise one-half (1/2) position.**

The conductors attached to the terminals of an overload relay act as a heat sink and are a consideration in establishing the current rating of each heater element. To prevent nuisance tripping, which will occur if undersized conductors are used, select the wire size as if the conductors had an insulation temperature rating of 167 °F (75 °C), even if the conductors actually used have a temperature rating higher than 167 °F (75 °C).

Protect heater and starter against short circuits by providing branch circuit protection in accordance with the National Electrical Code.

Note: Before installing heater packs, refer to the motor nameplate for **FLA** (full load amps) and service factor (1.5 or 1.0). Select the heater pack from the proper table on this page.

To install:

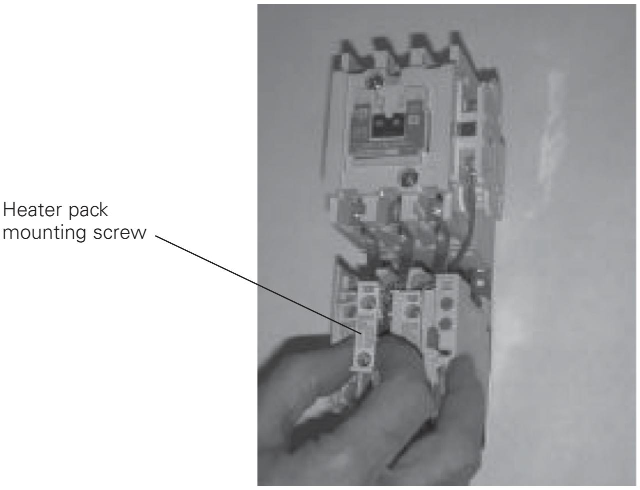


Figure 28. Heater pack

A. Insert three (3) identically numbered heater packs into the overload relay with an FLA rating that includes the motor nameplate FLA (full load amps).

B. Tighten the heater pack mounting screws securely per recommended torque values listed below.

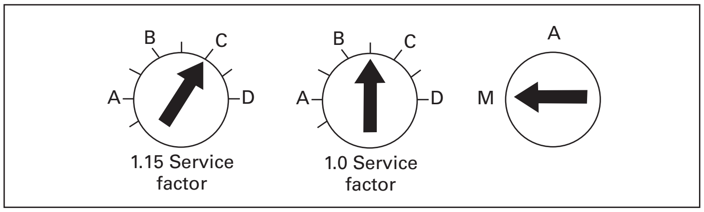
Heater pack numbers	Recommended torque
H2001B thru H2017B	9 lb-in (1 Nm)
H2018 thru H2024	24-30 lb-in (2.7–3.4 Nm)

C. Adjust the FLA adjustment dial to the motor nameplate FLA (full load amps).

The overload is now set for 1.15 service factor.

D. If the motor nameplate is 1.0 service factor, rotate the FLA adjustment dial counterclockwise one-half (1/2) position.

E. The overload is factory set for **M (MANUAL)** reset operation. If automatic reset is required, turn the reset adjustment dial to **A (AUTO)**. Automatic reset is not intended for two-wire control devices.



To remove heater packs

Loosen two (2) heater pack mounting screws and remove heater pack from overload relay.

Overload relay setting

This bimetallic ambient-compensated overload relay is adjustable within the FLA range of the heater pack. Each heater pack is marked with its FLA ratings. With proper heater selection, the overload relay will ultimately trip at 125% FLA for a 1.15 service factor motor and at 115% FLA for a 1.0 service factor motor.

Heater selection/installation

Select the appropriate heater pack number that corresponds to the motor FLA rating for your application. Insert each heater into the overload relay and tighten heater mounting screws securely per table below.

Note: A total of three individual heaters must be installed in order for the overload relay to work properly.

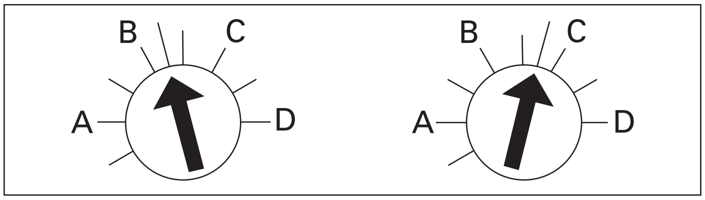
Heater pack numbers	Torque
H2001B thru H2017B	9 lb-in
H2018 thru H2024	24–30 lb-in

FLA dial adjustment

For motors having a 1.15 service factor, rotate the FLA adjustment dial to correspond to the motor's FLA rating. Estimate the dial position when the motor FLA falls between two letter values as shown in the example. For motors having 1.0 service factor, rotate the FLA dial one-half (1/2) position counterclockwise (CCW).

FLA ADJUSTMENT DIAL
1.0 SERVICE FACTOR

Example of a 12.0 FLA setting for a heater pack number H2011B showing position for 1.0 or 1.15 service factor motor.

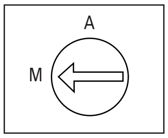


Manual/automatic reset

The overload relay is factory set at "M" for manual reset operation as shown in the illustration. For automatic reset operation, turn the reset adjustment dial to the "A" position. Automatic reset is not intended for two-wire control devices.

RESET
ADJUSTMENT
DIAL

Example of
setting for
manual reset.



Test for trip indication

To test overload relay for trip indication when in manual reset, pull out the blue Reset button. An orange flag will appear indicating that the device has tripped. Push Reset button in to reset.

For more information, go to www.1800oldunit.com or call 1-800-OLD-UNIT.

Table 1. NEMA Size 0 and 1 heater pack selection table

Motor FLA rating FLA dial positions				**Size F standard trip Class 20**
A	**B**	**C**	**D**	
0.254	0.306	0.359	0.411	H2001B
0.375	0.452	0.530	0.607	H2002B
0.560	0.676	0.791	0.907	H2003B
0.814	0.983	1.15	1.32	H2004B
1.20	1.45	1.71	1.96	H2005B
1.79	2.16	2.53	2.90	H2006B
2.15	2.60	3.04	3.49	H2007B
3.23	3.90	4.56	5.23	H2008B
4.55	5.50	6.45	7.40	H2009B
6.75	8.17	9.58	11.0	H2010B
9.14	10.8	12.4	14.0	H2011B
14.0	16.9	19.9	22.8	H2012B
18.7	22.7	26.7	30.7	H2013B ①
23.5	28.5	33.5	—	H2014B ①

① After the above referenced settings have been made, rotate the FLA dial one position clockwise for these heaters (see table). If less than one position is available, rotate dial maximum. This does not apply when these heaters are used with adapter base. Catalog No. C306TB1. Exception: does not apply to AN16DN0.

Note: For maximum ratings, see table below. Use 75 °C copper conductors only. Maximum wire size—8 AWG.

NEMA size	**Amperes**	**Size**	**Amperes**
0	18	—	—
1	27	F	32

⚠ WARNING

TO PROVIDE CONTINUED PROTECTION AGAINST FIRE OR SHOCK HAZARD, THE COMPLETE OVERLOAD RELAY MUST BE REPLACED IF BURNOUT OF THE HEATER ELEMENT OCCURS.

Table 2. NEMA Size 2 heater pack selection table

Motor FLA rating ① FLA dial positions				**Size J and K standard trip Class 20**
A	**B**	**C**	**D**	
3.23	3.90	4.56	5.23	H2008B
4.55	5.50	6.45	7.40	H2009B
6.75	8.17	9.58	11.0	H2010B
9.14	10.8	12.4	14.0	H2011B
14.0	16.9	19.9	22.8	H2012B
18.7	22.7	26.7	30.7	H2013B
23.5	28.5	33.5	38.5	H2014B
29.0	34.0	39.1	44.1	H2015B
39.6	45.5	51.5	57.4	H2016B ②
53.9	60.9	67.9	74.9	H2017B ②

① For motor FLA values not listed, turn the dial clockwise for higher or counterclockwise for lower ratings.

② After the above reference settings have been made, rotate the FLA dial one position clockwise for these heaters (see table). If less than one position is available, rotate dial to maximum. This note does not apply when these heaters are used with adapter base. Catalog No. C306TB1.

Note: For maximum ratings, see table below. Use 167 °F (75 °C) copper conductors only. Maximum wire size—3 AWG.

NEMA size	**Amperes**	**Size**	**Amperes**
2	45	J	60
—	—	K	73

Table 3. NEMA Size 3 and 4 heater pack selection table

Motor FLA rating ① FLA dial positions				**Size N standard trip Class 20**
A	**B**	**C**	**D**	
18.0	20.2	22.3	24.5	H2018
24.6	27.6	30.5	33.4	H2019
33.5	37.5	41.5	45.6	H2020
45.7	51.2	56.7	62.1	H2021
62.2	69.7	77.1	84.6	H2022
84.7	94.9	105.0	115.0	H2023
106.0	118.0	131.0	144.0	H2024

① For motor FLA values not listed, turn the dial clockwise for higher or counterclockwise for lower ratings.

Note: For maximum ratings, see table below. Minimum wire size—6 AWG.

NEMA size	**Amperes**	**Size**	**Amperes**
3	90	N	14
4	135	—	—

Table 4. NEMA Size 5 heater pack selection table

Motor FLA rating ① FLA dial positions A	B	C	D	Standard trip Class 20
34	41	48	54	H2003B
49	59	69	79	H2004B
72	87	103	118	H2005B
107	130	152	174	H2006B
129	156	182	209	H2007B
194	234	274	—	H2008B

① FLA rating marked on heater pack multiplied by a transformation ratio. For motor FLA values not listed, turn the dial clockwise for higher or counterclockwise for lower ratings.

Note: For maximum ratings, see table below. Minimum wire size—2 AWG.

NEMA size	Amperes
5	270

Table 5. NEMA Size 6 heater pack selection table

Motor FLA rating ① FLA dial positions A	B	C	D	Standard trip Class 20
144	174	205	235	H2005B
215	259	304	348	H2006B
258	312	365	419	H2007B
388	468	547	—	H2008B

① FLA rating marked on heater pack multiplied by a transformation ratio. For motor FLA values not listed, turn the dial clockwise for higher or counterclockwise for lower ratings.

Note: For maximum ratings, see table below.

NEMA size	Amperes
6	540

Table 6. Magnetic reduced-voltage starter classes F600, F700, F890 with C306 thermal overload relay

Starter type	Class	Multiply actual motor full load current by factor below and refer to adjusted full load current column in tables	Quantity of heaters required per starter
Autotransformer	F600	1	3
Part-winding	F700	0.5	6
Star-delta	F800	0.575	3

Part 8. Inspection prior to energizing

1. Before energizing the motor control center (MCC), conduct a thorough inspection to make certain that all foreign materials, such as tools, scraps of wire, and other debris, are removed from all units and the structure. Remove any accumulation of dust and dirt with a vacuum cleaner.
2. All circuit connections are tightened at time of assembly by power-driven tools with controlled torque. However, the vibrations experienced in transit may loosen some of these connections. Check at least 10% of the total connections for a tight connection. **Should this spot-check reveal some loose connections, it will be necessary to check all connection points.** The connections to be checked include bus hardware, circuit breaker and switch terminals, contactor and relay terminals, and terminal blocks. Always check the incoming line connections. Tighten to the torque values shown in **Table 7**.
3. Remove all blocks or other temporary holding means used for shipment from all component devices in the MCC interior.
4. Check the enclosure to see that it has not been damaged so as to reduce electrical spacings.
5. Compare all circuits for agreement with the wiring diagrams that accompany the MCC. Be sure that each motor is connected to its intended starter.
6. Make certain that field wiring is clear of live busses and physically secured to withstand the effects of fault current.
7. Check to determine that all grounding connections are made properly.
8. Check all devices for damage. Make all necessary repairs or replacements, prior to energizing.
9. Manually exercise all switches, circuit breakers, and other operating mechanisms to make certain that they are properly aligned and operate freely.
10. Test any ground-fault protection systems that were furnished.
11. Set any adjustable current and voltage trip mechanisms to the proper values.
12. Ensure that overload relay heater elements are installed and selected to the full-load current shown on the nameplate of each motor.
13. Install power circuit fuses in the fusible switches in accordance with NEC application requirements. Make sure that fuses are completely inserted in the clips provided. Do not attempt to defeat the rejection feature on the fuse clip, when provided.
14. Do not operate a current transformer with its secondary circuit open. Ensure current transformer is connected to a load, or a secondary shorting bar is installed.
15. To prevent possible damage to equipment or injury to personnel, check to ensure that all parts and barriers that may have been removed during wiring and installation have been properly reinstalled.
16. Conduct an electrical insulation resistance test to make sure that the MCC and field wiring are free from short circuits and grounds. Do this test phase-to-phase, phase-to-ground, and phase-to-neutral, with the switches or circuit breakers opened.
17. If the MCC contains a labyrinth vertical bus barrier system, verify the operation of the automatic shutters. See **Part 9** for adjustments of this mechanism.
18. Install covers, close doors, and make certain that no wires are pinched and that all enclosure parts are properly aligned and tightened.
19. Turn all circuit breakers and fusible switches to the OFF position before energizing the bus.

Table 7. Driving torque

Description	lb-in
Control wiring	
Coil leads	8 lb-in
Relays	8 lb-in
Pushbuttons	8 lb-in
Control fuse blocks	8 lb-in
Auxiliary contacts	8 lb-in
Control wiring terminal blocks	
Side-mounted lug/compression	9 lb-in
Rail-mounted lug type	12 lb-in
Rail-mounted compression type	18 lb-in

Table 8. Power wiring: starters

For Freedom starters with C306 overload and Freedom contactors	Tightening torque		Conductors
Size 1 Contactor	20 lb-in		Use 75 °C copper conductors
Size 2 Contactor	Wire size (AWG)	Torque (lb-in)	
	14–10	35	
	8	40	
	6–4	45	
	3–2	50	
Size 3 and Freedom Compact Size 4 (CN15MN)	Wire size (AWG)	Torque (lb-in)	
	Slotted head screw		
	8	40	
	6–4	45	
	3–1/0	50	
	Socket head screw		
	Socket size (in)	Torque (lb-in)	
	3/16	120	
	1/4	200	
	5/16	250	
Size 4	275 lb-in		
Size 5	500 lb-in		
Starter with C440 Solid State overload	Wire size (AWG)	Torque (lb-in)	
NEMA 1 and 2	12-10	23	
	8-6	28	
NEMA 3	6-1	28	

Table 9. Fused switches

Description	lb-in
30 A fuse assembly	25 lb-in
60 A fuse assembly	50 lb-in
100 A fuse assembly	50 lb-in
200 A fuse assembly	300 lb-in
400 A fuse assembly	300 lb-in
600 A fuse assembly	300 lb-in

Breakers—Refer to torque values on breaker case.

Table 10. Incoming line lugs

Description	lb-in
#2/0–350 kcmil	360 lb-in
#2/0–650 kcmil	360 lb-in
#2/0–750 kcmil	500 lb-in
500–1000 kcmil	600 lb-in

Table 11. Bus bolts

Description	lb-in
All	276 lb-in (23 lb-ft)

Part 9. Unit installation and adjustment

Door removal and installation

All doors on the control center are mounted on pin hinges to facilitate removal for installation and maintenance operations. With the operating handle on the OFF position, rotate the quarter-turn latches, open the door, remove the hinge pins as shown in **Figure 29**, partially close the door and lift it from the structure. Reverse this procedure for installation.

Unit removal and installation

After opening and/or removing the unit door, the control unit is exposed. With a screwdriver, push in on the latch at the top center of the unit and rotate ¼turn counterclockwise.

⚠ CAUTION

UNITS 18” OR MORE HIGH HAVE A RETAINING BRACE AT THE LOWER EDGE OF EACH SIDE OF THE UNIT FRAME TO ADD STABILITY IN SHIPPING. THE SHIPPING BRACES MAY BE RETAINED OR REMOVED AFTER INSTALLATION; UNSCREW PRIOR TO UNIT WITHDRAWAL.

⚠ CAUTION

FOR ARC RESISTANT MCCS, ENSURE THAT THE REPLACEMENT BUCKET IS MARKED ARC RESISTANT, AS INDICATED BY A YELLOW TRIANGULAR “ARC RESISTANT” LABEL IN THE UNIT.

⚠ CAUTION

IF ARC RESISTANT MCC UNITS ARE REMOVED, THEY MUST BE REPLACED WITH THE APPROPRIATE ITEMS SUCH AS ARC RESISTANT SPECIFIC UNIT DOORS, LATCHES, ETC.

Pull-apart terminal blocks in the vertical wireway must be disengaged (see **Figure 30** and **page 10**) and wiring from the unit to other units, to master terminal blocks or to load devices must be disconnected before the unit is removed. Grasp the unit as shown in **Figure 31** and pull it outward. The first inch of travel pulls the stabs free from the vertical bus, and the grounding clip on the side or top of the unit frame is also disengaged.

To replace a control unit, position the mounting points on the unit frame with the mating guide rails. Slide the unit inward until all mounting points are engaged, then move it inward with a quick push. This movement easily overcomes the compression of the stabs as they engage the vertical bus. With the unit in its correct position, the quarter-turn latch is easily engaged by pushing inward and rotating ¼ turn clockwise.

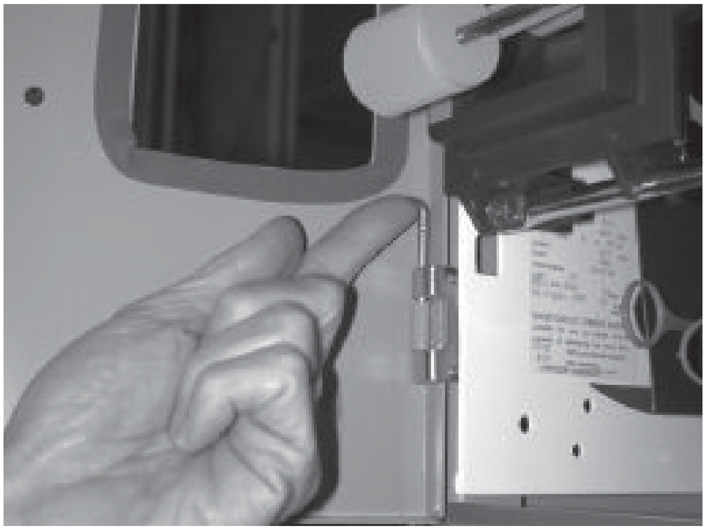


Figure 29. Hinge pin removal

Figure 30. Disengaging pull-apart terminal blocks

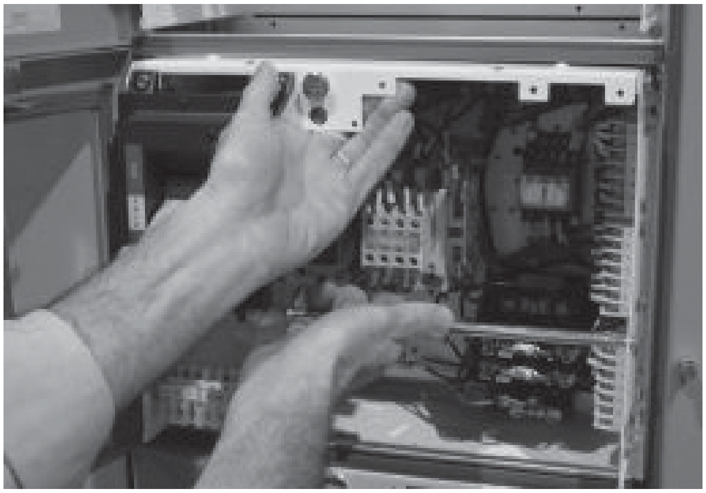


Figure 31. Withdrawing a unit

Detent position

For maintenance and test purposes, the unit can be partially withdrawn (approximately 1 ½ inches) until the stabs are free of the bus. In this position, the quarter-turn latch can be rotated clockwise to engage the detent position slot; this will secure the unit to ensure the stabs remain disengaged during maintenance. See **Figure 32**. The latch can be padlocked in this position.

Operating handle linkage adjustment

Movement of the operating handle in the vertical plane should not be restricted by the handle cavity at either the top or bottom to its travel. Should restriction occur, eliminate it adjusting the length of the operating linkage as shown in **Figure 33**. Depending on the type of primary disconnect device contained in the control unit, it may be necessary to lengthen or shorten the linkage.

Automatic shutter travel adjustment

When the optional labyrinth vertical bus barrier is installed in the control center, a shutter is provided to automatically cover the stab openings when a control unit is withdrawn. The shutter is opened by engagement of the left-hand side of the control unit with the shutter arm linkage attached to the left-hand vertical structural members. When the unit is withdrawn free of the linkage, a spring automatically moves the shutter to its closed position. See **Figure 34** and **Figure 35**.

With the control unit removed, the shutter should completely comer the stab openings. If it does not cover the openings, use an adjustable wrench to bend the link arm to the right until the shutter covers the stab openings.

If, on re-insertion of the control unit, interference is felt between the stab assembly at the rear of the unit and the shutter, the engagement of the control unit with the shutter arm linkage is insufficient to fully open the shutter. Use an adjustable wrench to bend the linkage arm inward toward the unit to increase its engagement with the unit. An inward bend of approximately ¼ inch will provide sufficient additional shutter travel

Installing pilot devices

The device panel can accommodate up to six pilot devices such as oil-tight pushbuttons, indicating lights, selector switches and miniature meters. If unused space is available and the addition of other devices is desired, observe the following procedure.

After opening the unit door, loosen the two screws at the top of the device panel. Slide the panel ½ inch left to permit it to swing down for access. See **Figure 36**. With the peen end of a ball-peen hammer or with a drift or chisel, remove the desired knockout.

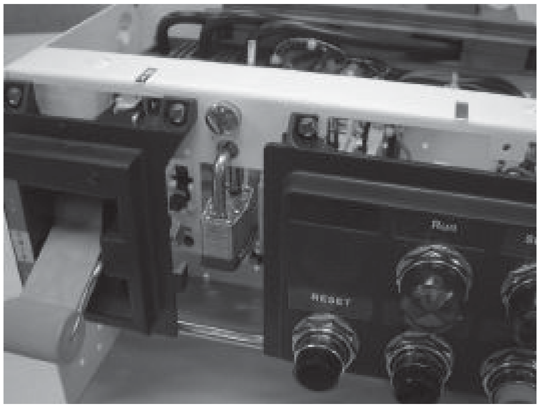


Figure 32. Unit locked in detent position

Figure 33. Operating handle linkage adjustment

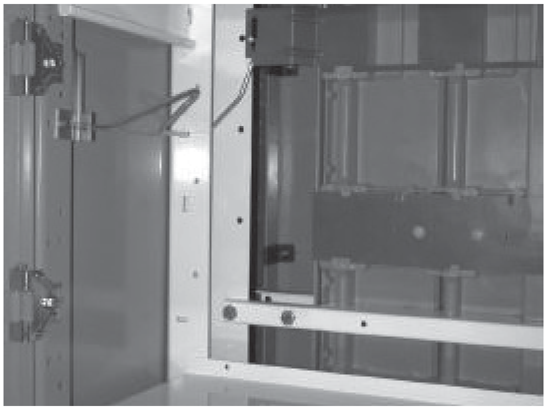


Figure 34. Shutter arm linkage

⚠ CAUTION

BRACE THE PANEL SOLIDLY TO AVOID BREAKING THE HINGE PINTS. USE A KNIFE OR SMALL FILE TO REMOVE REMAINING PLASTID BURRS. INSTALL AND WIRE THE NEW DEVICE AND RE-ATTACH THE TOP OF THE DEVICE PANEL TO THE UNIT.

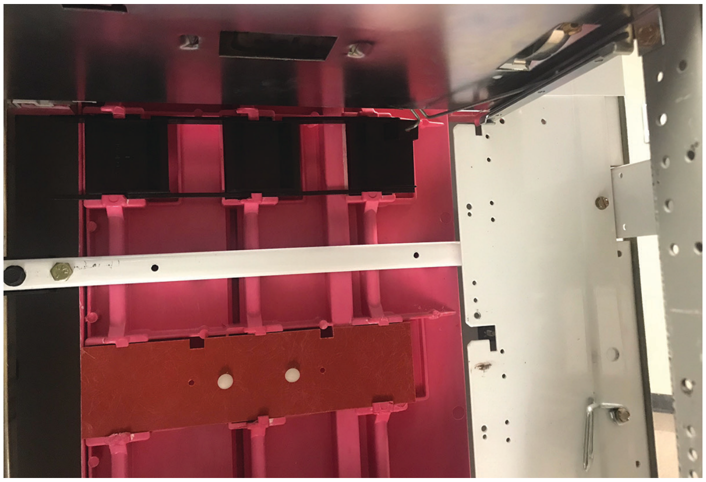


Figure 35. Shutter arm linkage

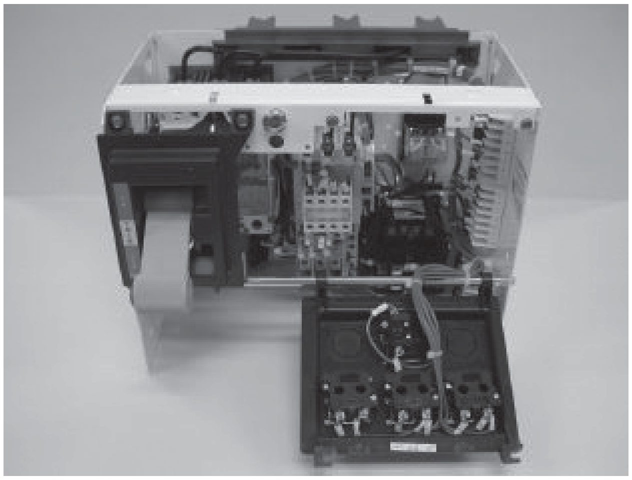


Figure 36. Unit device panel

Installing a new unit

It is recommended that a new unit be installed in a unit space at the top of a vertical compartment or directly below an existing unit. Material provided with the new unit by the factory includes: A divider pan with integral guide rails, a unit door, hinges, catches and hardware. Observe the following sequence of operations for installation.

1. Remove the existing blank door .
2. Position the new unit door over the open space to ensure the hinges and latches are aligned. If the spaces differ, the hinges and latches on the structure must be re-located to match the unit door hinges and latches. Mount the door, using the hinge pins provided.
3. Install the new divider pan in the notches provided in the rear barrier so that it is aligned with the bottom of the new door. Attach the pan to the vertical structure channels with one thread-forming screw on each side.
4. Remove from the vertical bus barrier the flat plate which covers the stab holes that will align with the stabs on the new unit. If an optional labyrinth vertical bus barrier is in place, install an automatic shutter over the stab cutouts. Follow the instruction sheet provided with the shutter kit.

Part 10. Maintenance

Preventive maintenance

Preventive maintenance should be a program, a scheduled periodic action that begins with the installation of the equipment. At that time, specific manufacturer's instruction literature should be consulted, then stored for future reference. Follow-up maintenance should be at regular intervals, as frequently as the severity of duty justifies. Time intervals of one week, or one month, or one year may be appropriate, depending on the duty. It is also desirable to establish specific check lists for each control, as well as a logbook to record the history of incidents. A supply of renewal parts should be obtained and stored.

This control equipment is designed to be installed, operated, and maintained by adequately trained workmen. These instructions do not cover all details, variations, or combinations of the equipment, its storage, delivery, installation, check-out, safe operation, or maintenance. Care must be exercised to comply with local, state, and national regulations, as well as safety practices, for this class of equipment.

Authorized personnel may open a unit door of a motor control center (MCC) while the starter unit is energized. This is accomplished by defeating the mechanical interlock between the operating mechanism and the unit door. A clockwise quarter turn of the slotted head screw located above the operating handle will allow the door to open. See **Figure 37**.

When servicing and adjusting the electrical equipment, refer to the applicable drawings covering the specific motor control center MCC and any other related interconnection drawings. Follow any instructions that may be given for each device. A list of instruction leaflets covering standard components is shown on page 31 of this manual. Any of these leaflets may be obtained by contacting your nearest Eaton representative.

General guidelines—The whole purpose of maintaining electrical equipment can be summarized in two rules:

1. Keep those portions conducting that are intended to be conducting.
2. Keep those portions insulated that are intended to be insulated.

Good conduction requires clean, tight joints, free of contaminants such as dirt and oxides.

Good insulation requires the absence of carbon tracking and the absence of contaminants, such as salt and dust that become hydroscopic and provide an unintended circuit between points of opposite polarity.

Figure 37. Defeater mechanism

⚠ CAUTION

MAINTENANCE OF THE CONTROL COMPONENTS REQUIRES THAT ALL POWER TO THESE COMPONENTS BE TURNED OFF BY OPENING THE BRANCH CIRCUIT DISCONNECT MEANS AND WITHDRAWING THE UNIT TO THE DETENT POSITION (SEE FIGURE 31) OR REMOVING THE UNIT ENTIRELY FROM THE MCC. WHEN UNITS ARE FULLY INSERTED INTO THE MCC, THE LINE SIDE OF EACH DISCONNECT IS ENERGIZED. DO NOT WORK ON FIXED UNITS UNLESS THE MAIN DISCONNECT FOR THE MCC IS OFF.

When working on portions of a branch circuit remote from the MCC, lock the disconnect means for that circuit in the OFF position. To positively lock the operating mechanism in the OFF position, a metal locking bar recessed in the handle may be extended and padlocked with from one to three padlocks. See **Figure 38**.

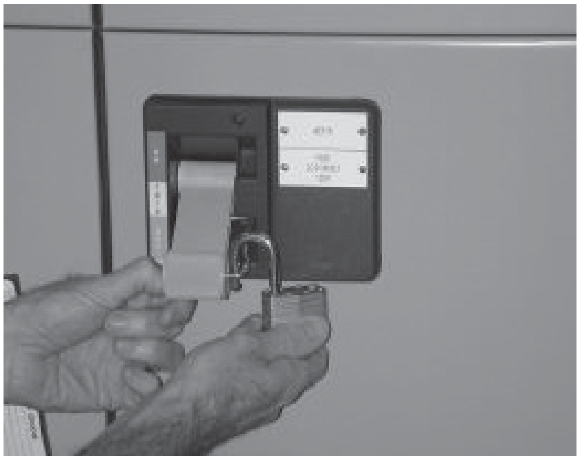


Figure 38. Locking out a disconnect

With the door open and the disconnect device OFF, the operating handle is mechanically interlocked to prevent inadvertently being pushed ON. To defeat this interlock, the bar on the top of the mechanism should be pushed in slightly, allowing the handle to move upward to the ON position.

⚠ WARNING

IF FULLY INSERTED, THE POWER AND CONTROL CIRCUITS WILL BE ENERGIZED. PADLOCKING TO PREVENT THIS HANDLE MOVEMENT MAY BE ACCOMPLISHED BY THE SAME METHOD AS DESCRIBED ABOVE.

Separate control sources of power must also be disconnected. If control power is used during maintenance, take steps to prevent feedback of a hazardous voltage through a control transformer. Be alert to power factor correction capacitors that may be charged. Discharge them before working on any part of the associated power circuit.

Cleaning. Soot, smoke, or stained areas (other than inside arc chutes), or other unusual deposits, should be investigated and the source determined before cleaning is undertaken. Vacuum or wipe clean all exposed surfaces of the control component and the inside of its enclosure. Equipment may be blown clean with compressed air that is dry and free from oil. (Be alert to built-in oilers in factory compressed air lines!) If air blowing techniques are used, remove arc covers from contactors and seal openings to control circuit contacts that are present. It is essential that the foreign debris be removed from the control center, not merely rearranged.

Control equipment should be clean and dry. Remove dust and dirt inside and outside the cabinet without using liquid cleaner. Remove foreign material from the outside top and inside bottom of the enclosure, including hardware and debris, so that future examination will reveal any parts that have fallen off or dropped onto the equipment. If there are liquids spread inside, determine the source and correct by sealing conduit, adding space heaters, or other action as applicable.

Mechanical Checks. Tighten all electrical connections. Look for signs of overheated joints, charred insulation, discolored terminals, and the like. Mechanically clean to a bright finish (don't use emery paper) or replace those terminations that have become discolored. Determine the cause of the loose joint and correct. Be particularly careful with aluminum wire connections. Aluminum wire is best terminated with a crimp type lug that is attached to the control component. When screw type lugs (marked CU/AL) are used with aluminum wire, the joint should be checked for tightness every 200 operations of the device.

Wires and cables should be examined to eliminate any chafing against metal edges caused by vibration, that could progress to an insulation failure. Any temporary wiring should be removed or permanently secured and diagrams marked accordingly.

The intended movement of mechanical parts, such as the armature and contacts of electromechanical contactors, and mechanical interlocks should be checked for freedom of motion and functional operation.

Wrap-up. Check all indicating lamps, mechanical flags, doors, latches, and similar auxiliaries and repair, if required.

Log changes and observations into record book before returning equipment into service. Do not remove any labels or nameplates. Restore any that are damaged.

Contact wear and replacement

Contactors are subject to both mechanical and electrical wear during their operation. In most cases, mechanical wear is insignificant. The erosion of the contacts is due to electrical wear. During arcing, material from each contact is vaporized and blown away from the useful contacting surface.

A critical examination of the appearance of the contact surfaces and a measurement of the remaining contact over-travel will give the user the information required to get the maximum contact life.

Over-travel measurement

Contact life has ended when the over-travel of the contacts has been reduced to 0.02 inch.

Over-travel of the contact assembly is that part of the stroke that the moving contacts would travel after touching the fixed contacts if they were not blocked from movement by the fixed contacts.

A method of measuring over-travel is as follows:

A. Place a 0.02-inch feeler gauge between the armature and magnet, with the armature held tightly against the magnet.

B. Check continually in each phase, i.e., determine if circuit from terminal-to-terminal for each pole is open under these conditions.

C. If there is continuity through all phases, the remaining over-travel is sufficient. If there is not continuity through all phases, replace all stationary and moving contacts plus moving contact over-travel springs. After replacing parts, manually operate contactor to be sure binding does not occur.

Table 12. Contactor troubleshooting chart

Defect	Cause	Remedy
Short contact life	Low contact force	Adjust over-travel, replace contacts, and replace contact springs as required to correct contact force.
	Contact bounce on opening or closing	Correct improper voltage applied to coil. Correct any mechanical defects or misalignment.
	Abrasive dust on contacts	Do not use emery cloth to dress contacts.
	Load current is too high	Reduce load. Use larger contactor.
	Jogging cycle is too severe	Reduce jogging cycle. Check factory for more durable contact material. Use larger contactor.
Overheating	Load current too high	Install arc box.
	Loose connections	Replace broken or eroded insulating parts, arc horns, and grid plates. Clean or replace insulating parts having a heavy coating of foreign conducting material.
	Over-travel and/or contact force too low	Remove contaminating materials that may have accumulated on arc horns and steel-grid plates.
	Ambient temperature is too high	Reduce load. Provide better ventilation. Relocate starter. Use larger contactor.
	Line and/or load cables are too small	Install terminal block and run larger conductors between contactor and terminal block.
Welding of contacts	Over-travel and/or contact force is too low	Adjust over-travel, replace contacts, and replace contact springs as required to correct contact force.
	Magnet armature stalls or hesitates at contact touch point	Correct low voltage at coil terminals as coil draws inrush current.
	Contactor drops open to contact-touch position because of voltage dip	Maintain voltage at coil terminals. Install low voltage protective device, sometimes called "Brownout Protector."
	Excessive contact bounce on closing	Correct coil overvoltage condition.

Maintenance of motor controllers after a fault

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In a motor branch circuit that has been properly installed, coordinated, and in service prior to the fault, opening of the branch-circuit short-circuit protective device (fuse, circuit breaker, motor short-circuit protector, and so on) indicates a fault condition in excess of operating overload. This fault condition must be corrected and the necessary repair or replacements made before re-energizing the branch circuit.

It is recommended that the following general procedures be observed by qualified personnel in the inspection and repair of the motor controller involved in the fault.

Procedure

⚠ CAUTION

ALL INSPECTIONS AND TESTS ARE TO BE MADE ON CONTROLLERS AND EQUIPMENT THAT ARE DE-ENERGIZED, DISCONNECTED, AND ISOLATED SO THAT ACCIDENTAL CONTACT CANNOT BE MADE WITH LIVE PARTS AND SO THAT ALL PLANT SAFETY PROCEDURES WILL BE OBSERVED.

Enclosure. Substantial damage to the unit door or frame, such as deformation, displacement of parts, or burning, requires replacement of the entire unit.

Circuit breaker. Examine the unit interior and the circuit breaker for evidence of possible damage. If evidence of damage is not apparent, the breaker may be reset and turned ON. If it is suspected that the circuit breaker has opened several short-circuit faults or if signs of circuit breaker deterioration appear within the enclosure, the circuit breaker should be replaced.

Disconnect switch. The external operating handle of the disconnect switch must be capable of opening the switch. If the handle fails to open the switch or if visual inspection after opening indicates deterioration beyond normal wear and tear, such as overheating, contact blade, or jaw pitting, insulation breakage or charring, the switch must be replaced.

Fuse holders. Deterioration of fuse holders or their insulating mounts requires their replacement.

Terminals and internal conductors. Indications of arcing damage and/or overheating, such as discoloration and melting of insulation, require the replacement of damaged parts.

Contactor. Contacts showing heat damage, displacement of metal, or loss of adequate wear allowance require replacement of the contacts and the contact springs. If deterioration extends beyond the contacts, such as binding in the guides or evidence of insulation damage, the damaged parts or the entire contactor must be replaced.

Overload relays. If burnout of the current element of an overload relay has occurred, the complete overload relay must be replaced. Any indication that an arc has struck and/or any indication of burning of the insulation of the overload relay also requires replacement of the overload relay.

If there is no visual indication of damage that would require replacement of the overload relay, the relay must be electrically or mechanically tripped to verify the proper functioning of the overload relay contact(s).

Return to service. Before returning the controller to service, checks must be made for the tightness of electrical connections and for the absence of short circuits, grounds, and leakage.

All equipment enclosures must be closed and secured before the branch circuit is energized.

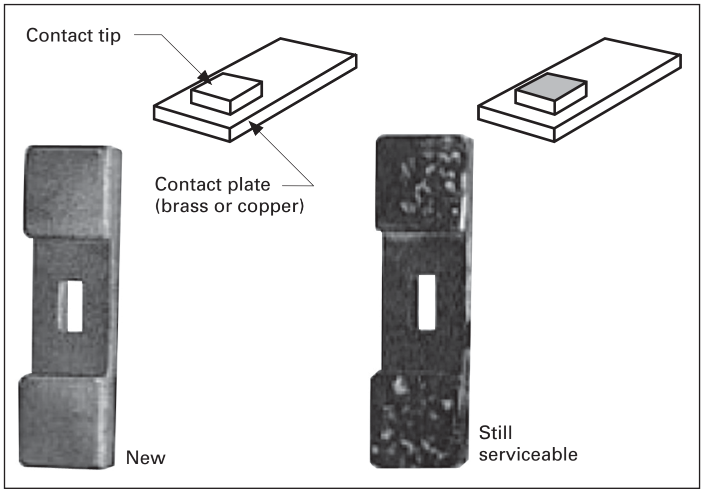

Figure 39. Normal service wear

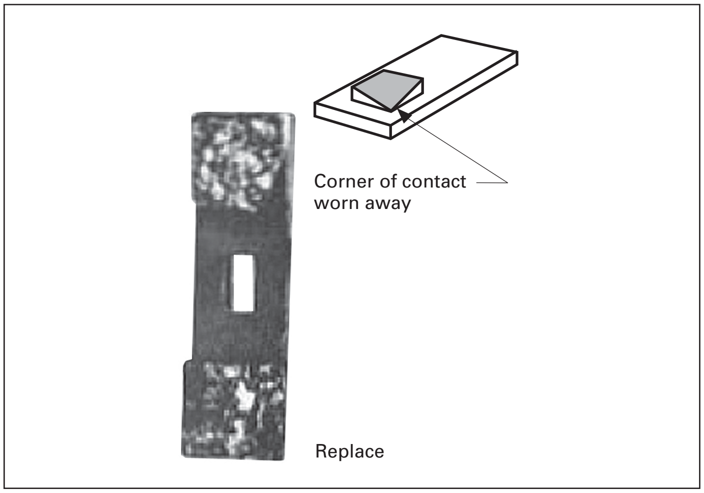

Figure 40. End of service life

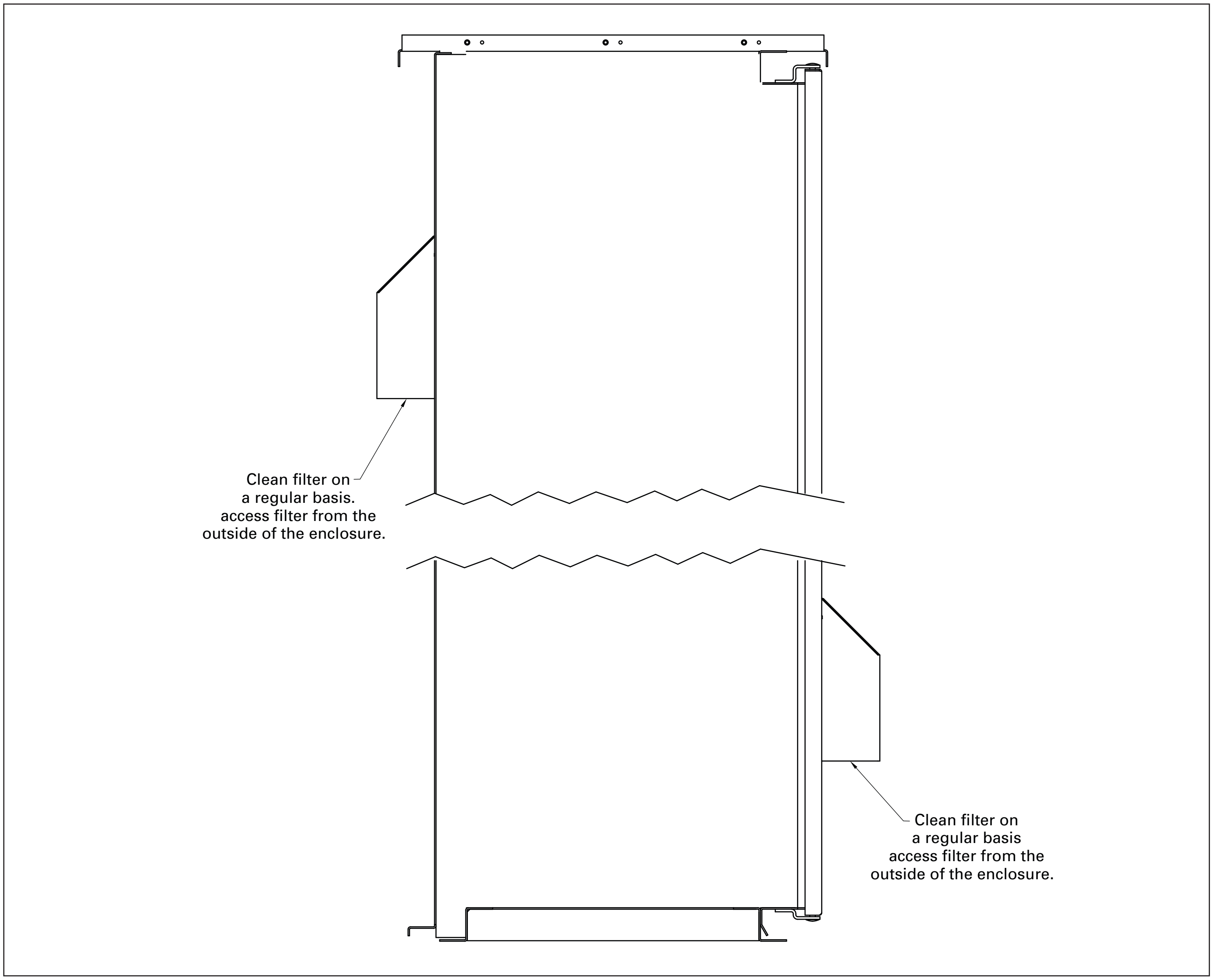

Figure 41. NEMA 3R MCC—all filters require cleaning on regular basis

Table 13. Renewal contact kits, coils, and overload relays

		Part number				
Description	**Coil suffix**	**NEMA Size 1 Series B1**	**NEMA Size 2 Series B1**	**NEMA Size 3**	**NEMA Size 4**	**NEMA Size 5 Series B1**
Renewal parts publication		22177	22177	20426	20428	20429
Contact kits						
Two-pole		6-65	6-65-7	6-43-5	6-44	6-45
Three-pole		6-65-2	6-65-8	6-43-6	6-44-2	6-45-2
Four-pole		6-65-9	6-65-15	—	—	—
Five-pole		6-65-10	6-65-16	—	—	—
Magnet coils						
120 V, 60 Hz or 110 V, 50 Hz	A	9-2703-1	9-2703-1	9-2756-1	9-1891-1	9-1891-1
240 V, 60 Hz or 220 V, 50 Hz	B	9-2703-2	9-2703-2	9-2756-2	9-1891-2	9-1891-2
480 V, 60 Hz or 440 V, 50 Hz	C	9-2703-3	9-2703-3	9-2756-3	9-1891-3	9-1891-3
600 V, 60 Hz or 550 V, 50 Hz	D	9-2703-4	9-2703-4	9-2756-4	9-1891-4	9-1891-4
208 V, 60 Hz	E	9-2703-9	9-2703-9	9-2756-5	9-1891-13	9-1891-13
277 V, 60 Hz	H	9-2703-7	9-2703-7	9-2756-9	9-1891-26	9-1891-26
208/240 V, 60 Hz	J	—	—	—	—	—
240 V, 50 Hz	K	9-2703-14	9-2703-14	9-2756-13	9-1891-20	9-1891-20
380–415 V, 50 Hz	L	9-2703-8	9-2703-8	—	—	—
380 V, 50 Hz	L	—	—	9-2756-12	9-1891-14	9-1891-14
415 V, 50 Hz	M	—	—	9-2756-8	9-1891-21	9-1891-21
550 V, 50 Hz	N	—	—	9-2756-14	9-1891-8	9-1891-8
Overload relays For replacement on existing starters three-pole—ambient-compensated bimetallic		C306GN3B	C306GN3B	C306KN3	C306NN3	C306DN3B

Table 14. Starter type

	Unit catalog number designation (class)		
	Disconnect means		
Description	**Fusible**	**Circuit breaker**	**Circuit breaker with current limiter**
Full voltage, non-reversing	F204	F206	F207
Full voltage, reversing	F214	F216	F217
Reduced voltage, autotransformer type	F604	F606	F607
Reduced voltage, part-winding type	F704	F706	F707
Reduced voltage, closed transition star-delta	F894	F896	F897
Full voltage, non-reversing, two-speed, two windings	F954	F956	F957
Full voltage, non-reversing, two-speed, one winding	F944	F946	F947

Part 11. Plan views

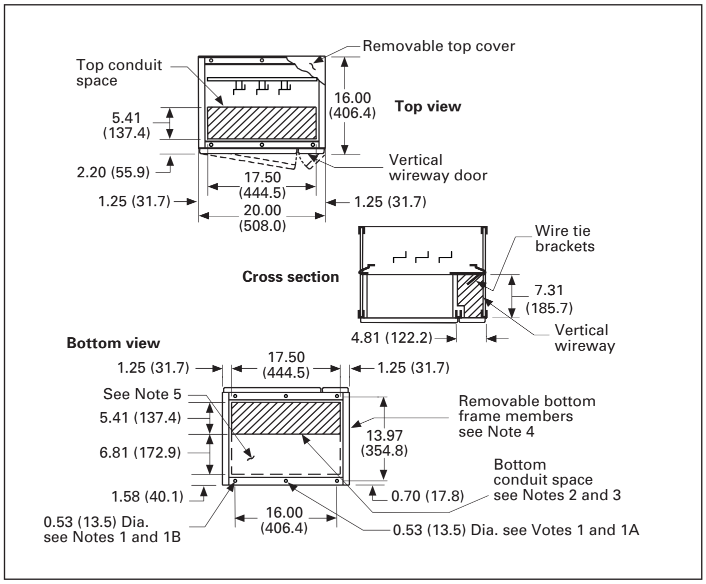

Figure 42. 20 inches wide, 16 inches deep, front mounted only (4710A30)

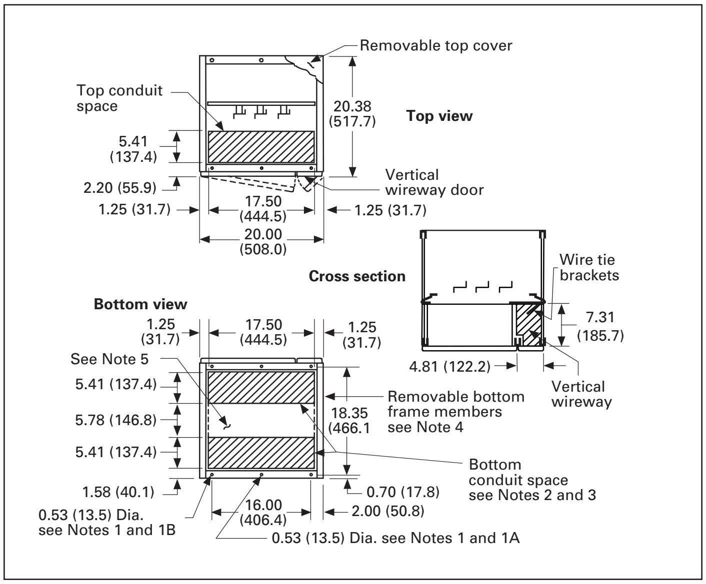

Figure 44. 20 inches wide, 21 inches deep, front mounted only (4710A31)

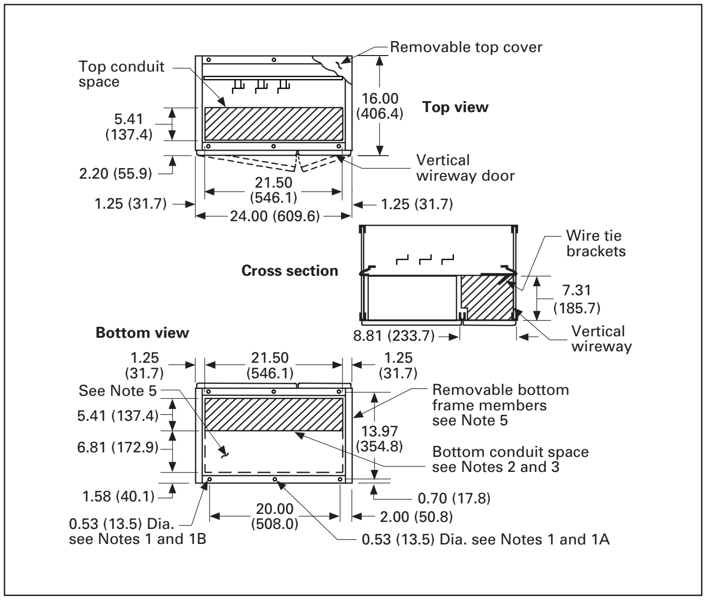

Figure 43. 24 inches wide, 16 inches deep, front mounted only (4710A33)

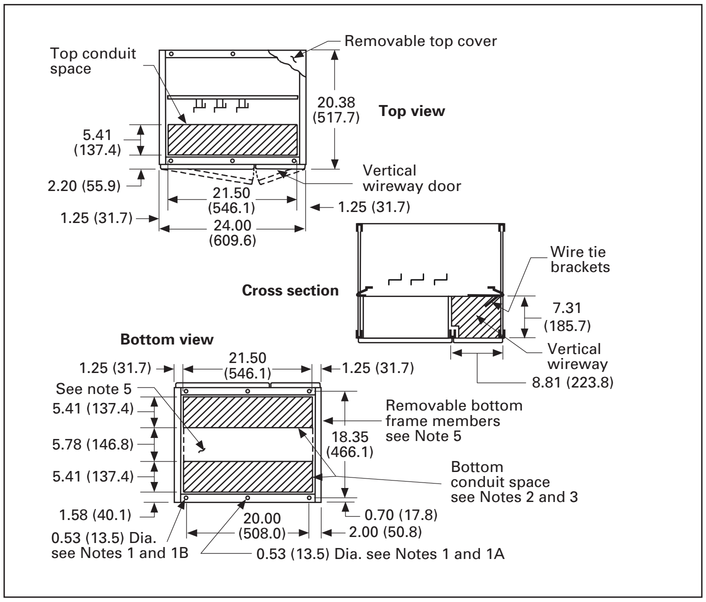

Figure 45. 24 inches wide, 21 inches deep, front mounted only (4710A34)

Notes:

1. Minimum length of anchor bolt is 2.00 (50.8) (0.38-16 grade 5 torqued at 31 lb-ft).
    A. For non-seismic, mount with two center bolts per enclosure.
    B. For seismic, mount with minimum four corner bolts per enclosure.
2. Recommended maximum conduit height above floor line is 3.50 inches (88.9 mm).
3. Maximum conduit space with channel sills is 17.50 x 9.73 inches (444.5 x 247.1 mm).
4. For multiple structure assemblies, either one or both of these members is removed to provide maximum unrestricted conduit space at the bottom of the MCC.
5. This conduit space is not recommended when a neutral bus and/or a space heater is required. Otherwise this space is available for conduit. See **Figure 48** for vertical dimensions.

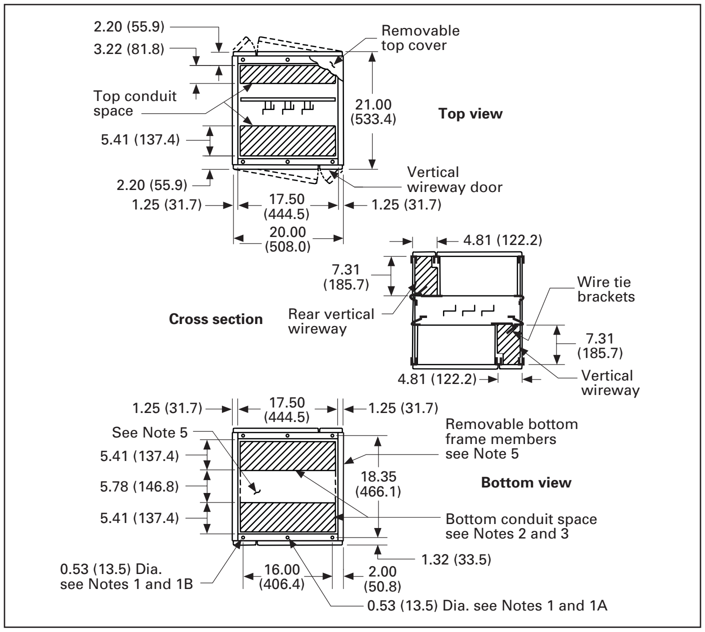

Figure 46. 20 inches wide, 21 inches deep, front and rear mounted (4710A32)

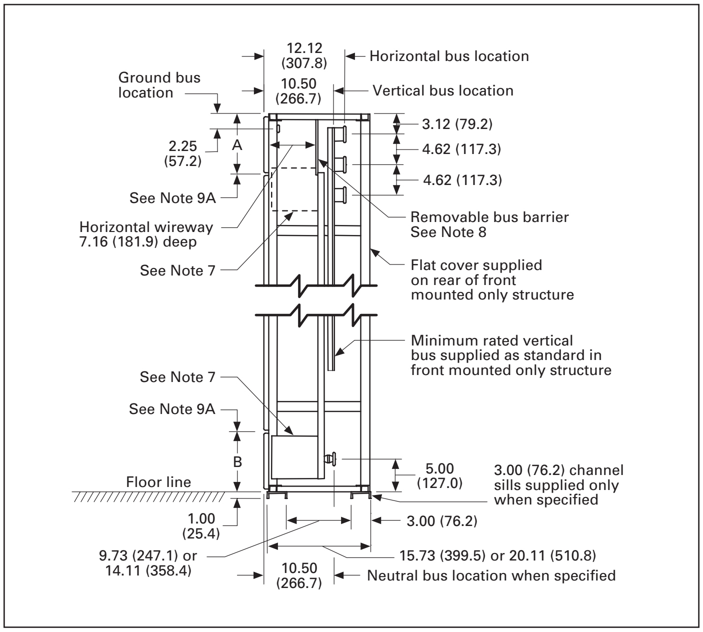

Figure 48. Side view A

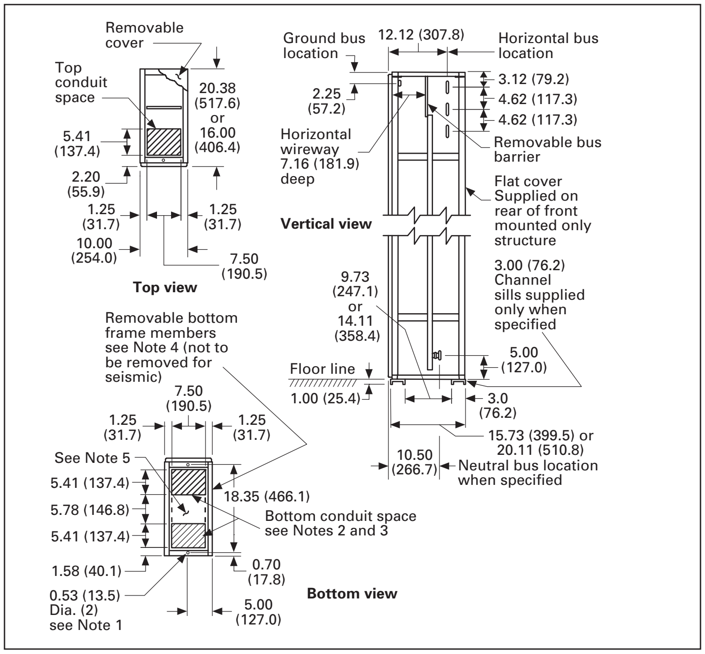

Figure 47. 10 inches wide, 16 or 21 inches deep, transition structure (4710A35/6)

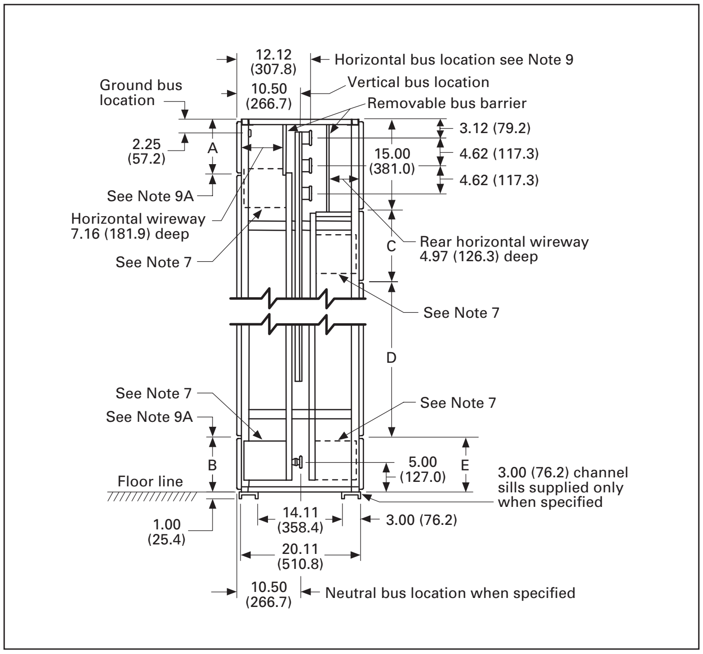

Figure 49. Side view B

Notes:

1. Minimum length of anchor bolt is 2.00 (50.8) (0.38-16 grade 5 torqued at 31 lb-ft).
   A. For non-seismic, mount with two center bolts per enclosure.
   B. For seismic, mount with minimum four corner bolts per enclosure.
2. Recommended maximum conduit height above floor line is 3.50 inches (88.9 mm).
3. Maximum conduit space with channel sills is 17.50 x 9.73 inches (444.5 x 247.1 mm).
4. For multiple structure assemblies, either one or both of these members is removed to provide maximum unrestricted conduit space at the bottom of the MCC.
5. This conduit space is not recommended when a neutral bus and/or a space heater is required. Otherwise, this space is available for conduit. See **Figure 49** for vertical dimensions.
7. Master Terminal Block (MTB) assembly is furnished for Type C wiring only when location not specified. MTB supplied at the bottom.
8. Rear horizontal bus barrier not supplied with front mounted only structure.
9. Standard structure arrangement:
   A. In front
      Without MTB: A and B = 9.00 (228.6 mm)
      With MTB at bottom: A and B = 9.00 (228.6 mm)
      With MTB at top: A and B = 3.00 (76.2 mm)
   B. In rear
      Without MTB: C = 0, D = 72 (1828.8 mm), E = 3.00 (76.2 mm)
      With MTB at bottom: C = 0, D = 66.00 (1676.4 mm), E = 9.00 (228.6 mm)
      With MTB at top: C = 12, D = 60 (1524.0 mm), E = 3.00 (76.2 mm)

Part 12. Related instructional leaflets

Publication	Publication No.
Starters	
Size 5, non-reversing and reversing, vacuum	IL17087
Contactors	
Size 5, non-reversing and reversing, vacuum	IL16999
Size 5, non-reversing and reversing, vacuum	IL17088
Circuit Breakers	
Magnum DS	I.B. 2C12060H08
RotoTract remote racking operating manual	IL04300001E
Series C, F-Frame	IL01219018E
Series C, F-Frame	IL29C101
Series C, J-Frame	IL01204004E
Series C, J-Frame	IL29C103
Series C, K-Frame	IL29C104C
Series C, L-Frame	IL01207002E
Series C, L-Frame	IL29C105
Series C, N-Frame	IL01209003E
Series C, N-Frame	IL29C106
Series C, R-Frame	IL29C613B
Series C, R-Frame	IL29C107
Series G, EG-Frame	IL29C515C
Series G, JG-Frame	IL01207009E
Series G, LG-Frame	IL01207001E
Transfer switches	IL14477

Part 13. Arc resistant LV MCC

General information

LV motor control center (MCC) testing guides have been established for equipment to be tested for the resistance to the effects of an arcing event due to an internal electrical arcing fault.

The Eaton LV MCC has been successfully tested in accordance with IEEE® C37.20.7 and CSA 22.2 No. 0.22-11. The following section of this manual covers the new Eaton Freedom arc resistant motor control center.

The overall construction of the new arc resistant LV MCC has been enhanced with structure robustness improvements to contain the dangerous effects of an internal electrical arcing fault event.

Arc resistant ratings nameplate

This rating plate states specifically the arc resistant rating per the IEEE C37.20.7 and CSA 22.2 No. 0.22-11 as follows:

- MCC accessibility type
- Internal arcing fault kA
- Arc duration—either device limited or a duration time
- Type of protective device—either NGH or RGH if specially stated as a device limited product

⚠ WARNING

ALL DOORS MUST BE CLOSED AND LATCHED AND ALL COVERS IN PLACE AND SECURED PRIOR TO ENERGIZING MCC.
MCC IS ONLY ARC RESISTANT WHEN ALL DOORS AND COVERS ARE CLOSED AND PROPERLY SECURED PRIOR TO ENERGIZING MCC.
FAILURE TO CLOSE AND SECURE MCC PER GUIDELINES COULD RESULT IN SEVERE INJURY OR DEATH.
THE ARC RESISTANT RATING IS ONLY VALID WHEN ALL DOORS ARE CLOSED AND PROPERLY LATCHED OR BOLTED, AND ALL COMPONENTS ARE INSTALLED AND WORKING PROPERLY.
IN ADDITION, REMOVAL OF ANY MCC UNIT/BUCKET FROM ITS CELL WITHOUT REINSTALLING A UNIT/BUCKET OR ARC RESISTANT FUTURE SPACE INNER COVER AND DOOR WILL VOID THE ARC RESISTANT RATING.
VERIFY THAT THE DOOR AND COVER ARE SECURE PRIOR TO ENERGIZING THE ARC RESISTANT LV MCC.

Accessibility

Note: If an installed MCC is wall mounted or has access that is less than 3 feet wide to a wall on the MCC sides and rear, the TYPE 2 accessibility rating defaults to TYPE 1. A Type 2 accessibility rating must have full OSHA and NFPA access clearance of 3 feet minimum.

Figure 50. Arc resistant LV MCC—wireway doors and labeling

Figure 51. MCC unit and vertical wireway door latches and hinges

The arc resistant MCC lineup left and right end sections are special 4-inch wide arc resistant chambers with permanent front covers. These chambers absorb the high pressure shock wave produced by an arcing event.

⚠ WARNING

DO NOT REMOVE OR ALTER THESE ARC RESISTANT END CHAMBERS. THE ARC RESISTANT RATING IS ONLY VALID WHEN THE MCC LINEUP IS COMPLETELY INSTALLED WITH THE ARC RESISTANT CHAMBERS IN PLACE ON BOTH ENDS OF THE MCC LINEUP.

⚠ WARNING

ONLY INSTALL CLEARLY MARKED UNITS (BUCKETS) WITH "ARC RESISTANT" LABEL IN FUTURE SPACES, USING INSTRUCTION MANUAL 50-41929.

Install "U" clamps in the positions as shipped. MCC frames are clamped together with four "U" clamps (4700A48H01) in the front. MCC frames are clamped together with five "U" clamps (4700A48H01) in the rear. There is one extra-long frame clamp at the rear behind the horizontal bus (79-23866). If the MCC has limited rear access, as with a bolted back-to-back MCC line, only install the very bottom clamp and extra-long top clamp.

In cases where the "U" clamp will not fit in the front, e.g., multiple 1X units, a 839A681H08 screw may be used in the normal "U" clamp position. The screw should be installed from the left structure wireway through the cornerpost into the adjacent structure cornerpost leftmost flange.

Figure 52. Arc resistant MCC lineup

Table 15. Arc resistant MCC door hinge, latch, and hardware configurations

Door arrangement	Hinges	Latches	Bolted (¼–20)
Top wireway door	2	0	1
Bottom wireway door	0	0	2
Vertical wireway door	3	3	0
MLO door	7	0	7
JG feeder 1X door	0	0	4
Dual feeder 2X door	2	0	4
LG feeder 4X door	4	0	4
RG/NG main 72-inch doors	7	0	7
6-inch unit 1X door	1	2	0
12-inch unit 2X door	2	2	0
18-inch unit 3X door	3	3	0
24-inch unit 4X door	4	4	0
30-inch unit 5X door	5	5	0
36-inch unit 6X door	6	6	0
42-inch unit 7X door	6	6	0
48-inch unit 8X door	6	6	0
54-inch unit 9X door	6	6	0
60-inch unit 10X door	6	6	0
66-inch unit 11X door	6	6	0
72-inch unit 12X door	7	7	0
TP1 transformer door 7X	6	0	6
TP1 transformer door 8X	6	0	6
20-inch wide relay panel door 12X	7	0	7
24-inch wide relay panel door 12X	7	0	7
28-inch wide relay panel door 12X	7	0	7
32-inch wide relay panel door 12X	7	0	7

Note: Contact your local Eaton representative if additional information is required.

Part 14. Contacting Eaton

Eaton understands that you have a choice in your selection of electrical products and that your expectation is that we continue to strive toward perfection in our product quality and service to you. If you require assistance, the numbers listed are available in addition to your local Eaton sales engineer or authorized distributor.

Engineering & Service: Eaton.com/Service
(800) 498-2678

Warranty Assistance: Eaton.com/Eatoncare
(800) 544-6691

Replacement Parts: Eaton.com/MCCAftermarket
(800) 653-8648

For the fastest resolution, please provide the following information when contacting Eaton.

1. **General Order # (see master nameplate on first structure)**
2. **MFG Date (see master nameplate on first structure)**
3. **Description of the issue/problem**
4. **Location in assembly (e.g., unit 2D)**
5. **Type of application**
6. **Your phone #'s, shipping address, email, contact name, and name of company**

Scan the QR code
for more information.

Powering Business Worldwide

Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
United States
Eaton.com

Printed in USA
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April 2019

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latest product and support information.

Component Data

February 2, 1998
Supersedes TIP AN16, AN56, CN15, CN55
Pages 1-20, Dated 1/1/94

ECN01, ECN02, ECN05, ECN06, ECN07
AN16, AN56, CN15 & CN55
Sizes 00-9, 600V Max.
Non-Reversing & Reversing
NEMA Type Enclosures 1, 3R, 4X & 12
Details On UL & cUL Listing and CSA Certified Included In This TIP

NEMA Contactors & Starters (Freedom)

SIZE 1
NON-REVERSING STARTER

SIZE 3
NON-REVERSING STARTER

DESIGN CHARACTERISTICS

- **Overload Relays —** Bimetallic Ambient Compensated

  Features include:
  - Selectable Manual or Automatic Reset operation.
  - Interchangeable Heater Packs ± 24% to match motor FLA and calibrated for 1.0 and 1.15 service factors.
  - Heater packs for Size 00-0 overload relays will mount in larger Size 1 and 2 overload relays — useful in derating applications such as jogging.
  - Single phase protection – Class 20 or 10 trip time.
  - Electrically isolated NO - NC contacts (pull RESET button to test).
  - Visual trip indication
  - Integral load lugs allows field wiring prior to heater pack installation.
  - NEMA Sizes 5-9 use Current Transformer with 32 Amp overload. Size 5 uses 300:5 CT, Size 6 uses 600:5 CT, Size 7 uses 1000:5 CT, Size 8 uses 1500:5 CT, and Size 9 uses 3000:5 CT.
- **Magnet Coil —** Encapsulated dual voltage/frequency – color coded and permanently marked with voltage, frequency and part number.

  A two-piece spring latch contactor design makes coil removal or replacement fast and simple for Sizes 00-2.

  The NEMA Size 3-5 features a quick change coil assembly which makes coil removal and replacement fast and simple.

  Coil terminals are located on top for easy accessibility. The Size 00 and 0 contactor magnet coils have three terminals, permitting either top or diagonal wiring — European or U. S. style starters can be replaced without changing wiring layout.

  The NEMA Sizes 6-8 features a special DC feeder group for coil feeding. This system allows AC or DC applied voltage, low noise and low inrush and holding consumption.

  The NEMA Size 9 coil is 110V dc/120V ac (Rectified).

  AC or DC magnet coils.
- **Contacts —** Long life twin break contacts provide excellent conductivity and superior resistance to welding and arc erosion. Generously sized for low resistance resulting in extended life.

NEMA, Contactors & Starters, (Freedom)

DESIGN CHARACTERISTICS (Continued)

- **Terminals — Size 00 through 1** ± screw type with captive, backed-out self-lifting pressure plates. Finger proof covers, to reduce electrical shock, are available. Size 2-9:
  Control: Back-out saddle clamp with ± screws
  Power: Box lugs, pressure type
- **Mounting Position —** Sizes 00-5: Horizontal or vertical on upright panel. Sizes 6-8: 25° from vertical maximum. Size 9: Vertical only.
- **Connections —** Straight through wiring — Line lugs at top, load lugs at bottom.
- **Standards —**
  UL listed (Size 00-8):
  Open — File #E1491, Guide #NLDX
  Enclosed — File #E19224, Guide #NLDX
  UL listed (Size 9):
  Open and Enclosed — File #E19224, Guide #NLDX
  Except Size 9 Reverser Not UL Listed.
  cUL listed (Size 00-8):
  Enclosed — File #E19224, Guide #NLDX
  CSA certified — (Size 00-8):
  Open — File #LR353, Class #3211-04
  Designed to meet or exceed NEMA standards.
- **Ambient Temperature —** –5°C to + 65°C
- **Enclosures —** Open or NEMA 1, 3R, 4X, and 12 enclosed. Snap-on cover control kits Size 00-4 NEMA 1; flange mount all other enclosure types.
- **Construction —** Designed specifically for use in applications requiring NEMA ratings. Starters meet or exceed NEMA standards ICS 2-1988.
- **Mechanical/Electrical Life —** Designed to 30 million mechanical operations at maximum HP ratings for Sizes 00 & 0, 10 million for Sizes 1& 2, 5 million for Sizes 3-8. Designed to 3 million electrical operations for Sizes 00-3 and 500 thousand for Sizes 4-8. Size 9 mechanical life in excess of 24K operations and electrical life AC-3 (N/A); AC-4 in excess of 50 operations.
- **Wiring —** Wired for separate or common control.
- **Holding Circuit Interlock —** NEMA Starters Sizes 0-3 are supplied with 1 NO auxiliary contact mounted on the right hand side. On Size 00, interlock occupies 4th power pole position — no increase in width. Sizes 4 and 5 have NO interlock on left side, Sizes 6 and 7 have a 2NO/2NC auxiliary mounted on top between arc-chutes and Size 8 has NO/NC auxiliary on left side and a NO on the right. Size 9 supplied with 2 auxiliary contacts. Each with 1 NO & 1 NC.
- **Mounting —** Supplied with steel mounting plate as standard.

OPTIONAL FEATURES

- **Auxiliary Contacts —** Open type starters will accept up to 8 NO or NC auxiliary contacts (4 for Size 8) — includes holding circuit interlock. Enclosed contactors and starters will accept up to 4 NO or NC auxiliary contacts up to Size 1 in NEMA 1 enclosures. For larger sizes and other NEMA type enclosures, up to 8 NO or NC auxiliary contacts can be added.
- **Mechanical Interlock & Reversing Kits —** Available for field assembly of reversing contactors/starters up to Size 7.
- **Timer —** Two types – Side mounted five function Solid-State timer with timing ranges up to 5 minutes for use with open or enclosed starters/contactors, and top mounted pneumatic timers convertible from OFF to ON delay with timing ranges up to 3 minutes for use with open starters/contactors. Sizes 00-5 only.
- **Transient Suppressor Kit —** Limit high voltage transients produced in the control circuit when power is removed from the coil. For Sizes 00 through 2 there are three separate panel-mounted suppressors for use on 120, 240 or 480 volt coils. For Sizes 3 through 5 there is one separate side mounted suppressor for use on 120 volt coils.
- **Control Circuit Fuse Block —** Sizes 00-2 panel mounted and Sizes 3-5 side mounted fuse holder for control circuit protection. Uses Class CC rejection type fuses, 30 ampere, 600 volt ac maximum.
- **Locking Cover for Overload Relay —** Snaps over top of overload relays to prevent accidental turning of trip or reset adjustments.
- **Branch Circuit Fuse Block Kits —** Sizes 00 through 2, 3-pole, top-mounted. Provide short circuit protection for branch circuits.
- **Phase Monitor Relays —** Designed to monitor phase voltage unbalance, incorrect phase sequence and line undervoltage of a 3 phase system. Sizes 00-5 only.
- **Cover Controls for Enclosures —** Numerous pushbuttons, selector switches and indicating lights are available either factory installed or as kits to be installed by others. These local control devices are available for NEMA 1, 3R, 4X and 12 enclosures.
- **Other Options for Enclosures —** Many other optional features such as meters, terminal strips, relays timers, control power transformers, fuse blocks and other accessories are available for installation in enclosed contactors and starters.

DESCRIPTION

Non-Reversing Starters

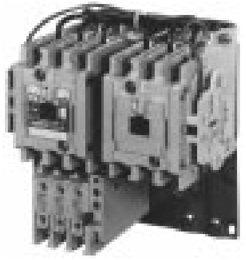
Line voltage magnetic starters are used for starting polyphase squirrel cage motors when full starting torque and the resulting inrush current are acceptable. These starters also provide protection to the motor against running or stalled overcurrents.

NEMA, Contactors & Starters, (Freedom)

The “Freedom Series” starters feature a compact space saving design using state-of-the-art technology and the latest in high strength, impact and temperature resistant insulating materials.

Reversing Starters

Three phase, full voltage magnetic starters are used primarily for reversing of polyphase squirrel cage motors. They consist of two contactors and a single overload relay assembled together. The contactors are mechanically and electrically interlocked to prevent line shorts and energization of both contactors simultaneously.



SIZE 1
REVERSING
STARTER

SIZE 0
REVERSING
STARTER

GENERAL

Magnet Coil — Magnet coils are encapsulated dual voltage/frequency coils which are color coded and permanently marked with voltage, frequency and part number. Coil terminals are located on top for easy accessibility.

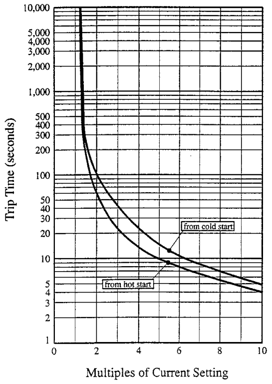
Overload and Heater Packs — Overload relays used on “Freedom Series” starters come in four sizes — 32 amperes, 75 amperes, 105 amperes and 144 amperes. They can be attached directly to contactors (panel mount or common mounting plate) or, with a panel mounting adapter, as a stand alone panel mounted 32 ampere or 75 ampere overload relay. The panel mounting adapter also provides a terminal block for line side wiring to the stand alone overload relay. Sizes 5-9 use 32 amps with CT’s.

The overload relay houses an adjustable, trip-free mechanism and provides mounting for three heater packs. The mechanism is bimetallic with ambient compensated operation. Single phase protection is built in. The reset mechanism can be set for AUTO or MANUAL operation. It has ± 24% adjustability to match motor full load ampere rating with calibration for 1.0 or 1.15 service factor motors. Two isolated contacts, one NC and one NO can be tested by pulling the RESET button. The NC and NO contacts are rated B600 and C600 (refer to Ratings tables on Page 8) respectively. Like the contactor, the overload relay has “finger proof” terminals to reduce the possibility of electrical shock.

Tamper proof overload relay adjustment locking covers snap over the top of overload relays to prevent accidental turning of trip or reset adjustments. Consult the Industrial Control Catalog for information on the variety of covers available.

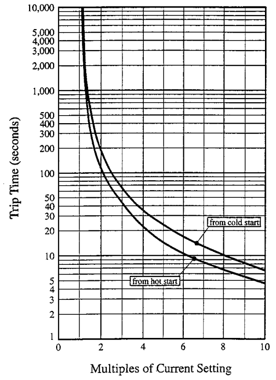
Visual trip indication is provided on all overload relays. The indicator window is located on the lower right-hand corner of the switch unit, just below the reset button. Upon an overload trip (or by pulling up on the reset button), a fluorescent orange indicating flag will appear in the window. Trip indication is only present when using Manual Reset.

CLASS 10
TYPE C306
OVERLOAD
RELAY



TRIP CURVE
TYPE C306 BIMETALLIC COMPENSATED
OVERLOAD RELAY 25°C OPEN RATING

CLASS 20
TYPE C306
OVERLOAD
RELAY



TRIP CURVE
TYPE C306 BIMETALLIC COMPENSATED
OVERLOAD RELAY 25°C OPEN RATING

The heater packs are securely held in the overload relay by two captive screws. Three Class 20 (Class 10 optional) heater packs are installed in the overload relay. The 32 ampere heater packs will mount in the 75 ampere overload relay for applications where the contactor is derated such as for jogging.

The overload relay is adjustable within the FLA range of the heater pack and will ultimately trip at 125% motor current. After the heater packs are selected and installed in the overload relay, the FLA adjustment dial should be rotated to the dial position corresponding to the motor FLA.

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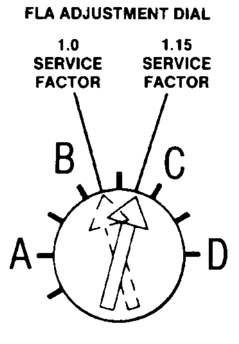
Diagram	Heater Pack Selection Table ❶				
	Motor FLA Rating				Heater Pack Number
	FLA Dial Positions				
	A	B	C	D	
	18.0	20.2	22.3	24.5	H2018-3
	24.6	27.6	30.5	33.4	H2019-3
	33.5	37.5	41.5	45.6	H2020-3
	45.7	51.2	56.7	62.1	H2021-3
	62.2	69.7	77.1	84.6	H2022-3
	84.7	95.0	105.0	115.0	H2023-3
	106.0	118.0	131.0	144.0	H2024-3

❶ Example of Heater Pack Selection Table only. Refer to catalog for complete table.

For example, if the FLA rating is 75.2 amperes, heater packs number H2022-3 should be selected from the above listed Heater Pack Selection Table. For a 1.15 service factor motor the FLA adjustment dial should be set at the location shown in the above diagram by interpolating between the B position of 69.7 amperes and the C position of 77.1 amperes. If a 1.0 service factor motor would be involved, the dial should be rotated counterclockwise one graduation (one half position) to the dotted location in the diagram.

Power Poles — Power poles are available for the Sizes 00, 0, 1 and 2 contactors and starters only. The 00 & 0 power pole is rated 12 amps (20 amp thermal) and the 1 & 2 is rated the same as the basic devices.

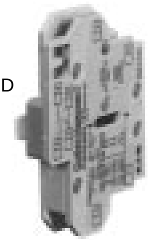
A maximum of two power poles can be used per contactor or starter. They cannot be field or factory installed. The power poles have been designed to accept mechanical interlocks and side mounted auxiliary contacts.

General Auxiliary Contacts Information — Auxiliary contact blocks are designed for snap-on installation — fast, easy installation (no tools required). Side mounted contact blocks are available in 8 different circuit configurations — top mounted contact blocks are offered in 21 different combinations. Enclosed type starters will accept side-mounted auxiliaries only when mounted in standard enclosures. In larger enclosures, top mounted contacts can be added.

All auxiliary contacts are of the bifurcated design with parallel circuit paths. This redundant path provides very high reliability.

For rating information, refer to the "Auxiliary Contact Ratings" table in this publication on Page 8.

TOP MOUNTED



SIDE MOUNTED

Side Auxiliary Contacts — All starters are supplied as standard with one normally open (1 NO) auxiliary contact for use as a holding circuit contact. Reversing starters have in addition, one normally closed (1 NC) auxiliary contact for electrical interlocking purposes.

On Size 00, the holding contact occupies the 4th power pole position (no additional space required). Up to two additional contacts may be added to each side of a Size 00 starter. On Sizes 0-2, the NO holding contact is located on the right side of the contactor. Up to two additional contacts may be added to the left side.

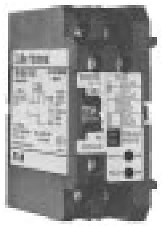
On Sizes 3-5, the NO holding contact is a base contact (on the right on Size 3 and on the left on Sizes 4 & 5). Up to 2 additional contacts can be mounted on the base interlock. On the opposite side, up to 4 additional auxiliary contacts can be added.

On Sizes 6 & 7, there is 2NO/2NC contact block mounted on the top-left position. An additional 2NO/2NC block may be added to the top-right position. On Size 8, there is a NO/NC block on the left back and a NO on the right back. Additional NO/NC blocks may be added on the left and right front positions.

On Size 9, 2 auxiliary contacts are provided, each with 1 NO and 1 NC.

Top Auxiliary Contacts — Open type starters, Sizes 00-2, will accept top auxiliary contacts (up to four circuits possible). This allows a total of up to 8 extra auxiliaries on Size 00 (6 extra auxiliaries on Sizes 00-2).

Electronic Timer — The side mounted, five-function Electronic Timer attachment has a 1 NO - 1 NC relay output and is designed for easy installation to any Freedom Series starter. It is available in three different timing ranges from 0.3 to 300 seconds. Additional auxiliary contacts cannot be installed on same side of starter when timer is used. For Sizes 3-5 a separate mounting bracket is required.



ELECTRONIC TIMER MODULE

- Timing Modes
  - ON DELAY - Timing begins when timer is energized.
  - OFF DELAY - Timing begins when timer is deenergized.
  - ONE SHOT - A single pulsed output occurs when timer is energized.

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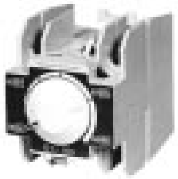
- ON DELAY/OFF DELAY - Timer delay occurs on both energization and deenergization of timer.
- CYCLE MODE - Dual delay with external connections to the NC output contact, cycles ON and OFF continuously.

Delay mode is selectable with two switches on the face of the timer. The time is set by a serrated dial on the module face. Timer can also be mounted directly on 35 mm DIN rail.

- Specifications
  - Repeat Accuracy – within ± 1%
  - Setting Accuracy – ± 10% of scale setting

Maximum Current Rating, Amperes			
Description	Volts, ac		Volts, dc (Resistive)
	120	240	30
Make	30	15	5
Break	3	1.5	5
Continuous	3	1.5	5

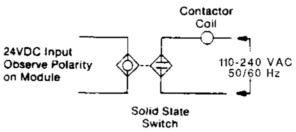
Pneumatic Timer — The Pneumatic Timer attachment is designed for snap-on installation to top of any Size 00-2 starter (top mounted auxiliary contacts cannot be installed on device when timer is used). It is available in two ranges from 0.1 to 180 seconds. Timer unit has D.P.D.T. timed contacts – circuits in each pole must be the same polarity. Units are convertible from OFF to ON delay or vice-versa. Contacts are rated A600. Repeat accuracy is ±10%.


PNEUMATIC TIMER ATTACHMENT

DC/AC Interface Module — The Interface Module is an optically isolated solid state switch which provides a means of operating ac coils with a 24 volt dc control signal. It acts as a space saving interposing relay which can switch a 110-240 volt, 50/60 Hz source to the contactor or starter coil.

The module may be directly attached to the coil terminals of any Freedom Series contactor or starter - Size 00-2. It also has provisions for DIN rail mounting.


INTERFACE MODULE



TYPICAL APPLICATION

DC Magnet Coils — Dc Magnet Coils are available either factory installed or as field conversion kits.

Transient Suppressor Kit — Sizes 00-2 device connects across terminals on any 120 V, 240 V or 480 V starter magnet coil and Sizes 3-5 side mounted device connects across terminals on a 120 volt starter magnet coil. Suppressors are designed to limit the high voltage transients produced in the circuit when power is removed from the coil.

TRANSIENT SUPPRESSOR KITS


FOR SIZES 00-2


FOR SIZES 3-5

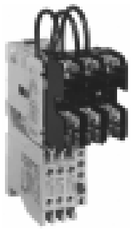
Control Circuit Fuse Block — Size 00-2 panel mounted and Size 3-5 side mounted fuse holders, designed for control circuit protection or other similar low current requirements, have extractor type fuse caps.

The Class CC rejection type fuses (KTK-R) used in these holders are intended for use with equipment designated as being suitable for use on systems having high available fault currents.

If branch circuit protective device is 45 amperes or greater, C320FBR1 fuse kit may be required for control circuit protection per NEC 430-72.


CONTROL CIRCUIT FUSE BLOCK

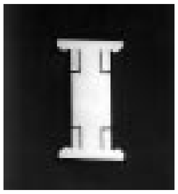
3-Pole Top Mounted Branch Circuit Fuse Block Kits — Designed to save space and reduce installation time, these top mounted fuse block kits field mount to any Size 00-2 starter and provide short circuit protection for branch circuits. Available for Class H, R, G or T fuses rated 15 through 60 amperes and Class J fuses rated 15 through 100 amperes, 250 through 600 volts.

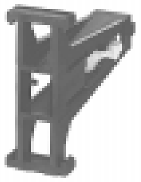

MOUNTED FUSE BLOCK

NEMA, Contactors & Starters, (Freedom)

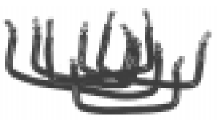
Mechanical Interlock and Reversing Kits — These kits are available for field assembly of reversing starters using components. The Reversing Kits include a mechanical interlock, stabilizer bar and a pre-cut, trimmed and formed wire set. Auxiliary contacts are not supplied but can be ordered separately. The snap-fit mechanical interlock and stabilizer bar do not require tools for assembly. Installation instructions are included with the device.

STABILIZER BAR



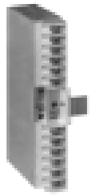


MECHANICAL INTERLOCK



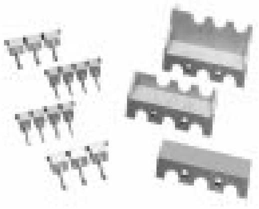
WIRE SET

Phase Monitor Relay — Phase Monitor Relays are designed to monitor phase voltage unbalance, incorrect phase sequence and line undervoltage of a 3 phase system.



PHASE MONITOR RELAY

Finger Protection Shields — Snap-on shields for both contactors and starters, reversing and non-reversing provides type IP20 Finger Protection. Prevents accidental contact with line load terminals.



FINGER PROTECTION SHIELDS

Overload Locking Covers — Snap-on transparent or opaque plastic panel for covering access port to the overload relay trip setting dials. Helps prevent accidental or unauthorized changes to trip reset setting. Five varieties offers maximum application flexibility.

OVERLOAD LOCKING COVER

Short Circuit Protection — Fuses and Inverse-Time Circuit Breakers may be selected per Article 430, Part D of the National Electrical Code to protect motor branch circuits from fault conditions. If higher ratings or settings are required to start the motor, do not exceed the maximum as listed in Exception No. 2, Article 430-52.

ENCLOSURES

NEMA Definitions

Type	Definition
1	Enclosures are intended for indoor use primarily to provide a degree of protection against limited amounts of falling dirt.
3R	Enclosures are intended for outdoor use primarily to provide a degree of protection against rain, sleet, and damage from external ice formation.
4X	Enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against corrosion, windblown dust and rain, splashing water, hose-directed water, and damage form external ice formation.
12	Enclosures are intended for indoor use primarily to provide a degree of protection agains circulating dust, falling dirt, and dripping noncorrosive liquids.

NEMA 1 NEMA 3R

ENCLOSED STARTERS

Cover Control Kits for Enclosures — These kits are available for NEMA 1 enclosures in versions such as Start/Stop, Hand-Auto, Hand-Off-Auto, Test-Off-Auto — all available with and without pilot light options. For reversing applications, Forward-Stop-Reverse, Up-Stop-Down and Open-Stop-Close with and without pilot lights are available. For other NEMA types, these and other versions such as On-Off are available. The kits are complete with wires and instructions. Assembly is fast and easy, requiring only a screwdriver in most cases. NEMA 1 enclosures have removable blank plates or knockouts and NEMA 3R, 4X and 12 enclosures have removable hole plugs that cover the pre-punched holes.

ISLAND & 10250T TYPE COVER CONTROL WITH ACCOMPANYING ENCLOSURES

NEMA, Contactors & Starters, (Freedom)

REFERENCE DATA

NEMA AN16 Starters — High Fault Current Circuit Ratings — UL508

SCPD	Max Rating SCPD (A)	Cir Bkr Intrp Rating (KA)	Short Circuit Volt (V)	Withstand Current (KA)	Typical Disconnect
Size 00					
Data To Be Available Later					
Size 0					
Class R, J Fuse ❶	60	100	600	100	C361
Mag Bkr — HMCP ❶	30	100	480	100	HMCP
Thrml Mag — FDC ❶	35	100	480	100	FDC
Size 1					
Class R, J Fuse ❶	60	100	600	100	C361
Mag Bkr — HMCP ❶	30	100	480	100	HMCP
Thrml Mag — FDC ❶	90	100	480	100	FDC
Size 2					
Class R, J Fuse ❶	100	100	600	100	C361
Mag Bkr — HMCP ❶	50	100	480	100	HMCP
Thrml Mag — FDC ❶	150	100	480	100	FDC
Size 3					
Class R, J Fuse ❶	200	100	600	100	C361
Mag Bkr — HMCP ❶	150	100	480	100	HMCP
Thrml Mag — FDC ❶	150	100	480	100	FDC
Size 4					
Class R, J Fuse ❶	400	100	600	100	400 A K SW
Mag Bkr — HMCP ❶	150	100	480	100	HMCP
Thrml Mag — JDC ❷	250	100	480	100	JDC
Size 5					
Class R, J Fuse ❶	600	100	600	100	600 A K SW
Mag Bkr — HMCP ❷	600	100	480	100	HMCP
Thrml Mag — KDC ❷	400	100	480	100	FDC
Size 6					
Class L Fuse ❶	1200	- - -	600	100	800 A K SW
Class L Fuse ❶	1200	- - -	600	100	Mld Case N Fr
Thrml Mag — HLD ❷	800	65	480	65	HLD

❶ UL File E39943 — Issue Date 2/15/89.
❷ UL File E47048 — Issue Date 11/23/87.

NOTE:
UL 508 STANDARD FAULT CURRENT RATINGS: All devices are UL Listed with fuses and inverse time circuit breakers to standard low level fault currents based on horsepower. All AN16 starters conform. Sizes 00-3 to 5kA. Sizes 4-5 to 10kA. Size 6 to 18kA. Size 7 to 30kA. Size 8 to 42kA and Size 9 to 85kA.

Electrical Data

NEMA Size Frame Width	Ampere Rating, Continuous	Maximum Horsepower		
		Motor Voltage 60 Hz	1 ϕ	3 ϕ
00 45 mm	9	115	⅓	- - -
		200	- - -	1½
		230	1	1½
		460	- - -	2
		575	- - -	2
0 45 mm	18	115	1	- - -
		200	- - -	3
		230	2	3
		460	- - -	5
		575	- - -	5
1 65 mm	27	115	2	- - -
		200	- - -	7½
		230	3	7½
		460	- - -	10
		575	- - -	10
2 65 mm	45	115	3	- - -
		200	- - -	10
		230	7½	15
		460	- - -	25
		575	- - -	25
3 90 mm	90	115	- - -	- - -
		200	- - -	25
		230	- - -	30
		460	- - -	50
		575	- - -	50
4 180 mm	135	115	- - -	- - -
		200	- - -	40
		230	- - -	50
		460	- - -	100
		575	- - -	100
5 180 mm	270	115	- - -	- - -
		200	- - -	75
		230	- - -	100
		460	- - -	200
		575	- - -	200
6 220 mm	540	115	- - -	- - -
		200	- - -	150
		230	- - -	200
		460	- - -	400
		575	- - -	400
7 280 mm	810	115	- - -	- - -
		200	- - -	200
		230	- - -	300
		460	- - -	600
		575	- - -	600
8 334 mm	1215	115	- - -	- - -
		200	- - -	400
		230	- - -	450
		460	- - -	900
		575	- - -	900
9 813 mm	2250	115	- - -	- - -
		200	- - -	- - -
		230	- - -	800
		460	- - -	1600
		575	- - -	1600

NEMA, Contactors & Starters, (Freedom)

Auxiliary Contact Ratings

NEMA Electrical Rating Designation	Volts	Amperes		
		Make	Break	Continuous
A600	120 240 480 600	60 30 15 12	6 3 1.5 1.2	10
B600	120 240 480 600	30 15 7.5 6	3 1.5 0.75 0.60	5
C600	120 240 480 600	15 7.5 3.75 3.00	1.5 0.75 0.38 0.30	2.5

Wire (75°C) Sizes — AWG or kcmil – Open and Enclosed

NEMA Size	Cu Only
Power Terminals — Contactors	
00	#12 – #16 Stranded, #12 – #14 Solid
0	#8 – #16 Stranded, #10 – #14 Solid
1	#8 – #14 Stranded or Solid
2	#3 – #14 (upper) and/or #6 – #14 (lower) Stranded or Solid ❷
Power Terminals — Load (Overload Relay)	
Heater Pack Cat. Nos.	**❶ Min. — Cu Only (Stranded or Solid)**
H2001B-H2010B H2101B-H2110B	#14
H2011B & H2111B	#12
H2012B & H2112B	#10
H2013B-H2014B H2113B-H2114B	#8
H2015B & H2115B	#6
H2016B & H2116B	#4
H2017B & H2117B	#3
H2015A-H2017A H2114-H2117	#14-#2
Power Terminals – Line and Load	
3	#1/0 – #14 Al Cu
4	#3/0 – #8 Al Cu
5	750 kcmil – #2 or (2) 250 kcmil – #3/0 Al Cu
6	(2) 750 kcmil — #3/0 Al Cu
7	(3) 750 kcmil — #3/0 Al Cu
8	(4) 750 kcmil — #1/0 Al Cu
9	(8) 500 kcmil
Control Terminals — Cu Only	
All	#12 – #16 Stranded or #12 – #14 Solid

❶ Minimum per NEC.
Maximum Wire Size: Sizes 00 & 0 — #8 and Sizes 1 & 2 — #2.
❷ Two compartment box lug.

Torque Requirements — Line/Load and Heaters (in-lbs)

NEMA Size	AN16/56 Starters				
	Line Lug ❹		Load Lug		Heater Packs in-lbs
	Torque in-lbs	Wire Range	Torque in-lbs	Wire Range	
00	7	❸	20	❸	9
0	15	❸	20	❸	9
1	20	❸	35 40 45 50	#14-10 #8 #6-4 #3	9 9 9 9
2	40 45 50	#14-8 #6-4 #3	35 40 45 50	#14-10 #8 #6-4 #3	9 9 9 9
3	35 40 45 50	#14-10 #8 #6-4 #3-1/0	35 40 45 50	#14-10 #8 #6-4 #3-1/0	24-30 24-30 24-30 24-30
4	200	❸	200	❸	24-30
5-7	550	❸	550	❸	9
8	500	❸	500	❸	9
9	400	4/0- 500 MCM	400	4/0- 500 MCM	9

❸ See "Wire Sizes" Table adjacent.
❹ For contactors this is "Line and Load Lug" data.

Plugging and Jogging Service Horsepower Rating

NEMA Size	200 Volts	230 Volts	460 Volts	575 Volts
Maximum horsepower where operation is interrupted more than 5 times per minute, or more than 10 times in a 10 minute period.				
00	- - -	½	½	½
0	1½	1½	2	2
1	3	3	5	5
2	7½	10	15	15
3	15	20	30	30
4	25	30	60	60
5	60	75	150	150
6	125	150	300	300

NEMA, Contactors & Starters, (Freedom)

AC COIL DATA

NEMA Sizes	P.U. Volts		P.U.			Sealed			D.O. Volts		Mech. Max. Operation Rate Ops/Hour	P.U. Time mS	D.O. Time mS
	Cold	Hot	VAR	VA	Watts	VAR	VA	Watts	Cold	Hot			
00	74.0%	78%	64	80	49	7.1	7.5	2.4	45%	46%	10,800	12	12
0	74.0%	78%	78	100	65	9.2	10	3.1	45%	46%	10,800	12	12
1-2	74.0%	78%	210	230	95	27	28	7.8	49%	50%	7,200	20	14
3	72.0%	76%	374	390	112	48	49.8	13	50%	52%	7,200	14	11
4	72.5%	76%	1132	1158	240	96	100	27.2	54%	56%	4,800	28	14
5	75.0%	77%	1132	1158	240	96	100	27.2	63%	64%	4,800	25	13
6	75.0%	75%	516	890	798	- - -	11	10	❶	❶	2,400	100	150-1000 ❷
7	75.0%	75%	868	1000	1345	11	25	20	❶	❶	1,200	100	150-1000
8	75.0%	75%	1262	2400	- - -	- - -	70	- - -	❶	❶	600	100	25-50
9	50.0%	65%	- - -	- - -	2100	- - -	- - -	350	40%	50%	- - -	18	20

❶ 20-30% of rated coil voltage.

❷ Adjustable drop out time.

DC COIL DATA

NEMA Sizes	Volts	P.U.			Sealed		D.O. Volts (Hot)	P.U. Time mS	D.O. Time mS	Max. Operation Rate Ops/Hour	Mech. Life Millions
		Amps	Watts	Volts (Hot)	Amps	Watts					
00/0	12	6.4	76.8	80%	0.28	3.36	60%	22	17	3,600	5
	24	3.2	76.8	80%	0.14	3.36	60%	22	17	3,600	5
	48	1.6	76.8	80%	0.07	3.36	60%	22	17	3,600	5
	120	0.64	76.8	80%	0.028	3.36	60%	22	17	3,600	5
1/2	12	15.4	126	68%	0.42	4.98	30%	21	12	3,600	2
	24	6.2	88.4	60%	0.21	4.96	29%	20	13	3,600	2
	48	2.9	76.2	56%	0.11	5.04	28%	20	14	3,600	2
	120	1.1	67.3	53%	0.041	4.87	29%	20	16	3,600	2
3	12	24	293	65%	0.40	4.84	23%	39	14	3,600	2
	24	12	288	61%	0.20	4.75	22%	38	14	3,600	2
	48	6.1	295	62%	0.097	4.67	22%	37	14	3,600	2
	120	2.5	298	61%	0.038	4.57	22%	37	16	3,600	2
4/5	24	18	400	67%	0.22	5.3	25%	53	14	2,400	2
	48	9.0	400	67%	0.11	5.2	25%	49	16	2,400	2
	120	3.3	450	65%	0.05	5.4	28%	56	19	2,400	2
	240	1.7	440	64%	0.02	4.9	26%	49	21	2,400	2
6	106	8.25	775	N/A	0.085	9	N/A	N/A	N/A	2,400	5
	214	4.09	775	N/A	0.042	9	N/A	N/A	N/A	2,400	5
	340	2.57	775	N/A	0.026	9	N/A	N/A	N/A	2,400	5
	430	2.03	775	N/A	0.021	9	N/A	N/A	N/A	2,400	5
7	106	13.92	1425	N/A	0.184	19.5	N/A	N/A	N/A	1,200	5 ❸
	214	6.89	1425	N/A	0.091	19.5	N/A	N/A	N/A	1,200	5 ❸
	340	4.34	1425	N/A	0.057	19.5	N/A	N/A	N/A	1,200	5 ❸
	430	3.43	1425	N/A	0.045	19.5	N/A	N/A	N/A	1,200	5 ❸
8	106	19.81	2100	N/A	0.566	60	N/A	N/A	N/A	600	5 ❸
	214	9.81	2100	N/A	0.280	60	N/A	N/A	N/A	600	5 ❸
	340	6.18	2100	N/A	0.176	60	N/A	N/A	N/A	600	5 ❸
	430	4.88	2100	N/A	0.139	60	N/A	N/A	N/A	600	5 ❸

❸ Change armature, magnet and armature interlock after 1×10^4 operations.

GENERAL COIL DATA

Coil Offering — Encapsulated – NEMA Sizes 00-9
(Except Size 6 is tape)

UL Insulation Rating — Encapsulated – Class 130 (B)
– 105 degree C
temp. rise

Operational Limits — 85% to 110% of Rated Voltage

Coil Data Notes

P.U. = Pick up time is the average time taken from closing of the coil circuit to main contact touch.

D.O. = Drop out time is the average time taken from opening of the coil circuit to main contact separation.

Cold = Coil data with a cold coil.

Hot = Coil data with a hot coil.

All data is based on a standard contactor with no auxiliary devices and a 120 VAC or 24 VDC magnet coil. Coil data has a ±5% range depending on the application, therefore specific data may vary.

NEMA, Contactors & Starters, (Freedom)

RENEWAL PARTS

Magnet Coils					
Coil Volts and Hertz	**Size 00 ❶**	**Size 0 ❶**	**Size 1-2**	**Size 3**	**Size 4-5**
120/60 or 110/50	9-2823-1	9-2824-1	9-2703-1	9-2756-1	9-1891-1
240/60 or 220/50	9-2823-2	9-2824-2	9-2703-2	9-2756-2	9-1891-2
480/60 or 440/50	9-2823-3	9-2824-3	9-2703-3	9-2756-3	9-1891-3
600/60 or 550/50	9-2823-4	9-2824-4	9-2703-4	9-2756-4	9-1891-4
24/60 or 24/50	9-2823-18	9-2824-18	9-2703-16	9-2756-16	– – –
24/60	9-2823-7	9-2824-7	9-2703-6	9-2756-6	9-1891-15
48/60	9-2823-8	9-2824-8	9-2703-11	9-2756-15	– – –
208/60	9-2823-5	9-2824-5	9-2703-9	9-2756-5	9-1891-13
277/60	9-2823-12	9-2824-14	9-2703-7	9-2756-9	9-1891-26
24/50	9-2823-13	9-2824-13	9-2703-12	9-2756-11	9-1891-16
208-240/60	9-2823-17	9-2824-17	– – –	– – –	– – –
32/50	– – –	– – –	9-2703-10	9-2756-10	9-1891-27
48/50	9-2823-9	9-2824-9	9-2703-13	9-2756-7	9-1891-18
240/50	9-2823-11	9-2824-11	9-2703-14	9-2756-13	9-1891-20
380/50	– – –	– – –	– – –	9-2756-12	9-1891-14
415/50	– – –	– – –	– – –	9-2756-8	9-1891-21
380-415/50	9-2823-6	9-2824-6	9-2703-8	– – –	– – –
550/50	– – –	– – –	– – –	9-2756-14	9-1891-8

Coil Volts and Hertz	**Size 6**	
	Main Coil	**Feeder Group**
120/60 or 110/50	9-3006	9-3007
240/60 or 220/50	9-3006-2	9-3007-2
480/60 or 440/50	9-3006-3	9-3007-3
600/60 or 550/50	9-3006-4	9-3007-4
218/60 or 200/50	9-3006-5	9-3007-5
277/60 or 254/50	9-3006-6	9-3007-6
415/60 or 380/50	9-3006-7	9-3007-7
52/60 or 48/50	– – –	– – –
110/50-60	– – –	– – –
120/50-60	– – –	– – –
208/50-60	– – –	– – –
220/50-60	– – –	– – –
240/50-60	– – –	– – –
380/50-60	– – –	– – –
415/50-60	– – –	– – –
440/50-60	– – –	– – –
480/50-60	– – –	– – –
550/50-60	– – –	– – –
600/60-50	– – –	– – –

Coil Volts and Hertz	**Size 7**	
	Main Coil	**Feeder Group**
120/60 or 110/50	9-2698	9-2705
240/60 or 220/50	9-2698-2	9-2705-2
480/60 or 440/50	9-2698-3	9-2705-3
600/60 or 550/50	9-2698-4	9-2705-4
415/60 or 380/50	9-2698-6	9-2705-6
48/60 or 44/50	9-2698-8	9-2705-8
208/50-60	9-2698-5	9-2705-5

❶ These are the only renewal parts available. Series B1/C1 only.

NEMA, Contactors & Starters, (Freedom)

RENEWAL PARTS

Magnet Coils (Continued)

Coil Volts and Hertz	Size 8			
	Common Control		Separate Control	
	Main Coils	Feeder Group	Main Coils	Feeder Group
120/50-60	9-2654	9-2664	9-2654	9-2664
208/50-60	9-2654-6	9-2664-6		
240/50-60	9-2654-2	9-2664-2		
380/50-60	9-2654-5	9-2664-5		
480/50-60	9-2654-3	9-2664-3		
550/50-60	9-2654-10	9-2664-10		
600/50-60	9-2654-4	9-2664-4		

Coil Volts and Hertz	Size 9	
	Common Control	Separate Control
120/50-60	5264C34G01	5264C34G01

Dc Coil Kits

NEMA Contactor or Starter Size	Volts	Catalog Number
00-0	12	**C335KD3R1**
	24	**KD3T1**
	48	**KD3W1**
	120	**KD3A1**
1-2	12	**C335KD4R4**
	24	**KD4T4**
	48	**KD4W4**
	120	**KD4A4**
3	12	**C335KD5R1**
	24	**KD5T1**
	48	**KD5W1**
	120	**KD5A1**
4-5	24	**C335KA3T1**
	48	**KA3W1**
	120	**KA3A1**
	240	**KA3B1**

Contact Kits

Contactor or Starter NEMA Size	Part Numbers	
	2 Pole	3 Pole
1	6-65	6-65-2
2	6-65-7	6-65-8
3	6-43	6-43-2
4	6-44	6-44-2
5	6-45	6-45-2
6 ❶	– – –	6-648
7	– – –	6-613
8	– – –	6-571
9	(2) — 5264C42G01	(3) — 5264C42G01

Publications

NEMA Size Starter	Publication Numbers
1-2	22177
3	20426
4	20428
5	20429
6	23349
7	20848
8	20849
9	IL 16978

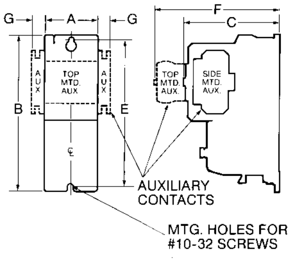
❶ Series B1 contactor, Series C1 starter.

NEMA, Contactors & Starters, (Freedom)

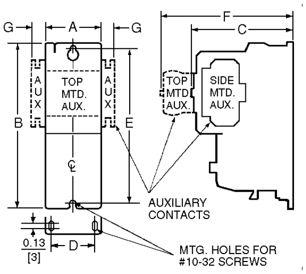
APPROXIMATE DIMENSIONS AND SHIPPING WEIGHTS

Do not use for construction.

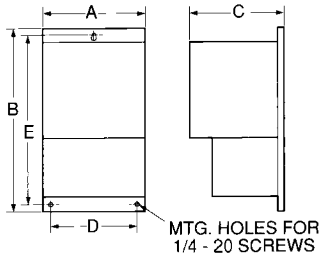
NON-REVERSING OPEN TYPE



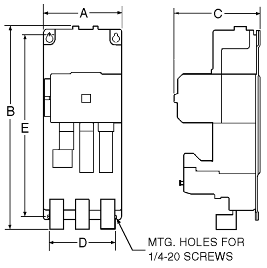
SIZE 00 & 0



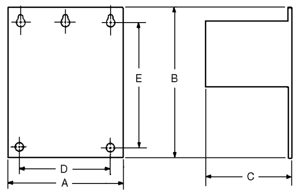
SIZE 1 & 2



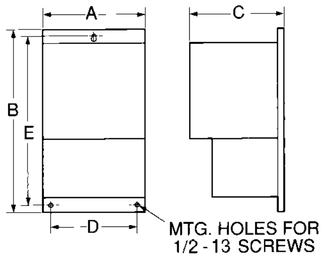
SIZE 3 & 4



SIZE 5



MOUNTING SCREWS — #1/2 - 13
SIZES 6 THROUGH 8



SIZE 9

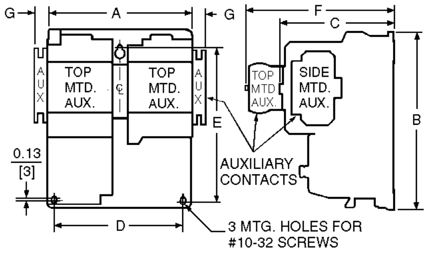
NEMA Size	Dimensions in Inches [mm]							Shipping Weight Lbs.
	Wide A	High B	Deep C	Mounting		F	G	
				D	E			
00-0	1.80 [45.5]	6.60 [168]	3.52 [89.5]	– – –	6.07 [154]	4.90 [124.5]	0.54 [13.7]	2.2
1	2.56 [65]	7.08 [180]	4.44 [113]	2.00 [51]	6.63 [168]	5.80 [147.5]	0.54 [13.7]	4.5
2	2.56 [65]	8.08 [205]	4.44 [113]	2.00 [51]	7.63 [194]	5.80 [147.5]	0.54 [13.7]	4.7
3	4.08 [104]	11.35 [288]	5.94 [151]	3.00 [76]	10.81 [275]	– – –	– – –	11.
4	7.05 [179]	12.06 [306]	7.25 [184]	6.00 [152]	8.50 [216]	– – –	– – –	23.
5	7.00 [178]	17.77 [451]	7.76 [197]	6.00 [152]	16.00 [406]	– – –	– – –	36.
6	9.47 [241]	21.69 [551]	9.90 [251]	3.10 [79]	18.00 [457]	– – –	– – –	75.
7	15.13 [384]	29.13 [740]	12.64 [321]	13.25 [337]	21.25 [540]	– – –	– – –	120.
8	15.13 [384]	34.50 [876]	15.00 [381]	13.75 [337]	16.75 [425]	– – –	– – –	210.
9	33.00 [838]	30.00 [762]	12.94 [329]	30.75 [781]	8.00 [203]	– – –	– – –	315.

NEMA, Contactors & Starters, (Freedom)

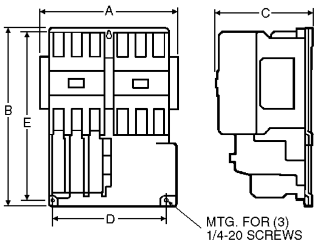
APPROXIMATE DIMENSIONS AND SHIPPING WEIGHTS (Continued)

Do not use for construction.

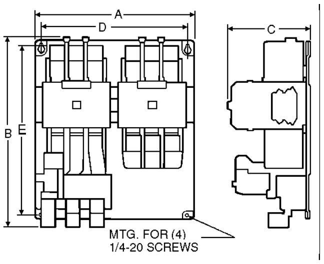
REVERSING OPEN TYPE



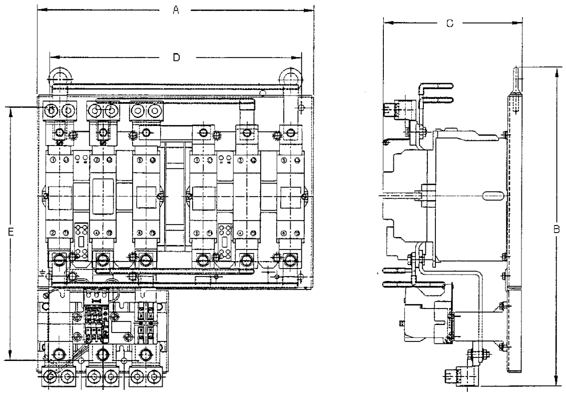
SIZE 00-2



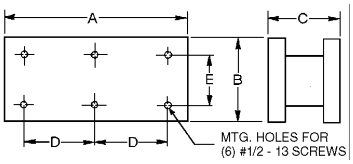
SIZE 3



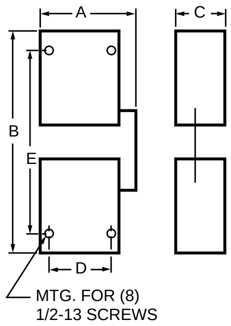
SIZE 4-5



SIZE 6



MOUNTING SCREWS #1/2 - 13
OPEN TYPE — SIZE 7-8 HORIZONTAL



SIZE 9
OPEN TYPE — VERTICAL

NEMA Size	Dimensions in Inches [mm]							Shipping Weight Lbs.
	Wide A	High B	Deep C	Mounting		F	G	
				D	E			
00-0	4.20 [106.5]	7.38 [187.5]	3.52 [89.5]	3.50 [89]	6.87 [174.5]	4.90 [124.5]	0.54 [13.7]	3.6
1	5.71 [145]	7.08 [180]	4.44 [113]	5.25 [133.5]	5.75 [146]	5.80 [147]	0.54 [13.7]	8.25
2	5.71 [145]	8.08 [205]	4.44 [113]	5.25 [133.5]	6.75 [171.5]	5.80 [147]	0.54 [13.7]	8.5
3	8.70 [221]	11.35 [288]	5.94 [151]	7.00 [178]	10.81 [275]	– – –	– – –	20.
4	14.68 [373]	12.06 [306]	7.25 [184]	13.50 [343]	8.50 [216]	– – –	– – –	49.
5	14.50 [368]	17.77 [451]	7.76 [197]	13.50 [343]	16.00 [406]	– – –	– – –	68.
6	19.77 [502]	22.63 [575]	9.90 [251]	18.00 [457]	18.00 [457]	– – –	– – –	130.
7	28.06 [713]	32.13 [816] ❶	12.70 [322]	12.75 [324]	21.25 [540]	– – –	– – –	175.
8	30.38 [772]	41.50 [1054] ❶	14.70 [373]	14.13 [359]	16.75 [425]	– – –	– – –	430.
9	33.00 [838]	63.12 [1603]	12.94 [329]	30.75 [781]	41.00 [1041]	– – –	– – –	640.

❶ Includes cross wiring overhang.

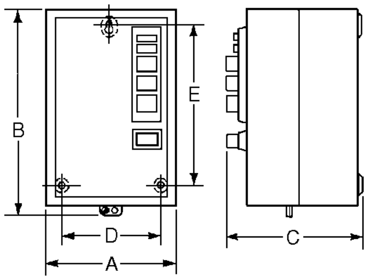
NEMA, Contactors & Starters, (Freedom)

APPROXIMATE DIMENSIONS AND SHIPPING WEIGHTS (Continued)

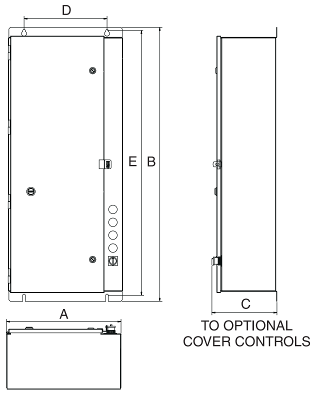
Do not use for construction.

NON-REVERSING & REVERSING CONTACTORS — ENCLOSED TYPE NEMA 1

NEMA Size (poles)	Box No.	Dimensions in Inches [mm]					Ship Wt. Lbs.
		Wide A	High B	Deep C	Mounting		
					Wide D	High E	
NON-REVERSING CONTACTORS - without Control Power Transformers							
00 (2P, 3P, 4P)	1	5.62 [143]	10.09 [256]	5.71 [145]	4.50 [114]	8.00 [203]	5.25
00 (2P, 3P, 4P) with top adders	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	7.3
0 (2P, 3P, 4P)	1	5.62 [143]	10.09 [256]	5.71 [145]	4.50 [114]	8.00 [203]	5.25
0 (2P, 3P, 4P) with top adders	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	7.3
0 (5P)	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	7.3
1 (2P, 3P)	1	5.62 [143]	10.09 [256]	5.71 [145]	4.50 [114]	8.00 [203]	7.9
1 (2P, 3P) with top adders	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	11
1 (4P, 5P)	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	8.5
2 (2P, 3P, 4P, 5P)	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	8.5
3 (2P, 3P)	4	11.66 [296]	26.51 [673]	8.89 [226]	9.00 [229]	23.38 [594]	35
4 (2P, 3P)	4	11.66 [296]	26.51 [673]	8.89 [226]	9.00 [229]	23.38 [594]	47
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	113
6		Consult Cutler-Hammer for Availability					
7							
8							
9							
NON-REVERSING CONTACTORS - with Control Power Transformers							
00 (2P, 3P, 4P)	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	12
00 (2P, 3P, 4P, 5P) with top adders	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	15
0 (2P, 3P, 4P, 5P)	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	12
0 (2P, 3P, 4P, 5P) with top adders	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	15
1 (2P, 3P)	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	12.2
1 (2P, 3P) with top adders	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	12.5
1 (4P, 5P)	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	12.6
2 (2P, 3P, 4P, 5P)	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	12.8
3 (2P, 3P)	4	11.66 [296]	26.51 [673]	8.89 [226]	9.00 [229]	23.38 [594]	40
4 (2P, 3P)	4	11.66 [296]	26.51 [673]	8.89 [226]	9.00 [229]	23.38 [594]	52
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	120
6		Consult Cutler-Hammer for Availability					
7							
8							
9							
3 POLE REVERSING CONTACTORS - without Control Power Transformers							
00	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	7.8
0	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	8
1	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	11
2	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	12
3	4	11.66 [296]	26.51 [673]	8.89 [226]	9.00 [229]	23.38 [594]	67
4	4	11.66 [296]	26.51 [673]	8.89 [226]	9.00 [229]	23.38 [594]	154
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	170
6		Consult Cutler-Hammer for Availability					
7							
8							
9							



BOXES 1-4



BOX 10

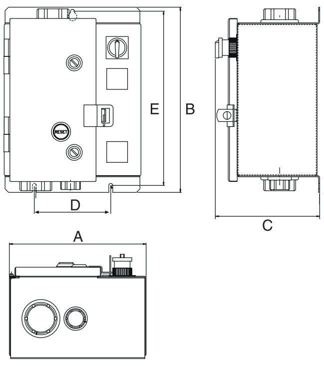
NEMA, Contactors & Starters, (Freedom)

APPROXIMATE DIMENSIONS AND SHIPPING WEIGHTS (Continued)

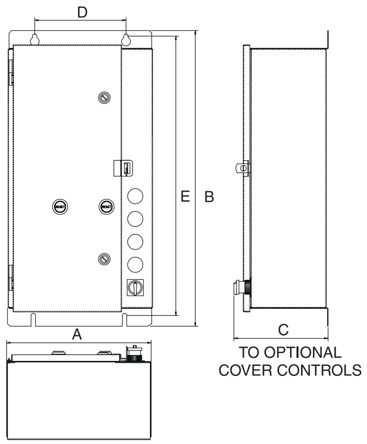
Do not use for construction.

NON-REVERSING & REVERSING CONTACTORS — ENCLOSED TYPE NEMA 3R, 4/4X & 12

NEMA Size (poles)	Box No.	Dimensions in Inches [mm]					Ship Wt. Lbs.
		Wide A	High B	Deep C	Mounting Wide D	Mounting High E	
NON-REVERSING CONTACTORS - without Control Power Transformers							
0 (2P, 3P, 4P)	5	9.84 [250]	13.31 [338]	7.51 [191]	5.50 [140]	12.50 [3.18]	14
1 (2P, 3P, 4P, 5P)	5	9.84 [250]	13.31 [338]	7.51 [191]	5.50 [140]	12.50 [3.18]	15
2 (2P, 3P, 4P, 5P)	5	9.84 [250]	13.31 [338]	7.51 [191]	5.50 [140]	12.50 [3.18]	15.5
3 (2P, 3P)	8	14.25 [362]	29.10 [739]	9.29 [234]	9.00 [229]	27.50 [699]	45
4 (2P, 3P)	8	14.25 [362]	29.10 [739]	9.29 [234]	9.00 [229]	27.50 [699]	56
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	140
6		Consult Cutler-Hammer for Availability					
7							
8							
9							
NON-REVERSING CONTACTORS - with Control Power Transformers							
0 (2P, 3P, 4P)	5	9.84 [250]	13.31 [338]	7.51 [191]	5.50 [140]	12.50 [3.18]	18
1 (2P, 3P, 4P, 5P)	6	12.01 [305]	14.39 [366]	7.51 [191]	8.00 [203]	13.50 [343]	19
2 (2P, 3P, 4P, 5P)	6	12.01 [305]	14.39 [366]	7.51 [191]	8.00 [203]	13.50 [343]	19.5
3 (2P, 3P)	8	14.25 [362]	29.10 [739]	9.29 [234]	9.00 [229]	27.50 [699]	52
4 (2P, 3P)	8	14.25 [362]	29.10 [739]	9.29 [234]	9.00 [229]	27.50 [699]	63
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	147
6		Consult Cutler-Hammer for Availability					
7							
8							
9							
3 POLE REVERSING CONTACTORS - with or without Control Power Transformers							
0	6	12.01 [305]	14.39 [366]	7.51 [191]	8.00 [203]	13.50 [343]	18
1	6	12.01 [305]	14.39 [366]	7.51 [191]	8.00 [203]	13.50 [343]	19
2	6	12.01 [305]	14.39 [366]	7.51 [191]	8.00 [203]	13.50 [343]	19
3	8	14.25 [362]	29.10 [739]	9.29 [234]	9.00 [229]	27.50 [699]	47
4	8	14.25 [362]	29.10 [739]	9.29 [234]	9.00 [229]	27.50 [699]	69
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	170
6		Consult Cutler-Hammer for Availability					
7							
8							
9							



BOXES 5, 6



TO OPTIONAL COVER CONTROLS

BOXES 8, 10

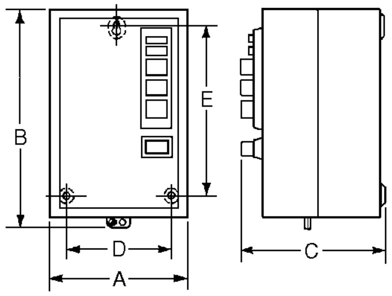
NEMA, Contactors & Starters, (Freedom)

APPROXIMATE DIMENSIONS AND SHIPPING WEIGHTS (Continued)

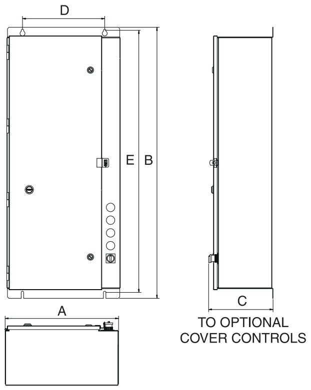
Do not use for construction.

NON-REVERSING & REVERSING STARTERS — ENCLOSED TYPE NEMA 1

NEMA Size (poles)	Box No.	Dimensions in Inches [mm]					Ship Wt. Lbs.
		Wide A	High B	Deep C	Mounting		
					Wide D	High E	
NON-REVERSING STARTERS Without Control Power Transformers							
00	1	5.62 [143]	10.09 [256]	5.71 [145]	4.50 [114]	8.00 [203]	7
00 with top adders	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	10
0	1	5.62 [143]	10.09 [256]	5.71 [145]	4.50 [114]	8.00 [203]	7.1
0 with top adders	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	10
1	1	5.62 [143]	10.09 [256]	5.71 [145]	4.50 [114]	8.00 [203]	7.9
1 with top adders	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	11.5
2	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	8.5
3	4	11.66 [296]	26.51 [673]	8.89 [226]	9.00 [229]	23.38 [594]	35
4	4	11.66 [296]	26.51 [673]	8.89 [226]	9.00 [229]	23.38 [594]	47
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	139
6		Consult Cutler-Hammer for Availability					
7							
8							
9							
NON-REVERSING STARTERS With Control Power Transformers							
00	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	15
0	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	15
1	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	16
2	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	16.2
3	4	11.66 [296]	26.51 [673]	8.89 [226]	9.00 [229]	23.38 [594]	42
4	4	11.66 [296]	26.51 [673]	8.89 [226]	9.00 [229]	23.38 [594]	54
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	146
6		Consult Cutler-Hammer for Availability					
7							
8							
9							
REVERSING STARTERS Without Control Power Transformers							
00	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	8
0	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	8
0 with top adders	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	11
1	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	13
1 with top adders	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	13.4
2	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	15
3	4	11.66 [296]	26.51 [673]	8.89 [226]	9.00 [229]	23.38 [594]	43
4	9	25.50 [648]	29.10 [739]	9.31 [237]	20.00 [508]	27.50 [699]	65
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	165
6		Consult Cutler-Hammer for Availability					
7							
8							
9							
REVERSING STARTERS With Control Power Transformers							
00 with top adders	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	15
0	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	15
1 with top adders	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	17
2	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	19
3	4	11.66 [296]	26.51 [673]	8.89 [226]	9.00 [229]	23.38 [594]	50
4	9	25.50 [648]	29.10 [739]	9.31 [237]	20.00 [508]	27.50 [699]	72
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	172
6		Consult Cutler-Hammer for Availability					
7							
8							
9							



BOXES 1-4



BOXES 9-10

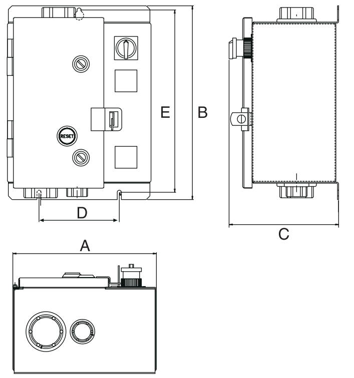
NEMA, Contactors & Starters, (Freedom)

APPROXIMATE DIMENSIONS AND SHIPPING WEIGHTS (Continued)

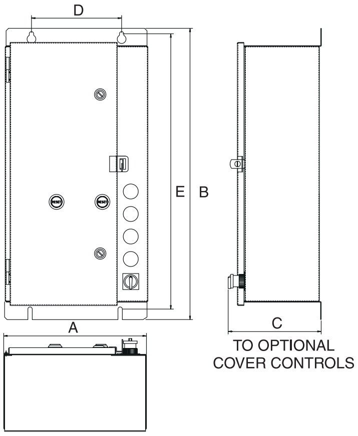
Do not use for construction.

NON-REVERSING & REVERSING STARTERS — ENCLOSED TYPE
NEMA 3R, 4/4X & 12

NEMA Size (poles)	Box No.	Dimensions in Inches [mm]					Ship Wt. Lbs.
		Wide A	High B	Deep C	Mounting		
					Wide D	High E	
NON-REVERSING STARTERS - without Control Power Transformers							
0	5	9.84 [250]	13.31 [338]	7.51 [191]	5.50 [140]	12.50 [318]	14.3
1	5	9.84 [250]	13.31 [338]	7.51 [191]	5.50 [140]	12.50 [318]	15.3
2	6	12.01 [305]	14.39 [366]	7.51 [191]	8.00 [203]	13.50 [343]	16
3	8	14.25 [362]	29.10 [739]	9.29 [234]	9.00 [229]	27.50 [699]	46
4	8	14.25 [362]	29.10 [739]	9.29 [234]	9.00 [229]	27.50 [699]	60
4	9	25.50 [648]	29.10 [739]	9.31 [237]	20.00 [508]	27.50 [699]	60
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	150
6		Consult Cutler-Hammer for Availability					
7							
8							
9							
NON-REVERSING STARTERS - with Control Power Transformers							
0	6	12.01 [305]	14.39 [366]	7.51 [191]	8.00 [203]	13.50 [343]	18
1	6	12.01 [305]	14.39 [366]	7.51 [191]	8.00 [203]	13.50 [343]	19
2	6	12.01 [305]	14.39 [366]	7.51 [191]	8.00 [203]	13.50 [343]	20
3	8	14.25 [362]	29.10 [739]	9.29 [234]	9.00 [229]	27.50 [699]	53
4	8	14.25 [362]	29.10 [739]	9.29 [234]	9.00 [229]	27.50 [699]	67
4	9	25.50 [648]	29.10 [739]	9.31 [237]	20.00 [508]	27.50 [699]	67
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	157
6		Consult Cutler-Hammer for Availability					
7							
8							
9							
REVERSING STARTERS - with or without Control Power Transformers							
0	6	12.01 [305]	14.39 [366]	7.51 [191]	8.00 [203]	13.50 [343]	18.5
1	6	12.01 [305]	14.39 [366]	7.51 [191]	8.00 [203]	13.50 [343]	19.5
2	6	12.01 [305]	14.39 [366]	7.51 [191]	8.00 [203]	13.50 [343]	21
1-2	7	16.26 [413]	14.37 [365]	7.51 [191]	11.00 [279]	13.50 [343]	24
3	8	14.25 [362]	29.10 [739]	9.29 [234]	9.00 [229]	27.50 [699]	48
4	9	25.50 [648]	29.10 [739]	9.31 [237]	20.00 [508]	27.50 [699]	72
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	175
6		Consult Cutler-Hammer for Availability					
7							
8							
9							



BOXES 5, 6, 7, 9

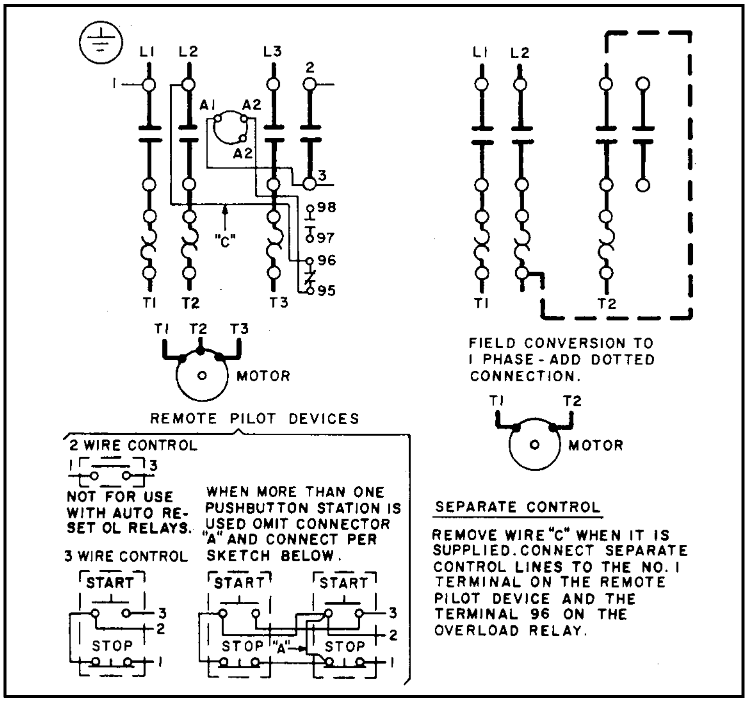


BOXES 8, 10

NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS

NON-REVERSING STARTERS



FIELD CONVERSION TO 1 PHASE - ADD DOTTED CONNECTION.

REMOTE PILOT DEVICES

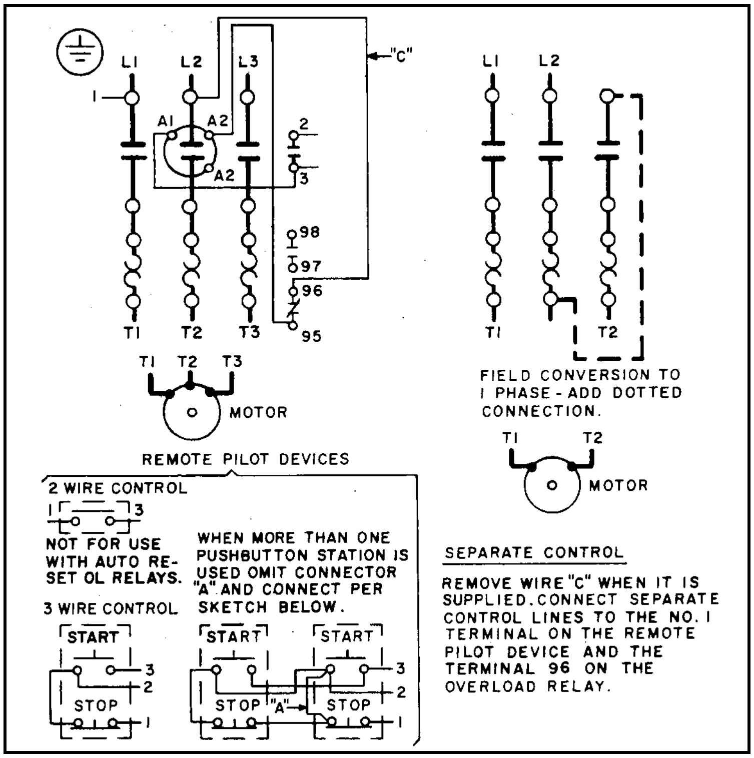
NOT FOR USE WITH AUTO RESET OL RELAYS.

WHEN MORE THAN ONE PUSHBUTTON STATION IS USED OMIT CONNECTOR "A" AND CONNECT PER SKETCH BELOW.

SEPARATE CONTROL

REMOVE WIRE "C" WHEN IT IS SUPPLIED. CONNECT SEPARATE CONTROL LINES TO THE NO. 1 TERMINAL ON THE REMOTE PILOT DEVICE AND THE TERMINAL 96 ON THE OVERLOAD RELAY.

SIZE 00



FIELD CONVERSION TO 1 PHASE - ADD DOTTED CONNECTION.

REMOTE PILOT DEVICES

NOT FOR USE WITH AUTO RESET OL RELAYS.

WHEN MORE THAN ONE PUSHBUTTON STATION IS USED OMIT CONNECTOR "A" AND CONNECT PER SKETCH BELOW.

SEPARATE CONTROL

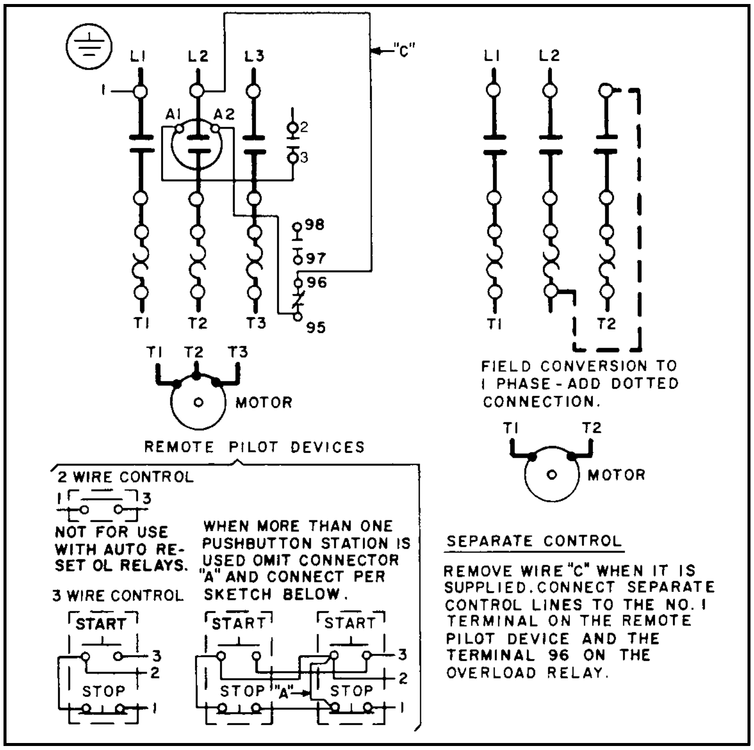
REMOVE WIRE "C" WHEN IT IS SUPPLIED. CONNECT SEPARATE CONTROL LINES TO THE NO. 1 TERMINAL ON THE REMOTE PILOT DEVICE AND THE TERMINAL 96 ON THE OVERLOAD RELAY.

SIZE 0

NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

NON-REVERSING STARTERS (Continued)



FIELD CONVERSION TO 1 PHASE - ADD DOTTED CONNECTION.

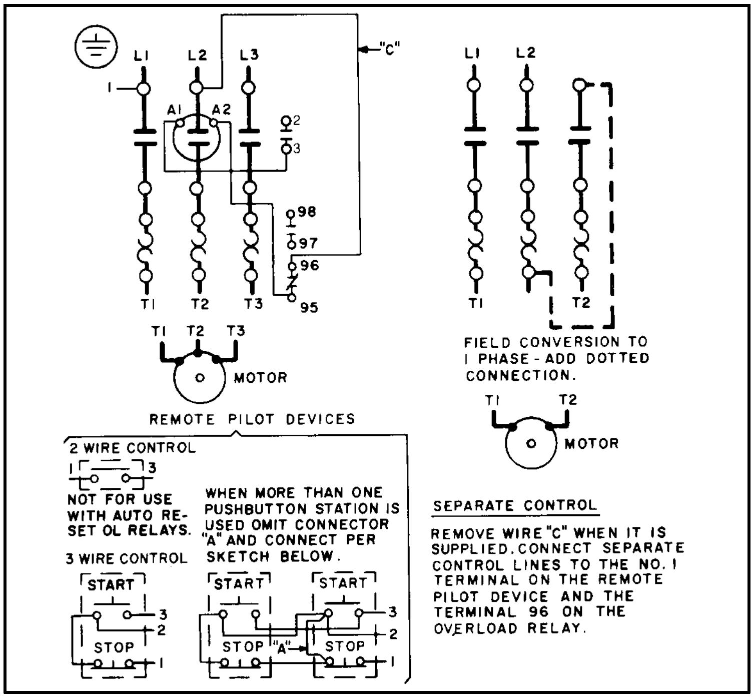
NOT FOR USE WITH AUTO RESET OL RELAYS.

WHEN MORE THAN ONE PUSHBUTTON STATION IS USED OMIT CONNECTOR "A" AND CONNECT PER SKETCH BELOW.

SEPARATE CONTROL

REMOVE WIRE "C" WHEN IT IS SUPPLIED. CONNECT SEPARATE CONTROL LINES TO THE NO. 1 TERMINAL ON THE REMOTE PILOT DEVICE AND THE TERMINAL 96 ON THE OVERLOAD RELAY.

SIZES 1 & 2



FIELD CONVERSION TO 1 PHASE - ADD DOTTED CONNECTION.

NOT FOR USE WITH AUTO RESET OL RELAYS.

WHEN MORE THAN ONE PUSHBUTTON STATION IS USED OMIT CONNECTOR "A" AND CONNECT PER SKETCH BELOW.

SEPARATE CONTROL

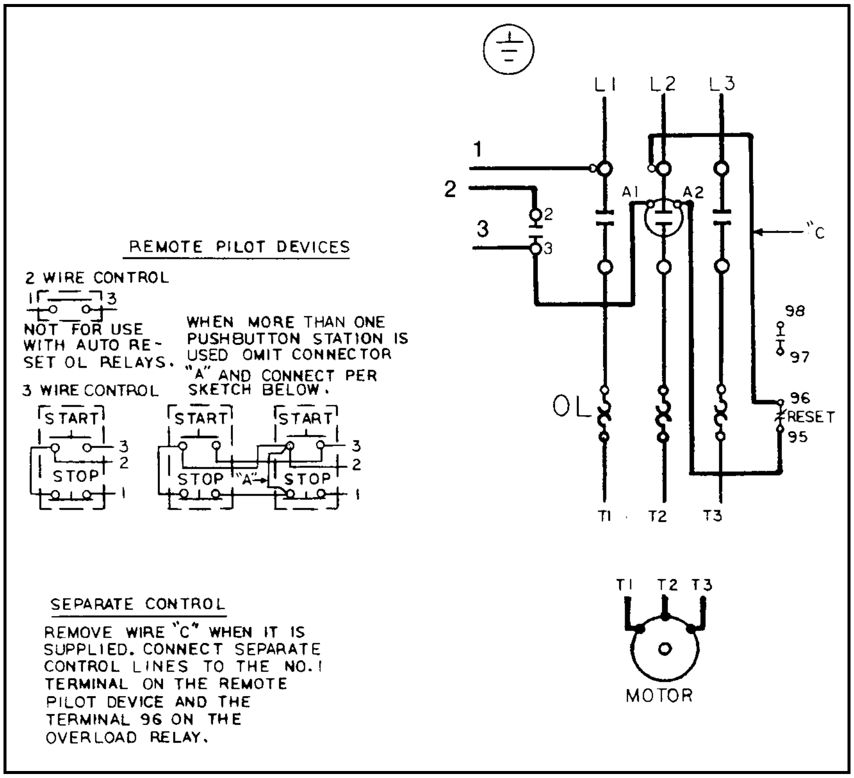
REMOVE WIRE "C" WHEN IT IS SUPPLIED. CONNECT SEPARATE CONTROL LINES TO THE NO. 1 TERMINAL ON THE REMOTE PILOT DEVICE AND THE TERMINAL 96 ON THE OVERLOAD RELAY.

SIZE 3

NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

NON-REVERSING STARTERS (Continued)



REMOTE PILOT DEVICES

2 WIRE CONTROL

NOT FOR USE WITH AUTO RESET OL RELAYS.

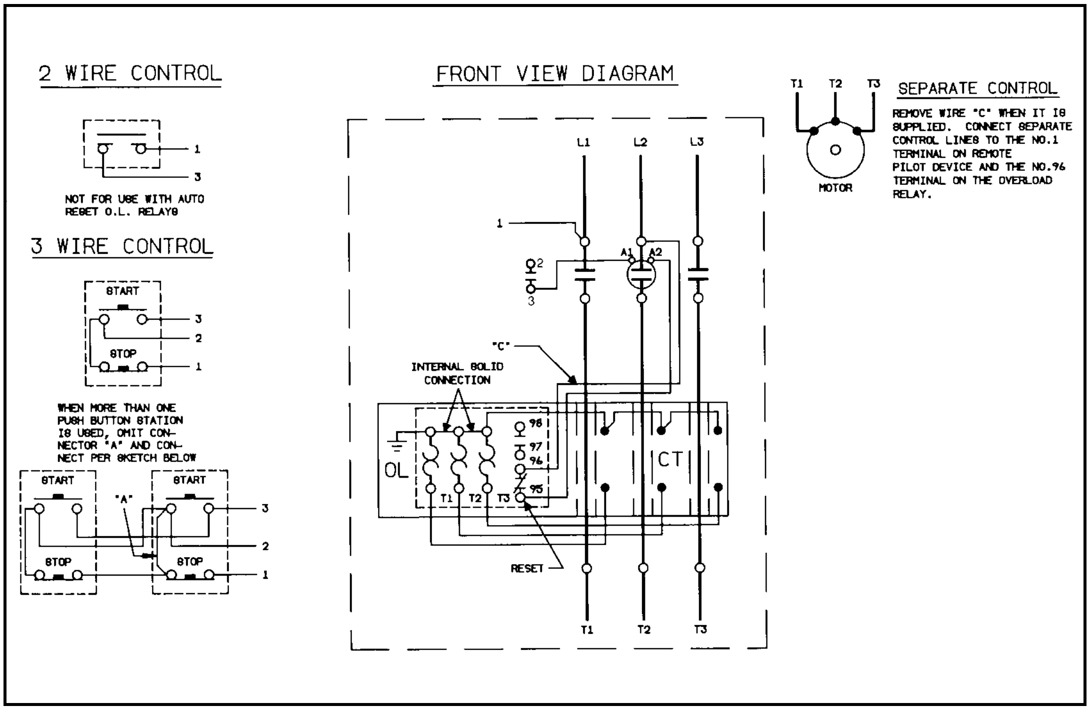
3 WIRE CONTROL

WHEN MORE THAN ONE PUSHBUTTON STATION IS USED OMIT CONNECTOR "A" AND CONNECT PER SKETCH BELOW.

SEPARATE CONTROL

REMOVE WIRE "C" WHEN IT IS SUPPLIED. CONNECT SEPARATE CONTROL LINES TO THE NO. 1 TERMINAL ON THE REMOTE PILOT DEVICE AND THE TERMINAL 96 ON THE OVERLOAD RELAY.

SIZE 4



2 WIRE CONTROL

NOT FOR USE WITH AUTO RESET O.L. RELAYS

3 WIRE CONTROL

WHEN MORE THAN ONE PUSH BUTTON STATION IS USED, OMIT CONNECTOR "A" AND CONNECT PER SKETCH BELOW

SEPARATE CONTROL

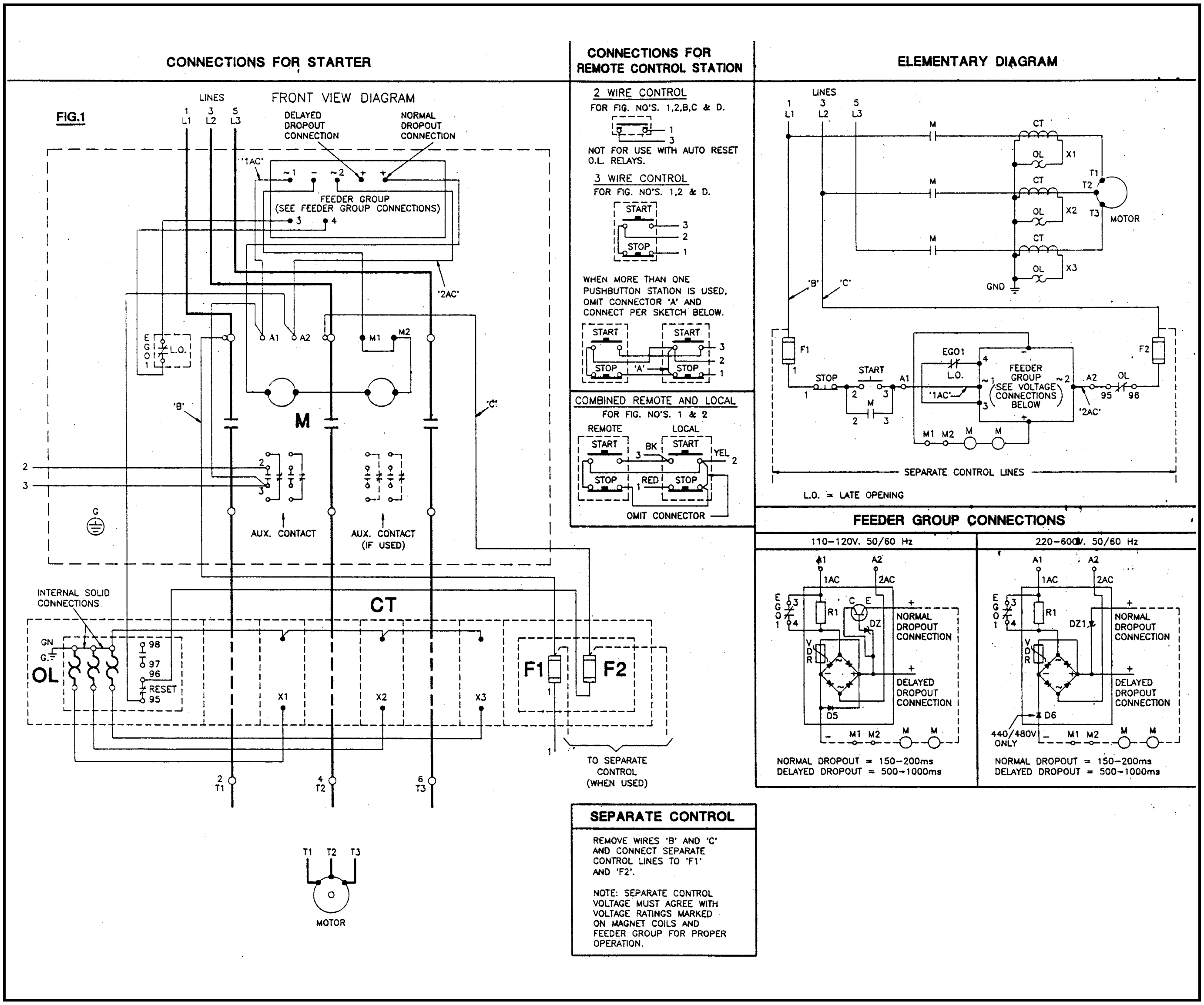
REMOVE WIRE "C" WHEN IT IS SUPPLIED. CONNECT SEPARATE CONTROL LINES TO THE NO.1 TERMINAL ON REMOTE PILOT DEVICE AND THE NO.96 TERMINAL ON THE OVERLOAD RELAY.

SIZE 5

NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

NON-REVERSING STARTERS (Continued)

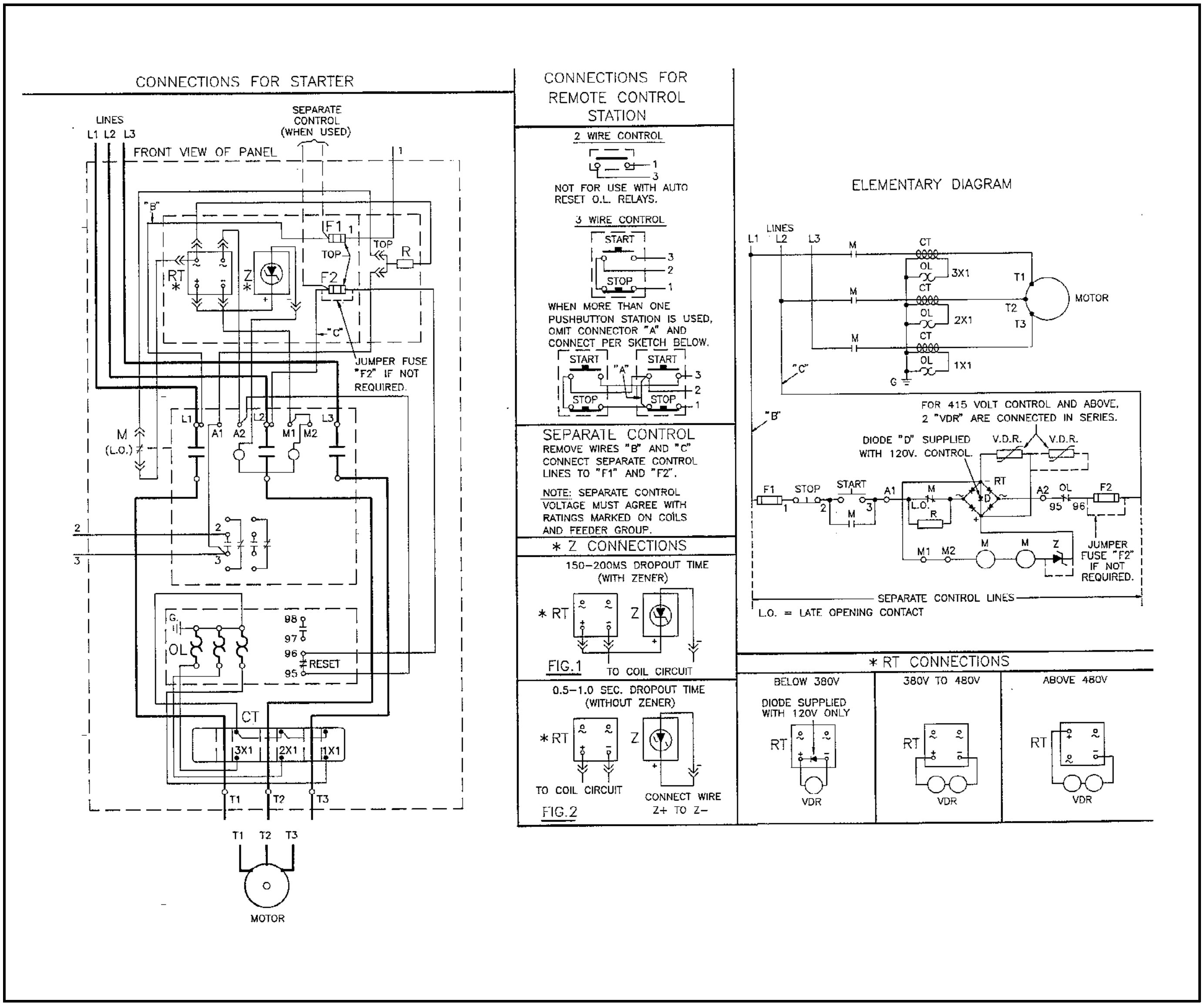


SIZE 6

NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

NON-REVERSING STARTERS (Continued)

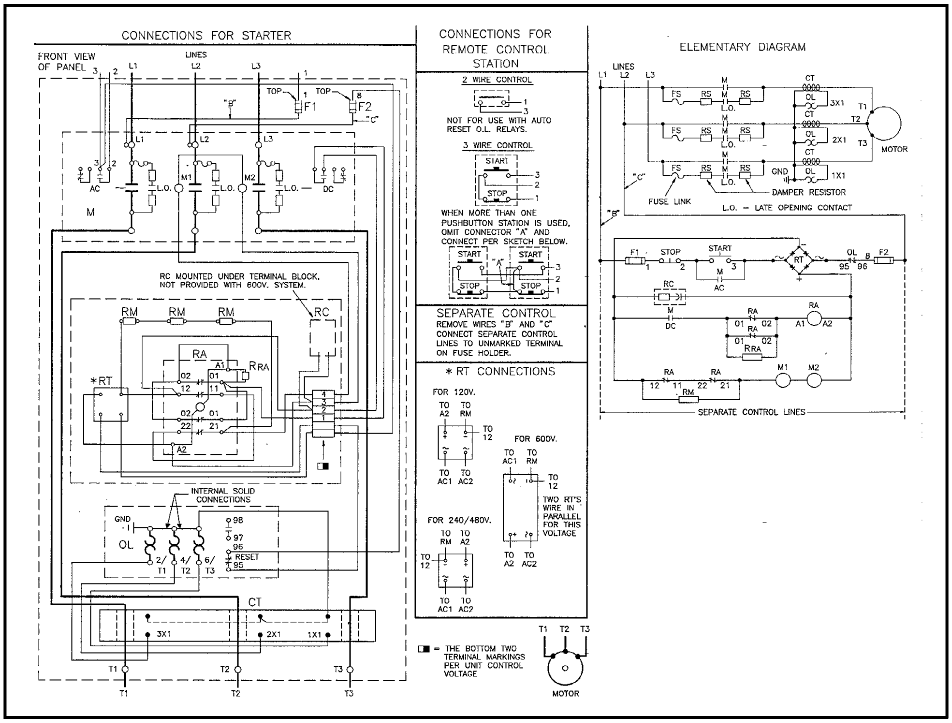


SIZE 7

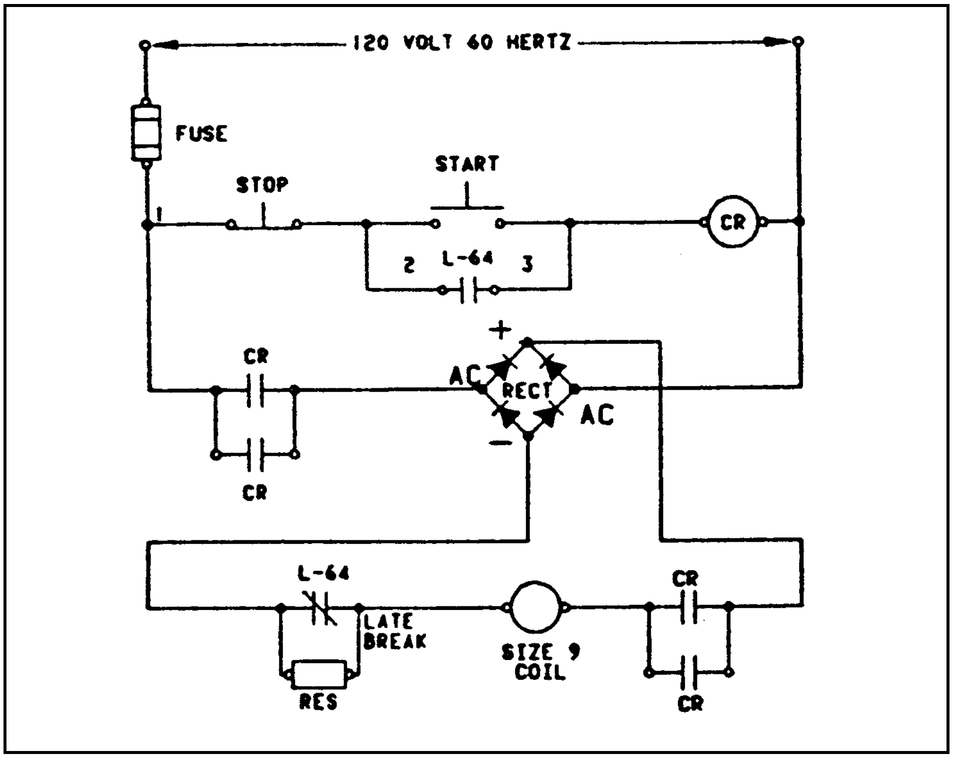
NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

NON-REVERSING STARTERS (Continued)



SIZE 8



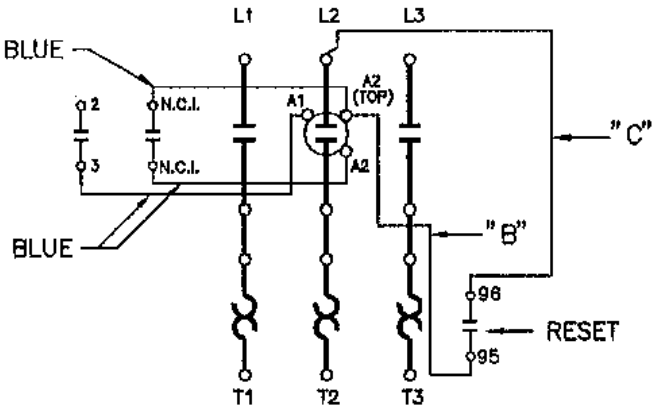
SIZE 9
CONTROL CIRCUIT

NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

TYPICAL DC CONTROL WIRING DIAGRAM

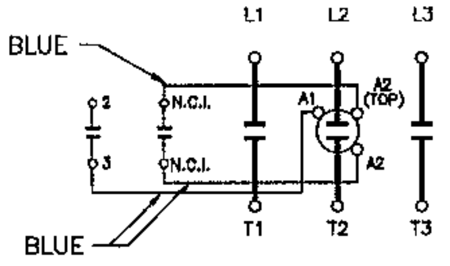
TYPICAL STARTER DIAGRAM



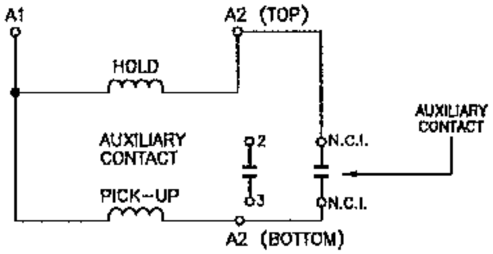
SEPARATE CONTROL

1. REMOVE WIRE "C" (WHEN SUPPLIED).
2. REMOVE RED CONTROL WIRE FROM TERMINAL NO.A2 (BOTTOM) TO TERMINAL NO.95 OF OVERLOAD RELAY.
3. CONNECT RED CONTROL WIRE "B" FROM TERMINAL NO.A2 (TOP) TO TERMINAL NO.95 OF THE OVERLOAD RELAY.
4. CONNECT SEPARATE CONTROL LINES TO THE NO.1 TERMINAL OF THE REMOTE PILOT DEVICE AND TO THE NO.96 TERMINAL OF THE OVERLOAD RELAY.

TYPICAL CONTACTOR DIAGRAM



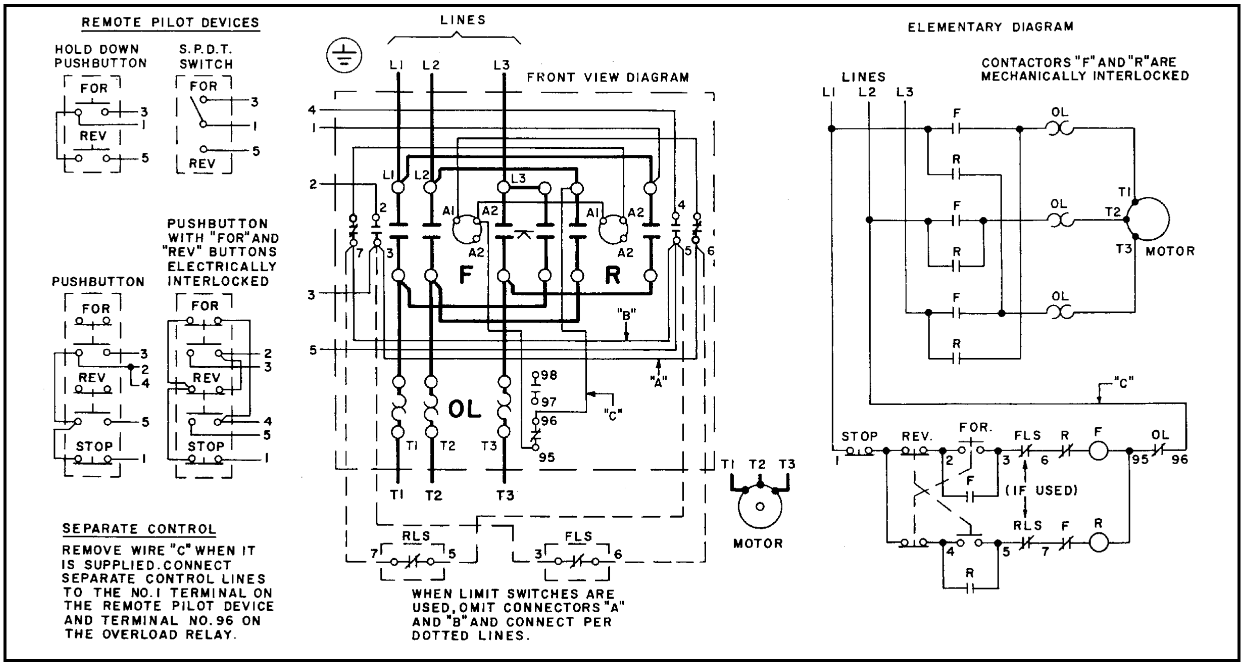
D.C. COIL ELEMENTARY DIAGRAM



NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

REVERSING STARTERS

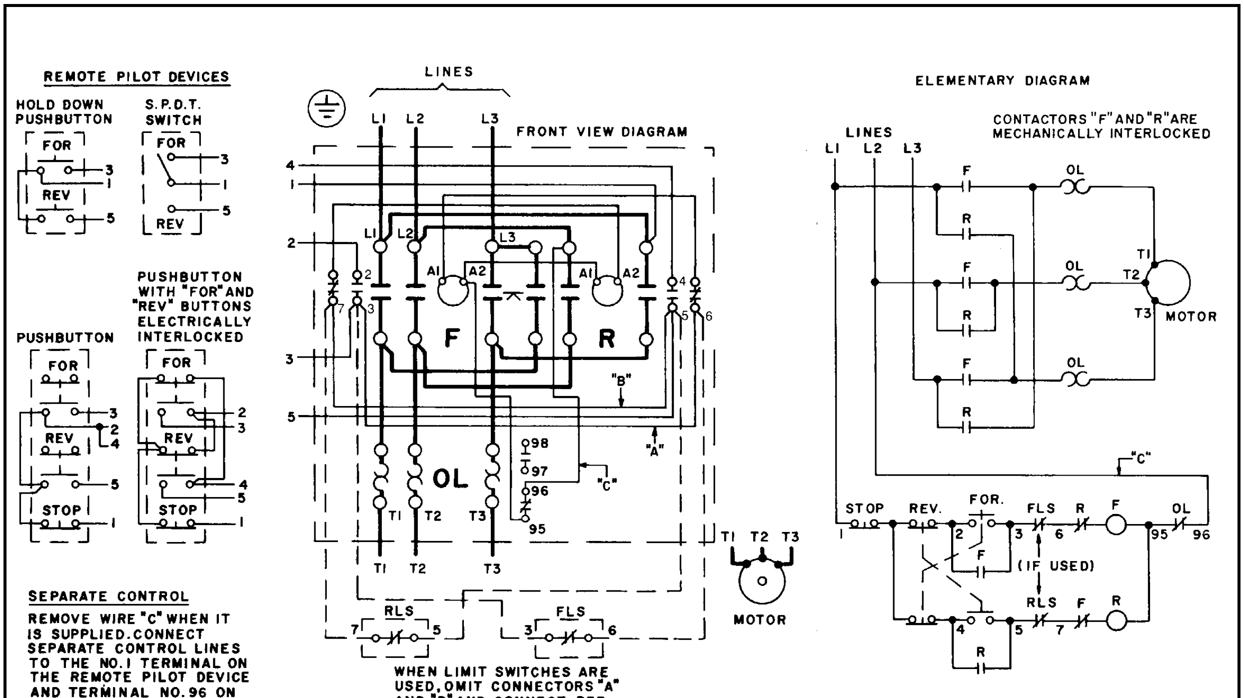


SEPARATE CONTROL
REMOVE WIRE "C" WHEN IT IS SUPPLIED. CONNECT SEPARATE CONTROL LINES TO THE NO. 1 TERMINAL ON THE REMOTE PILOT DEVICE AND TERMINAL NO. 96 ON THE OVERLOAD RELAY.

WHEN LIMIT SWITCHES ARE USED, OMIT CONNECTORS "A" AND "B" AND CONNECT PER DOTTED LINES.

CONTACTORS "F" AND "R" ARE MECHANICALLY INTERLOCKED

SIZES 00 & 0



SEPARATE CONTROL
REMOVE WIRE "C" WHEN IT IS SUPPLIED. CONNECT SEPARATE CONTROL LINES TO THE NO. 1 TERMINAL ON THE REMOTE PILOT DEVICE AND TERMINAL NO. 96 ON THE OVERLOAD RELAY.

WHEN LIMIT SWITCHES ARE USED, OMIT CONNECTORS "A" AND "B" AND CONNECT PER DOTTED LINES.

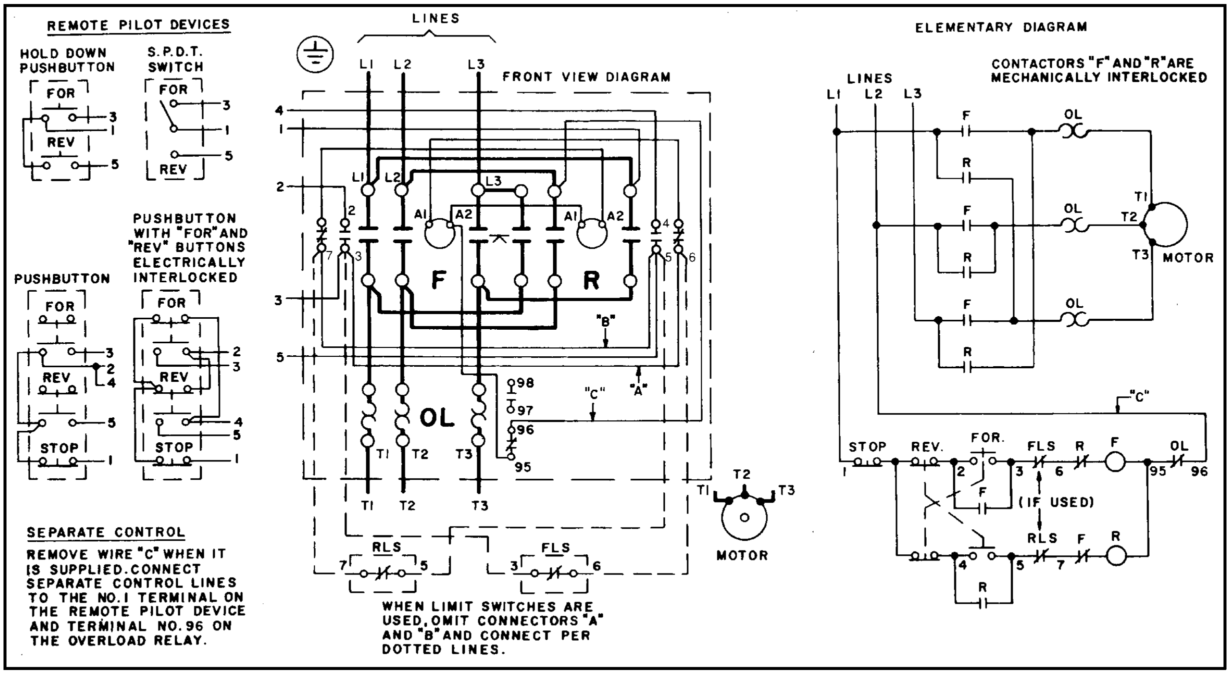
CONTACTORS "F" AND "R" ARE MECHANICALLY INTERLOCKED

SIZES 1 & 2

NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

REVERSING STARTERS (Continued)

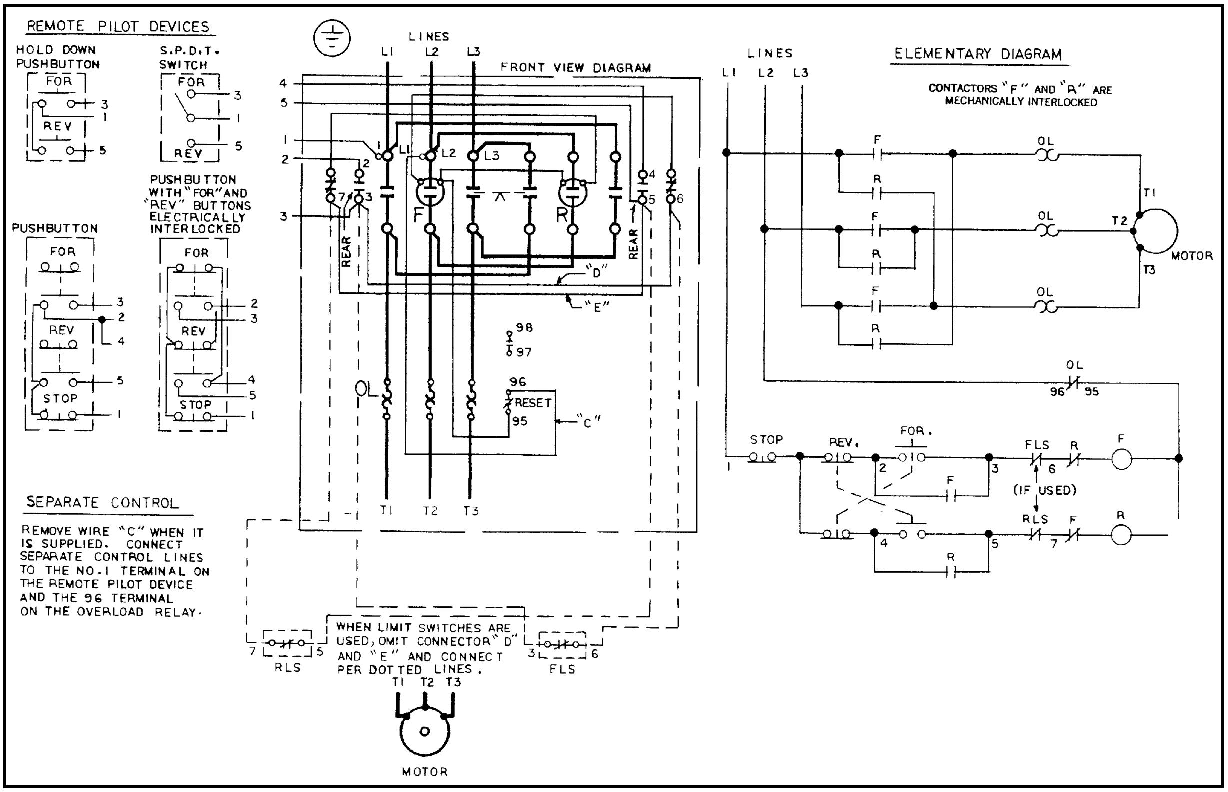


SEPARATE CONTROL

REMOVE WIRE "C" WHEN IT IS SUPPLIED. CONNECT SEPARATE CONTROL LINES TO THE NO. 1 TERMINAL ON THE REMOTE PILOT DEVICE AND TERMINAL NO. 96 ON THE OVERLOAD RELAY.

WHEN LIMIT SWITCHES ARE USED, OMIT CONNECTORS "A" AND "B" AND CONNECT PER DOTTED LINES.

SIZE 3



SEPARATE CONTROL

REMOVE WIRE "C" WHEN IT IS SUPPLIED. CONNECT SEPARATE CONTROL LINES TO THE NO. 1 TERMINAL ON THE REMOTE PILOT DEVICE AND THE 96 TERMINAL ON THE OVERLOAD RELAY.

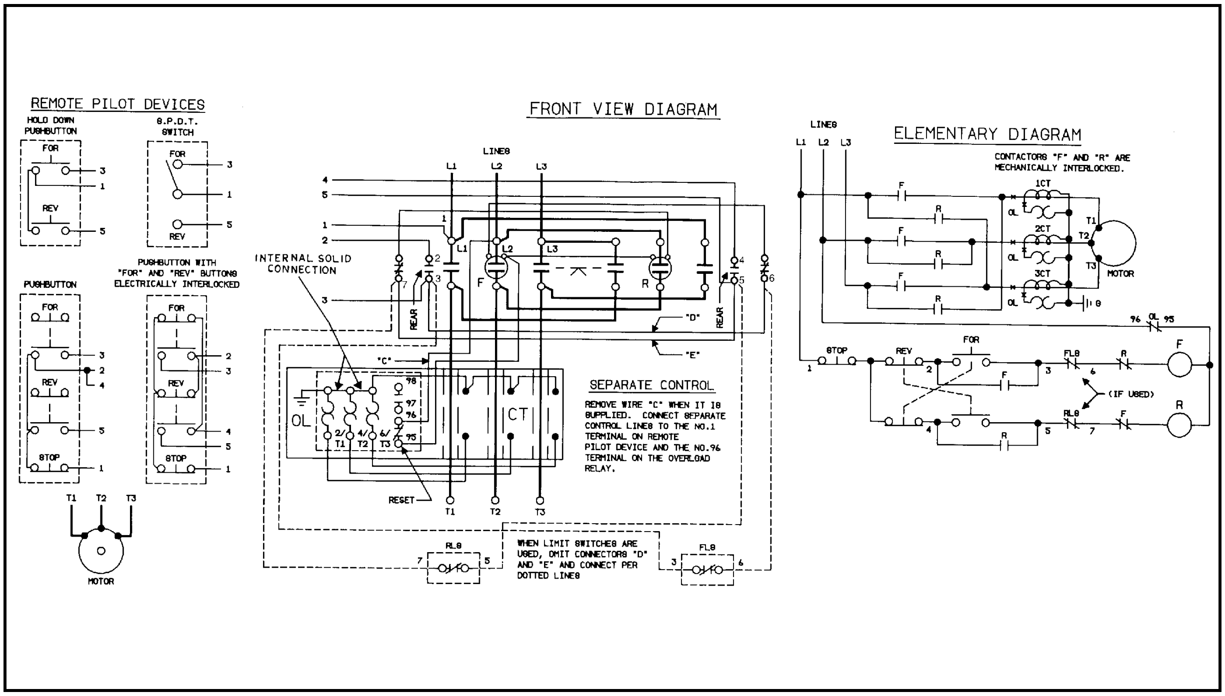
WHEN LIMIT SWITCHES ARE USED, OMIT CONNECTOR "D" AND "E" AND CONNECT PER DOTTED LINES.

SIZE 4

NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

REVERSING STARTERS (Continued)



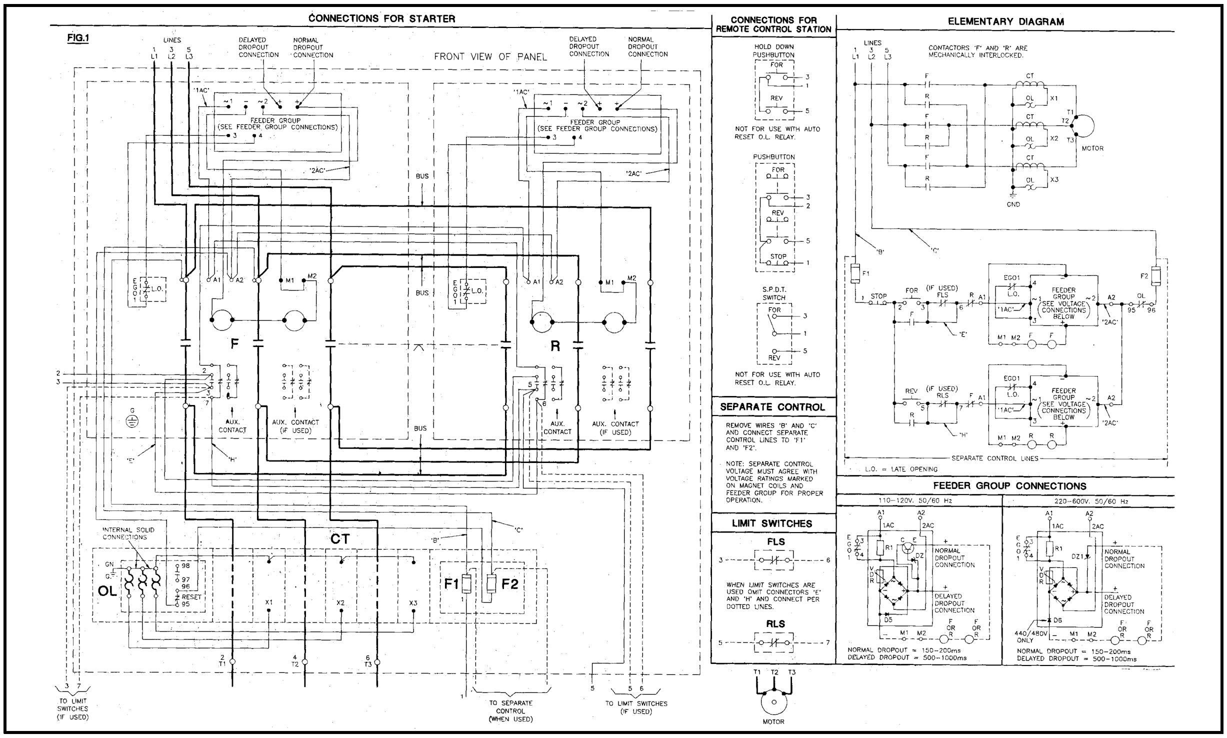
SEPARATE CONTROL

REMOVE WIRE "C" WHEN IT IS SUPPLIED. CONNECT SEPARATE CONTROL LINES TO THE NO.1 TERMINAL ON REMOTE PILOT DEVICE AND THE NO.96 TERMINAL ON THE OVERLOAD RELAY.

WHEN LIMIT SWITCHES ARE USED, OMIT CONNECTORS "D" AND "E" AND CONNECT PER DOTTED LINES

CONTACTORS "F" AND "R" ARE MECHANICALLY INTERLOCKED.

SIZE 5



NOT FOR USE WITH AUTO RESET O.L. RELAY.

NOT FOR USE WITH AUTO RESET O.L. RELAY.

SEPARATE CONTROL

REMOVE WIRES 'B' AND 'C' AND CONNECT SEPARATE CONTROL LINES TO 'F1' AND 'F2'.

NOTE: SEPARATE CONTROL VOLTAGE MUST AGREE WITH VOLTAGE RATINGS MARKED ON MAGNET COILS AND FEEDER GROUP FOR PROPER OPERATION.

WHEN LIMIT SWITCHES ARE USED OMIT CONNECTORS 'E' AND 'H' AND CONNECT PER DOTTED LINES.

CONTACTORS 'F' AND 'R' ARE MECHANICALLY INTERLOCKED.

L.O. = LATE OPENING

NORMAL DROPOUT = 150-200ms
DELAYED DROPOUT = 500-1000ms

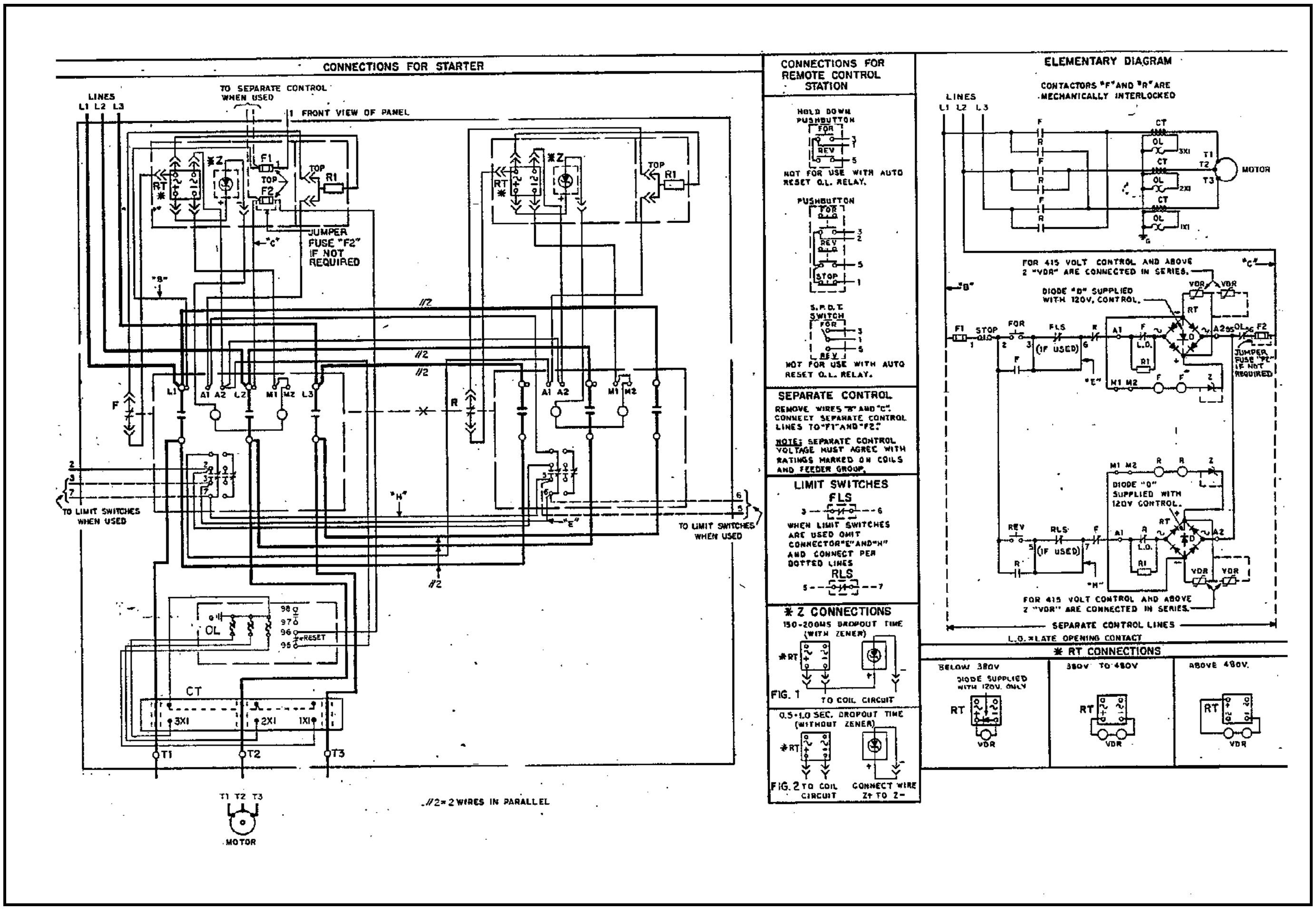
NORMAL DROPOUT = 150-200ms
DELAYED DROPOUT = 500-1000ms

SIZE 6

NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

REVERSING STARTERS (Continued)

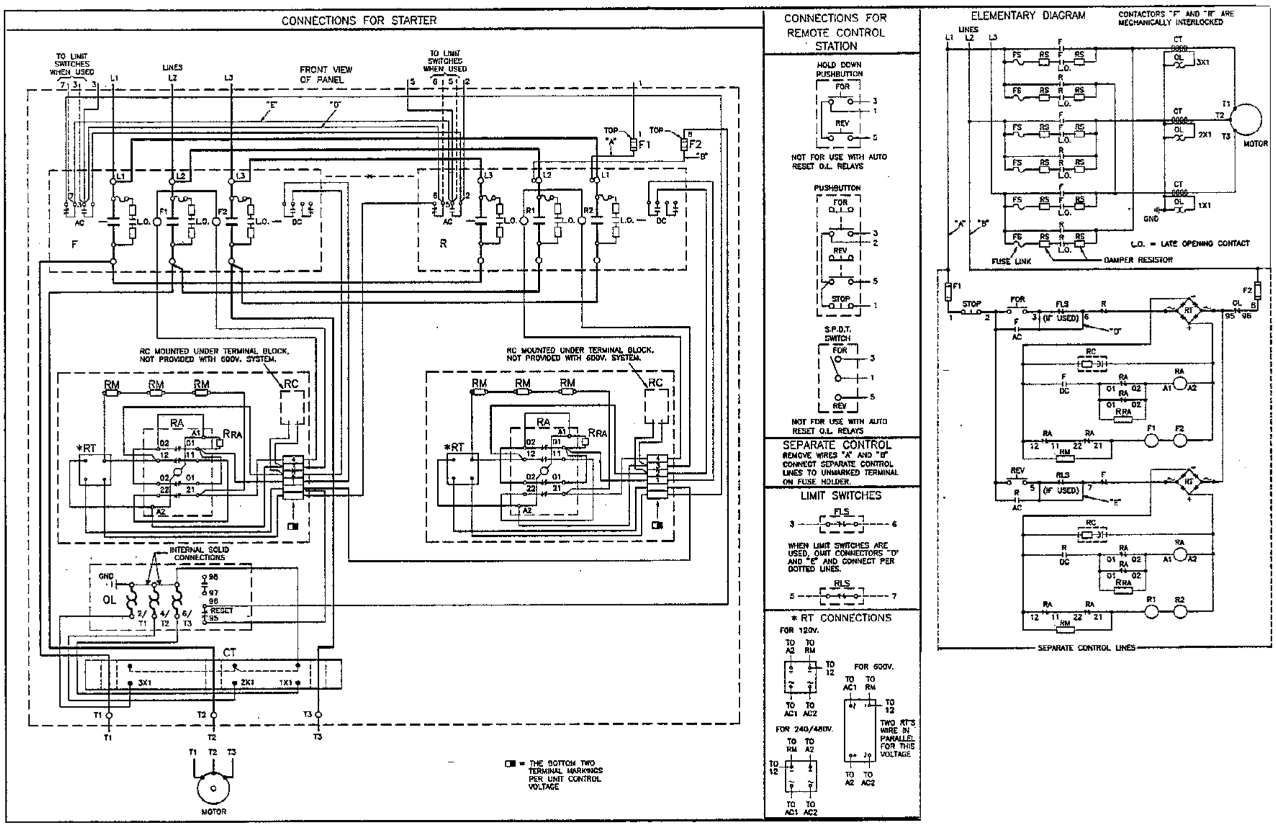


SIZE 7

NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

REVERSING STARTERS (Continued)

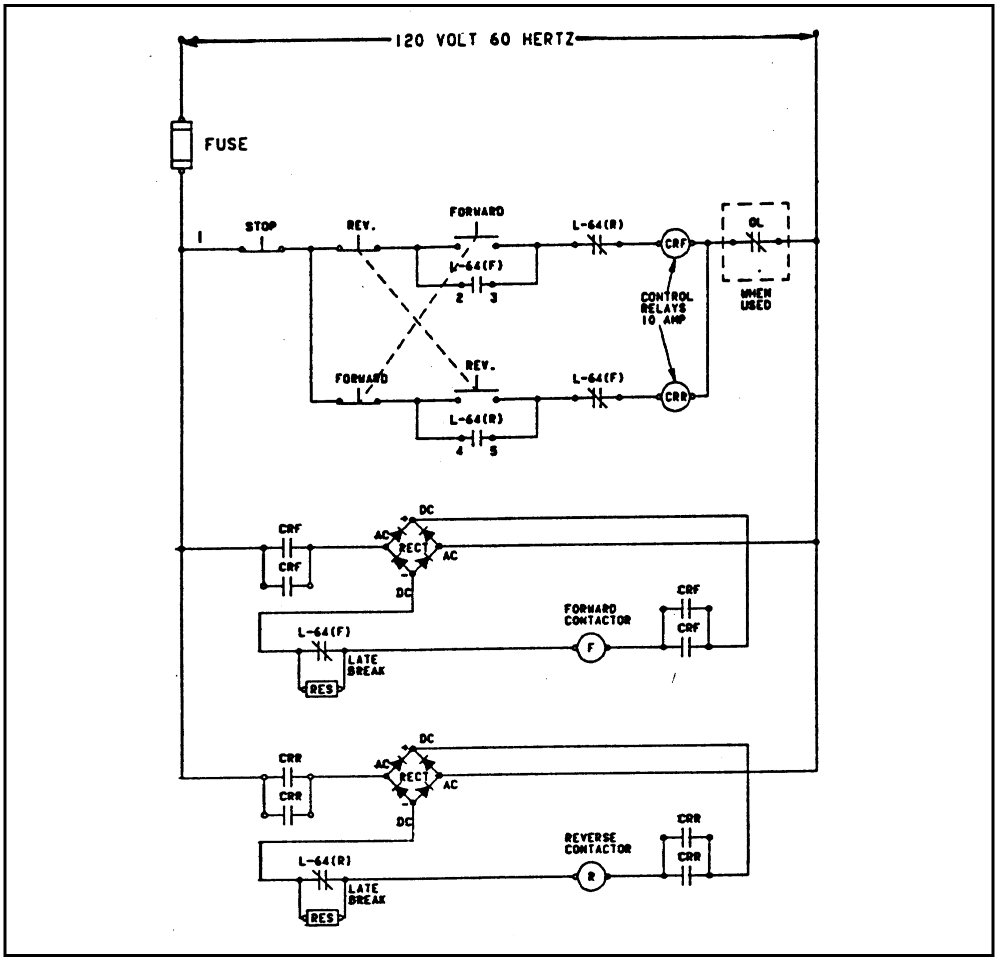


SIZE 8

NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

REVERSING STARTERS (Continued)

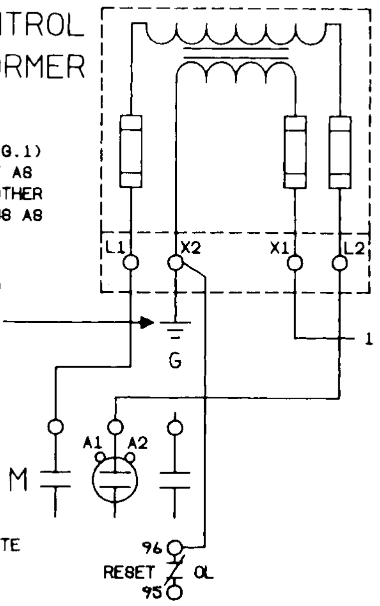


SIZE 9 — CONTROL CIRCUIT

NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

FIG.2 FUSIBLE CONTROL TRANSFORMER



REMOVE WIRE "C" (FIG.1) IF USED AND CONNECT AS SHOWN BELOW. (ALL OTHER STARTER WIRE REMAINS AS SHOWN IN FIG.1).

(CUSTOMER NOTE)
REMOVE GREEN
GROUND WIRE
IF NOT REQ'D.

CONNECTIONS FOR
DUAL VOLTAGE RATED
TRANSFORMER - SEE
TRANSFORMER NAMEPLATE

FIG.A START-STOP PUSHBUTTON

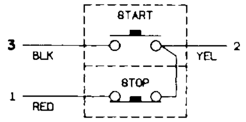


FIG.B 3-POSITION SELECTOR SWITCH

REMOVE LEAD FROM LEFT COIL TERMINAL TO TERMINAL NO.3

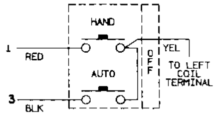
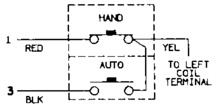


FIG.C 2-POSITION SELECTOR SWITCH

REMOVE LEAD FROM LEFT COIL TERMINAL TO TERMINAL NO.3



ACCESSORIES

FIG.D PILOT LIGHT

CONNECT
TO COIL
TERMINALS

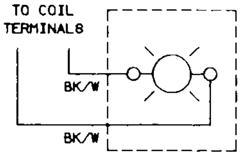
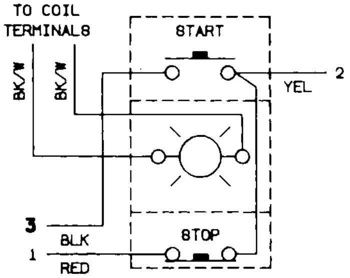


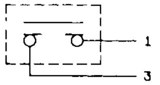
FIG.E START-STOP WITH PILOT LIGHT

CONNECT
TO COIL
TERMINALS



2 WIRE CONTROL

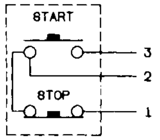
FOR FIG. NO.1, 2, B, C & D



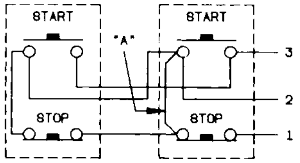
NOT FOR USE WITH AUTO RESET O.L. RELAYS

3 WIRE CONTROL

FOR FIG. NO.1, 2, & D

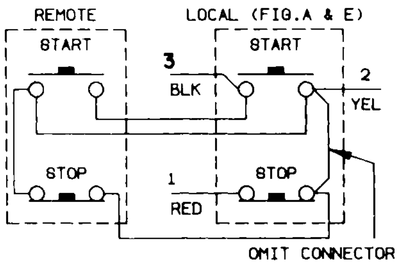


WHEN MORE THAN ONE PUSH BUTTON STATION IS USED, OMIT CONNECTOR "A" AND CONNECT PER SKETCH BELOW



COMBINED REMOTE AND LOCAL

FIG.1, 2, A & E



ACCESSORIES

EATON

Powering Business Worldwide

Instructional Leaflet **IL04210001E**

Effective April 2020
Supersedes November 2018

C440 NEMA Electronic Overload
- Self Powered

Dangerous Electrical Current!
Only skilled qualified persons may carry out the following operations.

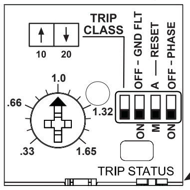
WARNING

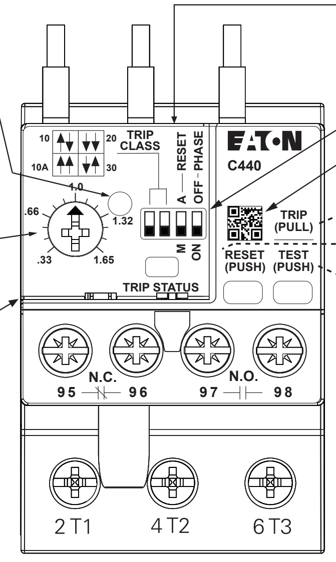
Automatic or network reset is not intended for two-wire control devices.

Un renclenchement automatique ou un de réseau ne convient pas aux dispositifs de contrôle a deux conducteurs.

Unit status	LED
Motor is running. Current < 1.15 Times Dial Seeting.	1 Flash/ 2 Seconds
Motor is running. Current ≥ 1.15 Times Dial Seeting.	2 flash/ 2 seconds
if the orange trip flag is visable, a trip has occurred.	No Flash
If the orange trip flag is not visable, motor is off or drawing < min FLA.	No flash

Ground Fault Unit
3Ø Systems only
GF 50% FLA Setting

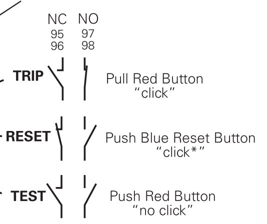




STANDARD UNIT 3Ø or 1Ø

Phase Imbalance Selection

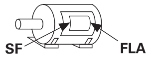
Scan Product QR code for Product Information.



TRIP	Pull Red Button "click"
RESET	Push Blue Reset Button "click*"
TEST	Push Red Button "no click"

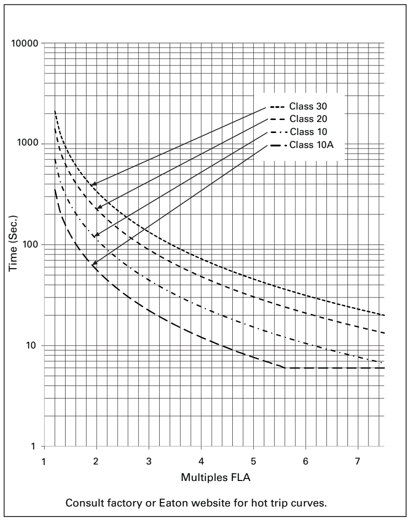
* Approximately 1 lbf

Motor Service Factor
Overload Tripping Current = 115%

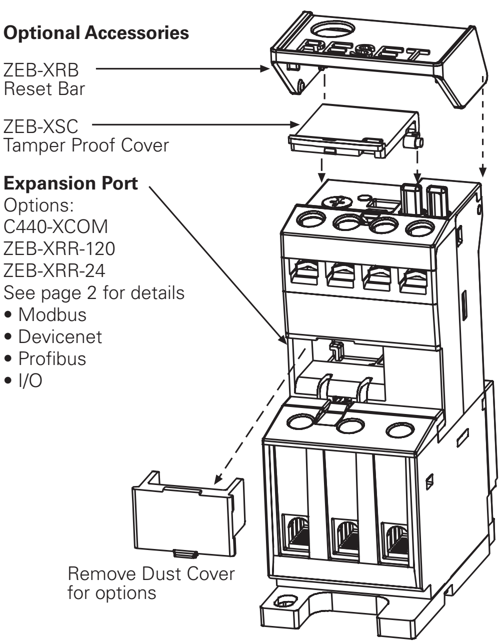


Rotate FLA dial to current listed on motor nameplate for all motor Service Factors.

Description	Terminal Capacity AWG	Terminal Capacity mm²	Torque lb-in	Torque N-m
Control	2 x (18-12)	2 x (0,75-4)	7-11	0,8 - 1.2
Load 45 mm	1 x (12-10)	1 x (4-6)	20-25	2,3 - 2,8
	1 x (8-6)	1 x (6-16)	25-30	2,8 - 3,4
Laod 55 mm	1 x (6-1)	1 x (16-50)	25-30	2,8 - 3,4



Consult factory or Eaton website for hot trip curves.



Optional Accessories

ZEB-XRB
Reset Bar

ZEB-XSC
Tamper Proof Cover

Expansion Port
Options:
C440-XCOM
ZEB-XRR-120
ZEB-XRR-24
See page 2 for details
- Modbus
- Devicenet
- Profibus
- I/O

Remove Dust Cover
for options

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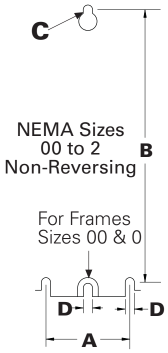
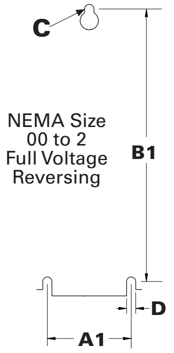
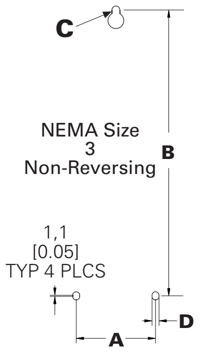
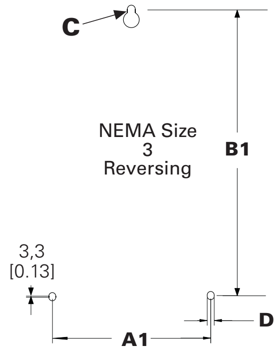
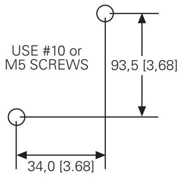
NEMA Starters	**Partial Catalog Number**	**A mm (in)**	**A1 mm (in)**	**B mm (in)**	**B1 mm (in)**	**C mm (in)**	**D mm (in)**
Freedom Size 00, 0	AN_9AN / AN_9BN	N/A	88,4 9 (3.50)	157,0 (6.18)	174,5 (6.87)	M5 (#10)	5.5 (0.22)
Freedom Size 1, 2 Freedom Size 1 FVR	AN_9DN / AN_9GN	50,8 (2.00)	133,3 (5.25)	165,1 (6.50)	143,0 (5.62)	M5 (#10)	5.5 (0.22)
Freedom Size 2 FVR	AN_9GN	N/A	133,3 (5.25)	N/A	168,3 (6.62)	M5 (#10)	5.5 (0.22)
Freedom Size 3	AN_9KN	76,2 (3.00)	177,8 (7.00)	274,6 (10.81)	274,6 (10.81)	M6 (1/4-20)	6,7 (0.27)



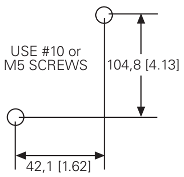




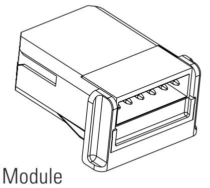
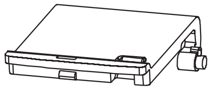
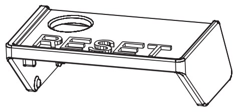
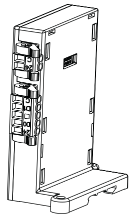


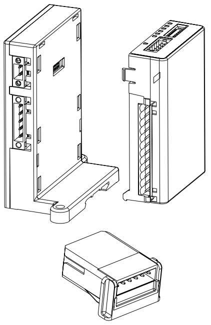


45 MM Stand Alone



55 MM Stand Alone

Description	**Catalog Number**	
Expansion Module (24V dc Remote Reset/Modbus RTU, RS485) - 6pin	C440-XCOM	 6pin Module
Remote Reset Module (120V ac) - 2pin	ZEB-XRR-120	
Remote Reset Module (24V ac) - 2pin	ZEB-XRR-24	
Tamper Proof FLA DIAL Cover	ZEB-XSC	
RESET BAR	ZEB-XRB	
Communication Adapter	C440-COM-ADP	

Communication Kits	**Catalog No.**	
Device Net Com module kit - 120V ac I/O	C440-DN-120	
Device Net Com module kit - 24V dc I/O	C440-DN-24	
Profibus Com module kit - 120V ac I/O	C440-DP-120	
Profibus Com module kit - 24V dc I/O	C440-DP-24	
Modbus Com module kit - 120V ac I/O	C440-MOD-120	
Modbus Com module kit - 24V dc I/O	C440-MOD-24	
Eithernet IP Com module kit - 120V ac I/O	Not Available	

Approved External CT to be used with 1-5A Stand Alone Overload

CT Package (60-300A)	ZEB-XCT300
CT Package (120-600A)	ZEB-XCT600
CT Package (200-1000A)	ZEB-XCT1000
CT Package (300-1500A)	ZEB-XCT1500

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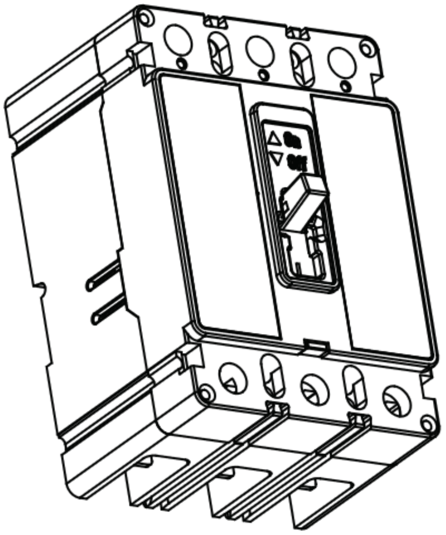
Instruction Leaflet **IL 29C401K**

Effective December 2013
Supersedes IL 29C401J Dated 12/10

Installation Instructions for Series C F-Frame Motor Circuit Protector Type HMCP & HMCPS



Contents

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⚠ WARNING

DO NOT ATTEMPT TO INSTALL OR PERFORM MAINTENANCE ON EQUIPMENT WHILE IT IS ENERGIZED. DEATH, SEVERE PERSONAL INJURY, OR SUBSTANTIAL PROPERTY DAMAGE CAN RESULT FROM CONTACT WITH ENERGIZED EQUIPMENT. ALWAYS VERIFY THAT NO VOLTAGE IS PRESENT BEFORE PROCEEDING WITH THE TASK, AND ALWAYS FOLLOW GENERALLY ACCEPTED SAFETY PROCEDURES.

EATON IS NOT LIABLE FOR THE MISAPPLICATION OR MISINSTALLATION OF ITS PRODUCTS.

1. INTRODUCTION

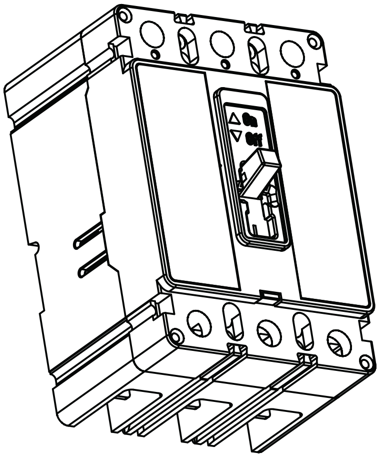

Fig. 1-1 F-Frame Series C Motor Circuit Protector

The user is cautioned to observe all recommendations, warnings, and cautions relating to the safety of personnel and equipment as well as all general and local health and safety laws, codes, and procedures.

The recommendations and information contained herein are based on Eaton experience and judgement, but should not be considered to be all-inclusive or covering every application or circumstance which may arise. If any questions arise, contact Eaton for further information or instructions.

General Information

The F-Frame Series C instantaneous-only (magnetic) motor circuit protector (MCP) (Fig. 1-1) is available in ratings from 3A to 150A continuous current for motor starter sizes 0 through 4. Designated as the Type HMCP and HMCPS, it is available in 3-pole frames only. The MCP is designed to comply with the applicable requirements of Underwriters Laboratories, Inc. Standard UL489 and the International Electrotechnical Commission Recommendations No. IEC 947.

The MCP is a UL recognized component under file E7819. It is used primarily to provide short-circuit protection as part of a combination controller where other circuit protective functions are performed by other devices within the controller. **The MCP is not suitable for reverse feed applications.**

This instruction leaflet (IL) gives procedures for installation, operation, inspection, and checking of F-Frame MCP’s by the end user.

Conforming to N.E.C. requirements, the maximum HMCP and HMCPS trip ampere value is set by the motor FLA. Since there are various types and classes of motor designs (based on duty cycle, electrical load, and manufacturer’s discretion), locked rotor currents (and resulting in rush current magnitudes) vary. These are normally identified by N.E.C. codes. The listed HMCP and HMCPS trip ampere value is considered typical, but not all inclusive. This is the reason for the adjustable magnetic trip setting, which compensates for different actual motor in rush currents. Trip level adjustments are normal and sometimes necessary to enable the motor to start without nuisance tripping especially when motor or system conditions induce higher than expected in rush currents. These circumstances may be beyond the control of the HMCP and HMCPS, relative to its allowable trip setting. Such conditions should be treated as a special case which may be referred to Eaton.

2. INSTALLATION

The installation procedure consists of inspecting and mounting the MCP, connecting and torquing the line and load terminations, and attaching terminal shields or barriers, when required. To install the MCP, perform the following steps:

F-Frame MCPs are factory sealed. UL489 requires that internal accessories be installed at the factory. Where local codes and standards permit and UL component recognition is not required, internal accessories can be field installed. Accessory installation should be done before the MCP is mounted and connected. The MCP has a cover interlock which requires the handle to be in the OFF positon when removing or installing the cover.

If the HMCP or HMCPS is opened at locations other than authorized, the side located adhesive seal must be removed and the 'UR' nameplate mark must be covered. Both of the above steps are required to comply with UL requirements.

No internal maintenance, adjustments, or replacement items are authorized. Misuse, mishandling, or unauthorized adjustments can change the operating characteristics of the HMCP or HMCPS.

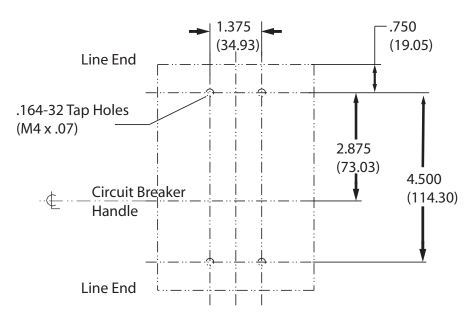

Fig. 2-1 MCP, HMCP and HMCPS Mounting Bolt Drilling Plans

Mounting hardware and unmounted accessories (where required) are supplied in separate packages.

2-1. Make sure that the MCP is suitable for the intended installation by comparing nameplate data with system requirements. Inspect the MCP for completeness and damage before mounting.

WARNING

BEFORE MOUNTING THE MCP IN AN ELECTRICAL SYSTEM, MAKE SURE THE MCP IS SWITCHED TO THE OFF POSITION AND THAT THERE IS NO VOLTAGE PRESENT WHERE WORK IS TO BE PERFORMED. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE DEATH OR SEVERE PERSONAL INJURY.

2-2. To mount the MCP, perform the following steps:

Note: If terminal shield or interphase barriers are to be installed on the MCP, install them after the terminals are connected.

a. For individual mounting panels, make sure that mounting panel is predrilled using drilling plan (Fig. 2-1).

b. If MCP includes factory installed internal accessories, make sure accessory wiring can be reached when the MCP is mounted.

c. Position MCP on mounting surface.

d. Install mounting screws, washers, and nuts. Tighten screws firmly, but do not exceed 28 pound-inches (3.16 N.m)

2-3 If an optional terminal end cover is to be installed with the MCP (usually line end only), it must be positioned before cable is connected to terminals.

CAUTION

WHEN ALUMINUM CONDUCTORS ARE USED, THE APPLICATION OF A SUITABLE JOINT COMPOUND IS RECOMMENDED TO REDUCE THE POSSIBILITY OF TERMINAL OVERHEATING. TERMINAL OVERHEATING CAN CAUSE DAMAGE TO THE MCP.

2-4. After mounting the MCP, line and load cables and accessory leads should be connected. (See accessory schematic diagram on side of MCP.)

2-5 If required, install terminal shield on MCP cover with mounting screws provided.

2-6 If required, install interphase barriers by sliding barriers into dovetail grooves between terminals.

2-7 After the MCP is installed, check all mounting hardware and terminal connecting hardware for correct torque loading. Torque values for lineload terminals are given in Tables 2-1 and 2-2 and on the MCP nameplate.

Table 2-1. TERMINAL TYPES

Terminal Catalog Number	Terminal Body Material	Screw Head Type	AWG Wire Range	Metric Wire Range	Wire Type	Torque Value LB in. (N•m)
3TA225FD(1)	Aluminum	3/16 Socket Hex	#4-4/0	25-95	Cu/Al	120 (13.6)
3TA225FDM(1)	Aluminum	5mm Socket Hex	#4-4/0	25-95	Cu/Al	120 (13.6)
3TA225FDK(1)(2)	Aluminum	5/16 Socket Hex	#6-300	16-150	Cu/Al	275 (31)
3TA100FD(1)	Aluminum	Slotted	#14-1/0	2.5-50	Cu/Al	See Table 2-2
3TA50FB(1)	Aluminum	Slotted	#14-#4	2.5-16	Cu/Al	See Table 2-2
3T100FB(1)	Steel	Slotted	#14-1/0	2.5-50	Cu/Al	See Table 2-2
3T150FB(1)	Stainless Steel	Slotted	#4-4/0	25-95	Cu Only	See Table 2-2

Note: Terminal wire connectors are UL listed for standard wire sizes as defined in UL 486A and UL 486B.

(1) Package of three

(2) Individual terminal identified as TA225FD1

TABLE 2-2. TERMINAL TORQUE VALUES FOR SLOTTED HEAD

Metric Wire Range	Torque Value. N•m	AWG Wire Range	Torque Value Lb. In.
2.5-6	3.96	#14-#10	35
10	4.52	#8	40
16-25	5.09	#6-#4	45
35-95	5.65	#3-4/0	50

TABLE 2-3. BOLTED CONNECTIONS (KEEPER NUT OR END CAP)

Termination Catalog Number	Screw Head Type	Nut Thread Size	Torque Value. Lb. In. (N•m)
KPR1A / KPR1AM	User Supplied	10-32 / M5	35(4.0)
KPEKxxx	Slotted	10-32 / M5	35(4.0)

3. MANUAL OPERATION

The MCP is normally operated by the handle or the PUSH-TO-TRIP button. The MCP handle has three indicating positions, two of which are shown on the cover by raised lettering to indicate ON and OFF. On the sliding handle barrier, ON, OFF, and TRIP are also shown by a color-coded strip for each MCP handle position: red for ON, white for TRIPPED, and green for OFF. On the sliding handle barrier, ON/OFF is also indicated by the international symbols I/O. (See Fig. 3-1).

CIRCUIT BREAKER RESET

After tripping, the MCP is reset by moving the MCP handle to the extreme OFF position.

PUSH-TO-TRIP Button

The PUSH-TO-TRIP button checks the tripping function and is used to periodically exercise the operating mechanism. The button is designed to be operated by using a small screwdriver.

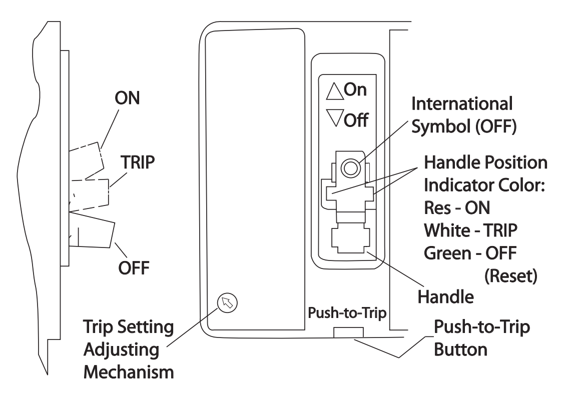

Fig. 3-1 Frame MCP Manual Controls

Adjustment of Trip Setting

The trip setting adjusting mechanism permits the MCP trip range to be changed. The mechanism consists of a cam with eight positions for different trip levels. The trip levels are labeled A through H. Trip values are shown on the MCP cover nameplate and in Tables 3.1 and 3.2. To adjust the trip level, perform the following steps:

3-1. Determine the motor locked rotor current from the motor nameplate. Refer to Table 3-1 and select appropriate MCP trip setting. Depress and rotate adjustment button clockwise to the setting.

CAUTION

A ROTATION STOP PREVENTS THE ADJUSTMENT BUTTON FROM BEING ROTATED COUNTER-CLOCKWISE BEYOND POSITION A. THE MCP CAN BE DAMAGED IF THE BUTTON IS FORCED PAST A IN THE COUNTER CLOCKWISE DIRECTION.

3-2. For closest protection, turn the adjustment button counter-clockwise to successively lower settings until the MCP trips when the the motor is started. When this setting has been determined, turn the adjustment button clockwise to the next highest setting. The MCP is now adjusted for normal operation.

3-3. If the MCP does not trip at the lowest setting (A), leave the adjustment button at this position.

TABLE 3-1: MCP TRIP SETTINGS

Cam Setting	Typical Motor Full Load Current Amperes ①	NEMA Starter Size	Continuous Amps	MCP Catalog Number	MCP Trip Setting②
A	.69 - .91	0	3	HMCP003A0 OR HMCPS003A0	9
B	.92 - 1.0				12
C	1.1 - 1.2				15
D	1.3 - 1.5				18
E	1.6 - 1.7				21
F	1.8 - 1.9				24
G	2.0 - 2.2				27
H	2.3 - 2.5				30
A	1.5 - 2.0	0	7	HMCP007C0 OR HMCPS007C0	21
B	2.1 - 2.5				28
C	2.6 - 3.1				35
D	3.2 - 3.6				42
E	3.7 - 3.9				49
F	4.3 - 4.7				56
G	4.8 - 5.2				63
H	5.3 - 5.7				70
A	3.4 - 4.5	0	15	HMCP015E0 OR HMCPS015E0	45
B	4.6 - 5.6				60
C	5.7 - 6.8				75
D	6.9 - 7.9				90
E	8.0 - 9.1				105
F	9.2 - 10.3				120
G	10.4 - 11.4				135
H	11.5 - 12.6				150
A	6.9 - 9.1	1	30	HMCP030H1 OR HMCPS030H1	90
B	9.2 - 11.4				120
C	11.5 - 13.7				150
D	13.8 - 16.0				180
E	16.1 - 18.3				210
F	18.4 - 20.6				240
G	20.7 - 22.9				270
H	23.0 - 25.2				300
A	11.5 - 15.2	2	50	HMCP050K2 OR HMCPS050K2	150
B	15.3 - 19.1				200
C	19.2 - 22.9				250
D	23.0 - 26.8				300
E	26.9 - 30.6				350
F	30.7 - 34.5				400
G	34.6 - 38.3				450
H	38.4 - 42.1				500

TABLE 3-1: MCP TRIP SETTINGS (CONTINUED)

Cam Setting	Typical Motor Full Load Current Amperes ①	NEMA Starter Size	Continuous Amps	MCP Catalog Number	MCP Trip Setting ②
A	16.1 - 21.4	2	70	HMCP070M2	210
B	21.5 - 26.8				280
C	26.9 - 32.2				350
D	32.3 - 37.5				420
E	37.6 - 42.9				490
F	43.0 - 48.3				560
G	48.4 - 53.7				630
H	53.8 - 59.1				700
A	23.0 - 30.6	3	100	HMCP100R3 OR HMCPS100R3	300
B	30.7 - 38.3				400
C	38.4 - 46.0				500
D	46.1 - 53.7				600
E	53.8 - 61.4				700
F	61.5 - 69.1				800
G	69.2 - 76.8				900
H	76.9 - 84.5				1000
A	34.6 - 46.0	4	150	HMCP150T4 OR HMCPS150T4	450
B	46.1 - 57.5				600
C	57.6 - 69.1				750
D	69.2 - 80.6				900
E	80.7 - 92.2				1050
F	92.3 - 103.7				1200
G	103.8 - 115.2				1350
H	115.3 - 126.7				1500
A	57.0 - 75.0	4	150	HMCP150U4 OR HMCPS150U4	750
B	76.0 - 95.0				1000
C	96.0 - 114.0				1250
D	115.0 - 130.0				1500
E	③				1750
F	③				2000
G	③				2250
H	③				2500

TABLE 3-2: SPECIAL APPLICATION MCP TRIP SETTINGS			
Cam Setting	Continuous Ampere Rating	MCP Catalog Number	MCP Trip Setting ②
A	25A	HMCP025D0	40
B			43
C			46
D			49
E			52
F			55
G			58
H			60
A	50A	HMCP050G2	81
B			87
C			93
D			98
E			103
F			109
G			115
H			120
A	70A	HMCP070J2	114
B			122
C			130
D			139
E			145
F			153
G			160
H			168
A	100A	HMCP100L3	163
B			174
C			185
D			196
E			207
F			218
G			229
H			240
①	Motor FLA ranges are typical. The corresponding trip setting is 13 times the FLA value shown. The ± 20% trip tolerance can affect trip response and require increase in cam setting per para 3-2.		
②	For dc applications, actual trip levels may exceed the values shown by as much as 100%. Actual dc trip values are application dependent.		
③	Settings above 130 amps are for special applications. N.E.C. Article 430-110(a) requires the ampere rating of the disconnecting means to be not less than 115% of the motor full ampere rating.		

4. INSPECTION AND FIELD CHECKS

Series C molded case MCPs are designed to provide years of almost maintenance-free operation. The following procedure describes how to inspect and test a MCP in service.

Inspection

MCPs in service should be inspected periodically. The inspection should include the following checks.

WARNING

BEFORE INSPECTING THE MCP IN AN ELECTRICAL SYSTEM, MAKE SURE THE MCP IS SWITCHED TO THE OFF POSITION AND THAT THERE IS NO VOLTAGE PRESENT WHERE WORK IS TO BE PERFORMED. THE VOLTAGES IN ENERGIZED EQUIPMENT CAN CAUSE DEATH OR SEVERE PERSONAL INJURY.

CAUTION

MAKE SURE THAT CLEANING AGENTS OR SOLVENTS USED TO CLEAN THE MCP ARE SUITABLE FOR THE JOB. SOME COMMERCIAL CLEANING AGENTS WILL DAMAGE THE NAMEPLATES OR MOLDED PARTS.

4-1. Remove dust, dirt, soot, grease, or moisture from the surface of the MCP using a lint-free dry cloth, brush, or vacuum cleaner. Do not blow debris into MCP. If contamination is found, look for the source and eliminate the problem.

4-2. Switch MCP to ON and OFF several times to be sure that the mechanical linkages are free and do not bind. If mechanical linkages are not free, replace MCP.

4-3. Press the PUSH-TO-TRIP button to mechanically trip the MCP. Trip, reset, and switch MCP ON several times. If mechanism does not reset each time the MCP is tripped, replace the MCP.

4-4. Check base, cover, and operating handle for cracks, chipping, and discoloration. MCPs should be replaced if cracks or severe discoloration is found.

4-5 Check terminals and connectors for looseness or signs of overheating. Overheating will show as discoloration, melting, or blistering of conductor insulation, or as pitting or melting of conductor surfaces due to arcing. If there is no evidence of overheating or looseness, do not disturb or tighten the connections. If there is evidence of overheating, terminations should be cleaned or replaced. Before re-energizing the MCP, all terminations and cable should be refurbished to the condition when originally installed.

4-6 Check MCP mounting hardware; tighten if necessary.

4-7 Check area where MCP is installed for any safety hazards including personal safety and fire hazards. Exposure to certain types of chemicals can cause deterioration of electrical connections.

Field Testing

Any field testing should be done in accordance with applicable NEMA Standards.

Installation Instructions for Series C F-Frame Motor Circuit ProtectorType HMCP & HMCPS

The instructions for installation, testing, maintenance, or repair herein are provided for the use of the product in general commercial applications and may not be appropriate for use in nuclear applications. Additional instructions may be available upon specific request to replace, amend, or supplement these instructions to qualify them for use with the product in safety-related applications in a nuclear facility.

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Powering Business Worldwide

Powering Business Worldwide

Renewal Parts

EATON | Cutler-Hammer

Motor Control Center
Type F2100

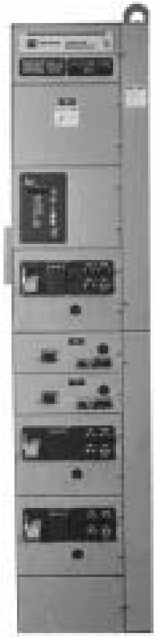
Renewal Parts

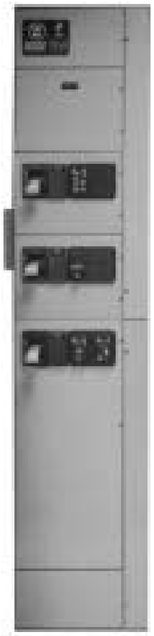
Supersedes RP.03A.01A.S.E
pages 1-24, dated September 2000

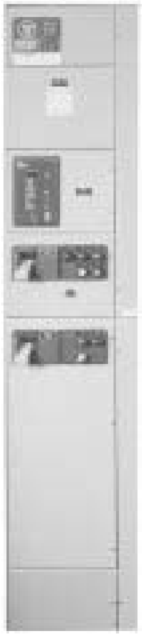
Description *Page*

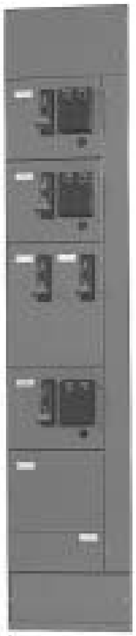
Motor Control Center Type F2100

MCC Type	Dates	Cutler-Hammer Renewal Parts Publication
F2100 Advantage™ Series 2100	1995 – 1992 – 1987 – 95	RP04304001E RP04304002E RP04304003E
5 Star Freedom Unitrol F10 Unitrol	1975 – 87 1988 – 94 1972 – 89	RP04304003E RP04304004E RP04304005E
Type W 9800 Unitrol 11-300	1965 – 75 1956 – 74 1935 – 65	RP04304006E RP04304007E RP04304008E


F2100


Advantage

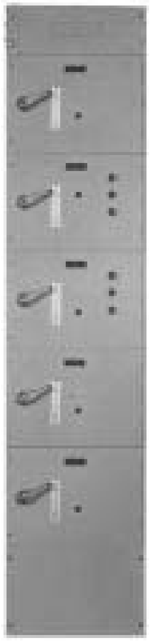

Series 2100/ 5 Star


Freedom Unitrol


F10 Unitrol


Type W


9800 Unitrol


11-300

Distributor Ordering Instructions

1. Specify the item by catalog or style number.
2. For pricing information, refer to Price List PL04304002E (formerly PL 8991A dated November 1997).
3. Enter the order on VISTALINE™ on Suffix **FVU**, or through e-POD on Suffix **FVU**.
4. Selling Policy 25-000 (SP03000001E) applies, the Discount Symbol is **1CD-2C**.

Procedure for Identifying Motor Control Centers Renewal Units and Parts

1. Identify the design of the Eaton's Cutler-Hammer Motor Control Center (MCC) from the data found on the nameplate. Critical information includes:
   - Type of MCC.
   - Type of contactor.
   - Door width.
   - Bucket width.

   Note: In the event that the nameplate is missing or unreadable, follow the procedure on **Page 4**.
2. Refer to **Pages 6 – 24** and turn to the section in this Renewal Parts to identify replacement units, options, structure parts, and unit parts for F2100.
3. For Replacement Feeder Units, refer to **Page 26**.
4. This publication identifies those replacement units and parts which are most frequently ordered. Units should be ordered by complete catalog number, and parts by complete style number.

   For parts not listed or shown, contact your authorized Cutler-Hammer distributor or local Cutler-Hammer sales representative.
5. If additional assistance is required, contact the Motor Control Center Aftermarket Product Center in Fayetteville, NC at **(910) 483-2222** or **1-800-OLD-UNIT** or Fax (910) 677-5208 or (910) 677-5272.

   You can also contact one of our eight Service Centers for assistance with F2100, Advantage, Series 2100/5 Star, Freedom Unitrol, F10 Unitrol, Type W, 11-300 and 9800 Unitrol Motor Control Centers.

Atlanta
Phone (770) 739-6282
Fax (770) 739-7178

Chicago
Phone (847) 299-1911
Fax (847) 299-0398

Cincinnati
Phone (513) 682-4000
Fax (513) 682-4004

Denver
Phone (303) 373-2133
Fax (303) 375-9095

Hartford
Phone (860) 683-4221
Fax (860) 683-0764

Houston
Phone (713) 939-9696
Fax (713) 939-0427

Los Angeles
Phone (562) 944-6413
Fax (562) 941-7178

Portland
Phone (503) 636-8333
Fax (503) 636-8545

Identifying Motor Control Center Types

In most cases, it is possible to identify MCC design by handle type. Starter type, bucket width and door width can assist in identification.

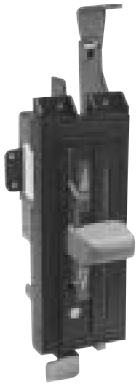
Table 1. Identifying Motor Control Center Types

MCC Type	Type of Handle Mechanism	Original MCC Starter Type	Bucket Width Inches (mm)	Door Width Inches (mm)	Original Manufacturer ①	Starter Type (Installed in New Unit)
F2100 ②	Lever	Freedom Series	13-3/4 (349.3)	15-5/8 (397.0)	Cutler-Hammer 1994 to Present	Freedom
Advantage ②	Lever	Advantage	13-3/4 (349.3)	15-5/8 (397.0)	Westinghouse until 1994 Cutler-Hammer 1994 to Present	Advantage
Series 2100 ②	Lever	A200	13-3/4 (349.3)	15-5/8 (397.0)	Westinghouse until 1994 Cutler-Hammer 1994 to Present	A200
5 Star ②	Lever	A200	13-3/4 (349.3)	15-5/8 (397.0)	Westinghouse 1975 – 1987	A200
Freedom Unitrol	Slider	Freedom Series	13-7/8 (352.5)	15-1/2 (393.7)	Cutler-Hammer 1988 – 1994	Freedom
F10 Unitrol	Slider and Lever	Citation	14 (355.6)	14-3/4 (374.7) w/ Wireway 19-1/2 (495.3) w/o Wireway	Cutler-Hammer 1972 – 1989	Freedom
Type W	Slider	A200 or 11-200	11-3/4 (298.5)	13-3/8 (339.9)	Westinghouse 1965 – 1975	A200
9800 Unitrol	Rotary ③	3 Star/Citation	16-1/8 (409.7)	19-3/8 (492.3)	Cutler-Hammer 1956 – 1974	Freedom
11-300	Rotary	11-200 Lifeline Type N/A200	15-3/4 (400.1)	20 (508.0)	Westinghouse 1950 – 1965	A200

① MCC types were sometimes produced outside the time spans shown. This was due to the overlap of production when a new design was adopted.
② The unit "wrappers" are mechanically identical for these designs.
③ 9800 originally was supplied with Rotary. New replacement units are manufactured with slider handle mechanism.

Identification by Original Handle Mechanism

F2100, Advantage, Series 2100/5 Star

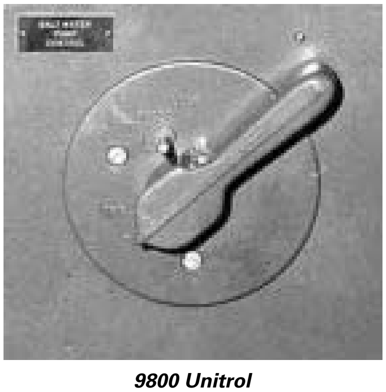


Freedom Unitrol

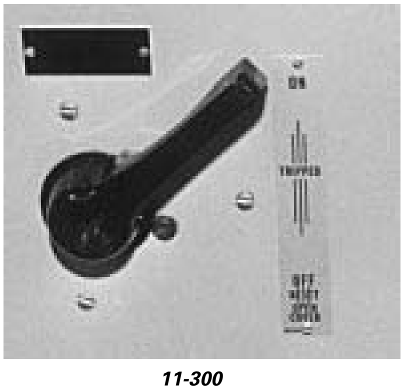
F10 Unitrol Slider 9800 Unitrol

F10 Unitrol Lever and 9800 Unitrol

Type W



9800 Unitrol



11-300

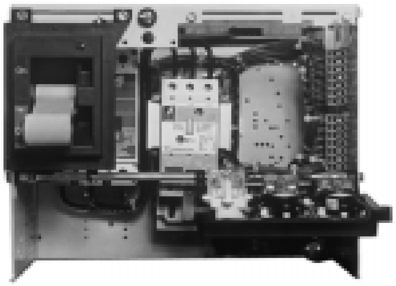
Procedure for Identifying Motor Control Center Types

In the event that the nameplate is missing, it is possible to identify the MCC design by the type of handle mechanism, starter type, bucket width and door width.

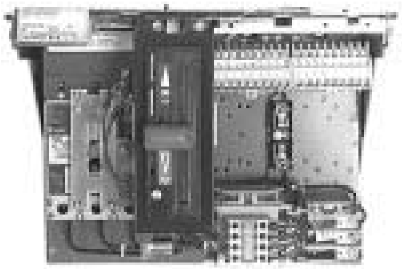
Table 2. Identifying Motor Control Center Types

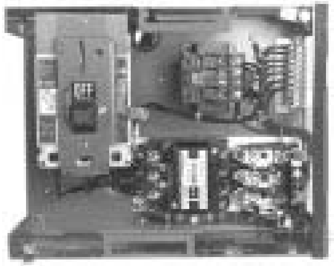
MCC Type	Type of Handle Mechanism	Starter Type	Bucket Width Inches (mm)	Door Width Inches (mm)	Cutler-Hammer Renewal Parts Publication
F2100	Lever	Freedom Series	13-3/4 (349.3)	15-5/8 (397.0)	RP04304001E
Advantage	Lever	Advantage	13-3/4 (349.3)	15-5/8 (397.0)	RP04304002E
Series 2100	Lever	A200	13-3/4 (349.3)	15-5/8 (397.0)	RP04304003E
5 Star	Lever	A200	13-3/4 (349.3)	15-5/8 (397.0)	RP04304003E
Freedom Unitrol	Slider	Freedom Series	13-7/8 (352.5)	15-1/2 (393.7)	RP04304004E
F10 Unitrol	Lever/Slider	Citation	14 (355.6)	14-3/4 (374.7) w/ Wireway or 19-1/2 (495.3) w/o Wireway	RP04304005E
Type W	Slider	A200 or 11-200	11-3/4 (298.5)	13-3/8 (339.9)	RP04304006E
9800 Unitrol	Rotary	3 Star and/or Citation	16-1/8 (409.7)	19-3/8 (492.3)	RP04304007E
11-300	Rotary	11-200 Lifeline N and/or A200	15-3/4 (400.1)	20 (508.0)	RP04304008E


F2100

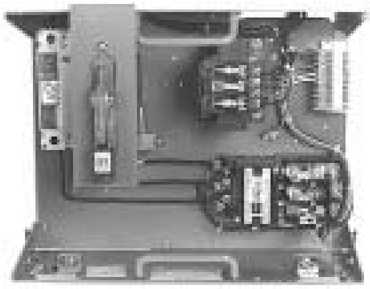

Advantage


Series 2100/5 Star


Freedom Unitrol


F10 Unitrol


Type W


9800 Unitrol


11-300

F2100 Product Description

The Eaton's Cutler-Hammer business introduced the F2100 MCC in 1995.

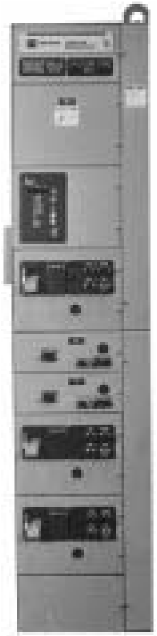
The structure is based on the 5 Star, Series 2100, and Advantage MCC design. Vertical structures are normally 20 inches (508.0 mm) wide, 90 inches (2286.0 mm) high, and 16 or 21 inches (406.4 or 533.4 mm) deep. Vertical sections may be bolted together forming a single line-up with continuous horizontal bus and open horizontal wireways. Unit height is measured in 6-inch (152.4 mm) increments, up to a maximum of 72 inches (1828.8 mm) of usable vertical space.

A two-tone paint system is used for this design. Ferro white is applied to the structural framework and units. ANSI 61 gray is applied to the exterior and doors. Starter units are 13-3/4 inches (349.3 mm) wide with 4-5/8 inch (117.6 mm) wireways.

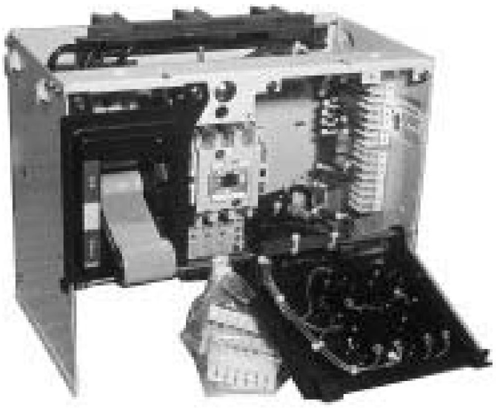
The Freedom starter is used in this design along with the HMCP or HMCPE motor circuit protector. The F2100 starter unit's handle mechanism is a gray toggle type handle with a black exterior mounting panel and is used on the Advantage and Series 2100/ 5 Star designs. Bus and bus support systems are typically braced to withstand fault currents of 65,000 amperes.

Table 3. F2100 Product Rating

Maximum Ratings
3-Phase, 600V, 600 hp, 3200A Bus



F2100 Structure



F2100 Starter Unit

F2100 Replacement Starter Units

How to Order

When ordering a replacement unit, you receive:

- Series C® HMCP or HMCPE.
- Freedom Starter.
- Unit options as specified.
- New steel wrapper, door and handle mechanism.
- New stabs.
- UL® label.

Use the following steps for creating a catalog number for your specific application:

Step 1

Select the correct replacement unit from **Page 6 – 15**. When selecting, you need to know the following:

- MCC type.
- Class of Unit (FVNR, FVR, Reduced Voltage — Autotransformer or Part Winding or Solid State, FV – 2 Speed, 1 Winding or 2 Speed, 2 Winding, etc.).
- Starter size or horsepower rating.
- Protection device (breaker or fusible).
- Service voltage.
- Control voltage.
- Space required.

Step 2

Verify required space is available.

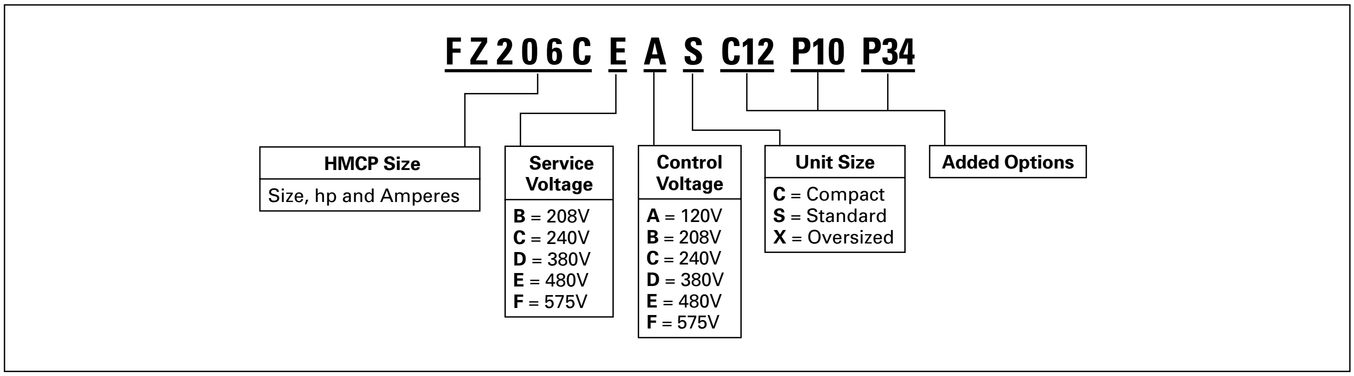
Step 3

Create a catalog number by selecting Catalog Codes from the columns per the example given.

Step 4

Add modifications as required from the Unit Options on **Pages 17 – 19**. Space available determines allowable options.

Table 4. Catalog Numbering System Example



FZ206C E A S C12 P10 P34

HMCP Size
Size, hp and Amperes

Service Voltage
B = 208V
C = 240V
D = 380V
E = 480V
F = 575V

Control Voltage
A = 120V
B = 208V
C = 240V
D = 380V
E = 480V
F = 575V

Unit Size
C = Compact
S = Standard
X = Oversized

Added Options

Table 5. Full Voltage Non-Reversing Combination Starter — HMCP (Must specify if HMCPE is required)

NEMA® Size	Maximum Horsepower					HMCP Size	Catalog Code	Service Voltage	Catalog Code	Control Voltage	Catalog Code	Space Options Inches (mm)	Catalog Code
	208V	240V	380V	480V	600V								
1	0.5 1 3 7.5	0.33 1 3 7.5	1 2 5 10	1 3 7.5 10	1.5 3 7.5 10	3 7 15 30	**FZ206A** **FZ206B** **FZ206C** **FZ206D**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	6 (152.4) High 12 (304.8) High 18 (457.2) High	**C** ① **S** **X**
2	10	15	25	25	25	50	**FZ206E**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	12 (304.8) High 18 (457.2) High	**S** **X**
3	25	30	50	50	50	100	**FZ206H**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	18 (457.2) High	**S**
4	40	50	75	100	100	150	**FZ206L**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	18 (457.2) High	**S**
5	60 75	60 100	125 150	150 200	150 200	250 400	**FZ206P** **FZ206R**	208 240 380 480	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	36 (914.4) High	**S**

① On 6-inch (152.4 mm) units, the only options available are (3) E22 pilot devices and separate source fuse or disconnect or CPT.

F2100 Replacement Starter Units

Table 6. Full Voltage Reversing Combination Starter — HMCP ①

NEMA Size	Maximum Horsepower					HMCP Size	Catalog Code	Service Voltage	Catalog Code	Control Voltage	Catalog Code	Space Options Inches (mm)	Catalog Code
	208V	240V	380V	480V	600V								
1	0.5 1 3 7.5	0.33 1 3 7.5	1 2 5 10	1 3 7.5 10	1.5 3 7.5 10	3 7 15 30	**FZ216A** **FZ216B** **FZ216C** **FZ216D**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	18 (457.2) High 24 (609.6) High	**S** **X**
2	10	15	25	25	25	50	**FZ216E**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	18 (457.2) High 24 (609.6) High	**S** **X**
3	25	30	50	50	50	100	**FZ216H**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	24 (609.6) High	**S**
4	40	50	75	100	100	150	**FZ216L**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	30 (762.0) High	**S**
5	50 75	60 100	100 150	125 200	150 200	250 400	**FZ216P** **FZ216R**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	60 (1524.0) High	**S**

① Must specify if HMCPE is required.

Table 7. Full Voltage 2 Speed 1 Winding — Constant/Variable Torque — HMCP ②③

NEMA Size	Maximum Horsepower					HMCP Size	Catalog Code	Service Voltage	Catalog Code	Control Voltage	Catalog Code	Space Options Inches (mm)	Catalog Code
	208V	240V	380V	480V	600V								
1	0.5 1 3 7.5	0.33 1 3 7.5	1 2 5 10	1 3 7.5 10	1.5 3 7.5 10	3 7 15 30	**FZ946A** **FZ946B** **FZ946C** **FZ946D**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	24 (609.6) High	**S**
2	10	15	25	25	25	50	**FZ946E**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	24 (609.6) High	**S**
3	25	30	50	50	50	100	**FZ946H**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	36 (914.4) High	**S**
4	40	50	75	100	100	150	**FZ946L**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	36 (914.4) High	**S**

② Must specify if HMCPE is required.
③ For constant horsepower instead of constant/variable torque, see Option SV6 on **Page 18**.

F2100 Replacement Starter Units

Table 8. Full Voltage 2 Speed 2 Winding — Constant/Variable Torque — HMCP ①②

NEMA Size	Maximum Horsepower					HMCP Size	Catalog Code	Service Voltage	Catalog Code	Control Voltage	Catalog Code	Space Options Inches (mm)	Catalog Code
	208V	**240V**	**380V**	**480V**	**600V**								
1	0.5 1 3 7.5	0.33 1 3 7.5	1 2 5 10	1 3 7.5 10	1.5 3 7.5 10	3 7 15 30	**FZ956A** **FZ956B** **FZ956C** **FZ956D**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	24 (609.6) High	**S**
2	10	15	25	25	25	50	**FZ956E**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	24 (609.6) High	**S**
3	25	30	50	50	50	100	**FZ956H**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	30 (762.0) High	**S**
4	40	50	75	100	100	150	**FZ956L**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	30 (762.0) High	**S**

① Must specify if HMCPE is required.

② For constant horsepower instead of constant/variable torque, see Option SV6 on **Page 18**.

Table 9. Reduced Voltage Autotransformer — HMCP ③④

NEMA Size	Maximum Horsepower					HMCP Size	Catalog Code	Service Voltage	Catalog Code	Control Voltage	Catalog Code	Space Options Inches (mm)	Catalog Code
	208V	**240V**	**380V**	**480V**	**600V**								
2	10	15	25	25	25	50	**FZ606E**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	36 (914.4) High	**S**
3	25	30	50	50	50	100	**FZ606H**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	48 (1219.2) High	**S**
4	40	50	75	100	100	150	**FZ606L**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	48 (1219.2) High	**S** ④

③ Must specify if HMCPE is required.

④ If existing MCC is back-to-back design, 36 inches (914.4 mm) in bottom rear is unusable.

F2100 Replacement Starter Units

Table 10. Reduced Voltage Part Winding — HMCP ①

NEMA Size	Maximum Horsepower					HMCP Size	Catalog Code	Service Voltage	Catalog Code	Control Voltage	Catalog Code	Space Options Inches (mm)	Catalog Code
	208V	240V	380V	480V	600V								
1	10	10	15	15	15	30	**FZ706D**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	24 (609.6) High	**S**
2	20	25	40	40	40	100	**FZ706F**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	24 (609.6) High	**S**
3	40	50	75	75	75	150	**FZ706J**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	30 (762.0) High	**S**
4	— 75	— 75	— 150	100 150	125 150	250 400	**FZ706L** **FZ706M**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	36 (914.4) High	**S**

① Must specify if HMCPE is required.

Table 11. Reduced Voltage Wye Delta Open Transition — HMCP ②

NEMA Size	Maximum Horsepower					HMCP Size	Catalog Code	Service Voltage	Catalog Code	Control Voltage	Catalog Code	Space Options Inches (mm)	Catalog Code
	208V	240V	380V	480V	600V								
2	20	25	40	40	40	100	**FZ806F**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	42 (1066.8) High	**S**
3	40	50	75	75	75	150	**FZ806J**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	54 (1371.6) High	**S**
4	60 —	75 —	125 150	150 —	150 —	250 400	**FZ806M** **FZ806N**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	60 (1524.0) High	**S**

② Must specify if HMCPE is required.

F2100 Replacement Starter Units

Table 12. Reduced Voltage Wye Delta Closed Transition — HMCP (Non-Chiller Application) ①

NEMA Size	**Maximum Horsepower**					**HMCP Size**	**Catalog Code**	**Service Voltage**	**Catalog Code**	**Control Voltage**	**Catalog Code**	**Space Options Inches (mm)**	**Catalog Code**
	208V	**240V**	**380V**	**480V**	**600V**								
2	20	25	40	40	40	100	**FZ896F**	208	**B**	120	**A**	42 (1066.8) High	**S**
								240	**C**	208	**B**		
								380	**D**	240	**C**		
								480	**E**	380	**D**		
								575	**F**	480	**E**		
										575	**F**		
3	40	50	50	50	50	100	**FZ896J**	208	**B**	120	**A**	54 (1371.6) High	**S**
								240	**C**	208	**B**		
								380	**D**	240	**C**		
								480	**E**	380	**D**		
								575	**F**	480	**E**		
										575	**F**		
4	60	75	125	150	150	250	**FZ896M**	208	**B**	120	**A**	60 (1524.0) High	**S**
	—	—	150	—	—	400	**FZ896N**	240	**C**	208	**B**		
								380	**D**	240	**C**		
								480	**E**	380	**D**		
								575	**F**	480	**E**		
										575	**F**		

① Must specify if HMCPE is required.

F2100 Replacement Starter Units

IT06 — Intelligent Technologies *IT.* Solid-State Reduced Voltage Starter — HMCP

The ***IT.*** solid-state reduced voltage starter uses SCRs when starting and a low impedance run circuit during operation. Solid-state starters have (5) 24V DC inputs and 2 relay outputs. Soft start units include a disconnect, starter, 24V DC power supply and 100VA CPT.

Motor Service Factor (SF) Effect on *IT.* Starter Selection

- A 1.0 service factor motor may draw up to 1.00 x full load amperes.
- A 1.15 service factor motor may draw up to 1.15 x full load amperes.
- 15% more current. ***IT.*** starters are current rated devices. In some cases, a larger ***IT.*** SSRV starter must be supplied for 1.15 SF motors. See the maximum horsepower chart below.

Note: Most motors used in industrial applications are 1.15 Service Factor (SF).

Table 13. Replacement *IT.* Soft Start Units

Service Factor	Horsepower	*IT.* Soft-Start Amperes	HMCP Amperes	Catalog Code	Service Voltage	Catalog Code	Control Voltage	Catalog Code	Space Options Inches (mm)	Catalog Code
1.15	10	37	100	**FZ306A**	208	**B**	120	**A**	12 (304.8) High	**S**
	15	66		**FZ306B**			208	**B**		
	30	105	150	**FZ306C**			240	**C**	18 (457.2) High	
	40	135		**FZ306D**			380	**D**		
	50	180	400	**FZ306E**			480	**E**	36 (914.4) High	
	60	240		**FZ306F**			575	**F**		
	75	304		**FZ306G**			—	**—**		
1.15	10	37	100	**FZ306A**	240	**C**	120	**A**	12 (304.8) High	**S**
	20	66		**FZ306B**			208	**B**		
	30	105	150	**FZ306C**			240	**C**	18 (457.2) High	
	40	135		**FZ306D**			380	**D**		
	60	180	250	**FZ306E**			480	**E**	36 (914.4) High	
	75	240	400	**FZ306F**			575	**F**		
	100	304		**FZ306G**			—	**—**		
1.15	15	37	100	**FZ306A**	380	**D**	120	**A**	12 (304.8) High	**S**
	30	66		**FZ306B**			208	**B**		
	45	105	150	**FZ306C**			240	**C**	18 (457.2) High	
	55	135	250	**FZ306D**			380	**D**		
	75	180	400	**FZ306E**			480	**E**	36 (914.4) High	
	110	240		**FZ306F**			575	**F**		
	132	304	600	**FZ306G**			—	**—**		
1.15	20	37	100	**FZ306A**	480	**E**	120	**A**	12 (304.8) High	**S**
	40	66		**FZ306B**			208	**B**		
	60	105	150	**FZ306C**			240	**C**	18 (457.2) High	
	75	135		**FZ306D**			380	**D**		
	125	180	400	**FZ306E**			480	**E**	36 (914.4) High	
	150	240		**FZ306F**			575	**F**		
	200	304		**FZ306G**			—	**—**		
1.15	30	37	100	**FZ306A**	575	**F**	120	**A**	12 (304.8) High	**S**
	50	66		**FZ306B**			208	**B**		
	75	105	150	**FZ306C**			240	**C**	18 (457.2) High	
	100	135		**FZ306D**			380	**D**		
	150	180	250	**FZ306E**			480	**E**	36 (914.4) High	
	200	240	400	**FZ306F**			575	**F**		
	250	304		**FZ306G**			—	**—**		

F2100 Replacement Starter Units

Table 14. Full Voltage Non-Reversing — Fusible ①

NEMA Size	Maximum Horsepower					Fuse Clip Amperes	Catalog Code	Service Voltage	Catalog Code	Control Voltage	Catalog Code	Space Options Inches (mm)	Catalog Code
	208V	240V	380V	480V	600V								
1	7.5	7.5	10	10	10	30	**FZ204C**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	6 (152.4) High 12 (304.8) High 18 (457.2) High	**C** ② **S** **X**
2	— 10	— 15	15 25	15 25	25 —	30 60	**FZ204E** **FZ204F**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	12 (304.8) High 18 (457.2) High	**S** **X**
3	— 25	20 30	30 50	40 50	50 —	60 100	**FZ204H** **FZ204J**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	24 (609.6) High	**S**
4	— 50	— 50	— 50	60 100	75 100	100 200	**FZ204L** **FZ204M**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	48 (1219.2) High	**S**
5	60 100	60 100	100 150	150 200	150 200	200 400	**FZ204P** **FZ204R**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480	**A** **B** **C** **D** **E**	60 (1524.0) High	**S**

① Fuse clip ratings shown are based on Class RK1, 5 fuses for all units except 6-inch (152.4 mm) units which use CC fuses.

② On 6-inch (152.4 mm) units, the only option available are (3) E22 pilot devices and separate source fuse or disconnect or CPT.

Table 15. Full Voltage Reversing — Fusible ③

NEMA Size	Maximum Horsepower					Fuse Clip Amperes	Catalog Code	Service Voltage	Catalog Code	Control Voltage	Catalog Code	Space Options Inches (mm)	Catalog Code
	208V	240V	380V	480V	600V								
1	7.5	7.5	10	10	10	30	**FZ214C**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	24 (609.6) High	**S**
2	— 10	— 15	15 25	15 25	25 —	30 60	**FZ214E** **FZ214F**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	24 (609.6) High	**S**
3	— 25	20 30	30 50	40 50	50 —	60 100	**FZ214H** **FZ214J**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	30 (762.0) High	**S**
4	— 50	— 50	— 60	60 100	75 100	100 200	**FZ214L** **FZ214M**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	54 (1371.6) High	**S**

③ Fuse clip ratings shown are based on Class RK1, 5 fuses for all units except 6-inch (152.4 mm) units which use CC fuses.

F2100 Replacement Starter Units

Table 16. Full Voltage 2 Speed 1 Winding — Fusible — Constant/Variable Torque ①②

NEMA Size	Maximum Horsepower					Fuse Clip Amperes	Catalog Code	Service Voltage	Catalog Code	Control Voltage	Catalog Code	Space Options Inches (mm)	Catalog Code
	208V	240V	380V	480V	600V								
1	7.5	7.5	10	10	10	30	**FZ944C**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	24 (609.6) High	**S**
2	— 10	— 15	15 25	15 25	25 —	30 60	**FZ944E** **FZ944F**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	36 (914.4) High	**S**
3	— 25	20 30	30 50	40 50	50 —	60 100	**FZ944H** **FZ944J**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	36 (914.4) High	**S**
4	— 50	— 50	— 60	60 100	75 100	100 200	**FZ944L** **FZ944M**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	60 (1524.0) High	**S**

① Fuse clip ratings shown are based on Class RK1, 5 fuses for all units except 6-inch (152.4 mm) units which use CC fuses.
② For constant horsepower instead of constant/variable torque, see Option SV6 on **Page 18**.

Table 17. Full Voltage 2 Speed 2 Winding — Fusible — Constant/Variable Torque ③④

NEMA Size	Maximum Horsepower					Fuse Clip Amperes	Catalog Code	Service Voltage	Catalog Code	Control Voltage	Catalog Code	Space Options Inches (mm)	Catalog Code
	208V	240V	380V	480V	600V								
1	7.5	7.5	10	10	10	30	**FZ954C**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	24 (609.6) High	**S**
2	— 15	— 15	15 25	15 25	25 —	30 60	**FZ954E** **FZ954F**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	24 (609.6) High	**S**
3	— 25	20 30	30 50	40 50	50 —	60 100	**FZ954H** **FZ954J**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	36 (914.4) High	**S**
4	— 50	— 50	— 60	60 100	75 100	100 200	**FZ954L** **FZ954M**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	54 (1371.6) High	**S**

③ Fuse clip ratings shown are based on Class RK1, 5 fuses for all units except 6-inch (152.4 mm) units which use CC fuses.
④ For constant horsepower instead of constant/variable torque, see option SV6 on **Page 18**.

F2100 Replacement Starter Units

Table 18. Reduced Voltage Autotransformer — Fusible ①

NEMA Size	Maximum Horsepower					Fuse Clip Amperes	Catalog Code	Service Voltage	Catalog Code	Control Voltage	Catalog Code	Space Options Inches (mm)	Catalog Code
	208V	240V	380V	480V	600V								
2	— 10	— 15	15 25	15 25	25 —	30 60	**FZ604E** **FZ604F**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	36 (914.4) High	**S**
3	— 25	20 30	30 50	40 50	50 —	60 100	**FZ604H** **FZ604J**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	54 (1371.6) High	**S**
4	— 50	— 50	— 60	60 100	75 100	100 200	**FZ604L** **FZ604M**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	72 (1828.8) High	**S** ②

① Fuse clip ratings shown are based on Class RK1, 5 fuses for all units except 6-inch (152.4 mm) units which use CC fuses.

② If existing MCC is back-to-back design, 36 inches (914.4 mm) in bottom rear is unusable.

Table 19. Reduced Voltage Part Winding — Fusible ③

NEMA Size	Maximum Horsepower					Fuse Clip Amperes	Catalog Code	Service Voltage	Catalog Code	Control Voltage	Catalog Code	Space Options Inches (mm)	Catalog Code
	208V	240V	380V	480V	600V								
1	10	10	15	15	15	60	**FZ704C**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	24 (609.6) High	**S**
2	— 20	15 25	25 40	30 40	40 —	60 100	**FZ704E** **FZ704F**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	24 (609.6) High	**S**
3	— 40	— 50	— 75	50 75	60 75	100 200	**FZ704H** **FZ704J**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	36 (914.4) High	**S**
4	50 75	— 75	100 150	100 150	150 —	200 400	**FZ704L** **FZ704M**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	54 (1371.6) High	**S**

③ Fuse clip ratings shown are based on Class RK1, 5 fuses for all units except 6-inch (152.4 mm) units which use CC fuses.

F2100 Replacement Starter Units

Table 20. Reduced Voltage Wye Delta Open Transition — Fusible ①

NEMA Size	Maximum Horsepower					Fuse Clip Amperes	Catalog Code	Service Voltage	Catalog Code	Control Voltage	Catalog Code	Space Options Inches (mm)	Catalog Code
	208V	240V	380V	480V	600V								
2	15	15	30	40	40	60	**FZ804F**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	30 (762.0) High	**S**
	20	25	40	—	—	100	**FZ804G**					36 (914.4) High	**S**
3	25	30	50	60	75	100	**FZ804J**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	36 (914.4) High	**S**
	40	50	75	75	—	200	**FZ804K**					48 (1219.2) High	**S**
4	50	60	100	125	150	200	**FZ804M**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	60 (1524.0) High	**S**
	60	75	150	150	—	400	**FZ804N**					72 (1828.8) High	**S**

① Fuse clip ratings shown are based on Class RK1, 5 fuses for all units except 6-inch (152.4 mm) units which use CC fuses.

Table 21. Reduced Voltage Wye Delta Closed Transition — Fusible (Non-Chiller Application) ②

NEMA Size	Maximum Horsepower					Fuse Clip Amperes	Catalog Code	Service Voltage	Catalog Code	Control Voltage	Catalog Code	Space Options Inches (mm)	Catalog Code
	208V	240V	380V	480V	600V								
2	15	15	30	40	40	60	**FZ894F**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	30 (762.0) High	**S**
	20	25	40	—	—	100	**FZ894G**					36 (914.4) High	**S**
3	25	30	50	60	75	100	**FZ894J**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	48 (1219.2) High	**S**
	40	50	75	75	—	200	**FZ894K**						
4	50	60	100	125	150	200	**FZ894M**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	60 (1524.0) High	**S**
	60	75	150	150	—	400	**FZ894N**					72 (1828.8) High	**S**

② Fuse clip ratings shown are based on Class RK1, 5 fuses for all units except 6-inch (152.4 mm) units which use CC fuses.

Table 22. Reduced Voltage Non-Reversing Vacuum Starters — Fusible ③

NEMA Size	Maximum Horsepower					Fuse Clip Amperes	Catalog Code	Service Voltage	Catalog Code	Control Voltage	Catalog Code	Space Options Inches (mm)	Catalog Code
	208V	240V	380V	480V	600V								
4	—	—	—	60	75	100	**FZV04L**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	36 (914.4) High	**S**
	50	50	60	100	100	200	**FZV04M**						
5	60	60	100	150	150	200	**FZV04P**	208 240 380 480 575	**B** **C** **D** **E** **F**	120 208 240 380 480 575	**A** **B** **C** **D** **E** **F**	36 (914.4) High	**S**
	100	100	150	200	200	400	**FZV04R**					48 (1219.2) High	**S**

③ Fuse clip ratings shown are based on Class RK1, 5 fuses for all units except 6-inch (152.4 mm) units which use CC fuses.

F2100 Unit Options

Table 23. Option Groups ①

Groups	Description	Page Number
B	Circuit Breaker Options	**16**
C	Control Power Source Options	**16**
G	Ground Fault Protection Options	**16**
M	Metering Options	**16**
O	Overload Options	**16**
P	Pilot Device Options	**17**
R	Relay and Timer (Control, Voltage, Current) Options	**17**
S	Starter Contact Options	**18**
SV	Vacuum Starter Options	**18**
T	Terminal Block Options	**18**
U	Unit Wiring Options	**18**

① Select your option suffix and attach it to the end of the catalog number.

Table 24. Option Suffix

Suffix	Description	Space Required ②
B — Breaker Options		
B10	Shunt Trip 120V AC Wired to Terminal Blocks for Remote Tripping	**C**
B11	Auxiliary Switch Form C (1NO/1NC) Wired to Terminal Blocks	**C**
B12	Form C Bell Alarm Contact (1NO/1NC) Wired to Terminal Blocks	**C**
B13	Undervoltage Release	**C**
B14	IQ Energy Sentinel — F Frame	③
B15	IQ Energy Sentinel — J Frame	③
B16	IQ Energy Sentinel — K Frame	③
B17	IQ Central Energy Display	③
B18	Thermal Magnetic Circuit Breaker Instead of HMCP	—
C — Control Power Source Options		
C10	Control Fuse Wired for Separate Source in Lieu of Control Power Transformer	**C**
C11	Control Fuse with Disconnect for Separate Source in Lieu of Control Power Transformer	**C**
C12	Control Power Transformer 100 VA for Size 1 and 2 Starters (Fused)	**C** ④
C13	Control Power Transformer 150 VA for Size 3 and 4 Starters (Fused)	**C**
C14	Control Power Transformer 100 VA with Interposing Relay for Size 5 Starters, Fused	**C**
C15	Extra 50 VA for Control Power Transformer	**S**
C16	Extra 100 VA for Control Power Transformer	**S**
C17	Service Voltage Control, Fused in Lieu of Control Power Transformer	**C**
C18	Full Capacity Control Power Transformer for Size 5 Starters, Fused	**C**
G — Ground Fault Protection Options		
G10	Class 1 Ground Fault Protection — GRT1 Size 1 – 4	**X**
G11	Class 1 Ground Protection — GRT1 Size 5 – 6	**X**
G12	Ground Fault Test Panel	**X**
M — Metering Options		
M10	Mini Voltmeter	**C** ④
M11	Mini Ammeter with Current Transformer	**S**
M12	Mini Elapsed Time Meter	**C** ④
M13	Current Transformer for Remote Metering	**S**
M14	Current Transducer 4-20 mA Output	**X**
O — Overload Options		
O10	IQ 500 Solid-State Overload Relay	—
O11	IQ 500 Load Protection Module	—
O16	Bell Alarm (1NO) Wired	**C**
O17	Bi-Metallic Overload Substitution	**C**
O18	Adjustable A200 Overload Substitution	**C**
O19	Overload Relay Heater/Heater Pack	**C**
O20	CEP7 Solid-State Overload Relay	**C**

② Minimum unit size required (refer to Replacement Unit pages).
③ Consult factory for spacing.
④ Not available in 6 inches (152.4 mm).

F2100 Unit Options

Table 24. Option Suffix (Continued)

Suffix	Description	Space Required ①
P — Pilot Device Options ②		
P10	Red "RUN" Light	C
P11	Green "STOPPED" Light	C
P12	Amber "OVERLOAD TRIPPED" Light	C
P13	Green "RUN" Light	C
P14	Red "STOPPED" Light	C
P15	Red "RUN" Push-to-Test Light	C
P16	Green "STOPPED" Push-to-Test Light	C
P17	Amber "OVERLOAD TRIPPED" Push-to-Test Light	C
P18	Green "RUN" Push-to-Test Light	C
P19	Red "STOPPED" Push-to-Test Light	C
P20	Special Function Light	C
P30	"START" Pushbutton	C
P31	"STOP" Pushbutton	C
P32	"START/STOP" Pushbutton	C
P33	"ON" Pushbutton	C
P34	"OFF" Pushbutton	C
P35	"ON/OFF" Pushbutton	C
P36	"FORWARD/REVERSE/STOP" Pushbutton	C
P37	"FAST/SLOW/STOP" Pushbutton	C
P38	"FAST/OFF/SLOW" Pushbutton	C
P39	"HIGH/LOW/STOP" Pushbutton	C
P40	"HIGH/LOW/OFF" Pushbutton	C
P41	Special Function Pushbutton	C
P50	"ON-OFF" Selector Switch	C
P51	"HIGH-LOW" Selector Switch	C
P52	"OFF-AUTO" Selector Switch	C
P53	"START-STOP" Selector Switch	C
P54	"SLOW-FAST" Selector Switch	C
P55	"FORWARD-REVERSE" Selector Switch	C
P56	Special Function 2-Position Selector Switch	C
P57	"HAND-OFF-AUTO" Selector Switch	C
P58	"LOCAL-OFF-REMOTE" Selector Switch	C
P59	"FAST-OFF-SLOW" Selector Switch	C
P60	"HIGH-OFF-LOW" Selector Switch	C
P61	Special Function 3-Position Selector Switch	C
P62	"HIGH-LOW-OFF-AUTO" Selector Switch	C
P63	Special Function 4-Position Selector Switch	C
R — Relay and Timer Options		
R10	Auxiliary Control Relay 2-Pole (1NO/1NC) Convertible Contacts Wired in Parallel with Starter Coil	S
R11	Auxiliary Control Relay 4-Pole (2NO/2NC) Convertible Contacts Wired in Parallel with Starter Coil	S
R12	Auxiliary Control Relay 2-Pole Overload Alarm (1NO/1NC) Convertible Contacts	S
R13	Mechanical Latching Relay (Specify Connection)	X
R14	Ice Cube Relay 300 Volts 3-Pole Blade Type (Specify Connection)	S
R15	Phase Voltage Relay	X
R16	Current Sensing Relay with Contacts Wired to Terminal Blocks	X
R17	Deceleration Timing Relay (Pneumatic "OFF" Delay)	S
R18	Compelling Timing Relay (Pneumatic "ON" Delay)	S
R19	Time Clock 24 Hour	③
R20	Time Clock 7 Day	③
R21	Solid-State Timer Type TR (Specify Connection)	S
R22	DN65 DeviceNet Interface Module	S
R23	D15 2-Pole Control Relay	C
R24	D15 4-Pole Control Relay	C

① Minimum unit size required (refer to Replacement Unit pages).
② Available only with F2100, Advantage, Series 2100/5 Star, Freedom Unitrol, F10 Unitrol and Type W. Consult factory for specific size limitations.
③ Consult factory for spacing.

F2100 Unit Options

Table 24. Option Suffix (Continued)

Suffix	Description	Space Required ①
S — Starter Contact Options (Maximum of 8 Contacts)		
S_ _	To order extra starter contacts, you must specify the number of NO/NC contacts, given a maximum of eight (8). To define the unit option required, create a suffix based on the following example:	
SV — Vacuum Starter Options		
SV4	Vacuum Starter Size 4 Substitution FVNR	②
SV5	Vacuum Starter Size 5 Substitution FVNR	②
SV6	Constant Horsepower Instead of Constant/Variable Torque	—
T — Terminal Block Options		
T10	Pull-apart Type Terminal Blocks (Standard on all Vintages Except TYPE W and 11-300)	**S**
T11	Utility Screw Type Terminal Blocks (Add 6 Inches (152.4 mm) for Every 18 Points)	—
T12	Front-mounted Pull-apart Terminal Block for F2100, Advantage, Series 2100/5 Star	**S**
T13	T-Lead Power Terminal Blocks for Size 1 Starter	—
U — Unit Wiring Options		
U10	Surge Suppressor on Coil	**C**
U11	Type SIS Control Wire	**C**
U12	Type SIS Power Wire	**C**
U13	Type 14 Gauge Control Wire (Standard for all Vintages Except F2100, Series 2100/5 Star, Type W and 11-300)	**C**
U14	Wiremarkers — Sleeve Type on all Control Wire	**C**
U15	Locking Fork Terminals on all Control Wiring	**S**
U16	Ring Wire Terminals on Power Wiring	**S**
U17	Wiring Diagram Inside Starter Unit Door	**C**
U18	Pre-insulated Ring Terminals on all Control Wiring	**C**
U19	Pre-insulated Ring Terminals on all Control Wiring, except for Freedom Starter Terminals	**C**
U20	Wiremarkers for Power Wiring	**C**

Example for S_ _:

	Quantity of Normally Open Contacts	Quantity of Normally Closed Contacts
S	2	3

① Minimum unit size required (refer to Replacement Unit pages).
② Consult factory for spacing.

F2100 Structure Parts

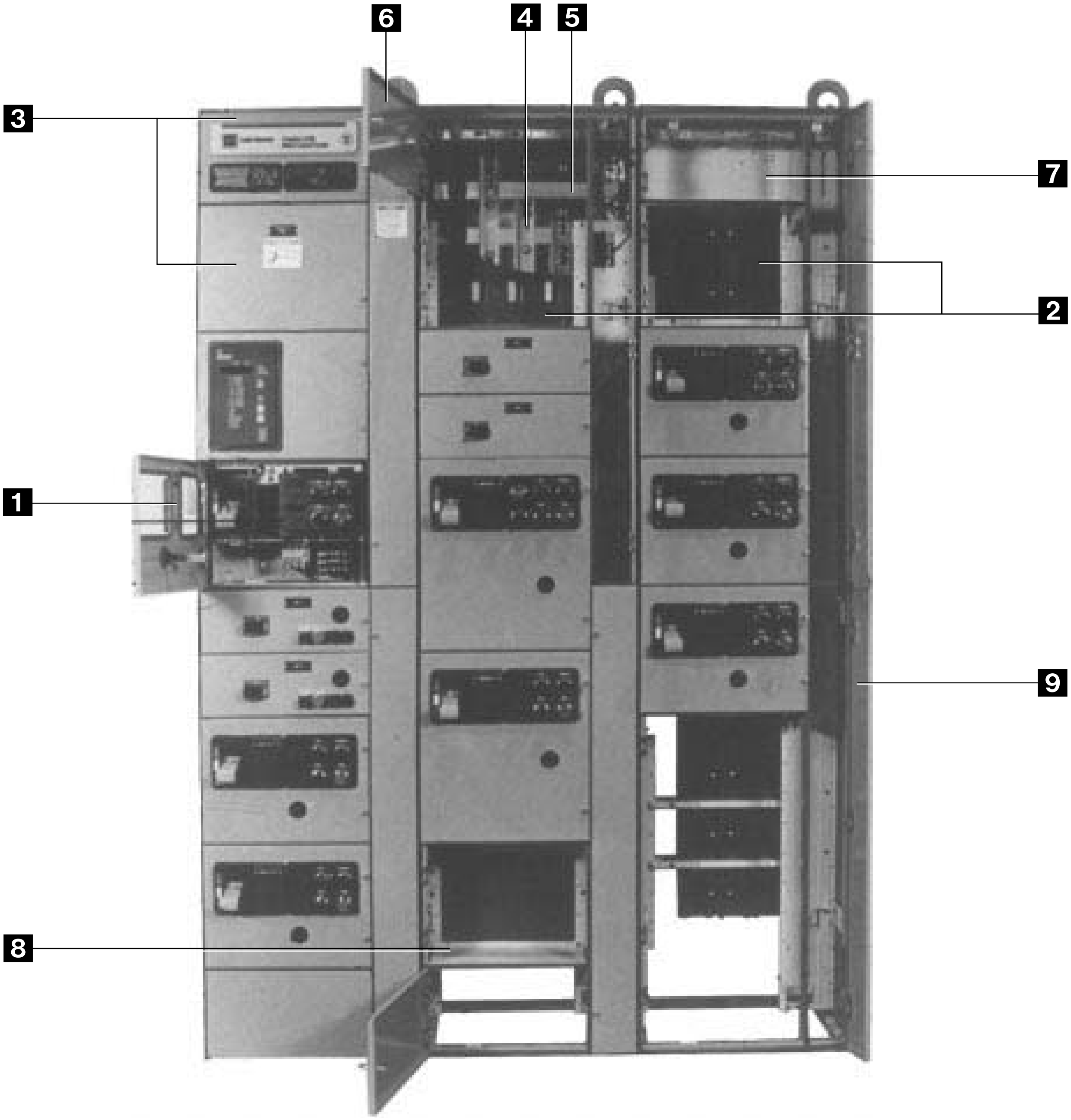


Table 25. Structure Parts

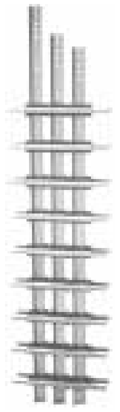
Reference	Description	Page
1	Blank Unit Door	20
2	Shutter Kit	20
3	Sheet Metal Covers Touch-up Paint Kit	20 20
4	Vertical Bus Bar Vertical Bus Barrier Kits Vertical Bus Insulation Kit	20 20 20
5	Horizontal Bus Bar	21

Reference	Description	Page
6	Horizontal Wireway Door	21
7	Horizontal Bus Barriers	21
8	Divider Pan/Guide Rails	21
9	Vertical Wireway Door Horizontal to Vertical Bus Connection Kit Horizontal Bus Insulator Kit Horizontal Bus Splice Kit Door Mounting Hardware Kit	21 22 22 22 22

F2100 Structure Parts

Vertical Bus Bar 4

65,000 ampere rms bus bracing.

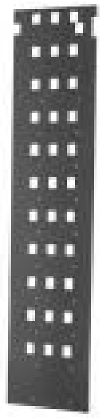


Vertical Bus Bar

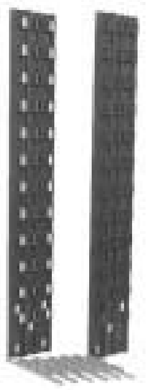
Table 26. Vertical Bus Bar — Copper Only

Ampere Rating	Mounting Type	Style Number
300	Front	**4719A80G01**
600	Front/Back-to-Back	**4719A80G02**
800	Front	**4719A80G04**
1200	Front	**4719A80G05**

Vertical Bus Barrier Kits 4



Standard Flat Barrier

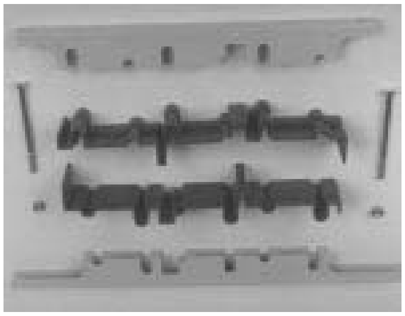


Labyrinth Barrier

Table 27. Vertical Bus Barrier Kits

Description	Style Number
Standard flat barrier kit includes one flat barrier, 12 covers and clips.	**4719A91G13**
Labyrinth barrier kit includes front and rear barrier, bus supports and hardware (does not include shutters).	**4719A91G14**

Vertical Bus Insulation Kit 4



Vertical Bus Insulation Kit

Table 28. Vertical Bus Insulation Kit

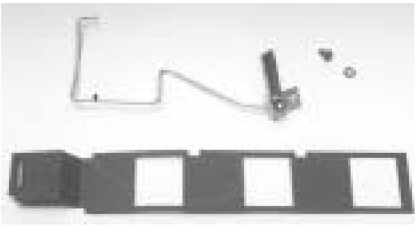
Description	Style Number
Kit includes 2 insulators, 2 mounting brackets and mounting hardware.	**4719A91G12**

Sheet Metal Covers with Mounting Hardware 3

Table 29. Sheet Metal Covers with Mounting Hardware

Description	Style Number
Side Sheets	
16-Inches (406.4 mm) Deep, Front Mounted	**4719A91G31**
21-Inches (533.4 mm) Deep, Front Mounted	**4719A91G32**
21-Inches (533.4 mm) Deep, Back-to-Back Mounted	**4719A91G33**
Rear Sheets	
20-Inches (508.0 mm) Wide x 90-Inches (2286.0 mm) High	**4719A91G34**
24-Inches (609.6 mm) Wide x 90-Inches (2286.0 mm) High	**4719A91G35**
Top Sheets	
20-Inches (508.0 mm) Wide x 16-Inches (406.4 mm) Front Mounted	**4719A91G36**
20-Inches (508.0 mm) Wide x 21-Inches (533.4 mm) Front Mounted	**4719A91G37**
20-Inches (508.0 mm) Wide x 21-Inches (533.4 mm) Back-to-Back Mounted	**4719A91G38**
24-Inches (609.6 mm) Wide x 16-Inches (406.4 mm) Front Mounted	**4719A91G39**
24-Inches (609.6 mm) Wide x 21-Inches (533.4 mm) Front Mounted	**4719A91G40**

Shutter Kit 2



Shutter Kit

Table 30. Shutter Kit

Description	Style Number
Kit includes shutter, spring loaded coupler and mounting screws.	**4719A91G15**

Blank Unit Door with Mounting Hardware 1

Table 31. Blank Unit Door with Mounting Hardware

Description	Style Number
6-Inches (152.4 mm) High x 15-1/2 Inches (393.7 mm) Wide	**4719A91G20**
12-Inches (304.8 mm) High x 15-1/2 Inches (393.7 mm) Wide	**4719A91G21**
18-Inches (457.2 mm) High x 15-1/2 Inches (393.7 mm) Wide	**4719A91G22**
24-Inches (609.6 mm) High x 15-1/2 Inches (393.7 mm) Wide	**4719A91G23**
30-Inches (762.0 mm) High x 15-1/2 Inches (393.7 mm) Wide	**4719A91G24**
36-Inches (914.4 mm) High x 15-1/2 Inches (393.7 mm) Wide	**4719A91G25**

Touch-up Paint Kit 3

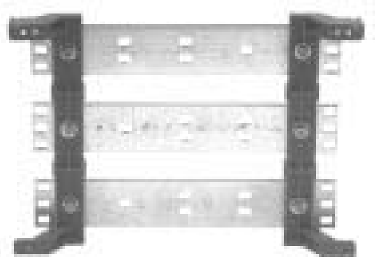
Table 32. Touch-up Paint Kit

Description	Style Number
Kit includes three spray cans of ANSI-61 Gray.	**4719A91G10**

F2100 Structure Parts

Horizontal Bus Bar 5

65,000 ampere rms Bus Bracing.



Horizontal Bus Bar

Table 33. Horizontal Bus Bar — Tin-Plated Copper

Structures		Bar Size Inches (mm)	Bars/ Phase	Ampere Rating		Style Number
Number	Width Inches (mm)			UL (50°C)	NEMA (65°C)	
1 2 3	20 (508.0) 40 (1016.0) 60 (1524.0)	1/4 x 2 (6.4 x 50.8)	1	600	600	**4719A97G28** **4719A97G29** **4719A97G30**
1 2 3	20 (508.0) 40 (1016.0) 60 (1524.0)	1/4 x 2 (6.4 x 50.8)	1	—	800	**4719A97G31** **4719A97G32** **4719A97G33**
1 2 3	20 (508.0) 40 (1016.0) 60 (1524.0)	1/4 x 3 (6.4 x 76.2)	1	—	1000	**4719A97G34** **4719A97G35** **4719A97G36**
1 2 3	20 (508.0) 40 (1016.0) 60 (1524.0)	1/4 x 3 (6.4 x 76.2)	2	—	1200	**4719A97G37** **4719A97G38** **4719A97G39**
1 2 3	20 (508.0) 40 (1016.0) 60 (1524.0)	1/4 x 3 (6.4 x 76.2)	1	800	—	**4719A97G40** **4719A97G41** **4719A97G42**
1 2 3	20 (508.0) 40 (1016.0) 60 (1524.0)	1/4 x 2-1/2 (6.4 x 63.5)	2	1200	—	**4719A97G43** **4719A97G44** **4719A97G45**

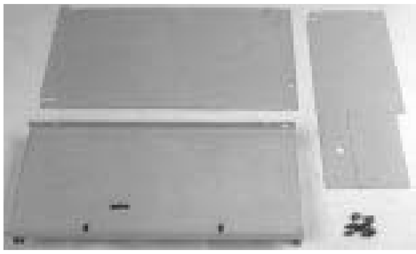
Horizontal Wireway Door Kit 6

Horizontal Wireway Door kit

Table 34. Horizontal Wireway Door Kit

Description Inches (mm)	Style Number
9 (228.6) High x 15-1/2 (393.7) Wide (Standard Kit of 2)	**4719A91G18**
(1) 15 (381.0) High x 15-1/2 (393.7) Wide, (1) 3 (76.2) High	**4719A91G19**

Horizontal Bus Barrier Kit 7



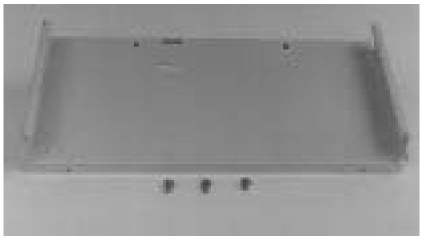
Horizontal Bus Barrier Kit

Table 35. Horizontal Bus Barrier Kit

Description Inches (mm)	Style Number
9 (228.6) High, Front Mounted	**4719A91G02**
15 (381.0) High, Front Mounted	**4719A91G03**
15 (381.0) High, Rear Mounted	**4719A91G04**

Kit includes divider pan, horizontal and vertical barriers, junction piece, and mounting hardware.

Divider Pan/Guide Rails with Mounting Hardware 8

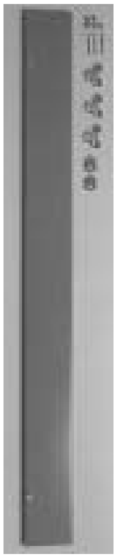


Divider Pan/Guide Rails with Mounting Hardware

Table 36. Divider Pan/Guide Rails with Mounting Hardware

Description	Style Number
Divider Pan/Guide Rails with mounting hardware.	**4719A91G05**

Vertical Wireway Door Kit 9



Vertical Wireway Door Kit

Table 37. Vertical Wireway Door Kit

Description Inches (mm)	Style Number
Kit includes 4 x 45 (101.6 x 1143.0) door, hinges, hinge pins and mounting hardware.	**4719A91G17**

F2100 Structure Parts

Horizontal to Vertical Bus Connection Kit 9

Horizontal to Vertical Bus Connection Kit

Table 38. Horizontal to Vertical Bus Connection Kit

Description	Horizontal Bus		Vertical Bus		Style Number
	Ampere Rating	Bars/Phase	Ampere Rating	Material	
Kit includes bus spacers with mounting hardware.	600	1	300 600	Cu Cu	**4719A97G64** **4719A97G65**
	800	2	300 600 800	Cu Cu Cu	**4719A97G72** **4719A97G73** **4719A97G74**
	1200	3	300 600 800 1200	Cu Cu Cu Cu	**4719A97G80** **4719A97G81** **4719A97G82** **4719A97G84**

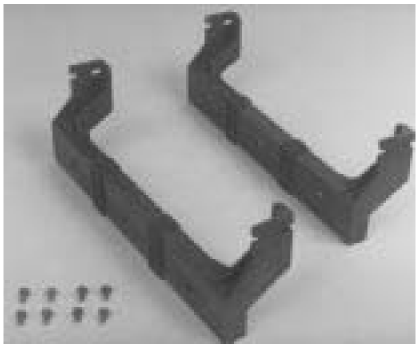
Horizontal Bus Splice Kit 9

Horizontal Bus Splice Kit

Table 39. Horizontal Bus Splice Kit — Tin-Plated Copper

Description	Bus Ampere Rating		Bus Size Inches (mm)	Bars/ Phase	Style Number
	UL (50°C)	NEMA (65°C)			
Kit includes bus splice plates with mounting hardware.	600	600	2 (50.8)	1	**4719A97G86**
	—	800	2 (50.8)	1	**4719A97G87**
	800	—	3 (76.2)	1	**4719A97G88**
	—	1000	3 (76.2)	1	**4719A97G89**
	1000	1200	3 (76.2)	2	**4719A97G90**
	1200	—	2-1/2 (63.5)	2	**4719A97G91**

Horizontal Bus Insulator Kit 9



Horizontal Bus Insulator Kit

Table 40. Horizontal Bus Insulator Kit

Description	Style Number
Kit includes 2 insulators with mounting hardware.	**4719A91G11**

Door Mounting Hardware Kit 9

Door Mounting Hardware Kit

Table 41. Door Mounting Hardware Kit

Description	Style Number
Kit includes 2 hinges, hinge pins and (2) 1/4 turn latches.	**4719A91G26**

F2100 Unit Parts

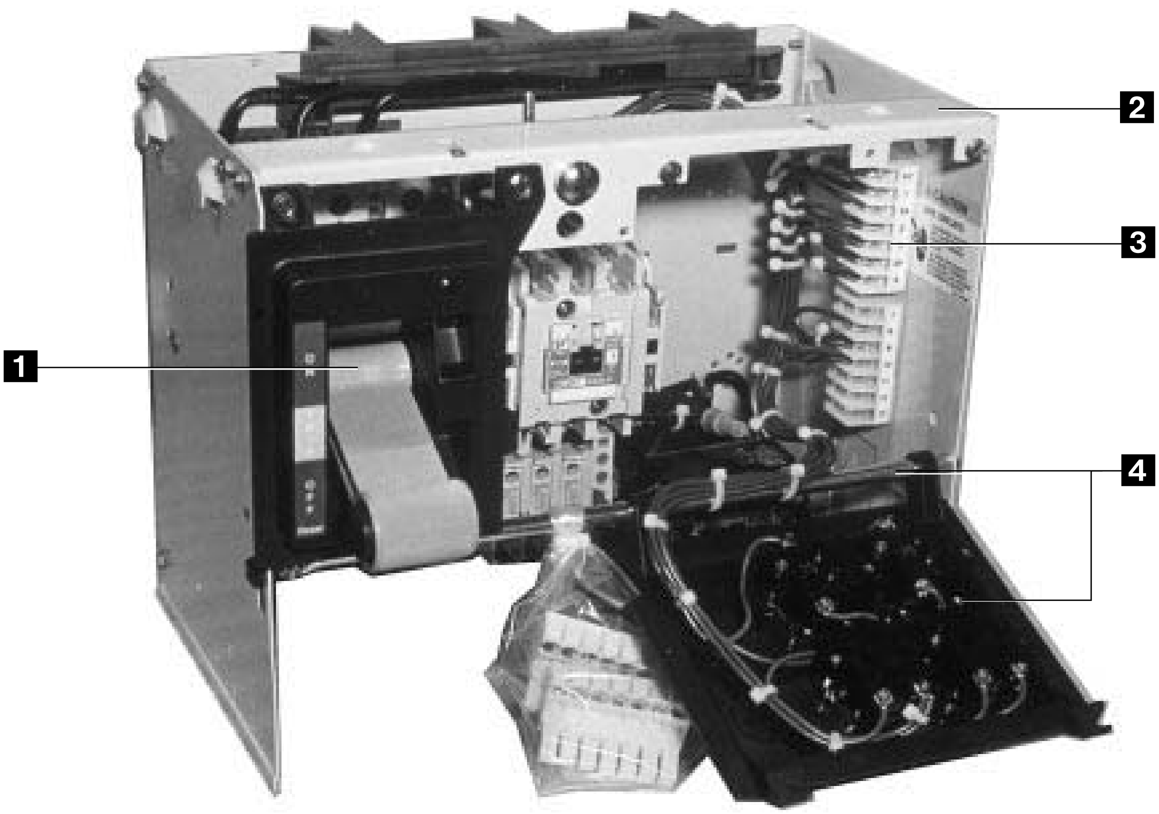


Table 42. Unit Parts

Reference	Description	Page
1	Operating Handle Mechanism Overload Reset Button and Reset Rod Ext. Kit	23 23
2	Unit Drawout Top Rail	24
3	Terminal Blocks	24
4	Control Transformers Primary/Secondary Fuse Holder Kit Device Panel/Pivot Tube	24 24 24

Operating Handle Mechanism Kit 1

Operating Handle Mechanism Kit

Kit includes operating arm, adjustable linkage, and mounting hardware.

Table 43. Operating Handle Mechanism Kit

Description	Style Number
Circuit Breaker Units	
FB/MCP	**4719A92G43**
KB	**4719A92G05**
HFD/HMCP	**4719A88G01**
HMCPE	**4700A99G69**
HLD	**4700A99G65**
HJD/HKD	**4719A89G01**
LB	**4719A92G06**
MA/MC	**4719A92G07**
NB	**4719A92G08**
FCL	**4719A92G44**
LCL	**4719A92G45**
HFD/HMCP (6-Inch Unit)	**4719A92G56**
Fusible Switch Units	
30/60/100A K Switch	**5A10098G01**
200A K Switch	**5A10098G03**
400A K Switch	**5A10098G05**

Overload Reset Button and Reset Rod Extension Kit 1

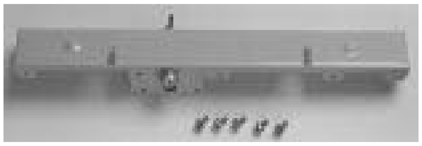
Overload Reset Button and Reset Rod Extension Kit

Table 44. Overload Reset Button and Reset Rod Extension Kit

Description	Style Number
For Freedom starters, the kit includes reset button, retainer, and adapter.	**4719A92G58**

F2100 Unit Parts

Unit Drawout Top Rail [2]

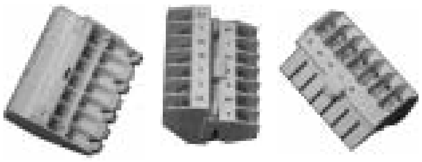


Unit Drawout Top Rail

Table 45. Unit Drawout Top Rail

Description	Style Number
Unit Top Rail with Hardware	**4719A92G02**

Terminal Blocks [3]

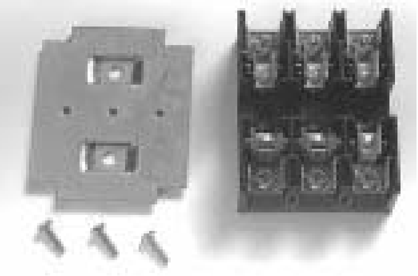


Terminal Blocks

Table 46. Terminal Blocks

Description	Style Number
White, 7 Circuit, Pull-apart	**4719A92G57**

Primary/Secondary Fuse Holder Kit [4]



Primary/Secondary Fuse Holder Kit

Table 47. Primary/Secondary Fuse Holder Kit

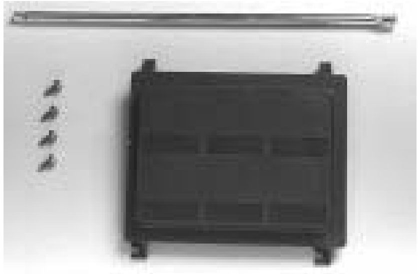
Description	Style Number
Kit includes fuse block, mounting bracket and screws.	**4719A92G59**

Control Transformers (480/240V to 120V Single-Phase) [4]

Table 48. Control Transformers (480/240V to 120V Single-Phase)

Description	Style Number
50 VA	**4719A92G46**
100 VA	**4719A92G48**
150 VA	**4719A92G49**
200 VA	**4719A92G50**
250 VA	**4719A92G51**
300 VA	**4719A92G52**
350 VA	**4719A92G53**
500 VA	**4719A92G54**

Device Panel/Pivot Tube with Mounting Hardware [4]



Device Panel/Pivot Tube with Mounting Hardware

Table 49. Device Panel/Pivot Tube with Mounting Hardware

Description	Style Number
Device panel/pivot tube with mounting hardware.	**4719A92G03**

K-SW Clip Change-Over Information

Fuse Clip Kits are the parts you will need to order to change out the fuse clips on an order.

The kits include clip and hardware for the switch and fuse block. Refer to Vista for pricing.

Table 50. Fuse Clip Kits

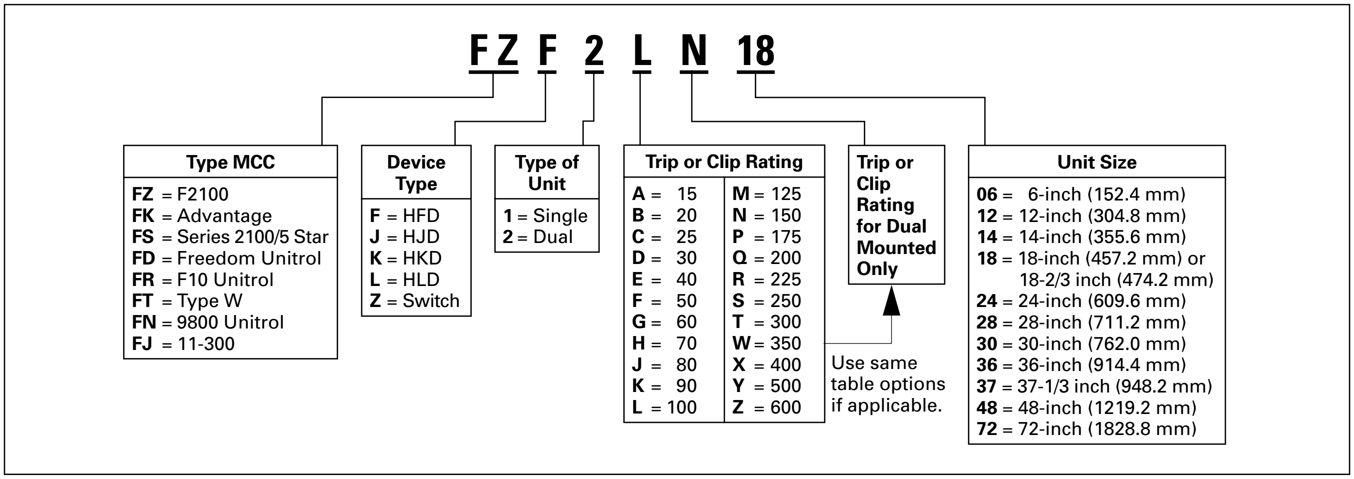
Need	Order Kit Number
30 Ampere 600V/R	
30A 250V/R	**C351KC21R**
30A 600V/J	**C351KD71**
30A 600V/R	**C351KD22-61R**
30A Form II	**C351KD81**
60 Ampere 600V/R	
60A 250V/R	**C351KD22-61R**
60A 600V/J	**C351KD72**
60A 600V/R	**C351KD62R**
60A Form II	**C351KD82**
100 Ampere 600V/R	
100A 250V/R	**C351KE23-63**
100A 600V/J	**C351KE73**
100A 600V/R	**C351KE23-63**
100A Form II	**C351KE83**
200 Ampere 600V/R	
200A 250V/R	**C351KF24-64**
200A 600V/J	**C351KF74**
200A 600V/R	**C351KF24-64**
200A Form II	**C351KF84**

How to Create a Catalog Number

After selecting the circuit device required, create a Dual Mounted feeder unit catalog number based on the following:

Note: Catalog number varies in length based on single or dual mounted unit.

Table 51. Catalog Numbering System Example



FZ F 2 L N 18

Type MCC

- **FZ** = F2100
- **FK** = Advantage
- **FS** = Series 2100/5 Star
- **FD** = Freedom Unitrol
- **FR** = F10 Unitrol
- **FT** = Type W
- **FN** = 9800 Unitrol
- **FJ** = 11-300

Device Type

- **F** = HFD
- **J** = HJD
- **K** = HKD
- **L** = HLD
- **Z** = Switch

Type of Unit

- **1** = Single
- **2** = Dual

Trip or Clip Rating

A = 15	**M** = 125
B = 20	**N** = 150
C = 25	**P** = 175
D = 30	**Q** = 200
E = 40	**R** = 225
F = 50	**S** = 250
G = 60	**T** = 300
H = 70	**W** = 350
J = 80	**X** = 400
K = 90	**Y** = 500
L = 100	**Z** = 600

Trip or Clip Rating for Dual Mounted Only

Use same table options if applicable.

Unit Size

- **06** = 6-inch (152.4 mm)
- **12** = 12-inch (304.8 mm)
- **14** = 14-inch (355.6 mm)
- **18** = 18-inch (457.2 mm) or 18-2/3 inch (474.2 mm)
- **24** = 24-inch (609.6 mm)
- **28** = 28-inch (711.2 mm)
- **30** = 30-inch (762.0 mm)
- **36** = 36-inch (914.4 mm)
- **37** = 37-1/3 inch (948.2 mm)
- **48** = 48-inch (1219.2 mm)
- **72** = 72-inch (1828.8 mm)

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Replacement Feeder Units

Product Description

Each Feeder Unit consists of a single mounted 3-pole molded case circuit breaker or fusible switch (dual mounted are also available). Each unit includes a new wrapper, stab assembly, door, handle mechanism and customer specific disconnect device. They are shipped assembled and ready to install into the existing motor control center.

The following are simple steps to select and order a new feeder unit:

Step 1

Select the circuit device required from **Table 52** below.

Step 2

Verify the amount of space available.

Step 3

Create a catalog number using **Table 51** on **Page 25**.

Unit options and modifications for replacement feeder units:

For factory installed molded case circuit breaker modifications or additional unit options, contact the factory for prices and availability.

Table 52. Electrical Characteristics and Space Requirements of Molded Case Circuit Breaker and Fusible Switch Replacement Feeder Units — Inches (mm)

Device Type	Maximum Amperes	Interrupting Rating (kAIC)			Trip Rating or Clip	Freedom 2100 Series 2100/5 Star Advantage		Freedom Unitrol		F10		Type W		9800		11-300	
		240V	480V	600V		Single	Dual	Single	Dual ①	Single	Dual ①	Single	Dual	Single	Dual ①	Single	Dual
HFD	150	100	65	25	15 20 25 30 40 50 60 70												
					80	6 ② (152.4)		6 ② (152.4)						9 (228.6)			
					90	12 ③ (304.8)	12 (304.8)	12 (304.8)	12 (304.8)	12 ③ (304.8)	12 (304.8)	12 ③ (304.8)	12 (304.8)	14 (355.6)	14 (355.6)	14 (355.6)	14 (355.6)
					100												
					125	12 (304.8)	12 (304.8)	12 (304.8)	18 (457.2)	12 (304.8)	18 (457.2)	12 (304.8)	12 (304.8)	14 (355.6)	18 (457.2)	14 (355.6)	14 (355.6)
					150	12 ③ (304.8)						12 ③ (304.8)		9 (228.6)			
HJD	250	100	65	25	175 200												
					225	18 (457.2)		24 (609.6)		18 (457.2)		18 (457.2)		18 (457.2)		14 (355.6)	
					250												
HKD	400	100	65	35	300 350												
					400	24 (609.6)		24 ④ (609.6)		24 ④ (609.6)		24 (609.6)		28 ④ (711.2)		14 (355.6)	
HLD	600	100	65	35	500												
					600	24 (609.6)		24 ④ (609.6)		24 ④ (609.6)							
Fusible Switch	30	100	100	100	30	12 (304.8)	12 ③ (304.8)	12 (304.8)	18 (457.2)	12 (304.8)	18 (457.2)	12 (304.8)	12 ③ (304.8)	14 (355.6)	18 (457.2)	14 (355.6)	14 (355.6)
	60	100	100	100	60	12 (304.8)	12 ③ (304.8)	12 (304.8)	18 (457.2)	18 (457.2)	18 (457.2)	12 (304.8)	12 ③ (304.8)	14 (355.6)	18 (457.2)	14 (355.6)	14 (355.6)
	100	100	100	100	100	18 (457.2)		18 (457.2)		18 (457.2)		12 ③ (304.8)		18 (457.2)		18 (457.2)	18-2/3 (474.2)
	200	100	100	100	200	36 (914.4)		30 (762.0)		30 (762.0)		24 (609.6)		28 (711.2)		28 (711.2)	
	400	100	100	100	400	36 (914.4)		72 ④ (1828.8)		48 ④ (1219.2)		42 (1066.8)		42 ④ (1066.8)		42 (1066.8)	
	600	100	100	100	600	48 (1219.2)		72 (1828.8)									

① Combined ampacity no greater than 150A for 12-inch (304.8 mm) height. For greater than 150A, 18-inch (457.2 mm) required.

② 100A maximum.

③ Available in 18-inch (457.2 mm) height.

④ Cable in/cable out, no stab assembly.

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Eaton Corporation
Cutler-Hammer business unit
1000 Cherrington Parkway
Moon Township, PA 15108-4312
USA
tel: 1-800-525-2000
www.cutler-hammer.eaton.com

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Publication No. RP04304001E
December 2002

Powering Business Worldwide

Adjustable Frequency Drives

Section Table of Contents
Adjustable Frequency Drives

Powering Business Worldwide

Drawings

Master Document Index

Drives - Enclosed
Drives - Enclosed

	Drawing Description	Document Name	Rev
1	Master Drawing List	D00FTF5M01.DOC	2
2	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-000710-12409.DWG	01
3	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12542.DWG	02
4	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12542_SHT02.DWG	02
5	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-900500-12522.DWG	01

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		D7580427X2K2		
		IRP-3161	**Construction Drawings**	
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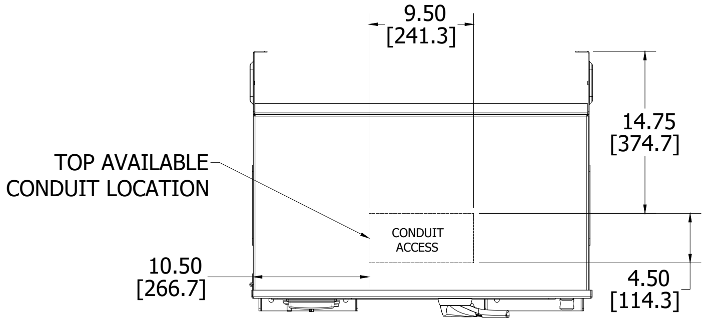
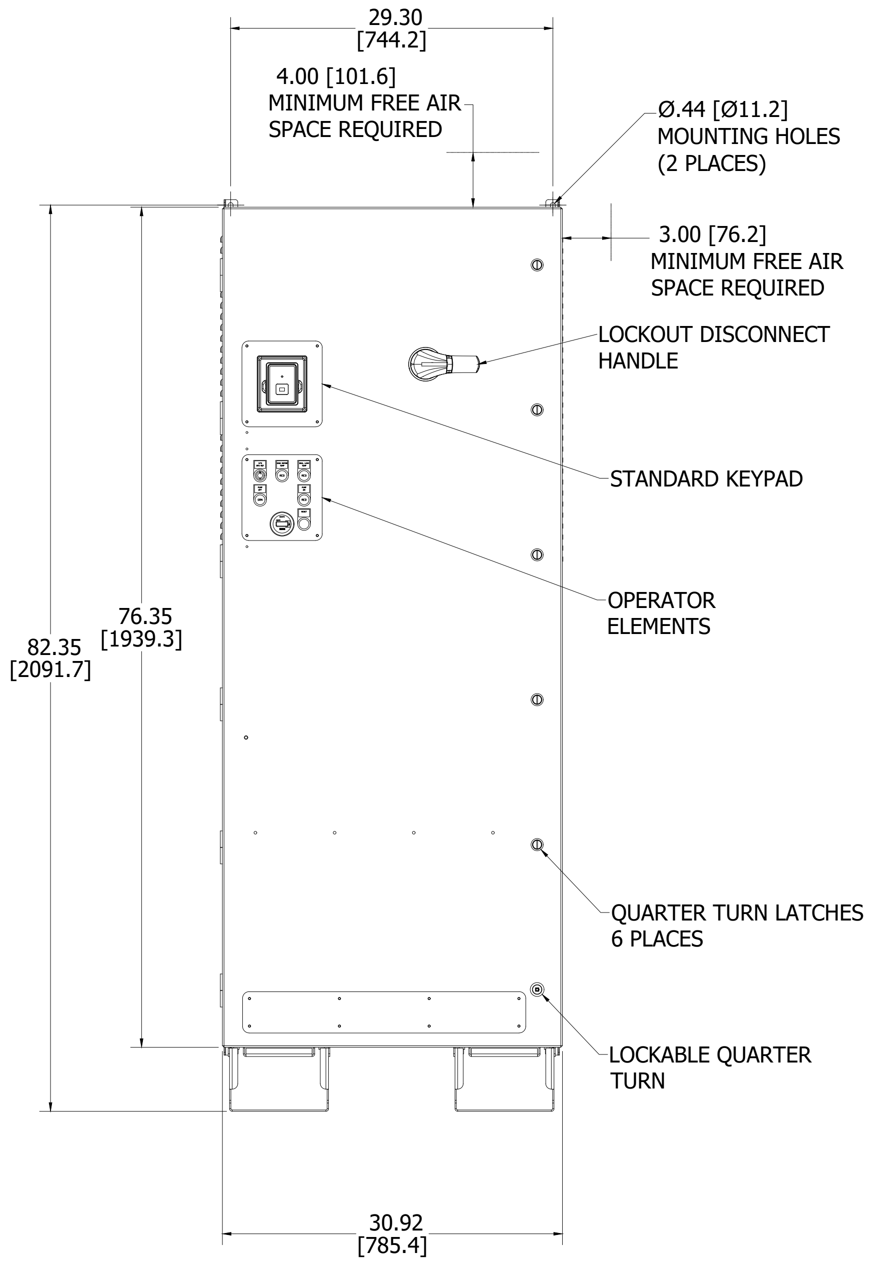
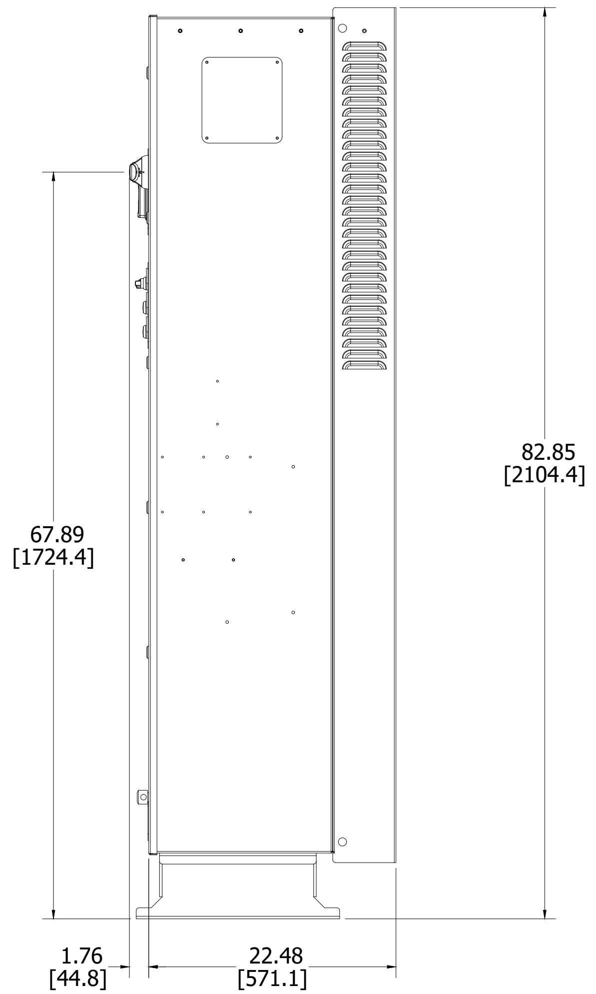
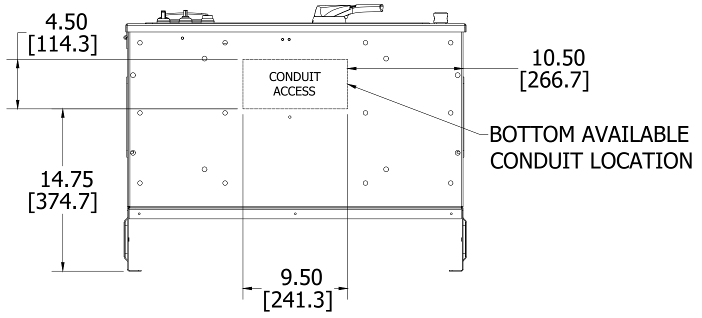


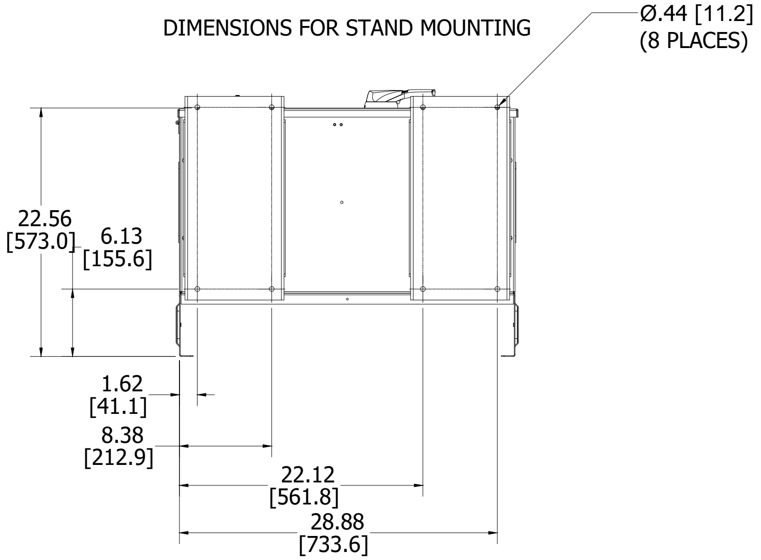




BOTTOM CONDUIT ACCESS LOCATION
SHOWN WITH FLOOR STANDS REMOVED



DIMENSIONS FOR STAND MOUNTING



NOTES:
FINISH: ENCLOSURE - ANSI 61 (LIGHT) GRAY.
WEIGHT: APPROXIMATELY 900 LBS. [408] KG.
MATERIAL: 14GA (0.0747) [1.90] CRS.
DIMENSIONS: INCHES, [MILLIMETERS].
CONSTRUCTION: NEMA TYPE 12 OVERSIZE

EGF0344D2300D00000*-IRP-3161
EGF0344D2300D00000*-IRP-3162
EGF0344D2300D00000*-IRP-3261
EGF0344D2300D00000*-IRP-3262

▲ NEW RELEASE

EATON

DR PNP	DATE 11/09/22	TITLE USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2	
CKD KD	DATE 1/11/23		
APPD	DATE	PRODUCT DG1	DWG TYPE OUTLINE DIMENSION

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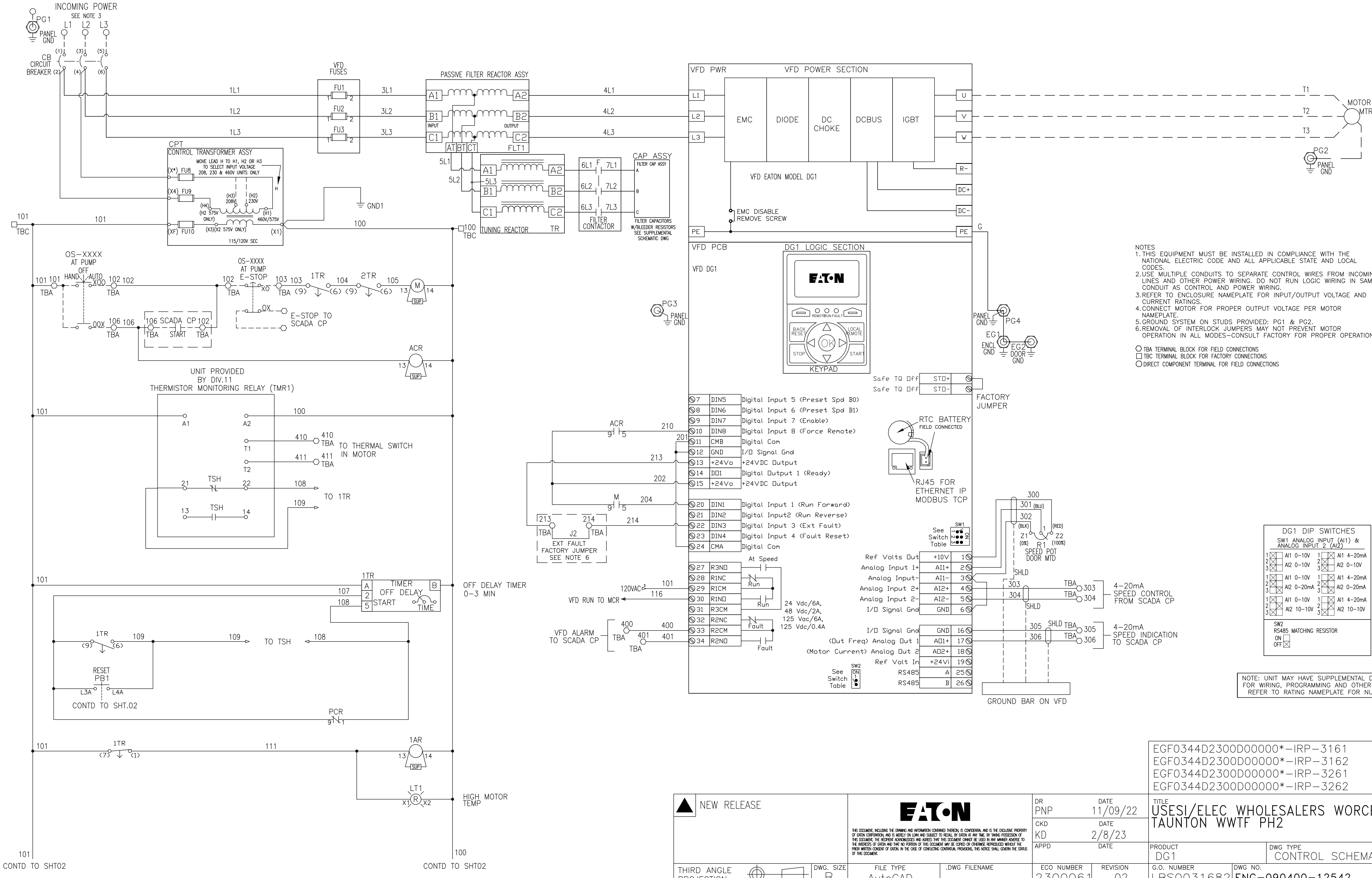

NOTES
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2. USE MULTIPLE CONDUITS TO SEPARATE CONTROL WIRES FROM INCOMING LINES AND OTHER POWER WIRING. DO NOT RUN LOGIC WIRING IN SAME CONDUIT AS CONTROL AND POWER WIRING.
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4. CONNECT MOTOR FOR PROPER OUTPUT VOLTAGE PER MOTOR NAMEPLATE.
5. GROUND SYSTEM ON STUDS PROVIDED: PG1 & PG2.
6. REMOVAL OF INTERLOCK JUMPERS MAY NOT PREVENT MOTOR OPERATION IN ALL MODES—CONSULT FACTORY FOR PROPER OPERATION.

⬡ TBA TERMINAL BLOCK FOR FIELD CONNECTIONS
☐ TBC TERMINAL BLOCK FOR FACTORY CONNECTIONS
○ DIRECT COMPONENT TERMINAL FOR FIELD CONNECTIONS

DG1 DIP SWITCHES

SW1 ANALOG INPUT (AI1) & ANALOG INPUT 2 (AI2)

1 ☒ ☐ 2 ☒ ☐ 3 ☒ ☐	AI1 0-10V AI2 0-10V	1 ☐ ☒ 2 ☒ ☐ 3 ☒ ☐	AI1 4-20mA AI2 0-10V
1 ☒ ☐ 2 ☒ ☐ 3 ☐ ☒	AI1 0-10V AI2 0-20mA	1 ☐ ☒ 2 ☒ ☐ 3 ☐ ☒	AI1 4-20mA AI2 0-20mA
1 ☒ ☐ 2 ☐ ☒ 3 ☒ ☐	AI1 0-10V AI2 10-10V	1 ☐ ☒ 2 ☐ ☒ 3 ☒ ☐	AI1 4-20mA AI2 10-10V

SW2
RS485 MATCHING RESISTOR
ON ☐
OFF ☒

NOTE: UNIT MAY HAVE SUPPLEMENTAL DRAWINGS FOR WIRING, PROGRAMMING AND OTHER DETAILS REFER TO RATING NAMEPLATE FOR NUMBERS

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EGF0344D2300D00000*-IRP-3162
EGF0344D2300D00000*-IRP-3261
EGF0344D2300D00000*-IRP-3262

▲ NEW RELEASE

EATON

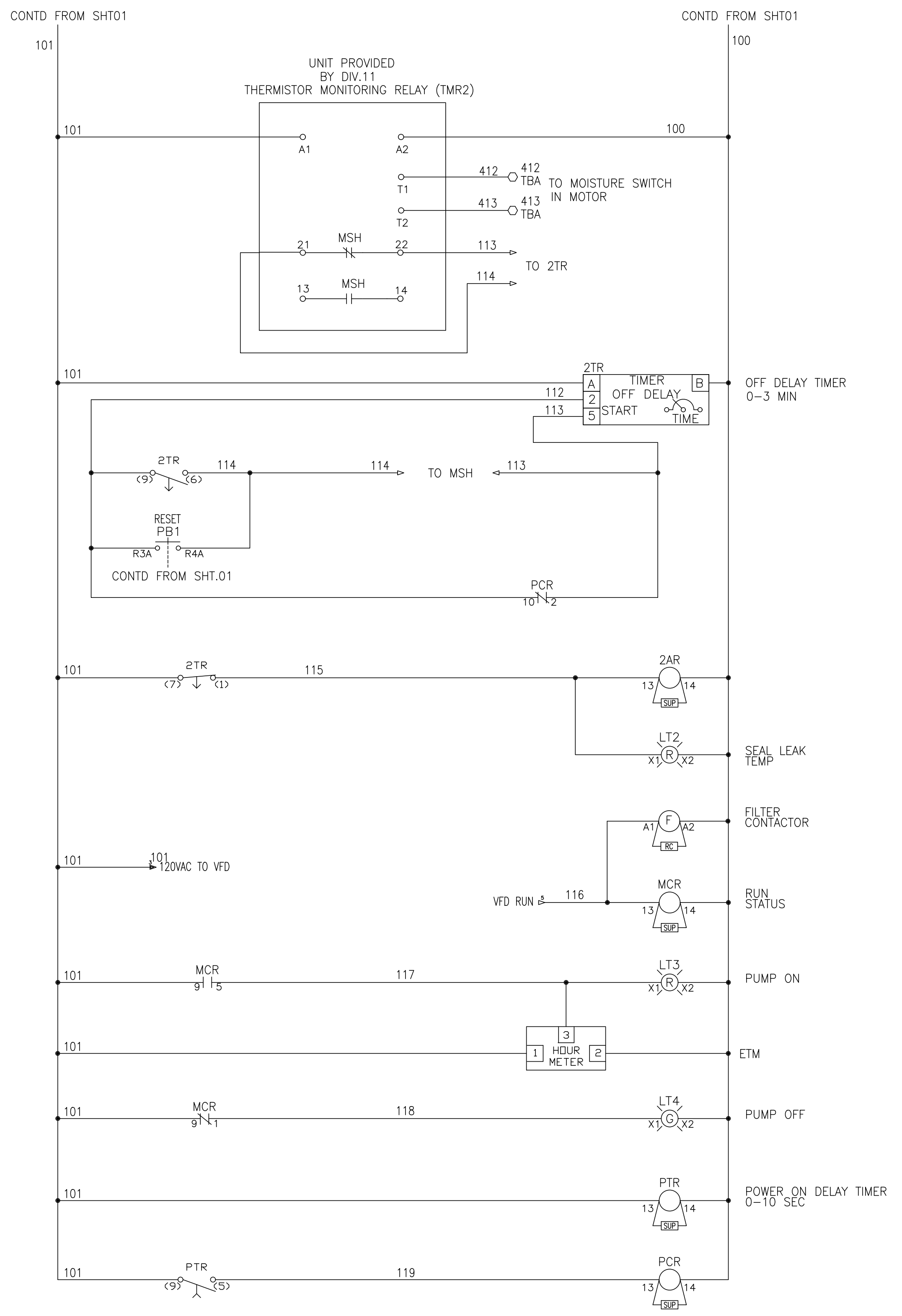
DR PNP DATE 11/09/22
CKD KD DATE 2/8/23
APPD DATE

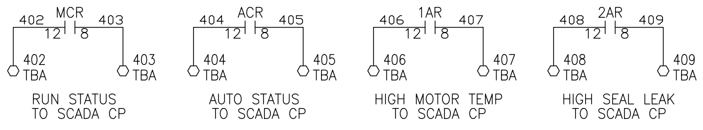
TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2300061
REVISION 02
G.O. NUMBER LBS0031682
DWG NO. ENG-090400-12542
SHEET 1 OF 2

468-1140
REV. 11/11





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▲ SEE SHT.01

EATON

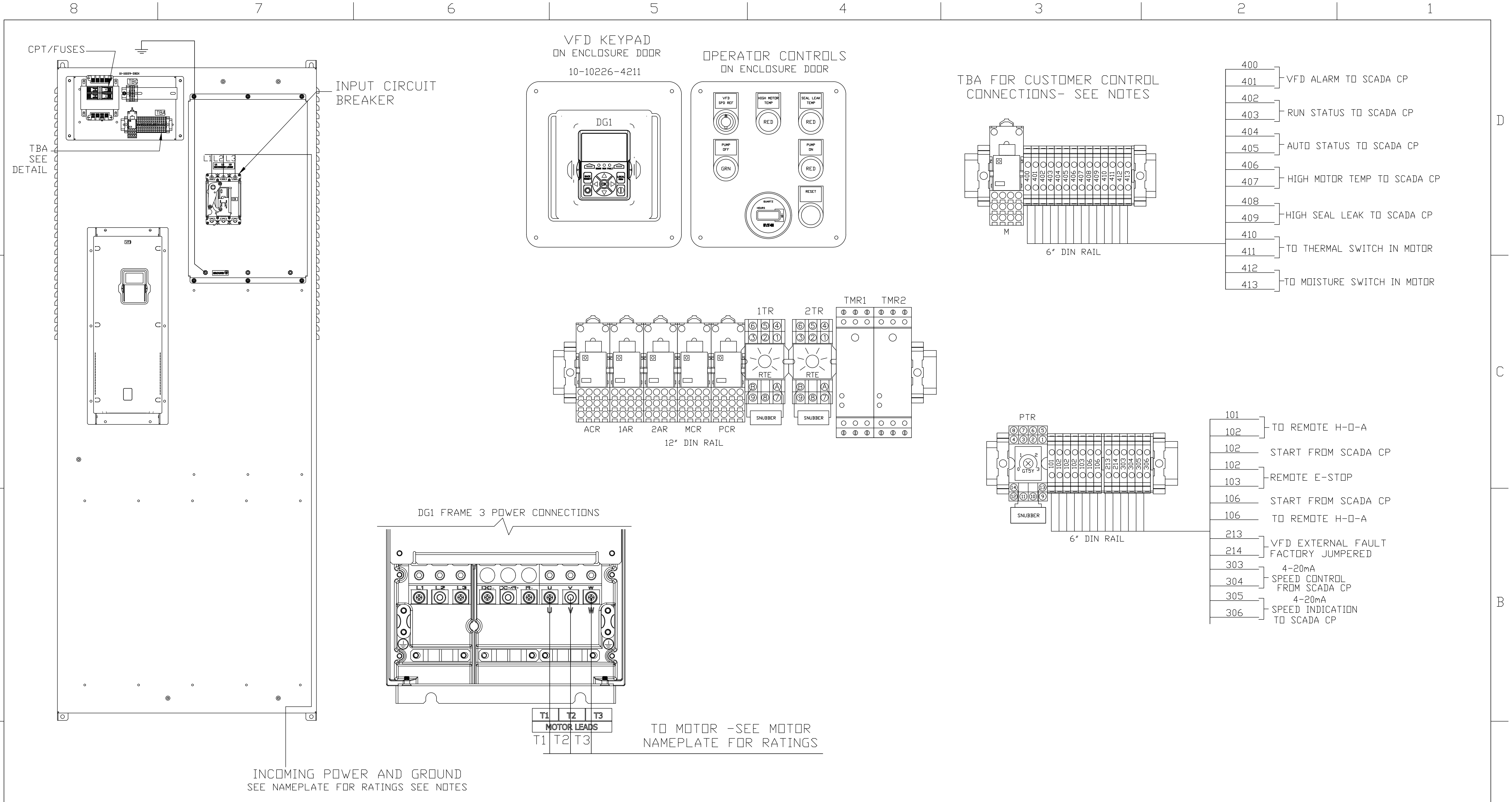
DR PNP DATE 11/09/22
CKD KD DATE 2/8/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2300061
REVISION 02
G.O. NUMBER LBS0031682
DWG NO. ENG-090400-12542
SHEET 2 OF 2

468-1140
REV. 11/11



NOTES

1. SEE SCHEMATIC FOR DETAILS AND CONTROL LOGIC - FACTORY WIRING DETAILS OMITTED.
2. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGES AND CURRENT RATINGS.
3. ENCLOSURE MUST BE GROUNDED USING INPUT AND OUTPUT STUDS PROVIDED.
4. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL STATE/LOCAL CODES.
5. USE MULTIPLE CONDUITS TO SEPARATE 120 CONTROL (TBA 101/102 & 106/104) WIRING FROM INCOMING POWER WIRING.
6. 4-20MA AUTO SPEED SIGNAL CONNECTIONS ARE MADE DIRECTLY TO VFD CONTROL MODULE.
7. DO NOT RUN LOGIC WIRES (TBA 213/214 VFD EXT FAULT) IN SAME CONDUIT AS 120V OR POWER WIRING.
8. REMOVAL OF INTERLOCKS (TBA 101/102,213/214) MAY NOT PREVENT MOTOR OPERATION IN ALL MODES- CONSULT FACTORY FOR DETAILS.

EGF0344D2300D00000*–IRP–3161
EGF0344D2300D00000*–IRP–3162
EGF0344D2300D00000*–IRP–3261
EGF0344D2300D00000*–IRP–3262

▲ NEW RELEASE

EATON

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONNECTION DIAGRAM

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2200787
REVISION 01
G.O. NUMBER LBS0031682
DWG NO. ENG–900500–12522
SHEET 1 OF 1

468–1140
REV. 11/11

Master Document Index

Drives - Enclosed

Drives - Enclosed

	Drawing Description	Document Name	Rev
1	Master Drawing List	D00FTF6M01.DOC	2
2	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-000710-12409.DWG	01
3	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12542.DWG	02
4	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12542_SHT02.DWG	02
5	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-900500-12522.DWG	01

User **Karla Devora Maldonado**	**Date** **2/8/2023 10:19:59 AM**			EATON Powering Business Worldwide
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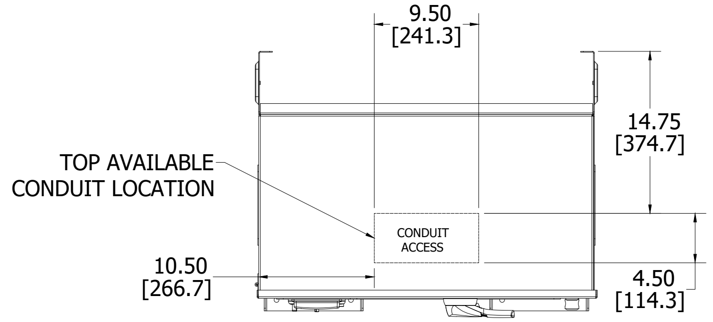
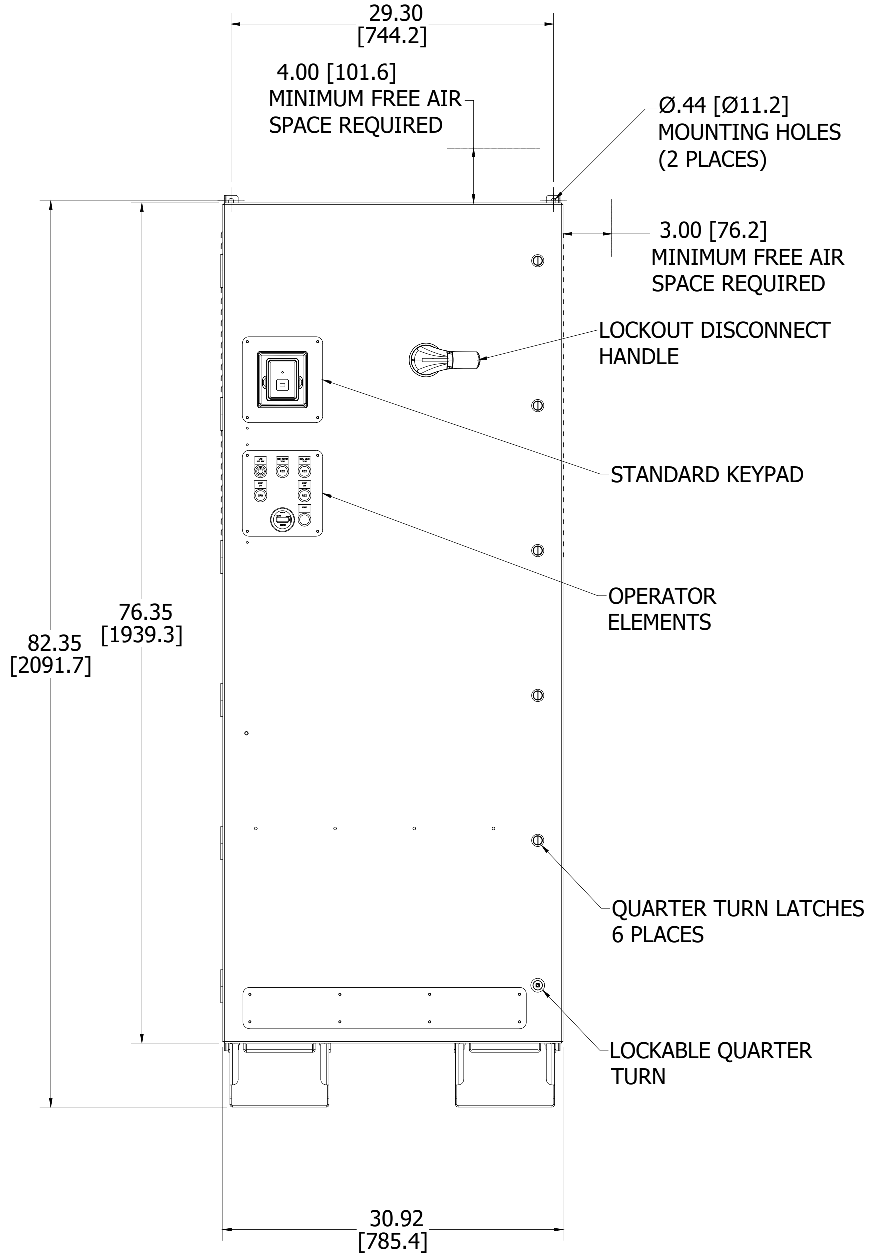
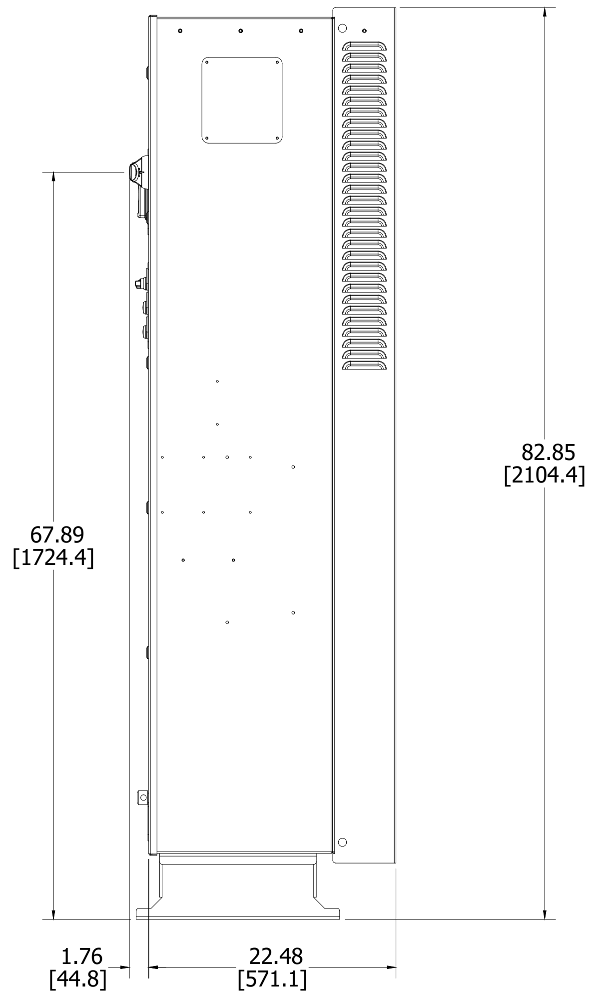
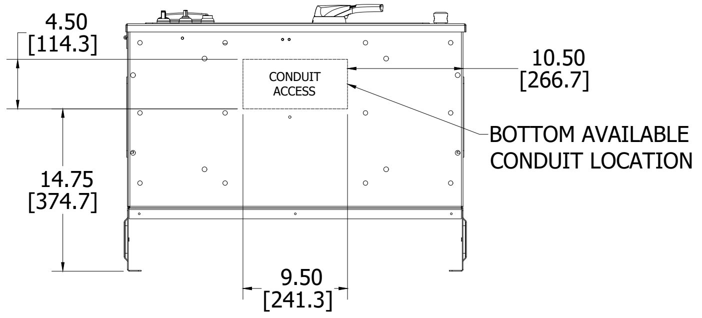


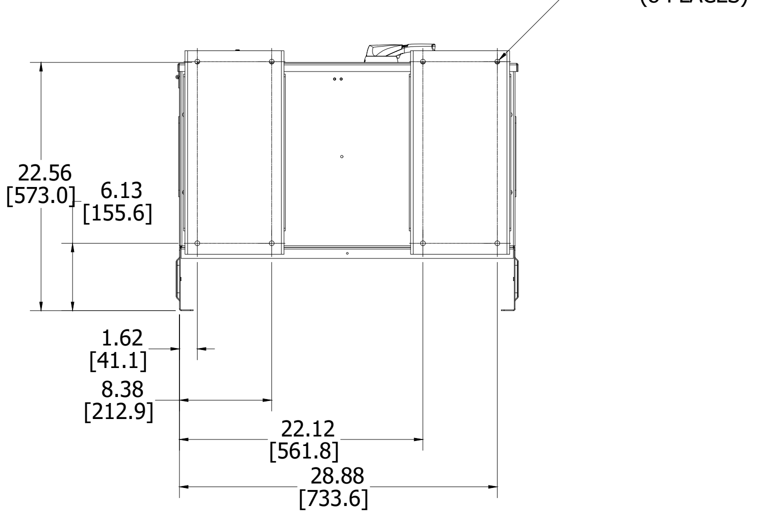




BOTTOM CONDUIT ACCESS LOCATION
SHOWN WITH FLOOR STANDS REMOVED



DIMENSIONS FOR STAND MOUNTING



NOTES:
FINISH: ENCLOSURE - ANSI 61 (LIGHT) GRAY.
WEIGHT: APPROXIMATELY 900 LBS. [408] KG.
MATERIAL: 14GA (0.0747) [1.90] CRS.
DIMENSIONS: INCHES, [MILLIMETERS].
CONSTRUCTION: NEMA TYPE 12 OVERSIZE

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EGF0344D2300D00000*–IRP–3261
EGF0344D2300D00000*–IRP–3262

▲ NEW RELEASE

EATON

DR PNP	DATE 11/09/22	TITLE USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2	
CKD KD	DATE 1/11/23		
APPD	DATE	PRODUCT DG1	DWG TYPE OUTLINE DIMENSION

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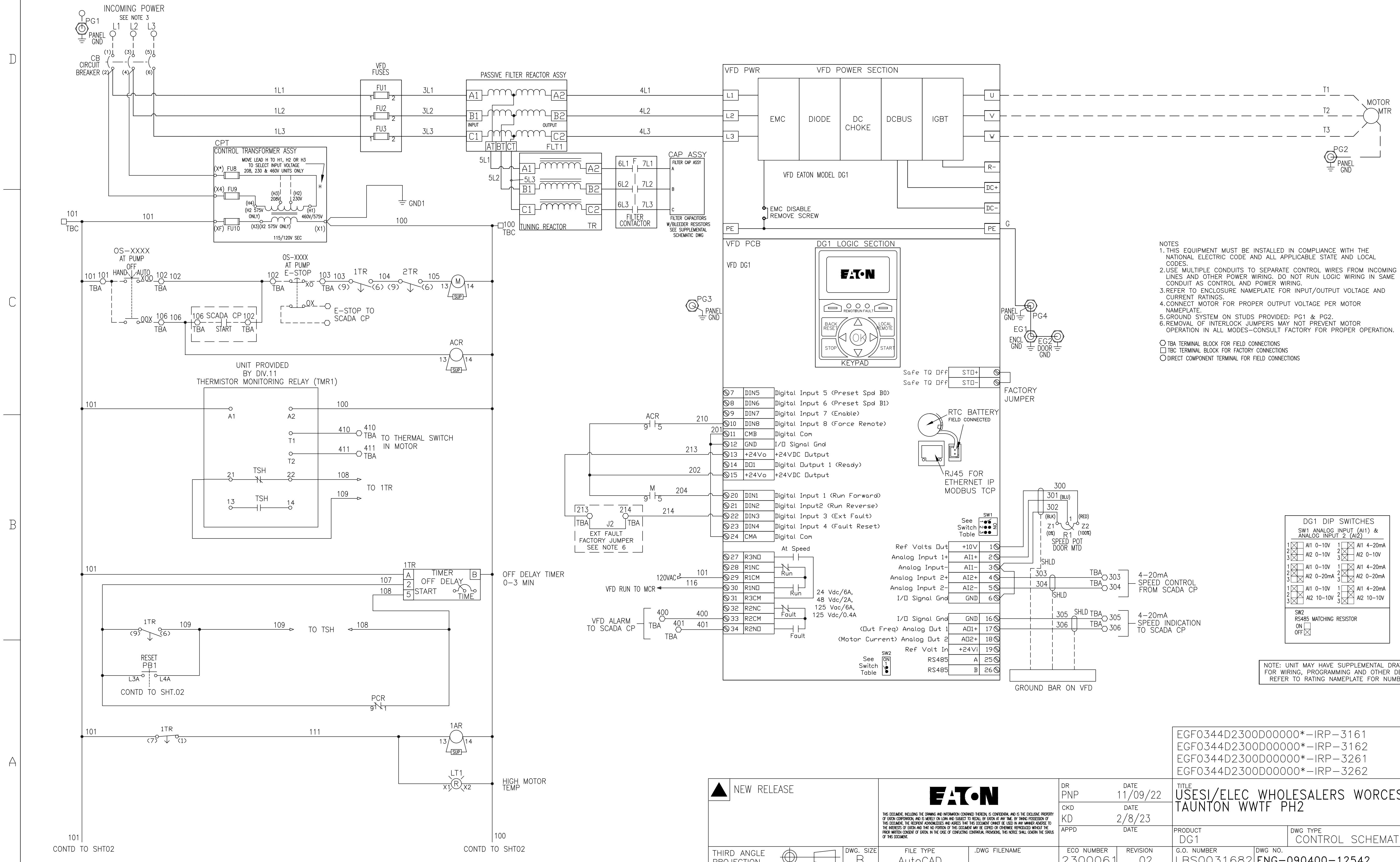

NOTES

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☐ TBC TERMINAL BLOCK FOR FACTORY CONNECTIONS
○ DIRECT COMPONENT TERMINAL FOR FIELD CONNECTIONS

NOTE: UNIT MAY HAVE SUPPLEMENTAL DRAWINGS FOR WIRING, PROGRAMMING AND OTHER DETAILS REFER TO RATING NAMEPLATE FOR NUMBERS

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▲ NEW RELEASE

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DR PNP	DATE 11/09/22	TITLE USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2	
CKD KD	DATE 2/8/23		
APPD	DATE	PRODUCT DG1	DWG TYPE CONTROL SCHEMATIC

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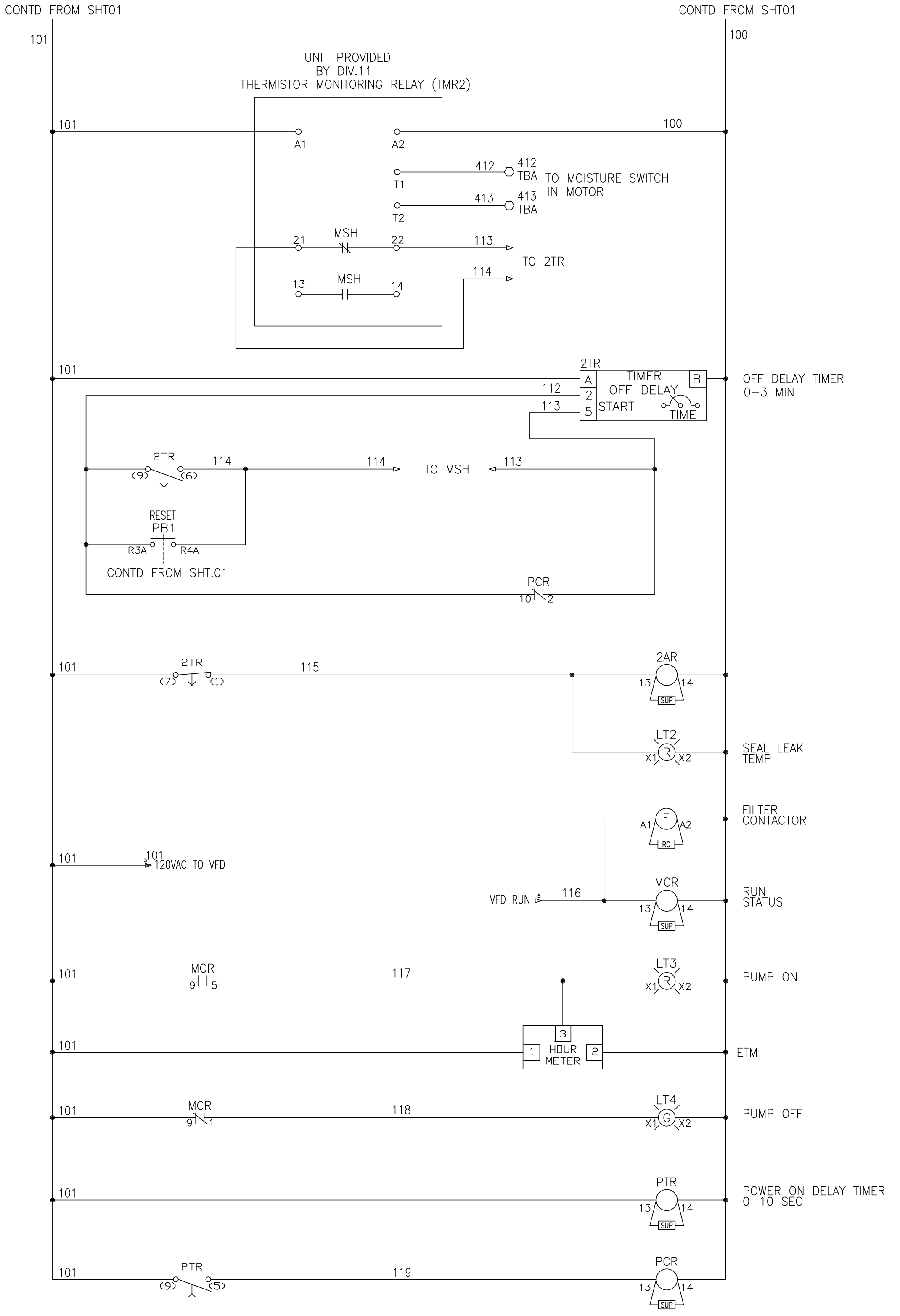

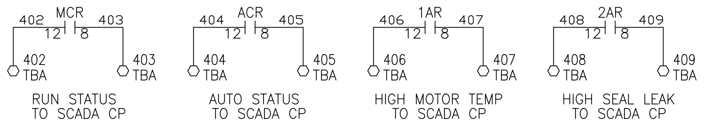

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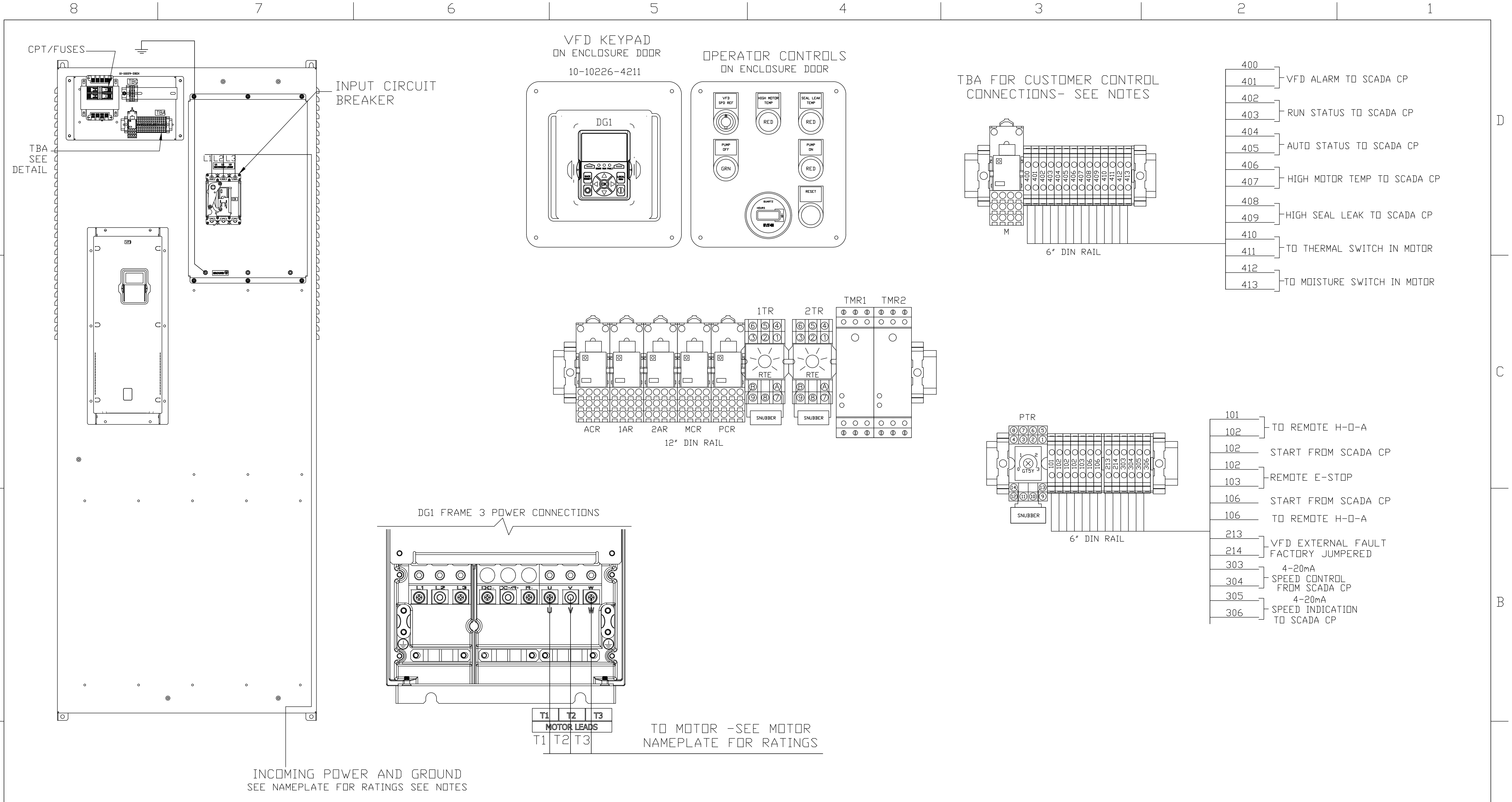
▲ SEE SHT.01

DR PNP DATE 11/09/22
CKD KD DATE 2/8/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2300061
REVISION 02
G.O. NUMBER LBS0031682
DWG NO. ENG–090400–12542
SHEET 2 OF 2



NOTES

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EGF0344D2300D00000*-IRP-3161
EGF0344D2300D00000*-IRP-3162
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EGF0344D2300D00000*-IRP-3262

▲ NEW RELEASE	EATON	DR PNP	DATE 11/09/22	TITLE USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2	
		CKD KD	DATE 1/11/23		
		APPD	DATE	PRODUCT DG1	DWG TYPE CONNECTION DIAGRAM
THIRD ANGLE PROJECTION	DWG. SIZE B	ECO NUMBER 2200787	REVISION 01	G.O. NUMBER LBS0031682	DWG NO. ENG-900500-12522
FILE TYPE AutoCAD	.DWG FILENAME			SHEET 1 OF 1	

Master Document Index

Drives - Enclosed
Drives - Enclosed

	Drawing Description	Document Name	Rev
1	Master Drawing List	D00FTF4M01.DOC	2
2	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-000710-12409.DWG	01
3	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12542.DWG	02
4	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12542_SHT02.DWG	02
5	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-900500-12522.DWG	01

User **Karla Devora Maldonado**	**Date** **2/8/2023 10:32:00 AM**	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.		EATON Powering Business Worldwide
		D7580427X2K2		
		IRP-3261	**Construction Drawings**	
REVISION	DWG SIZE	G.O.	DWG	SHEET
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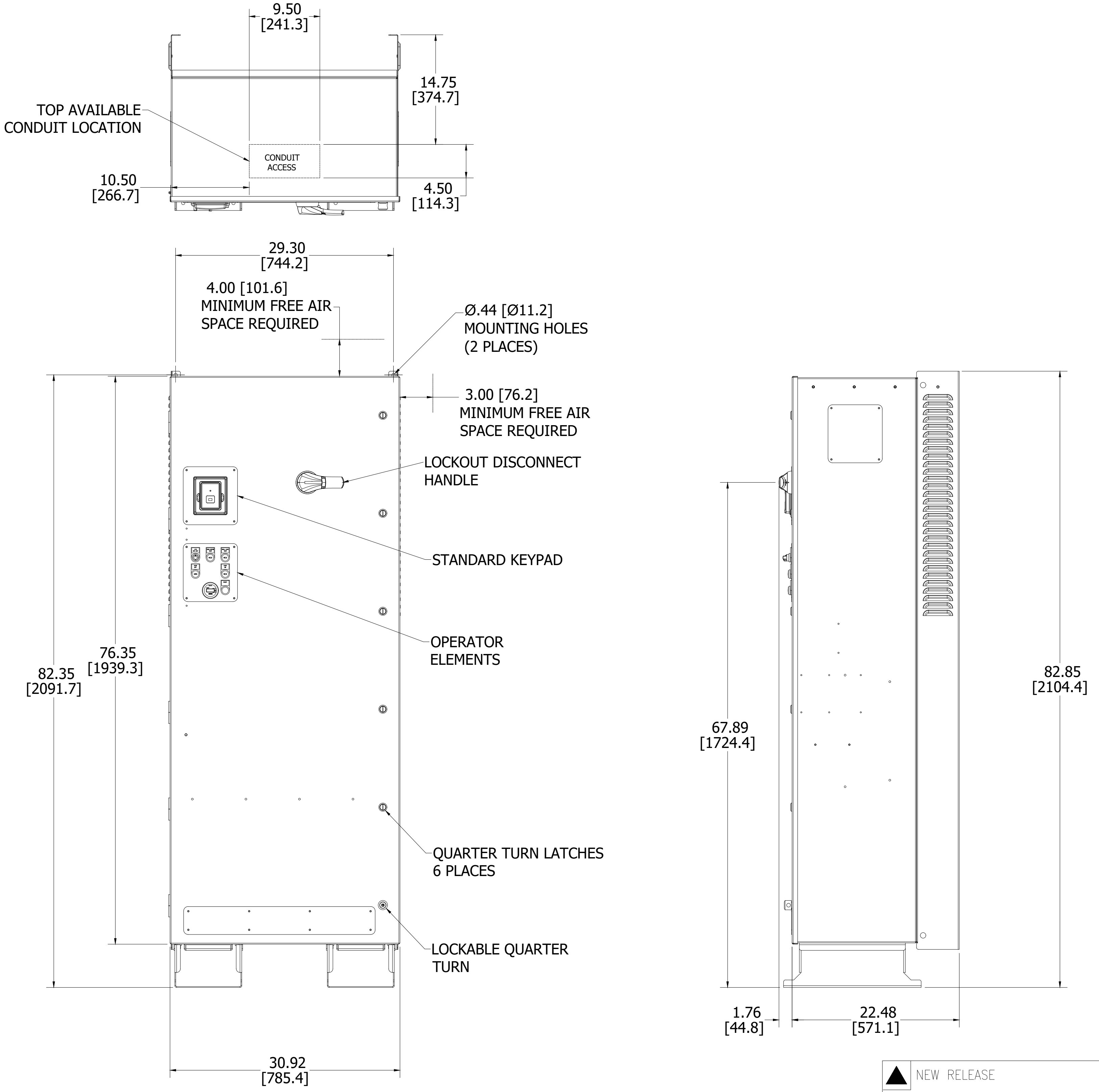
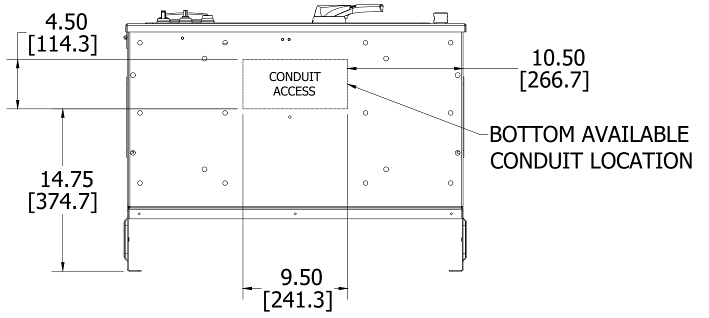
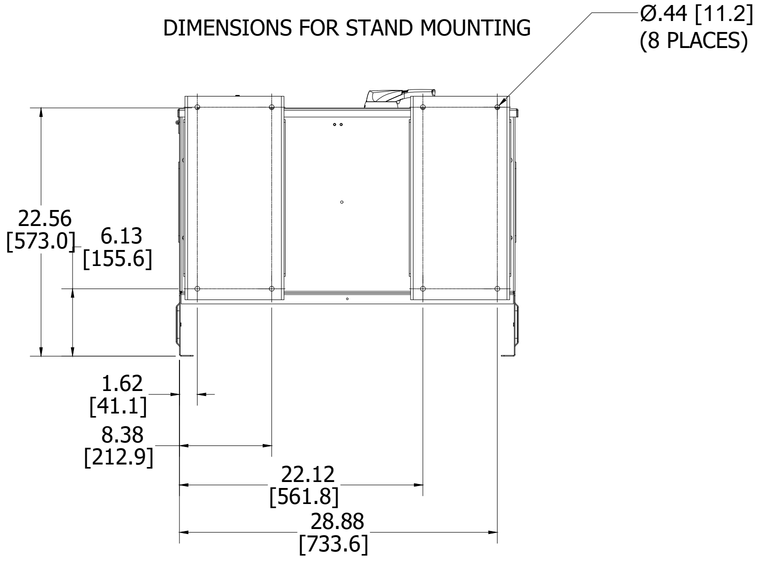


BOTTOM CONDUIT ACCESS LOCATION
SHOWN WITH FLOOR STANDS REMOVED



DIMENSIONS FOR STAND MOUNTING



NOTES:
FINISH: ENCLOSURE - ANSI 61 (LIGHT) GRAY.
WEIGHT: APPROXIMATELY 900 LBS. [408] KG.
MATERIAL: 14GA (0.0747) [1.90] CRS.
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CONSTRUCTION: NEMA TYPE 12 OVERSIZE

EGF0344D2300D00000*-IRP-3161
EGF0344D2300D00000*-IRP-3162
EGF0344D2300D00000*-IRP-3261
EGF0344D2300D00000*-IRP-3262

▲ NEW RELEASE

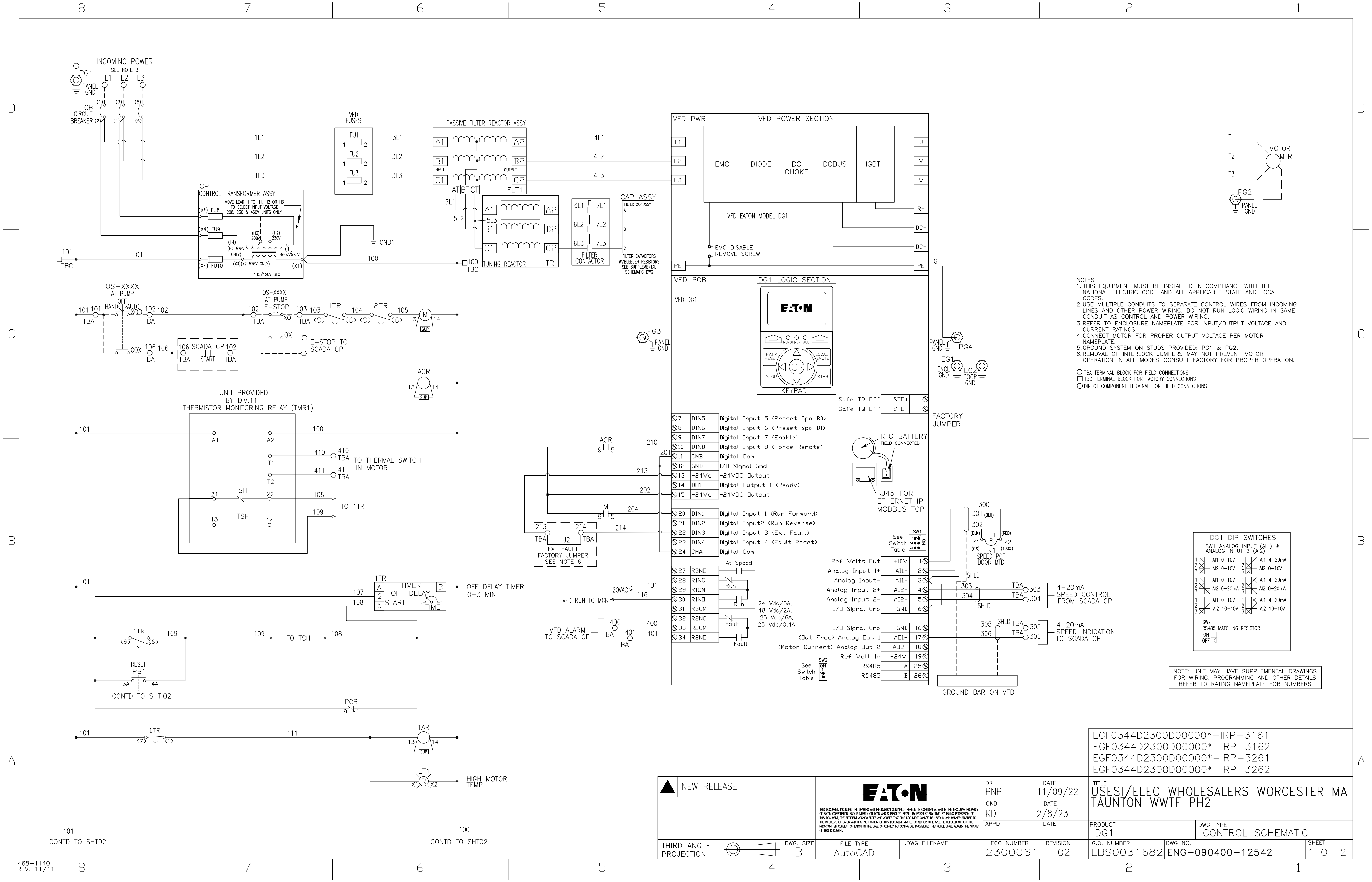
EATON

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE OUTLINE DIMENSION

THIRD ANGLE PROJECTION	DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
	B	AutoCAD		2200787	01	LBS0031682	ENG-000710-12409	1 OF 1



NOTES
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2. USE MULTIPLE CONDUITS TO SEPARATE CONTROL WIRES FROM INCOMING LINES AND OTHER POWER WIRING. DO NOT RUN LOGIC WIRING IN SAME CONDUIT AS CONTROL AND POWER WIRING.
3. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGE AND CURRENT RATINGS.
4. CONNECT MOTOR FOR PROPER OUTPUT VOLTAGE PER MOTOR NAMEPLATE.
5. GROUND SYSTEM ON STUDS PROVIDED: PG1 & PG2.
6. REMOVAL OF INTERLOCK JUMPERS MAY NOT PREVENT MOTOR OPERATION IN ALL MODES—CONSULT FACTORY FOR PROPER OPERATION.

⬡ TBA TERMINAL BLOCK FOR FIELD CONNECTIONS
☐ TBC TERMINAL BLOCK FOR FACTORY CONNECTIONS
○ DIRECT COMPONENT TERMINAL FOR FIELD CONNECTIONS

DG1 DIP SWITCHES

SW1 ANALOG INPUT (AI1) & ANALOG INPUT 2 (AI2)

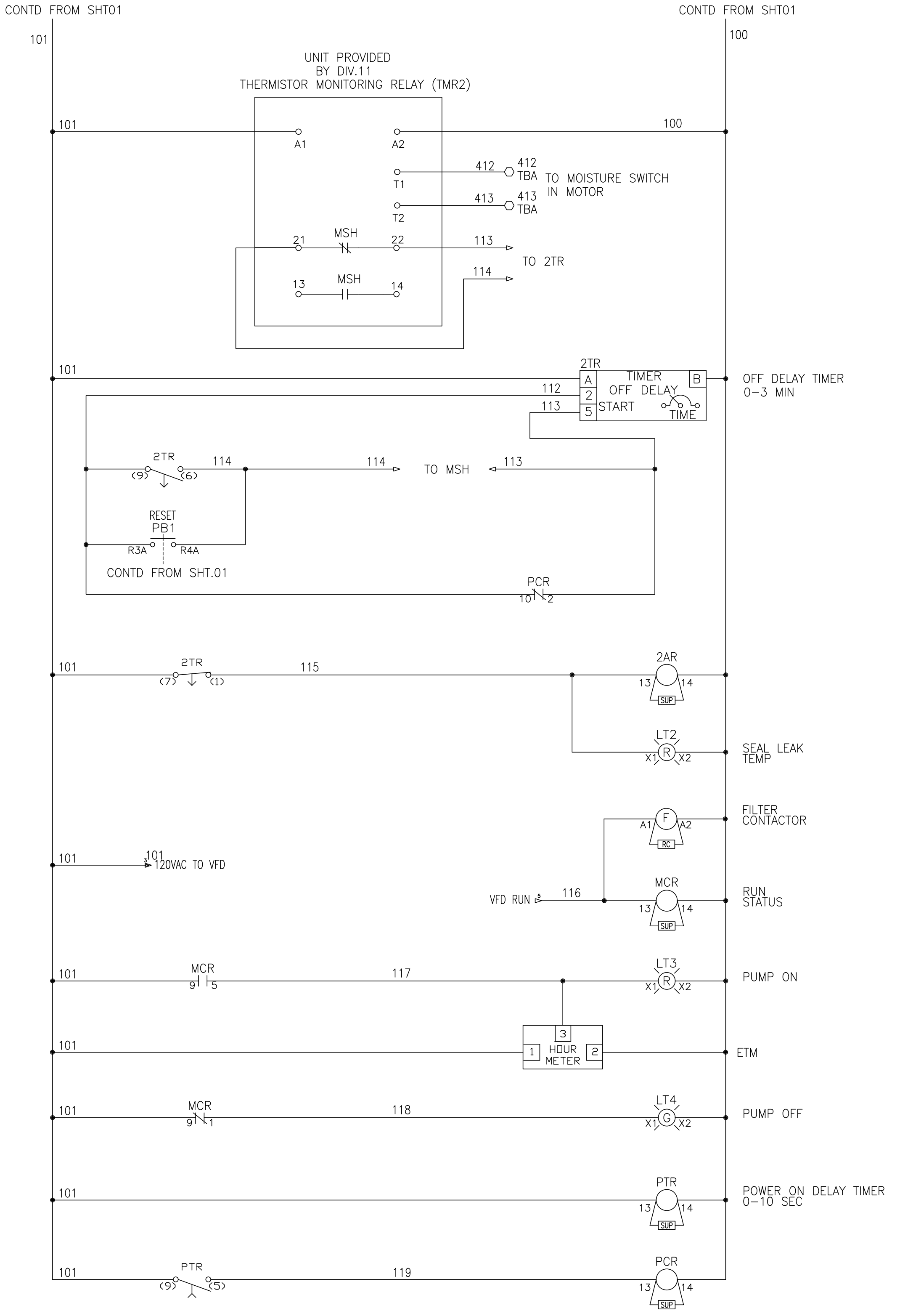
1 ☒ ☐ 2 ☒ ☐ 3 ☒ ☐	AI1 0–10V AI2 0–10V		1 ☐ ☒ 2 ☒ ☐ 3 ☒ ☐	AI1 4–20mA AI2 0–10V
1 ☒ ☐ 2 ☒ ☐ 3 ☐ ☒	AI1 0–10V AI2 0–20mA		1 ☐ ☒ 2 ☒ ☐ 3 ☐ ☒	AI1 4–20mA AI2 0–20mA
1 ☒ ☐ 2 ☐ ☒ 3 ☒ ☐	AI1 0–10V AI2 10–10V		1 ☐ ☒ 2 ☐ ☒ 3 ☒ ☐	AI1 4–20mA AI2 10–10V

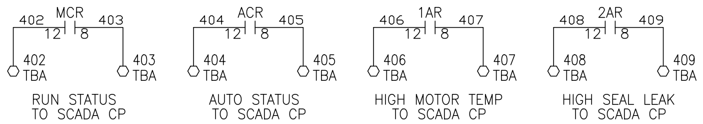
SW2
RS485 MATCHING RESISTOR
ON ☐
OFF ☒

NOTE: UNIT MAY HAVE SUPPLEMENTAL DRAWINGS FOR WIRING, PROGRAMMING AND OTHER DETAILS REFER TO RATING NAMEPLATE FOR NUMBERS

EGF0344D2300D00000*–IRP–3161
EGF0344D2300D00000*–IRP–3162
EGF0344D2300D00000*–IRP–3261
EGF0344D2300D00000*–IRP–3262

▲ NEW RELEASE	EATON	DR PNP	DATE 11/09/22	TITLE USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2		
		CKD KD	DATE 2/8/23			
		APPD	DATE	PRODUCT DG1	DWG TYPE CONTROL SCHEMATIC	
THIRD ANGLE PROJECTION	DWG. SIZE B	FILE TYPE AutoCAD	.DWG FILENAME	ECO NUMBER 2300061	REVISION 02	G.O. NUMBER LBS0031682
DWG NO. ENG–090400–12542	SHEET 1 OF 2					





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EGF0344D2300D00000*–IRP–3162
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EGF0344D2300D00000*–IRP–3262

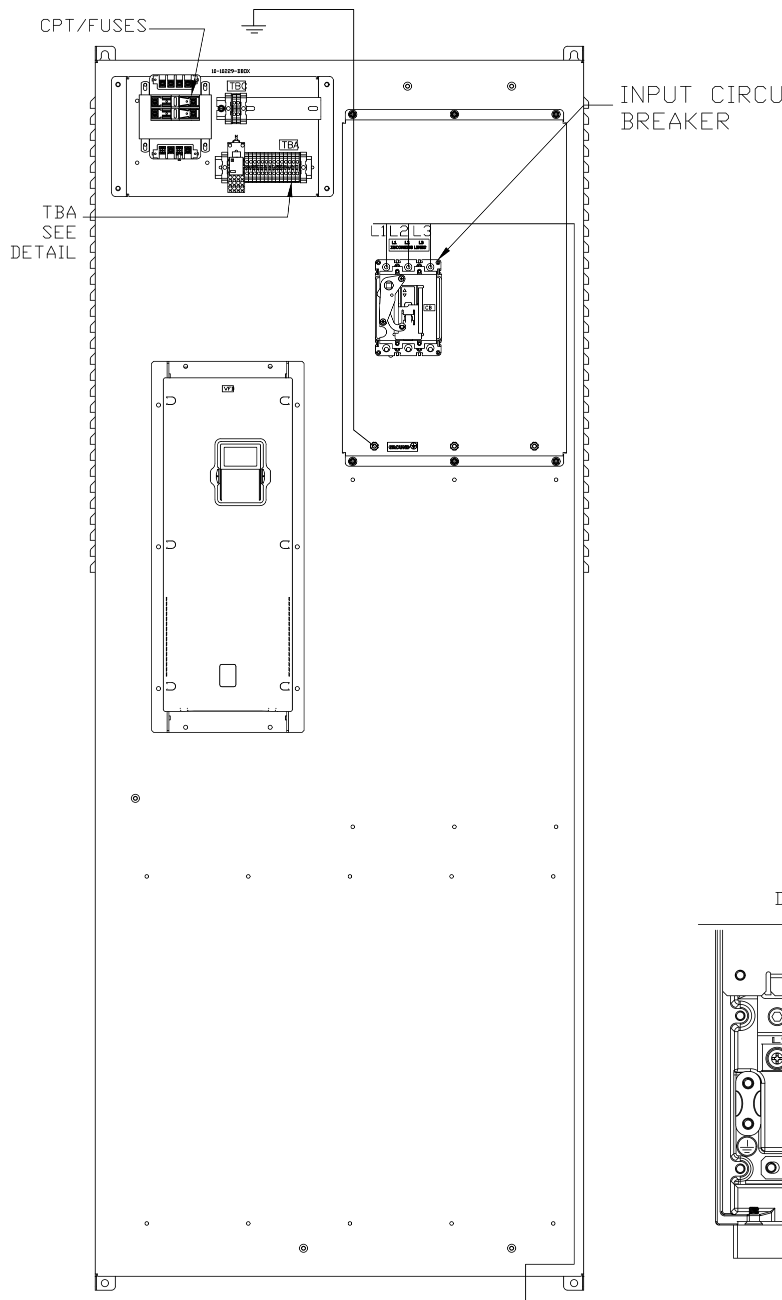
▲ SEE SHT.01

EATON

DR PNP	DATE 11/09/22	TITLE USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2	
CKD KD	DATE 2/8/23		
APPD	DATE	PRODUCT DG1	DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION	DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
	B	AutoCAD		2300061	02	LBS0031682	ENG–090400–12542	2 OF 2

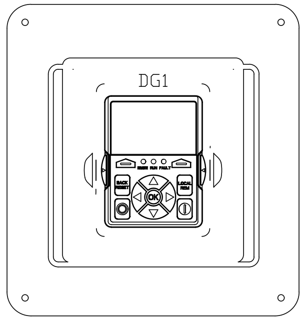
468–1140
REV. 11/11



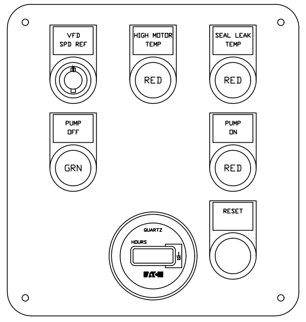
INCOMING POWER AND GROUND
SEE NAMEPLATE FOR RATINGS SEE NOTES

VFD KEYPAD
ON ENCLOSURE DOOR

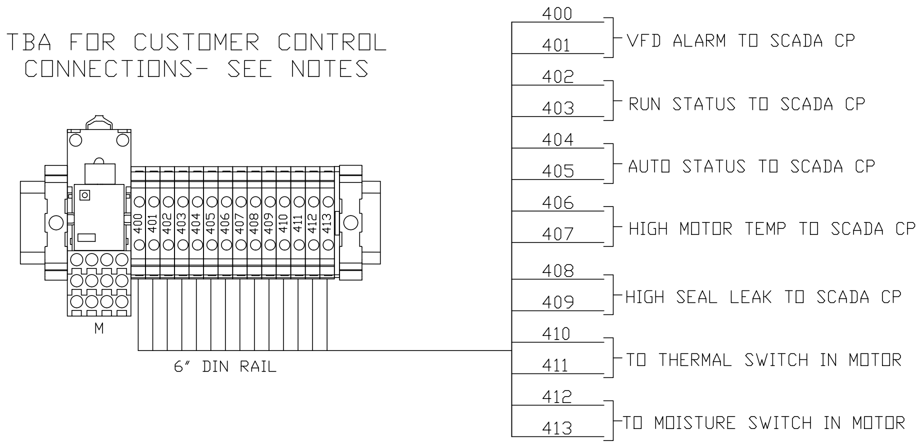
10-10226-4211

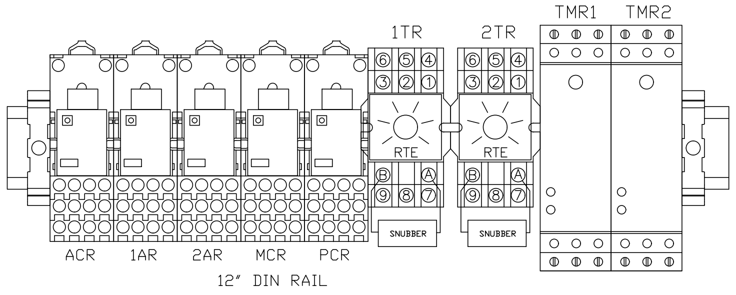


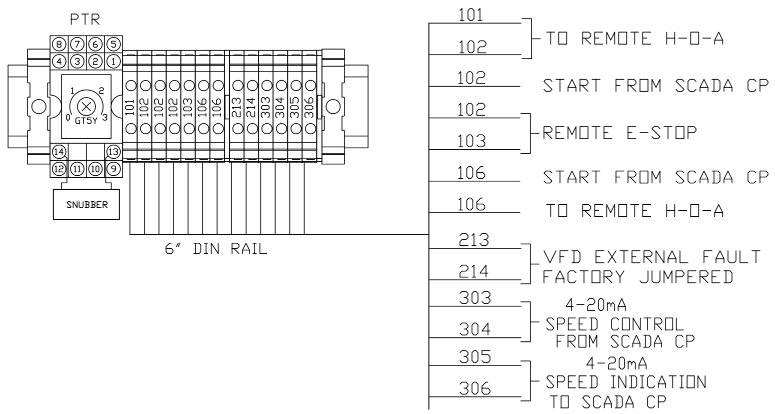
OPERATOR CONTROLS
ON ENCLOSURE DOOR



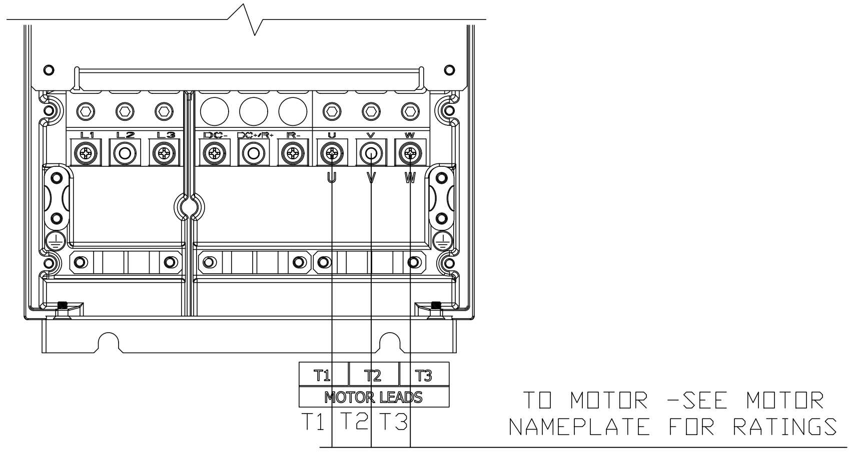
TBA FOR CUSTOMER CONTROL CONNECTIONS- SEE NOTES







DG1 FRAME 3 POWER CONNECTIONS



TO MOTOR -SEE MOTOR NAMEPLATE FOR RATINGS

NOTES

1. SEE SCHEMATIC FOR DETAILS AND CONTROL LOGIC - FACTORY WIRING DETAILS OMITTED.
2. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGES AND CURRENT RATINGS.
3. ENCLOSURE MUST BE GROUNDED USING INPUT AND OUTPUT STUDS PROVIDED.
4. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL STATE/LOCAL CODES.
5. USE MULTIPLE CONDUITS TO SEPARATE 120 CONTROL (TBA 101/102 & 106/104) WIRING FROM INCOMING POWER WIRING.
6. 4-20MA AUTO SPEED SIGNAL CONNECTIONS ARE MADE DIRECTLY TO VFD CONTROL MODULE.
7. DO NOT RUN LOGIC WIRES (TBA 213/214 VFD EXT FAULT) IN SAME CONDUIT AS 120V OR POWER WIRING.
8. REMOVAL OF INTERLOCKS (TBA 101/102,213/214) MAY NOT PREVENT MOTOR OPERATION IN ALL MODES- CONSULT FACTORY FOR DETAILS.

EGF0344D2300D00000*-IRP-3161
EGF0344D2300D00000*-IRP-3162
EGF0344D2300D00000*-IRP-3261
EGF0344D2300D00000*-IRP-3262

▲ NEW RELEASE	EATON	DR PNP DATE 11/09/22	TITLE USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2	
		CKD KD DATE 1/11/23		
		APPD DATE	PRODUCT DG1	DWG TYPE CONNECTION DIAGRAM
THIRD ANGLE PROJECTION DWG. SIZE B	FILE TYPE AutoCAD .DWG FILENAME	ECO NUMBER 2200787 REVISION 01	G.O. NUMBER LBS0031682	DWG NO. ENG-900500-12522 SHEET 1 OF 1

Master Document Index

Drives - Enclosed

Drives - Enclosed

	Drawing Description	Document Name	Rev
1	Master Drawing List	D00FTF3M01.DOC	2
2	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-000710-12409.DWG	01
3	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12542.DWG	02
4	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12542_SHT02.DWG	02
5	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-900500-12522.DWG	01

User **Karla Devora Maldonado**	**Date** **2/8/2023 10:27:44 AM**	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.		EATON Powering Business Worldwide
		D7580427X2K2		
		IRP-3262	**Construction Drawings**	
REVISION	DWG SIZE	G.O.	DWG	SHEET
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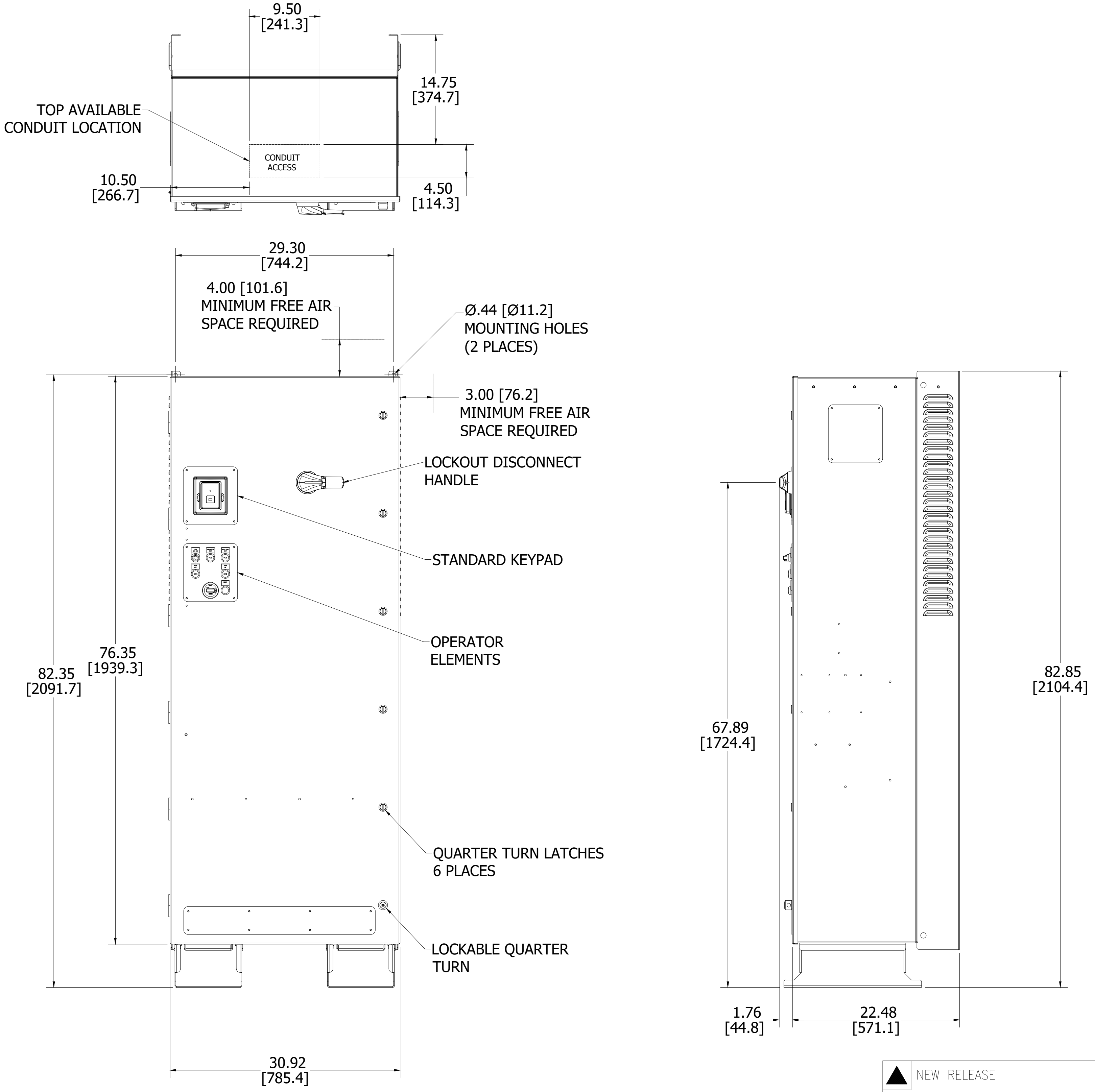
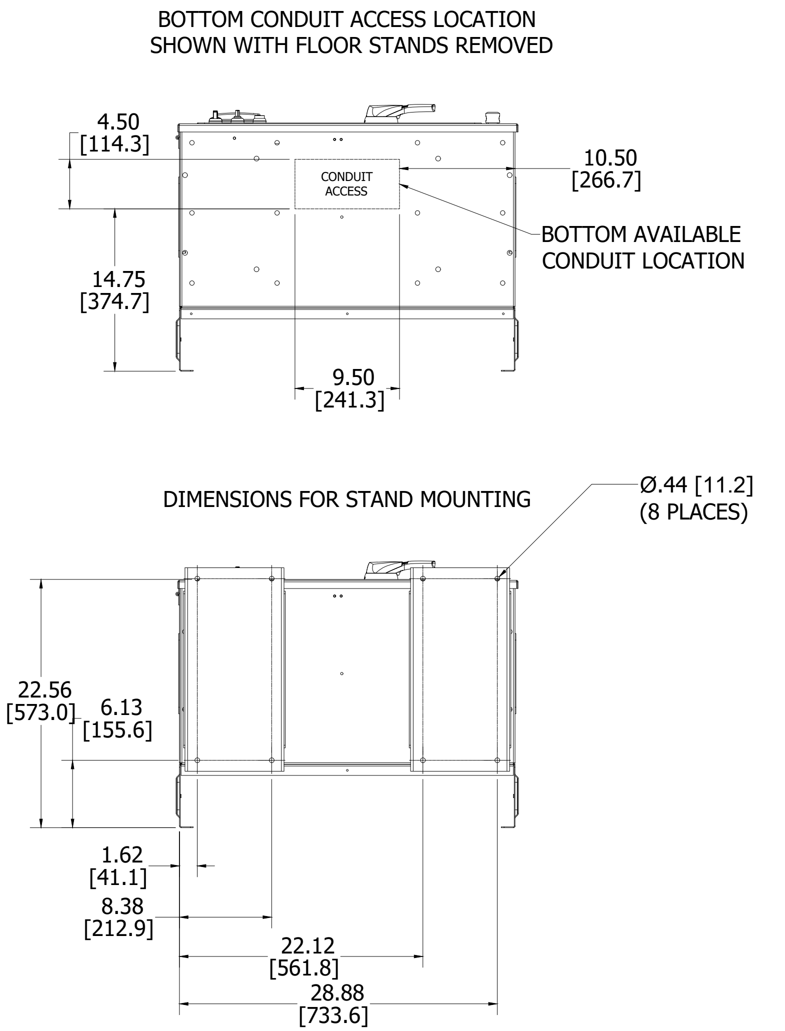




NOTES:
FINISH: ENCLOSURE - ANSI 61 (LIGHT) GRAY.
WEIGHT: APPROXIMATELY 900 LBS. [408] KG.
MATERIAL: 14GA (0.0747) [1.90] CRS.
DIMENSIONS: INCHES, [MILLIMETERS].
CONSTRUCTION: NEMA TYPE 12 OVERSIZE

EGF0344D2300D00000*-IRP-3161
EGF0344D2300D00000*-IRP-3162
EGF0344D2300D00000*-IRP-3261
EGF0344D2300D00000*-IRP-3262

▲ NEW RELEASE

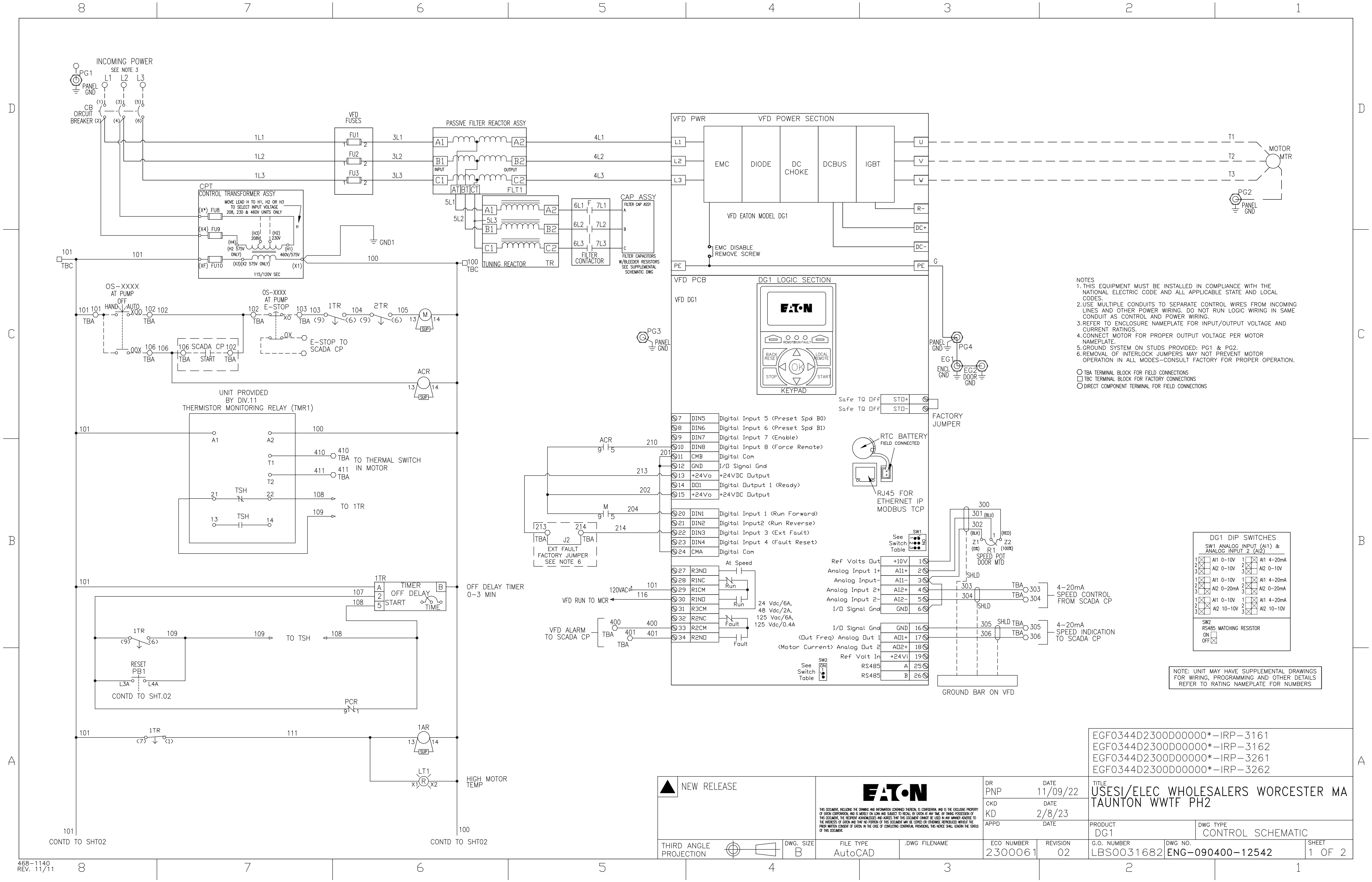
EATON

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE OUTLINE DIMENSION

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2200787
REVISION 01
G.O. NUMBER LBS0031682
DWG NO. ENG-000710-12409
SHEET 1 OF 1



NOTES
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DG1 DIP SWITCHES

SW1 ANALOG INPUT (AI1) & ANALOG INPUT 2 (AI2)

AI1 0–10V AI2 0–10V	AI1 4–20mA AI2 0–10V
AI1 0–10V AI2 0–20mA	AI1 4–20mA AI2 0–20mA
AI1 0–10V AI2 10–10V	AI1 4–20mA AI2 10–10V

SW2
RS485 MATCHING RESISTOR
ON ☐
OFF ☒

NOTE: UNIT MAY HAVE SUPPLEMENTAL DRAWINGS FOR WIRING, PROGRAMMING AND OTHER DETAILS REFER TO RATING NAMEPLATE FOR NUMBERS

EGF0344D2300D00000*–IRP–3161
EGF0344D2300D00000*–IRP–3162
EGF0344D2300D00000*–IRP–3261
EGF0344D2300D00000*–IRP–3262

▲ NEW RELEASE

EATON

DR	DATE
PNP	11/09/22
CKD	DATE
KD	2/8/23
APPD	DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT: DG1
DWG TYPE: CONTROL SCHEMATIC

THIRD ANGLE PROJECTION	DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
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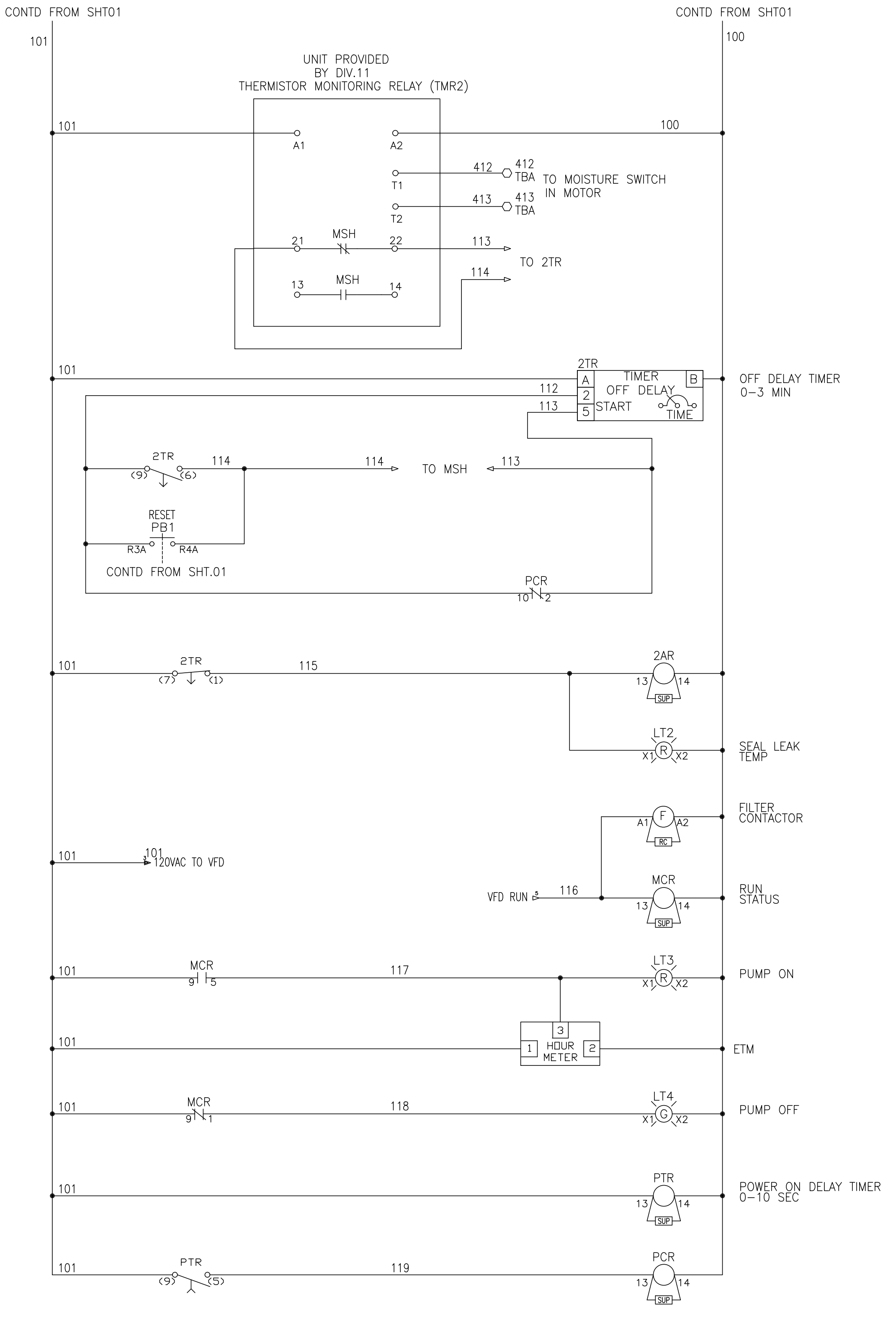

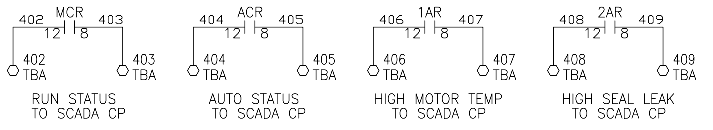

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EGF0344D2300D00000*–IRP–3261
EGF0344D2300D00000*–IRP–3262

▲ SEE SHT.01

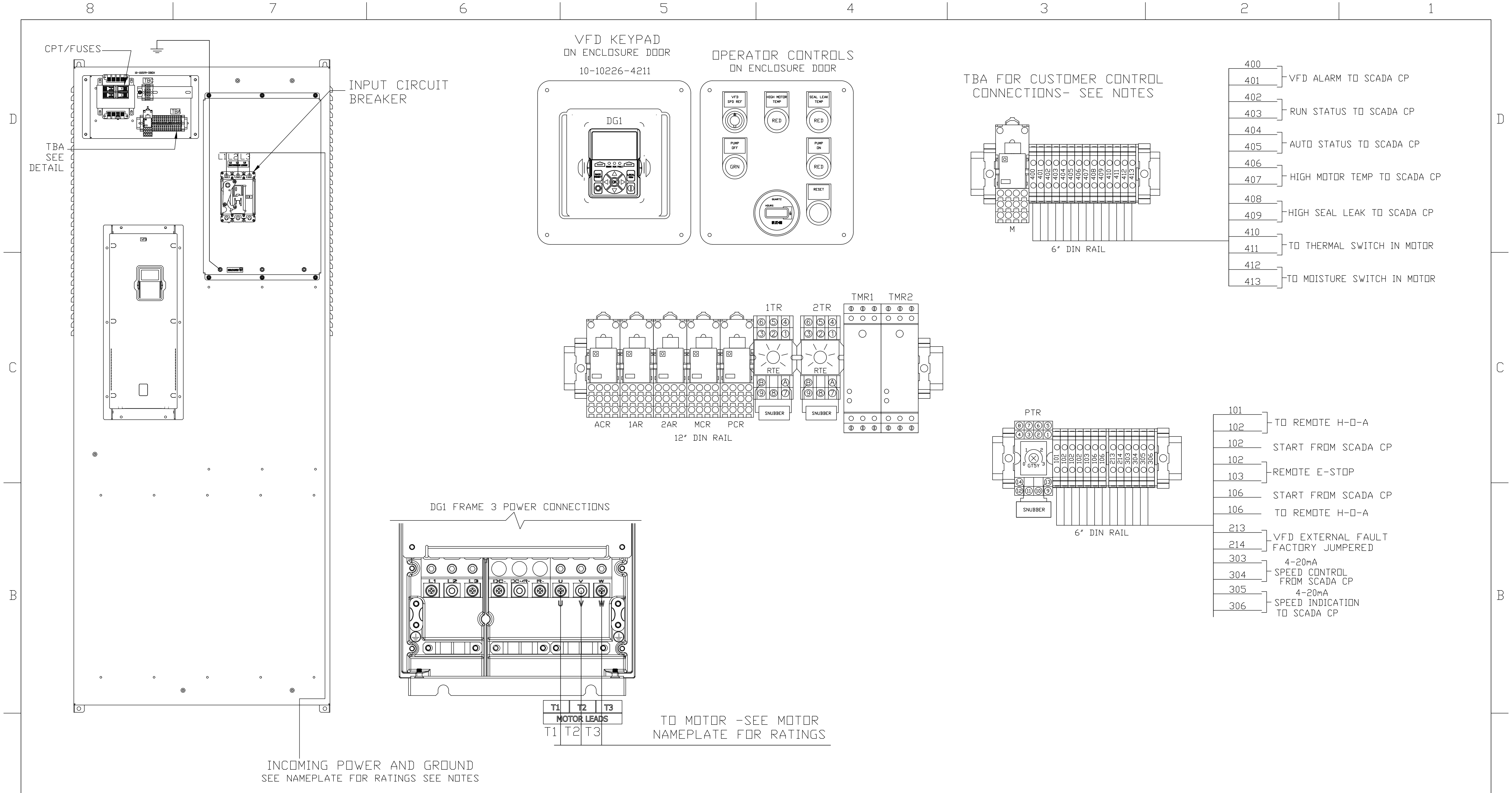
EATON

DR PNP DATE 11/09/22
CKD KD DATE 2/8/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2300061
REVISION 02
G.O. NUMBER LBS0031682
DWG NO. ENG–090400–12542
SHEET 2 OF 2



NOTES

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EGF0344D2300D00000*-IRP-3161
EGF0344D2300D00000*-IRP-3162
EGF0344D2300D00000*-IRP-3261
EGF0344D2300D00000*-IRP-3262

▲ NEW RELEASE	EATON	DR PNP	DATE 11/09/22	TITLE USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2	
		CKD KD	DATE 1/11/23		
		APPD	DATE	PRODUCT DG1	DWG TYPE CONNECTION DIAGRAM
THIRD ANGLE PROJECTION / DWG. SIZE B	FILE TYPE AutoCAD / .DWG FILENAME	ECO NUMBER 2200787	REVISION 01	G.O. NUMBER LBS0031682	DWG NO. ENG-900500-12522 / SHEET 1 OF 1

Master Document Index

Drives - Enclosed
Drives - Enclosed

	Drawing Description	Document Name	Rev
1	Master Drawing List	D00FTC0M01.DOC	4
2	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-000710-12410.DWG	02
3	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12543.DWG	03
4	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12543_SHT02.DWG	03
5	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-900500-12523.DWG	04

User **Karen Estrada**	**Date** **10/5/2023** **4:25:45 PM**	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.		EATON Powering Business Worldwide
		D7580427X2K2		
		RSP-4111	**Construction Drawings**	
REVISION	DWG SIZE	G.O.	DWG	SHEET
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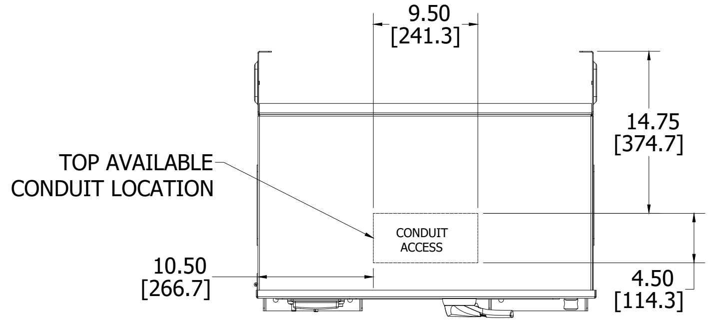
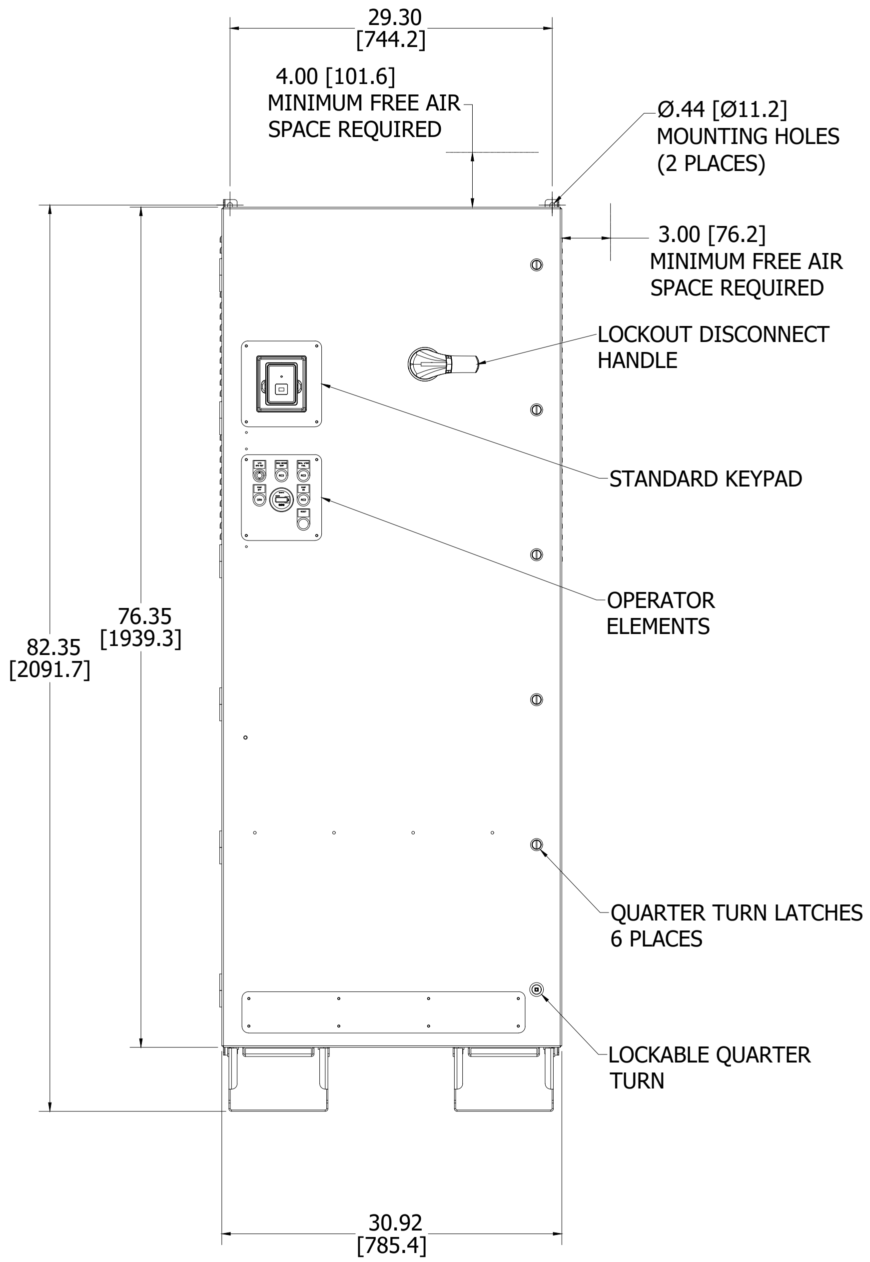
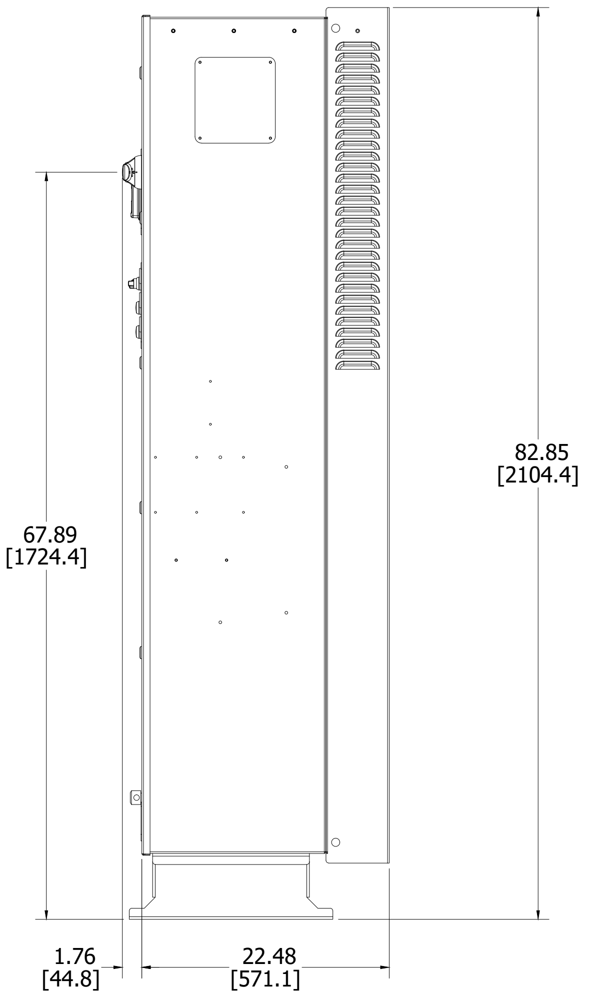
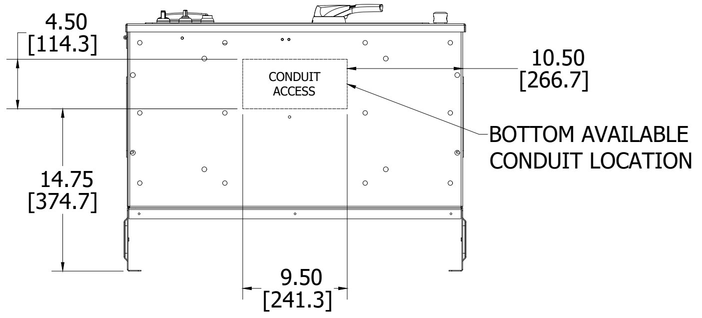


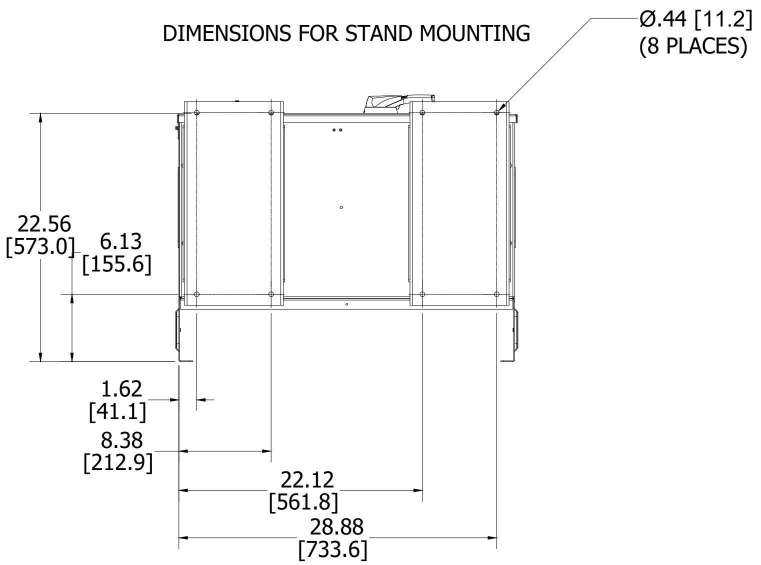




BOTTOM CONDUIT ACCESS LOCATION
SHOWN WITH FLOOR STANDS REMOVED



DIMENSIONS FOR STAND MOUNTING



NOTES:
FINISH: ENCLOSURE - ANSI 61 (LIGHT) GRAY.
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MATERIAL: 14GA (0.0747) [1.90] CRS.
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CONSTRUCTION: NEMA TYPE 12 OVERSIZE

EGF0404D2300D00000*-RSP-4213
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EGF0404D2300D00000*-RSP-4211
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EGF0404D2300D00000*-RSP-4112
EGF0404D2300D00000*-RSP-4111

▲ 10/05/23; RELOCATED ETM
REV 02, KE

EATON

DR	PNP
DATE	11/09/22
CKD	KD
DATE	1/11/23
APPD	
DATE	
TITLE	USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2
PRODUCT	DG1
DWG TYPE	OUTLINE DIMENSION
THIRD ANGLE PROJECTION	
DWG. SIZE	B
FILE TYPE	AutoCAD
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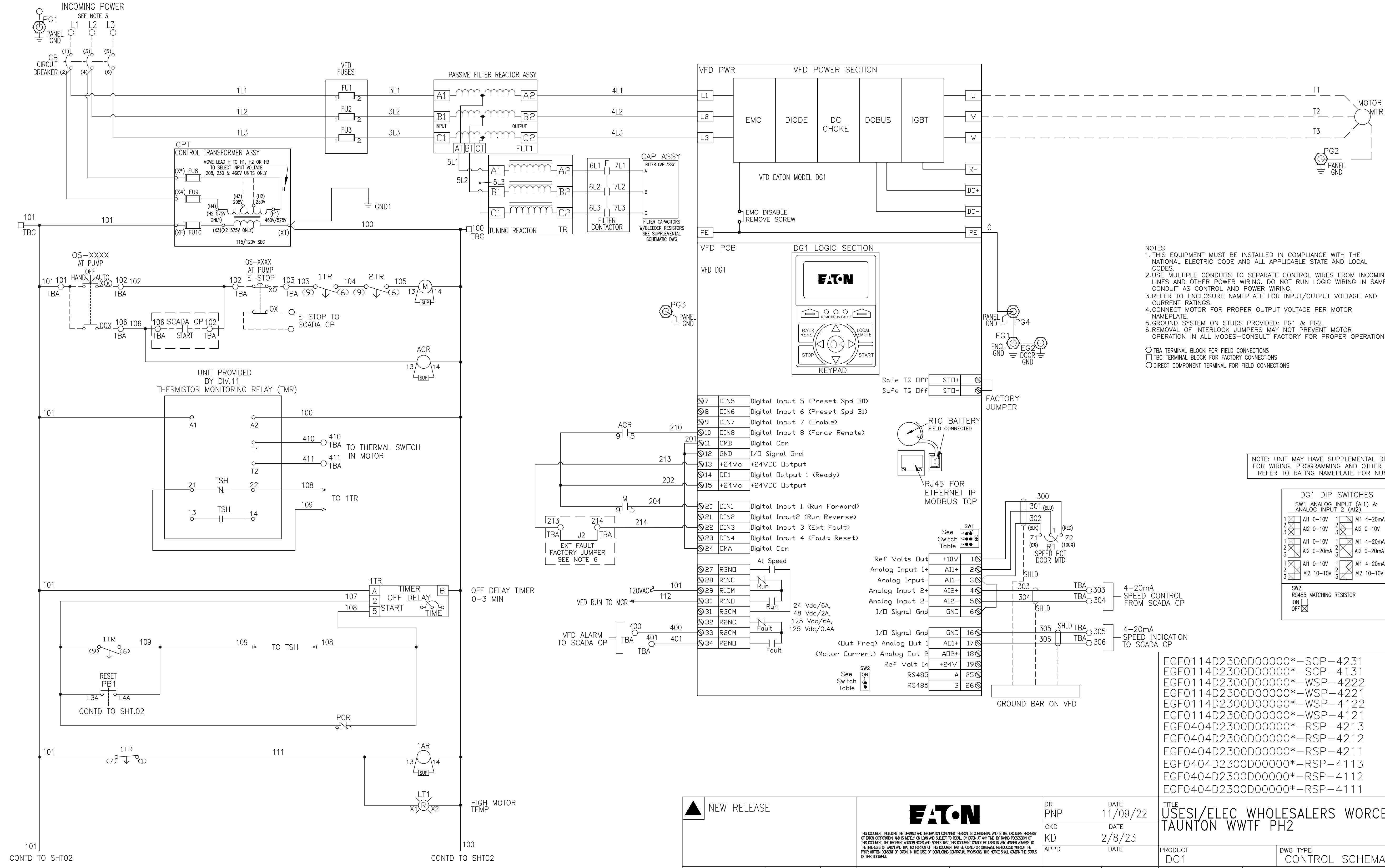
ECO NUMBER	2200787
REVISION	02
G.O. NUMBER	LBS0031682
DWG NO.	ENG-000710-12410
SHEET	1 OF 1



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⬡ TBA TERMINAL BLOCK FOR FIELD CONNECTIONS
☐ TBC TERMINAL BLOCK FOR FACTORY CONNECTIONS
○ DIRECT COMPONENT TERMINAL FOR FIELD CONNECTIONS

NOTE: UNIT MAY HAVE SUPPLEMENTAL DRAWINGS FOR WIRING, PROGRAMMING AND OTHER DETAILS REFER TO RATING NAMEPLATE FOR NUMBERS

EGF0114D2300D00000*–SCP–4231
EGF0114D2300D00000*–SCP–4131
EGF0114D2300D00000*–WSP–4222
EGF0114D2300D00000*–WSP–4221
EGF0114D2300D00000*–WSP–4122
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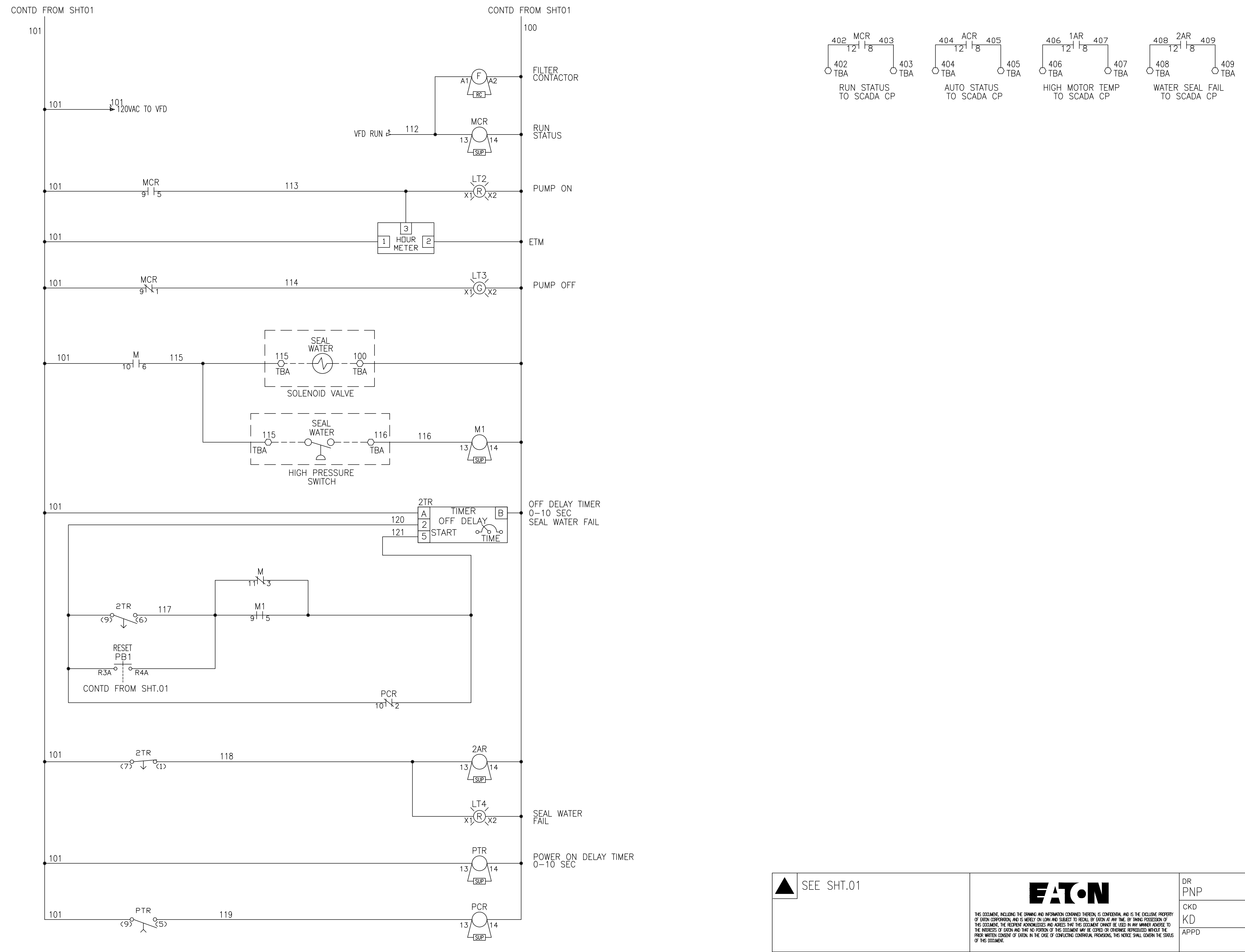
EGF0404D2300D00000*–RSP–4212
EGF0404D2300D00000*–RSP–4211
EGF0404D2300D00000*–RSP–4113
EGF0404D2300D00000*–RSP–4112
EGF0404D2300D00000*–RSP–4111

▲ NEW RELEASE	EATON	DR PNP	DATE 11/09/22	TITLE USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2	
		CKD KD	DATE 2/8/23		
		APPD	DATE	PRODUCT DG1	DWG TYPE CONTROL SCHEMATIC
THIRD ANGLE PROJECTION	DWG. SIZE B	FILE TYPE AutoCAD	.DWG FILENAME	ECO NUMBER 2300061	REVISION 02
G.O. NUMBER LBS0031682	DWG NO. ENG-090400-12543	SHEET 1 OF 2			



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EGF0404D2300D00000*-RSP-4112
EGF0404D2300D00000*-RSP-4111

▲ SEE SHT.01

EATON

DR PNP	DATE 11/09/22	TITLE USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2	
CKD KD	DATE 2/8/23		
APPD	DATE	PRODUCT DG1	DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION	DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
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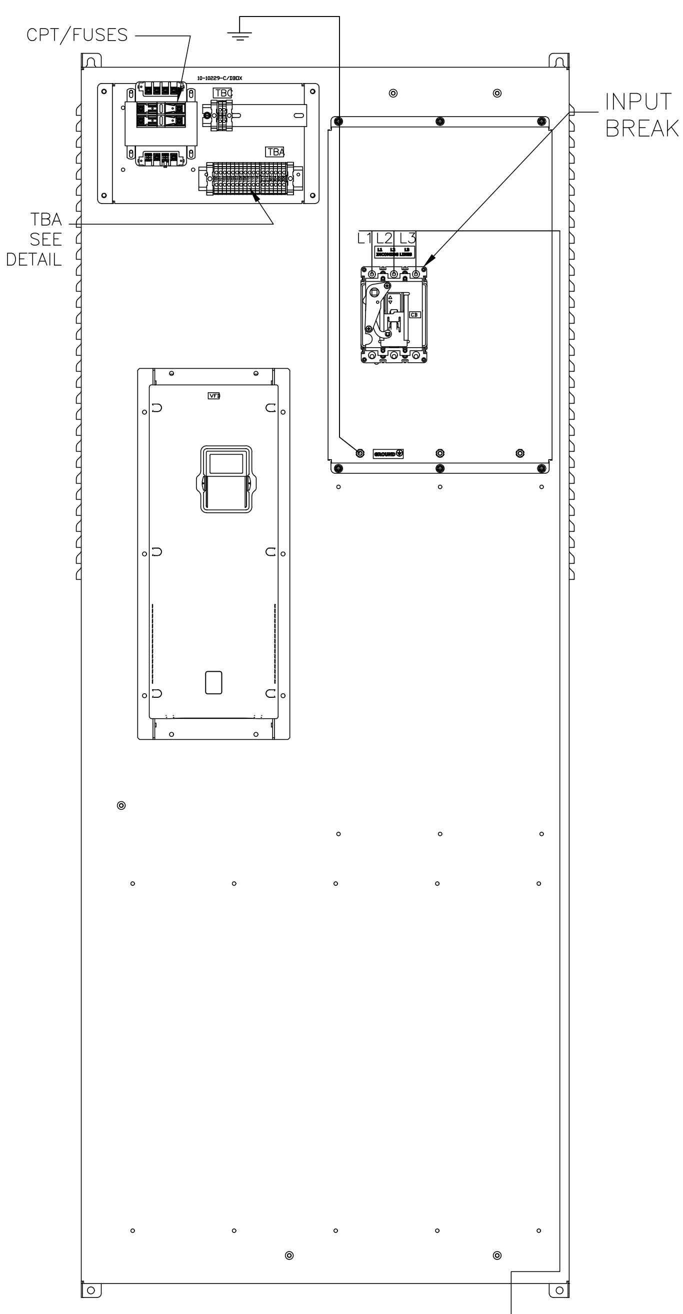
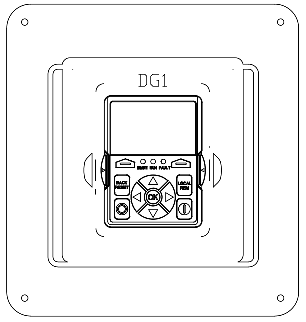
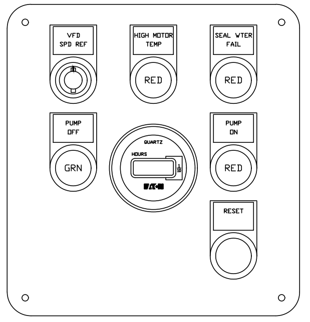


INCOMING POWER AND GROUND
SEE NAMEPLATE FOR RATINGS SEE NOTES

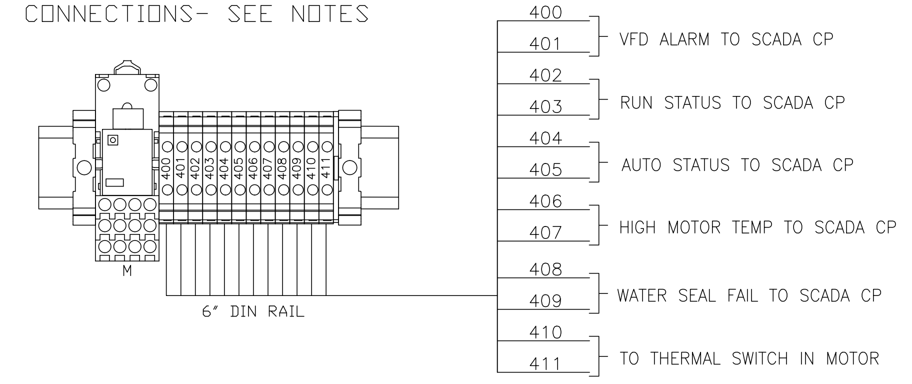
VFD KEYPAD
ON ENCLOSURE DOOR
10-10226-4211

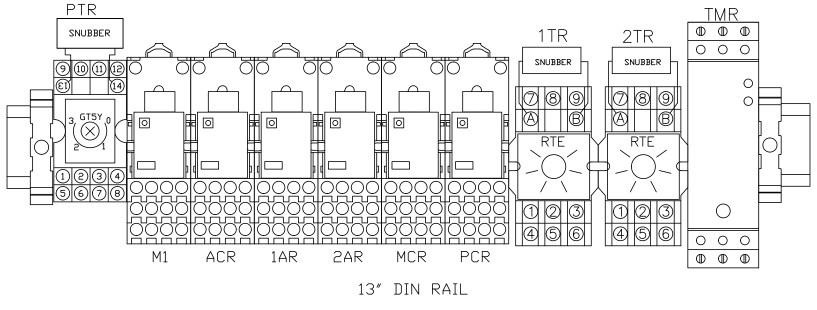


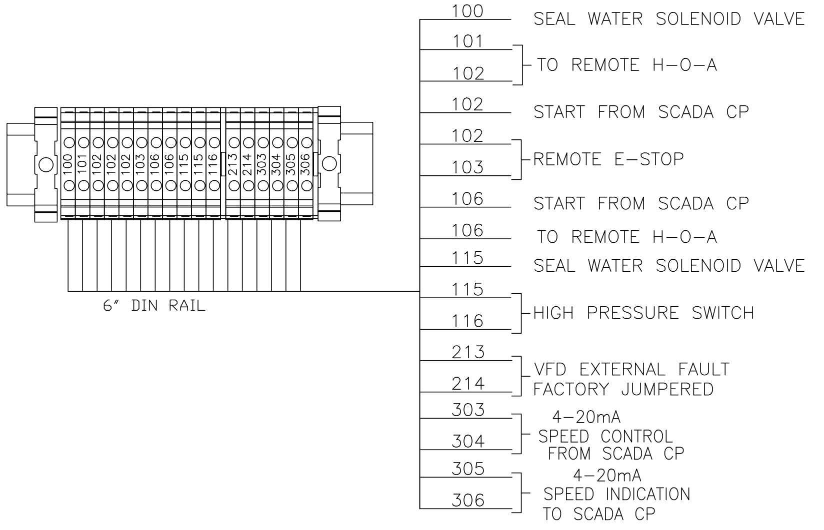
OPERATOR CONTROLS
ON ENCLOSURE DOOR



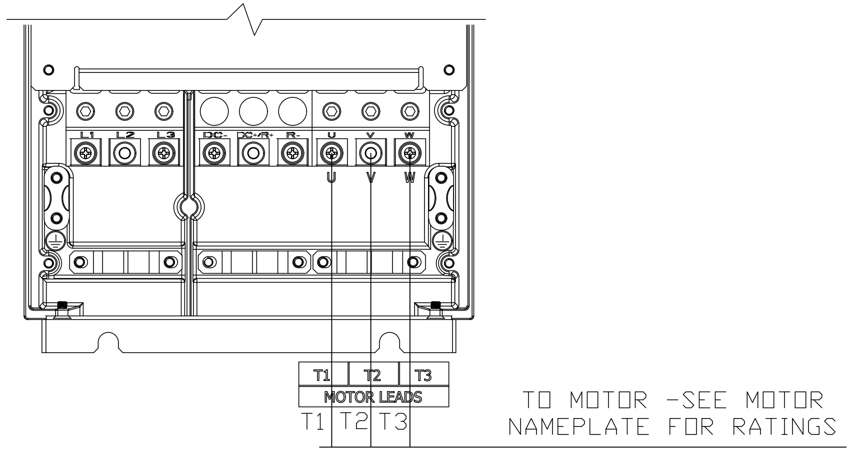
TBA FOR CUSTOMER CONTROL
CONNECTIONS- SEE NOTES







DG1 FRAME 3 POWER CONNECTIONS



TO MOTOR -SEE MOTOR
NAMEPLATE FOR RATINGS

NOTES

1. SEE SCHEMATIC FOR DETAILS AND CONTROL LOGIC - FACTORY WIRING DETAILS OMITTED.
2. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGES AND CURRENT RATINGS.
3. ENCLOSURE MUST BE GROUNDED USING INPUT AND OUTPUT STUDS PROVIDED.
4. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL STATE/LOCAL CODES.
5. USE MULTIPLE CONDUITS TO SEPARATE 120 CONTROL (TBA 101/102 & 106/104) WIRING FROM INCOMING POWER WIRING.
6. 4-20MA AUTO SPEED SIGNAL CONNECTIONS ARE MADE DIRECTLY TO VFD CONTROL MODULE.
7. DO NOT RUN LOGIC WIRES (TBA 213/214 VFD EXT FAULT) IN SAME CONDUIT AS 120V OR POWER WIRING.
8. REMOVAL OF INTERLOCKS (TBA 101/102,213/214) MAY NOT PREVENT MOTOR OPERATION IN ALL MODES-CONSULT FACTORY FOR DETAILS.

EGF0404D2300D00000*-RSP-4213
EGF0404D2300D00000*-RSP-4212
EGF0404D2300D00000*-RSP-4211
EGF0404D2300D00000*-RSP-4113
EGF0404D2300D00000*-RSP-4112
EGF0404D2300D00000*-RSP-4111

▲ 10/05/23; RELOCATED ETM
REV 4, KE

EATON

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE
TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2
PRODUCT DG1
DWG TYPE CONNECTION DIAGRAM
THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2200787
REVISION 04
G.O. NUMBER LBS0031682
DWG NO. ENG-900500-12523
SHEET 1 OF 1

Master Document Index

Drives - Enclosed

Drives - Enclosed

	Drawing Description	Document Name	Rev
1	Master Drawing List	D00FTB9M01.DOC	4
2	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-000710-12410.DWG	02
3	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12543.DWG	03
4	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12543_SHT02.DWG	03
5	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-900500-12523.DWG	04

User **Karen** **Estrada**	**Date** **10/5/2023** **4:29:59 PM**	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.		EATON Powering Business Worldwide
		D7580427X2K2		
		RSP-4112	**Construction Drawings**	
REVISION	DWG SIZE	G.O.	DWG	SHEET
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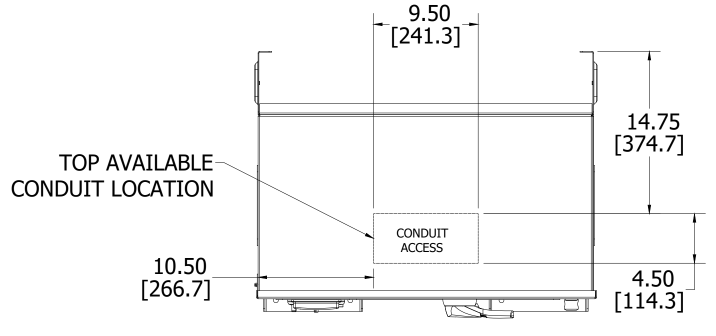
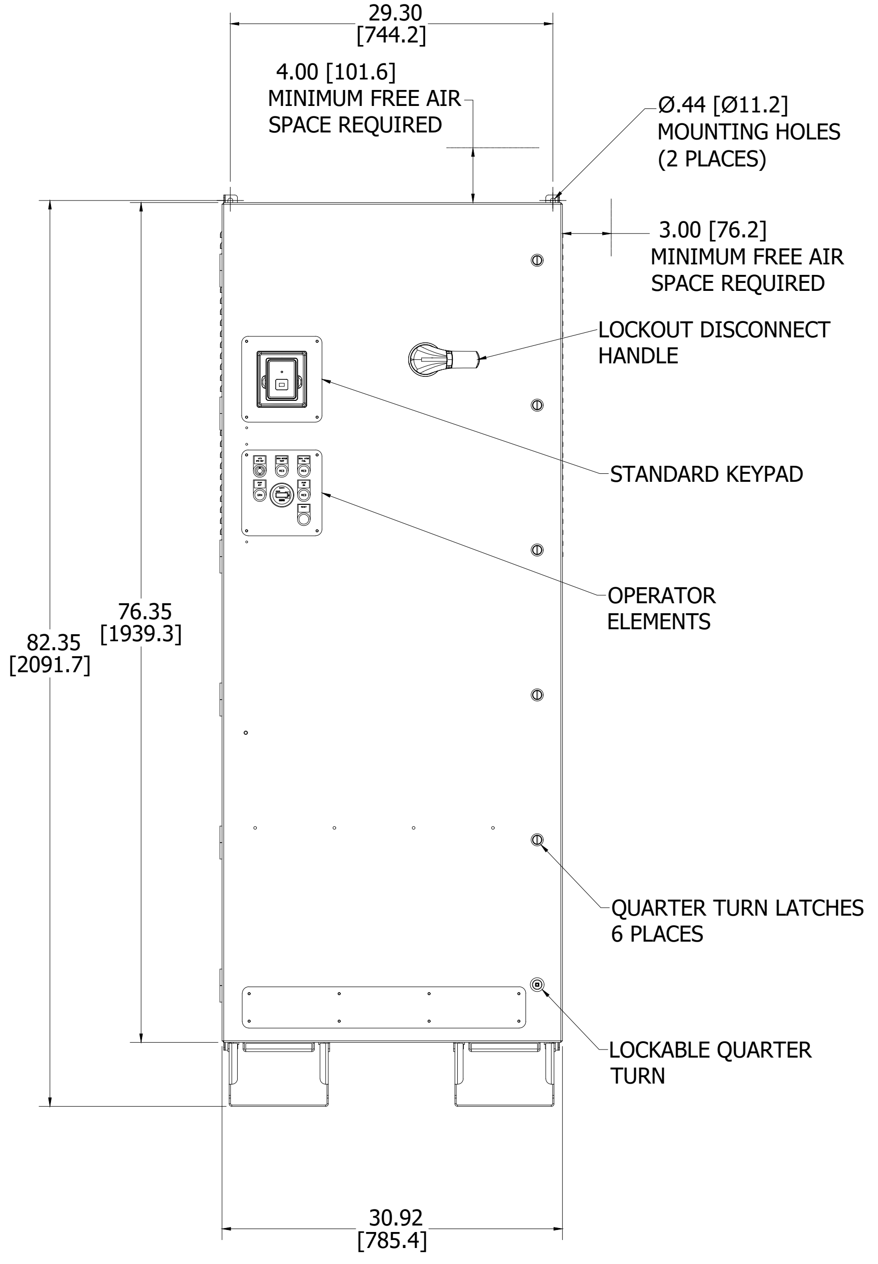
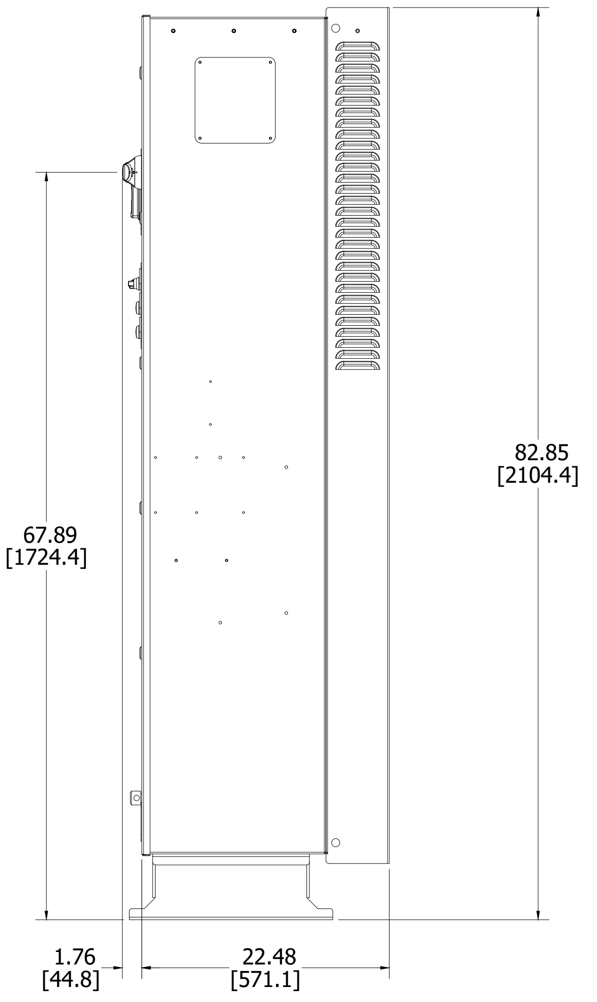
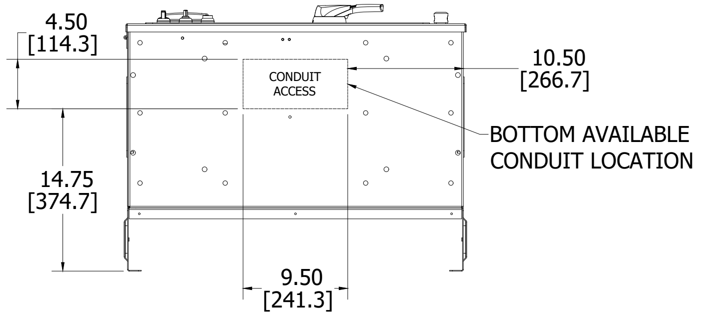


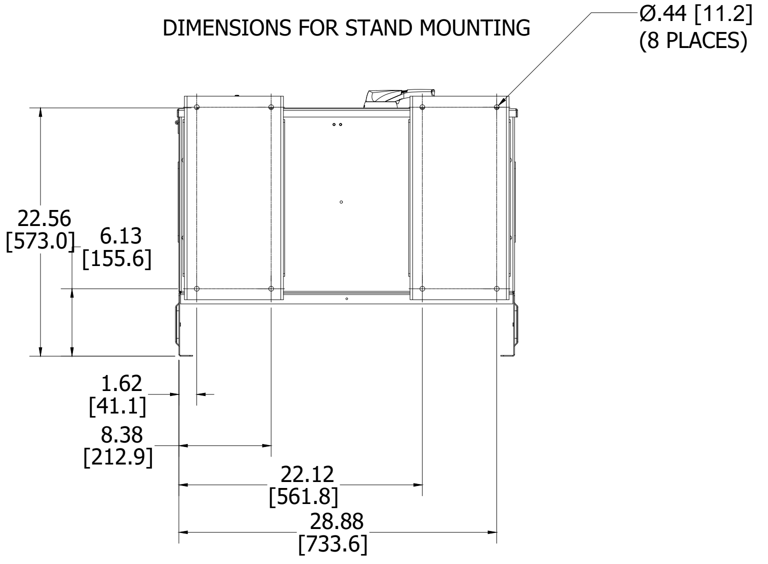




BOTTOM CONDUIT ACCESS LOCATION
SHOWN WITH FLOOR STANDS REMOVED



DIMENSIONS FOR STAND MOUNTING



NOTES:
FINISH: ENCLOSURE - ANSI 61 (LIGHT) GRAY.
WEIGHT: APPROXIMATELY 900 LBS. [408] KG.
MATERIAL: 14GA (0.0747) [1.90] CRS.
DIMENSIONS: INCHES, [MILLIMETERS].
CONSTRUCTION: NEMA TYPE 12 OVERSIZE

EGF0404D2300D00000*-RSP-4213
EGF0404D2300D00000*-RSP-4212
EGF0404D2300D00000*-RSP-4211
EGF0404D2300D00000*-RSP-4113
EGF0404D2300D00000*-RSP-4112
EGF0404D2300D00000*-RSP-4111

▲ 10/05/23; RELOCATED ETM
REV 02, KE

EATON

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE OUTLINE DIMENSION

THIRD ANGLE PROJECTION

DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
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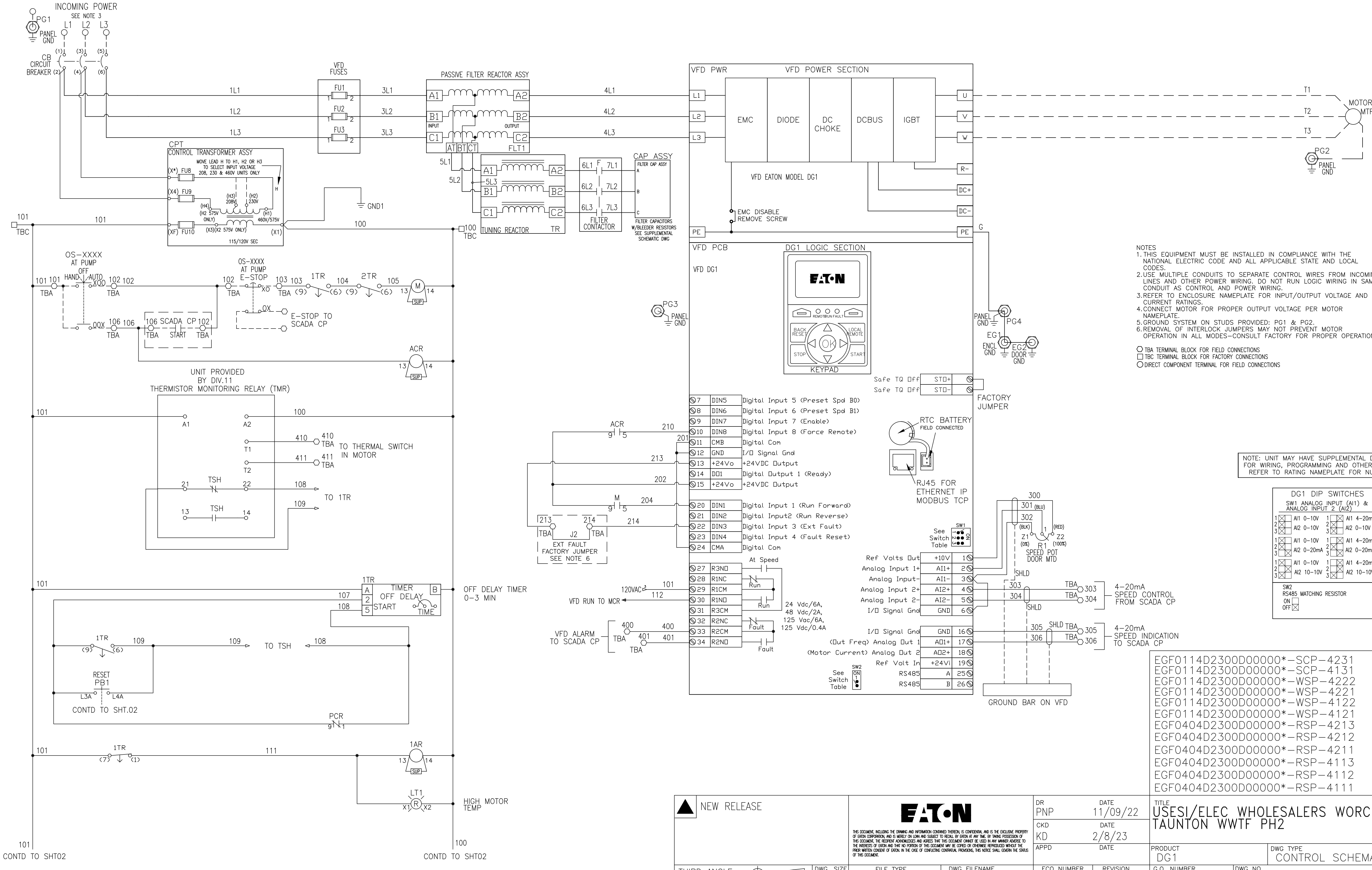

NOTES
1. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL APPLICABLE STATE AND LOCAL CODES.
2. USE MULTIPLE CONDUITS TO SEPARATE CONTROL WIRES FROM INCOMING LINES AND OTHER POWER WIRING. DO NOT RUN LOGIC WIRING IN SAME CONDUIT AS CONTROL AND POWER WIRING.
3. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGE AND CURRENT RATINGS.
4. CONNECT MOTOR FOR PROPER OUTPUT VOLTAGE PER MOTOR NAMEPLATE.
5. GROUND SYSTEM ON STUDS PROVIDED: PG1 & PG2.
6. REMOVAL OF INTERLOCK JUMPERS MAY NOT PREVENT MOTOR OPERATION IN ALL MODES—CONSULT FACTORY FOR PROPER OPERATION.

⬡ TBA TERMINAL BLOCK FOR FIELD CONNECTIONS
☐ TBC TERMINAL BLOCK FOR FACTORY CONNECTIONS
○ DIRECT COMPONENT TERMINAL FOR FIELD CONNECTIONS

NOTE: UNIT MAY HAVE SUPPLEMENTAL DRAWINGS FOR WIRING, PROGRAMMING AND OTHER DETAILS REFER TO RATING NAMEPLATE FOR NUMBERS

DG1 DIP SWITCHES

SW1 ANALOG INPUT (AI1) & ANALOG INPUT 2 (AI2)

AI1 0-10V AI2 0-10V	AI1 4-20mA AI2 0-10V
AI1 0-10V AI2 0-20mA	AI1 4-20mA AI2 0-20mA
AI1 0-10V AI2 10-10V	AI1 4-20mA AI2 10-10V

SW2
RS485 MATCHING RESISTOR
ON ☐
OFF ☒

EGF0114D2300D00000*-SCP-4231
EGF0114D2300D00000*-SCP-4131
EGF0114D2300D00000*-WSP-4222
EGF0114D2300D00000*-WSP-4221
EGF0114D2300D00000*-WSP-4122
EGF0114D2300D00000*-WSP-4121
EGF0404D2300D00000*-RSP-4213
EGF0404D2300D00000*-RSP-4212
EGF0404D2300D00000*-RSP-4211
EGF0404D2300D00000*-RSP-4113
EGF0404D2300D00000*-RSP-4112
EGF0404D2300D00000*-RSP-4111

NEW RELEASE

EATON

DR	DATE	CKD	DATE	APPD	DATE
PNP	11/09/22	KD	2/8/23		

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION	DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
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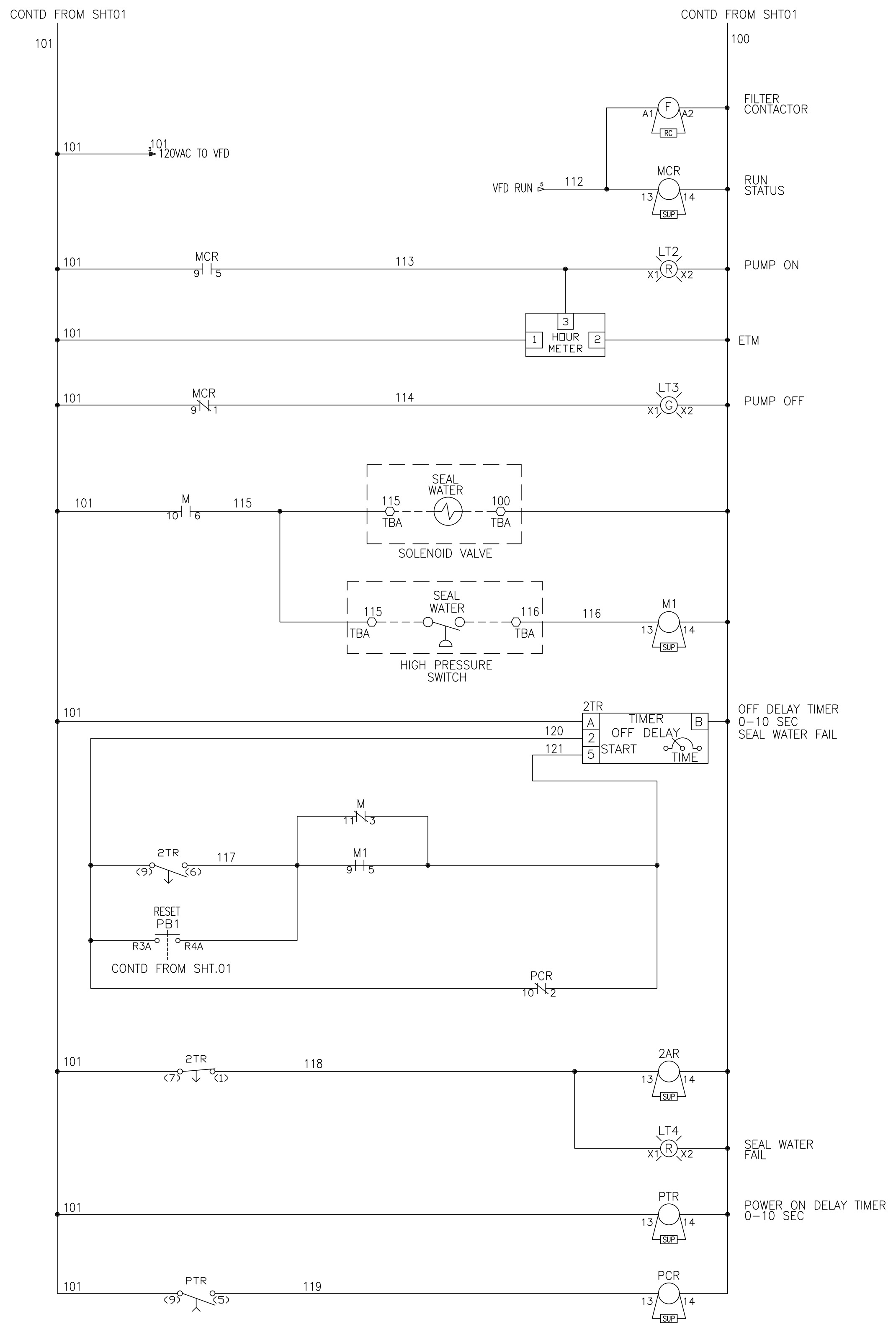

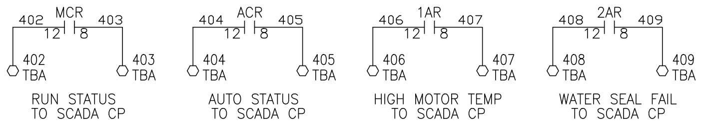

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EGF0114D2300D00000*-SCP-4131
EGF0114D2300D00000*-WSP-4222
EGF0114D2300D00000*-WSP-4221
EGF0114D2300D00000*-WSP-4122
EGF0114D2300D00000*-WSP-4121
EGF0404D2300D00000*-RSP-4213
EGF0404D2300D00000*-RSP-4212
EGF0404D2300D00000*-RSP-4211
EGF0404D2300D00000*-RSP-4113
EGF0404D2300D00000*-RSP-4112
EGF0404D2300D00000*-RSP-4111

▲ SEE SHT.01

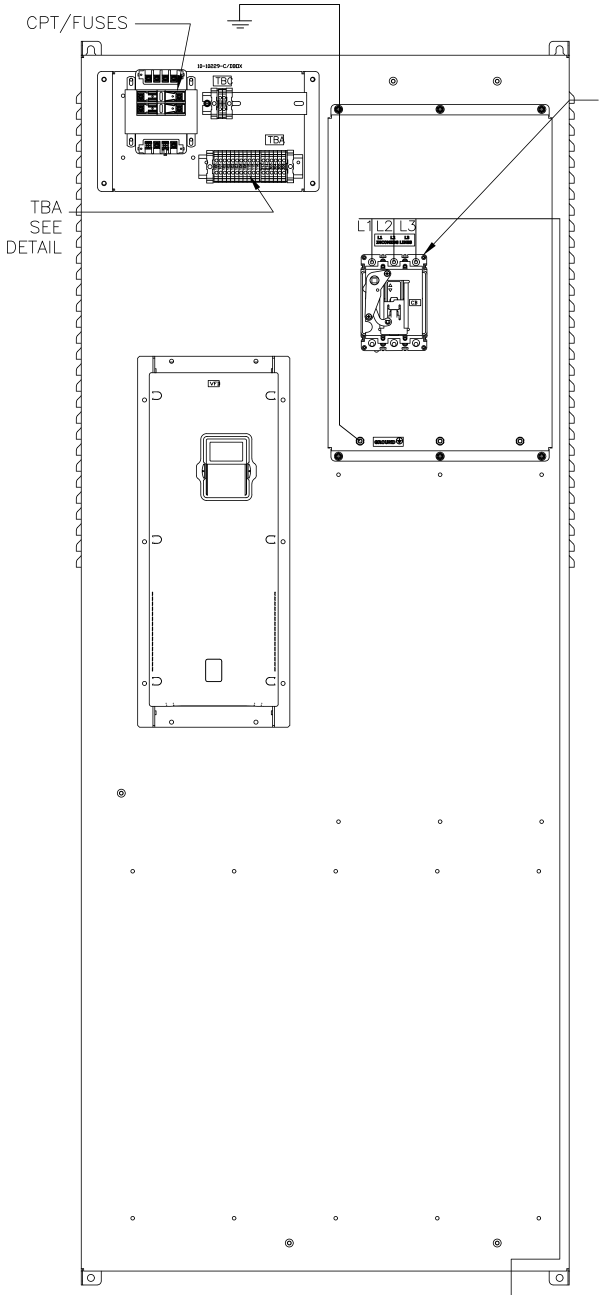
EATON

DR PNP DATE 11/09/22
CKD KD DATE 2/8/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

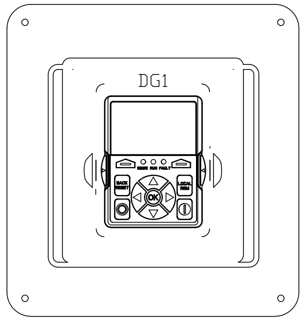
PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2300061
REVISION 02
G.O. NUMBER LBS0031682
DWG NO. ENG-090400-12543
SHEET 2 OF 2

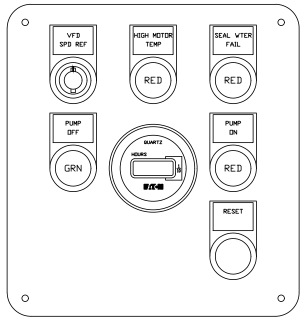


INCOMING POWER AND GROUND
SEE NAMEPLATE FOR RATINGS SEE NOTES

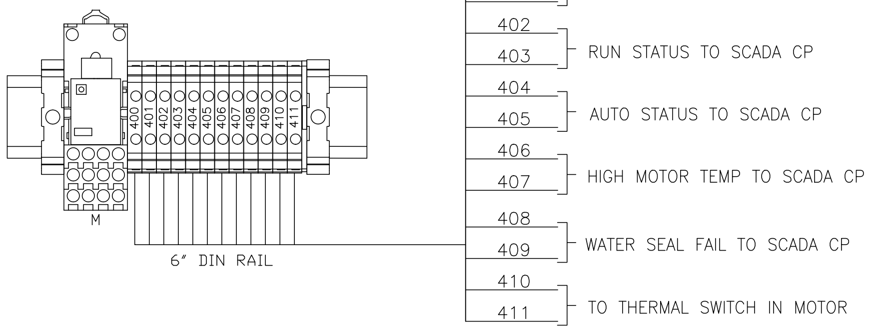
VFD KEYPAD
ON ENCLOSURE DOOR
10-10226-4211



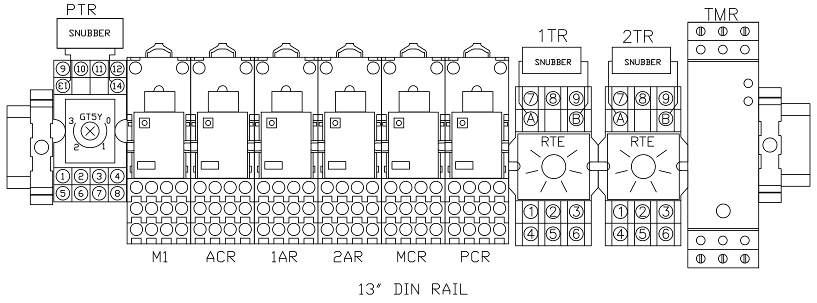
OPERATOR CONTROLS
ON ENCLOSURE DOOR

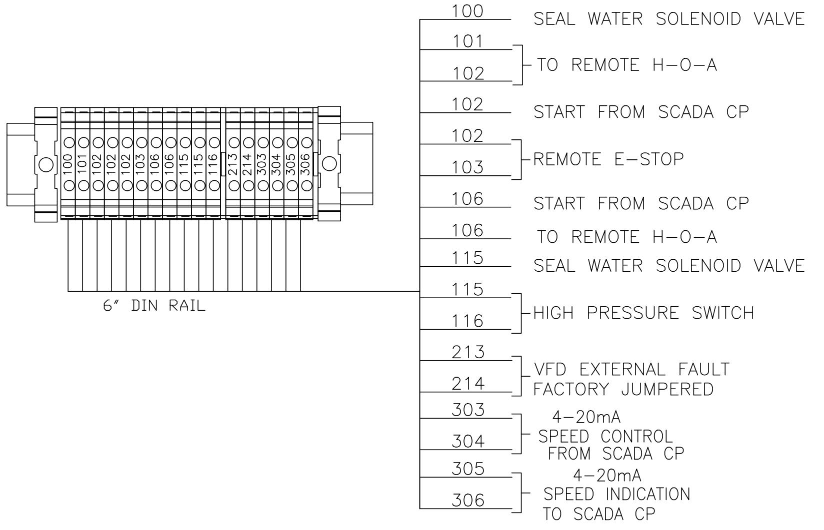


TBA FOR CUSTOMER CONTROL
CONNECTIONS- SEE NOTES



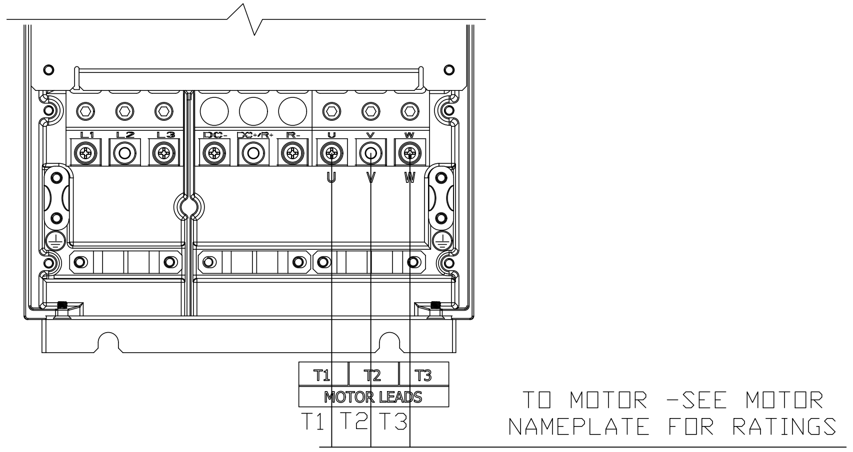
Terminals	Connection
400 401	VFD ALARM TO SCADA CP
402 403	RUN STATUS TO SCADA CP
404 405	AUTO STATUS TO SCADA CP
406 407	HIGH MOTOR TEMP TO SCADA CP
408 409	WATER SEAL FAIL TO SCADA CP
410 411	TO THERMAL SWITCH IN MOTOR





Terminals	Connection
100	SEAL WATER SOLENOID VALVE
101 102	TO REMOTE H-O-A
102	START FROM SCADA CP
102 103	REMOTE E-STOP
106	START FROM SCADA CP
106	TO REMOTE H-O-A
115	SEAL WATER SOLENOID VALVE
115 116	HIGH PRESSURE SWITCH
213 214	VFD EXTERNAL FAULT FACTORY JUMPERED
303 304	4-20mA SPEED CONTROL FROM SCADA CP
305 306	4-20mA SPEED INDICATION TO SCADA CP

DG1 FRAME 3 POWER CONNECTIONS



TO MOTOR -SEE MOTOR
NAMEPLATE FOR RATINGS

NOTES

1. SEE SCHEMATIC FOR DETAILS AND CONTROL LOGIC - FACTORY WIRING DETAILS OMITTED.
2. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGES AND CURRENT RATINGS.
3. ENCLOSURE MUST BE GROUNDED USING INPUT AND OUTPUT STUDS PROVIDED.
4. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL STATE/LOCAL CODES.
5. USE MULTIPLE CONDUITS TO SEPARATE 120 CONTROL (TBA 101/102 & 106/104) WIRING FROM INCOMING POWER WIRING.
6. 4-20MA AUTO SPEED SIGNAL CONNECTIONS ARE MADE DIRECTLY TO VFD CONTROL MODULE.
7. DO NOT RUN LOGIC WIRES (TBA 213/214 VFD EXT FAULT) IN SAME CONDUIT AS 120V OR POWER WIRING.
8. REMOVAL OF INTERLOCKS (TBA 101/102,213/214) MAY NOT PREVENT MOTOR OPERATION IN ALL MODES-CONSULT FACTORY FOR DETAILS.

EGF0404D2300D00000*-RSP-4213
EGF0404D2300D00000*-RSP-4212
EGF0404D2300D00000*-RSP-4211
EGF0404D2300D00000*-RSP-4113
EGF0404D2300D00000*-RSP-4112
EGF0404D2300D00000*-RSP-4111

▲ 10/05/23; RELOCATED ETM
REV 4, KE

EATON

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONNECTION DIAGRAM

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2200787
REVISION 04
G.O. NUMBER LBS0031682
DWG NO. ENG-900500-12523
SHEET 1 OF 1

Master Document Index

Drives - Enclosed

Drives - Enclosed

	Drawing Description	Document Name	Rev
1	Master Drawing List	D00FTC8M01.DOC	4
2	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-000710-12410.DWG	02
3	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12543.DWG	03
4	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12543_SHT02.DWG	03
5	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-900500-12523.DWG	04

User **Karen Estrada**	**Date** **10/5/2023** **4:31:15 PM**	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.		EATON Powering Business Worldwide
		D7580427X2K2		
		RSP-4113	**Construction Drawings**	
REVISION	DWG SIZE	G.O.	DWG	SHEET
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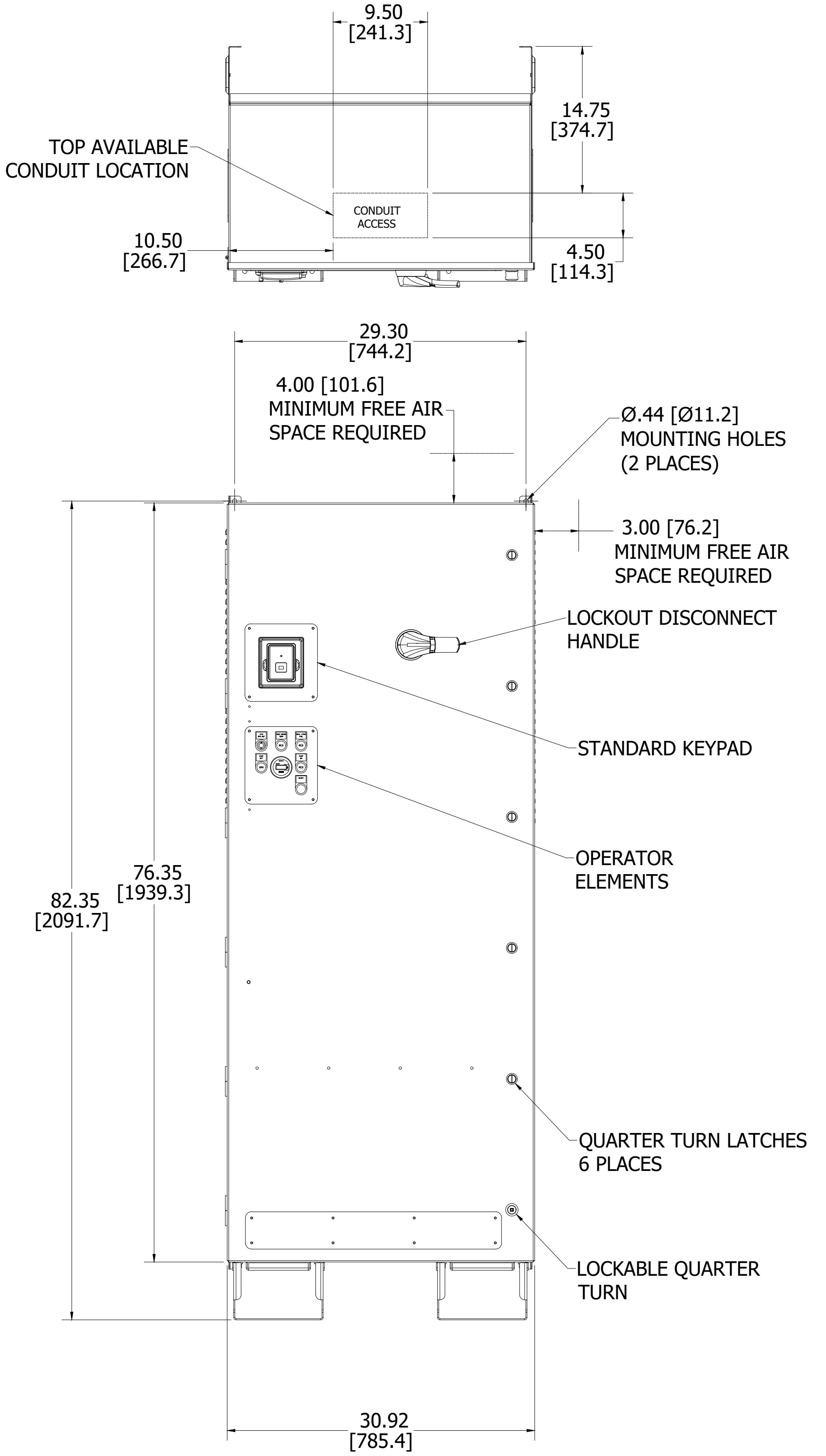
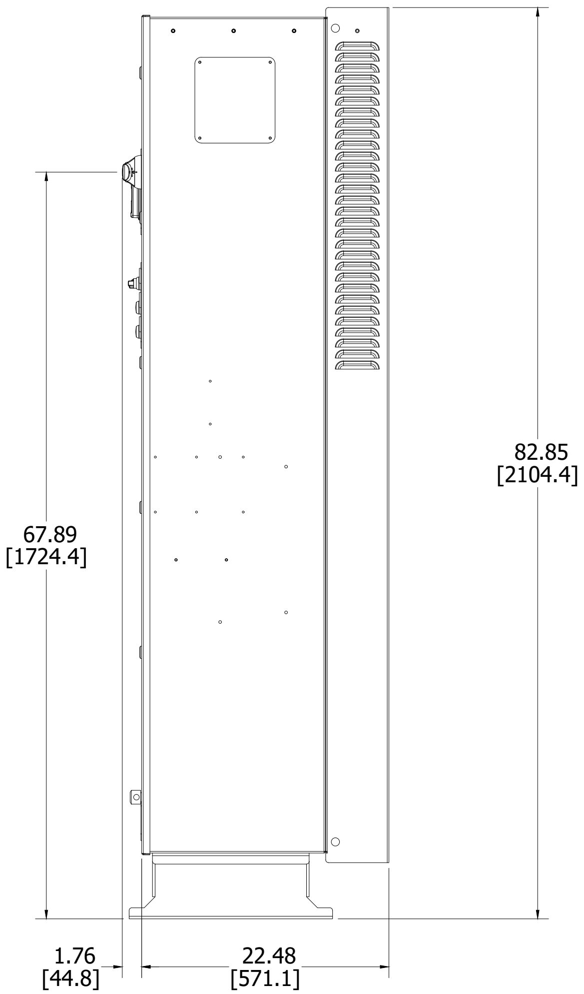
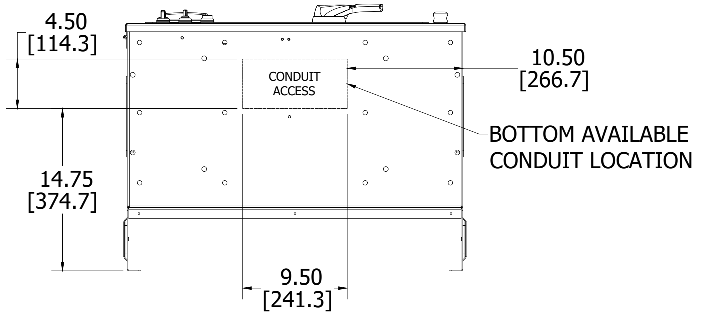
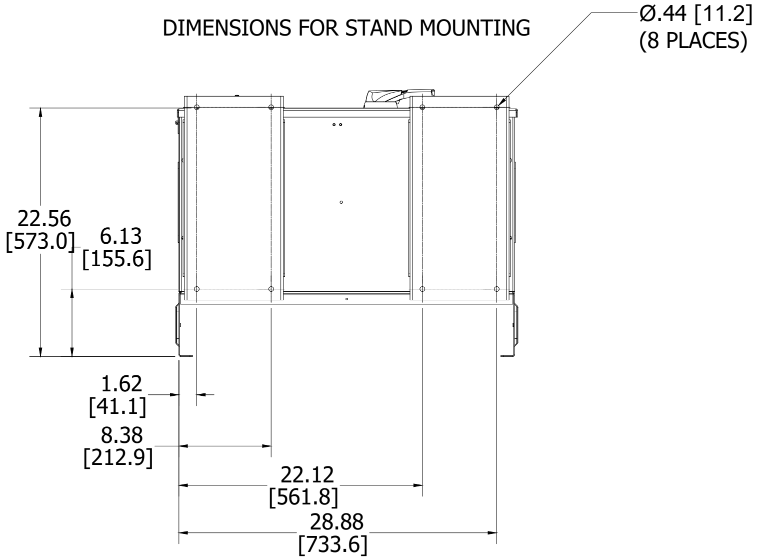




BOTTOM CONDUIT ACCESS LOCATION
SHOWN WITH FLOOR STANDS REMOVED



DIMENSIONS FOR STAND MOUNTING



NOTES:
FINISH: ENCLOSURE - ANSI 61 (LIGHT) GRAY.
WEIGHT: APPROXIMATELY 900 LBS. [408] KG.
MATERIAL: 14GA (0.0747) [1.90] CRS.
DIMENSIONS: INCHES, [MILLIMETERS].
CONSTRUCTION: NEMA TYPE 12 OVERSIZE

EGF0404D2300D00000*-RSP-4213
EGF0404D2300D00000*-RSP-4212
EGF0404D2300D00000*-RSP-4211
EGF0404D2300D00000*-RSP-4113
EGF0404D2300D00000*-RSP-4112
EGF0404D2300D00000*-RSP-4111

▲ 10/05/23; RELOCATED ETM
REV 02, KE

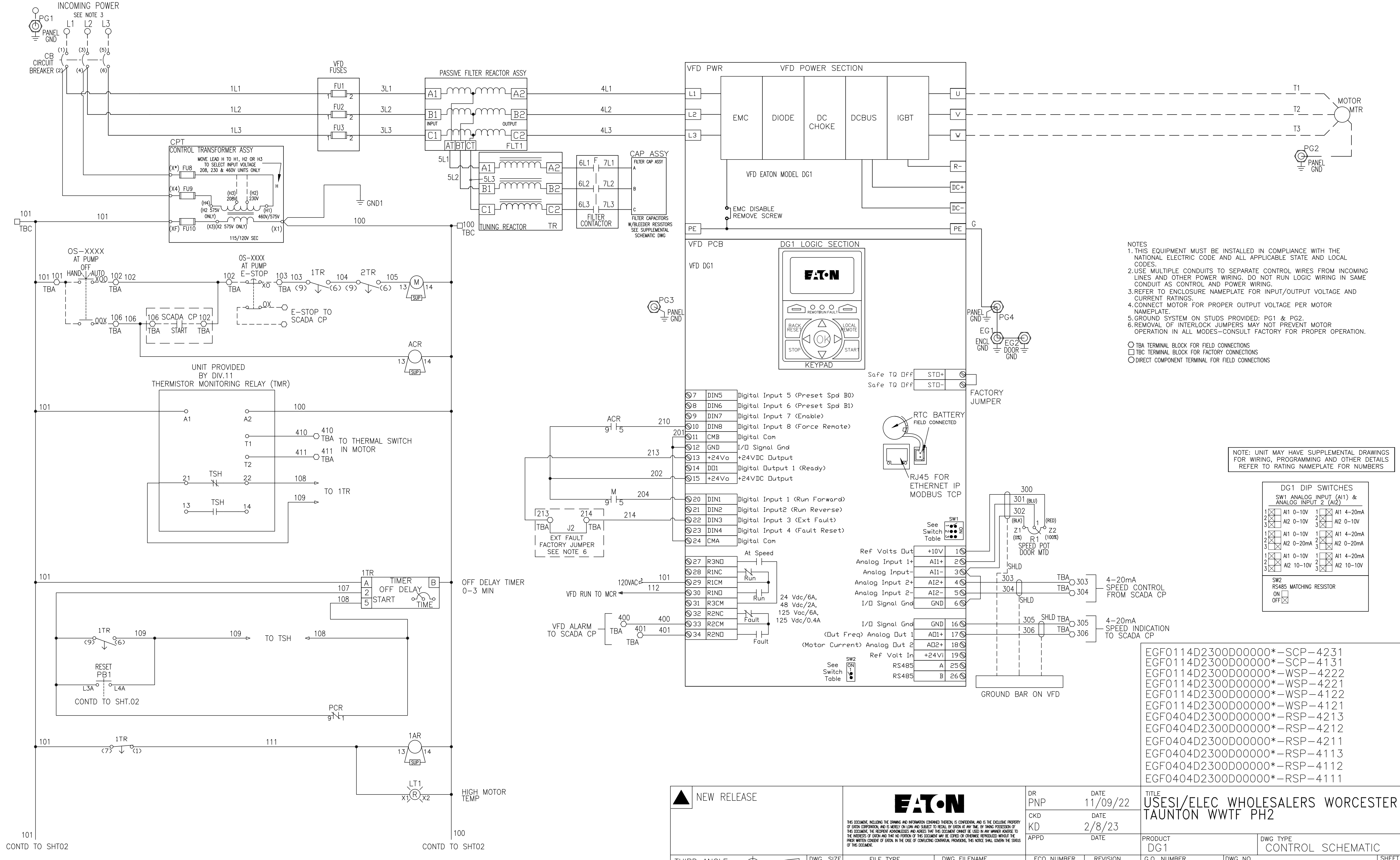
EATON

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE OUTLINE DIMENSION

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2200787
REVISION 02
G.O. NUMBER LBS0031682
DWG NO. ENG-000710-12410
SHEET 1 OF 1



NOTES
1. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL APPLICABLE STATE AND LOCAL CODES.
2. USE MULTIPLE CONDUITS TO SEPARATE CONTROL WIRES FROM INCOMING LINES AND OTHER POWER WIRING. DO NOT RUN LOGIC WIRING IN SAME CONDUIT AS CONTROL AND POWER WIRING.
3. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGE AND CURRENT RATINGS.
4. CONNECT MOTOR FOR PROPER OUTPUT VOLTAGE PER MOTOR NAMEPLATE.
5. GROUND SYSTEM ON STUDS PROVIDED: PG1 & PG2.
6. REMOVAL OF INTERLOCK JUMPERS MAY NOT PREVENT MOTOR OPERATION IN ALL MODES—CONSULT FACTORY FOR PROPER OPERATION.

⬡ TBA TERMINAL BLOCK FOR FIELD CONNECTIONS
☐ TBC TERMINAL BLOCK FOR FACTORY CONNECTIONS
○ DIRECT COMPONENT TERMINAL FOR FIELD CONNECTIONS

NOTE: UNIT MAY HAVE SUPPLEMENTAL DRAWINGS FOR WIRING, PROGRAMMING AND OTHER DETAILS REFER TO RATING NAMEPLATE FOR NUMBERS

EGF0114D2300D00000*-SCP-4231
EGF0114D2300D00000*-SCP-4131
EGF0114D2300D00000*-WSP-4222
EGF0114D2300D00000*-WSP-4221
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EGF0114D2300D00000*-WSP-4121
EGF0404D2300D00000*-RSP-4213
EGF0404D2300D00000*-RSP-4212
EGF0404D2300D00000*-RSP-4211
EGF0404D2300D00000*-RSP-4113
EGF0404D2300D00000*-RSP-4112
EGF0404D2300D00000*-RSP-4111

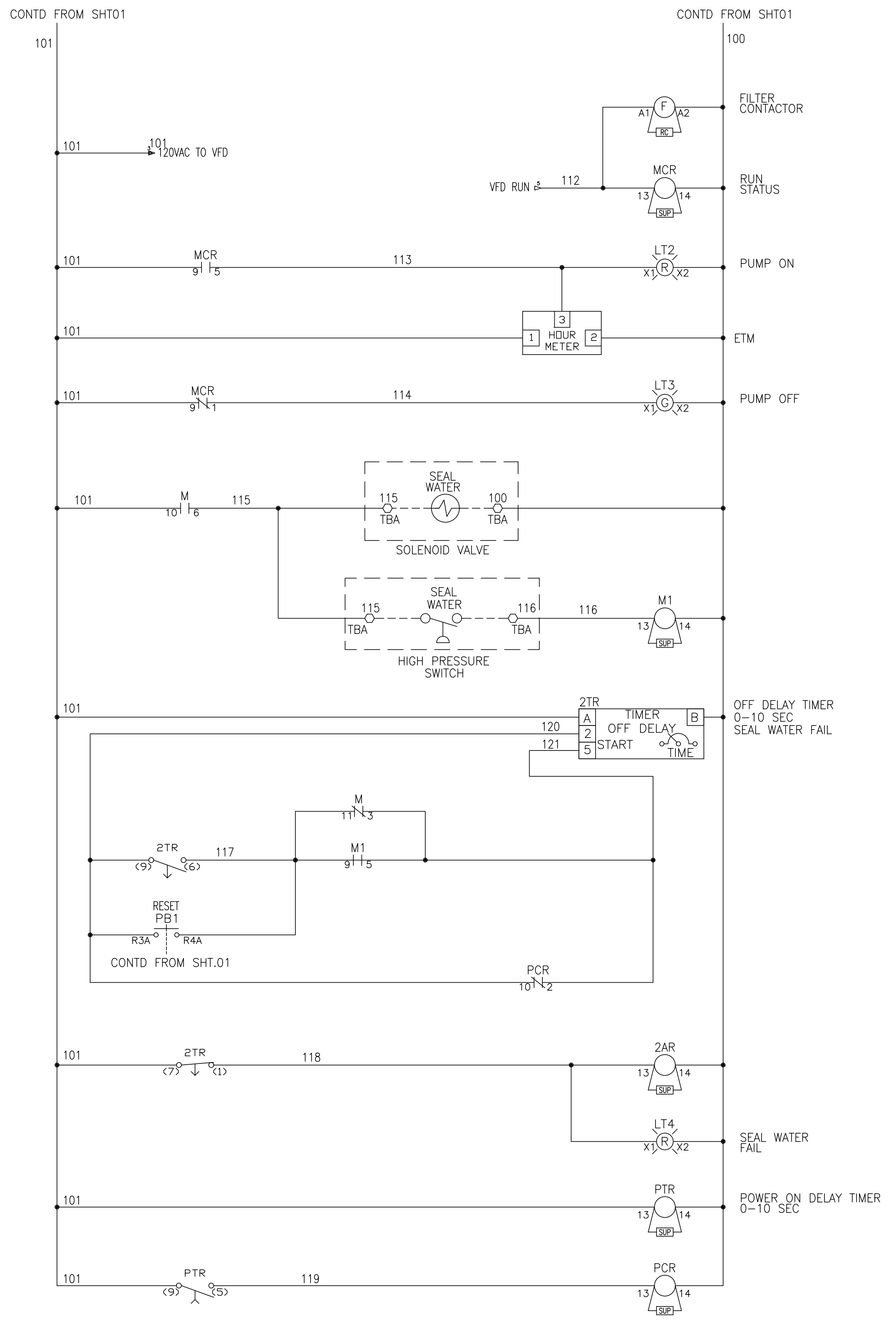
▲ NEW RELEASE

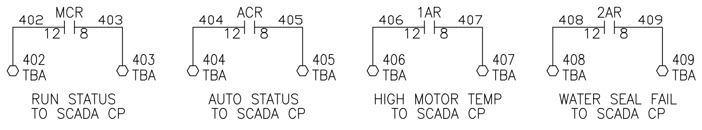
EATON

DR	DATE	TITLE		
PNP	11/09/22	USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2		
CKD	DATE			
KD	2/8/23			
APPD	DATE	PRODUCT	DWG TYPE	
		DG1	CONTROL SCHEMATIC	

THIRD ANGLE PROJECTION	DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
	B	AutoCAD		2300061	02	LBS0031682	ENG-090400-12543	1 OF 2

468-1140
REV. 11/11





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EGF0114D2300D00000*–WSP–4121
EGF0404D2300D00000*–RSP–4213
EGF0404D2300D00000*–RSP–4212
EGF0404D2300D00000*–RSP–4211
EGF0404D2300D00000*–RSP–4113
EGF0404D2300D00000*–RSP–4112
EGF0404D2300D00000*–RSP–4111

▲ SEE SHT.01

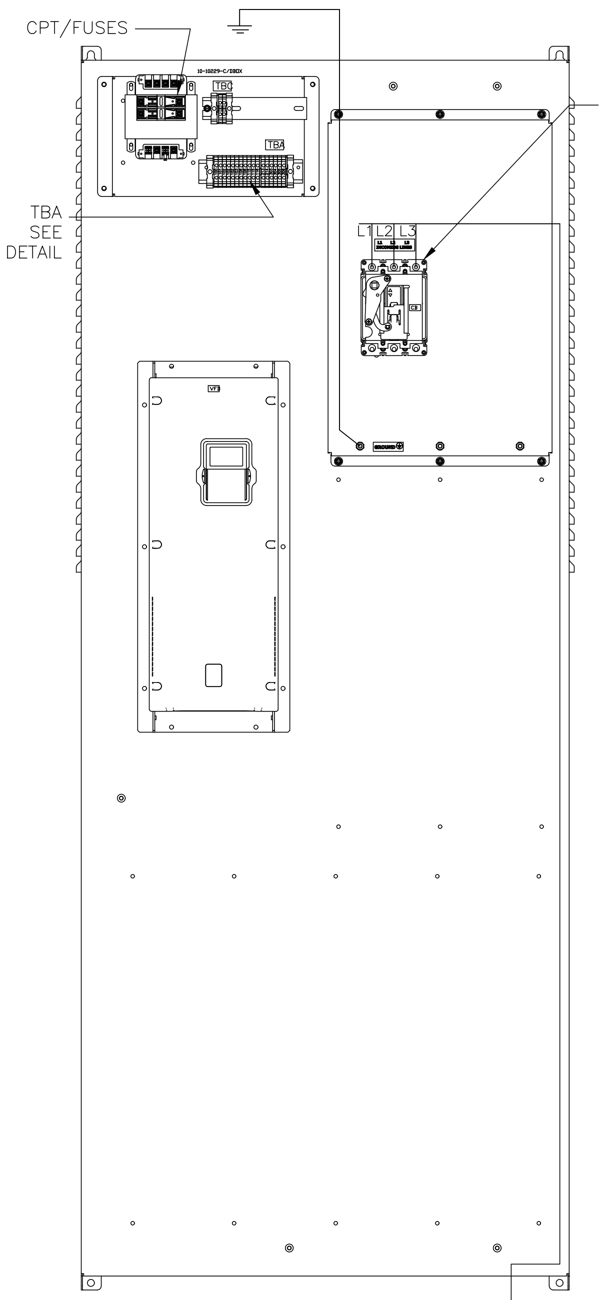
EATON

DR PNP DATE 11/09/22
CKD KD DATE 2/8/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

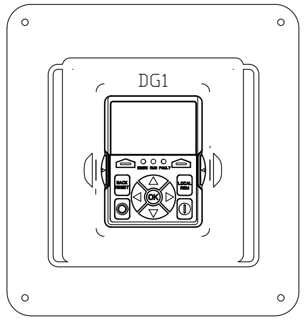
PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2300061
REVISION 02
G.O. NUMBER LBS0031682
DWG NO. ENG–090400–12543
SHEET 2 OF 2

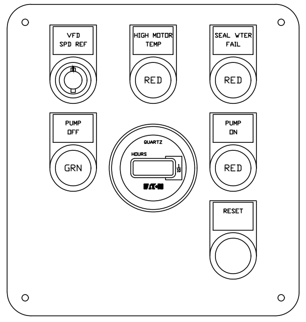


INCOMING POWER AND GROUND
SEE NAMEPLATE FOR RATINGS SEE NOTES

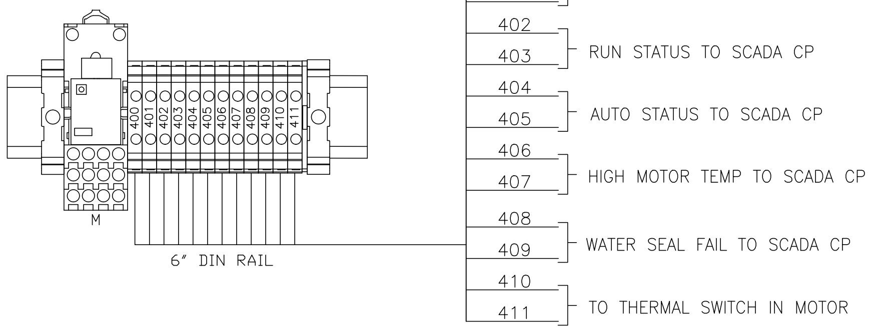
VFD KEYPAD
ON ENCLOSURE DOOR
10-10226-4211

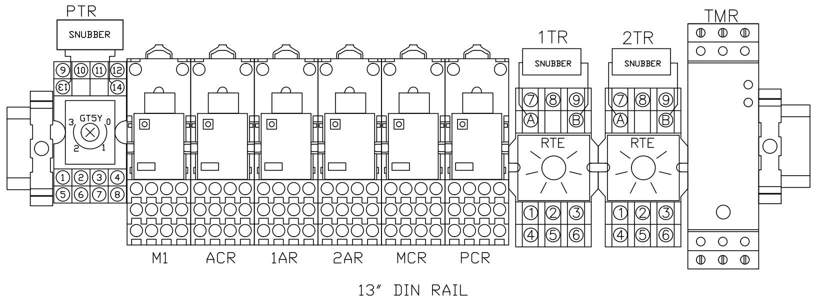


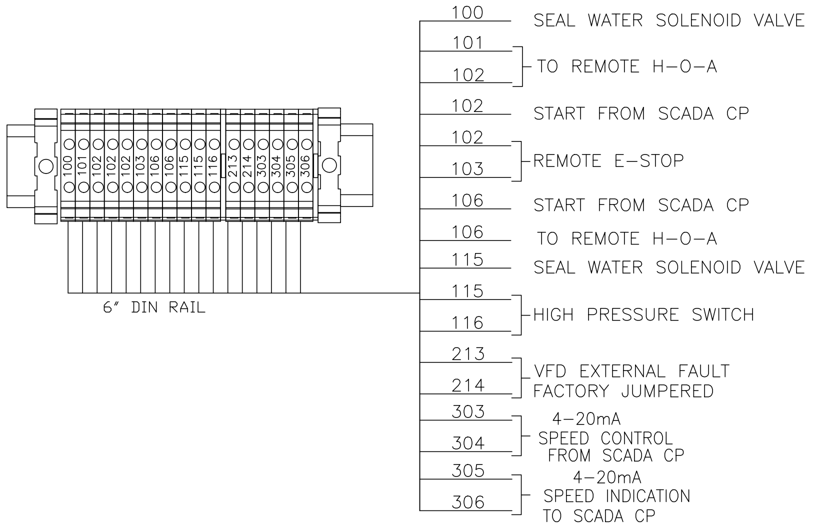
OPERATOR CONTROLS
ON ENCLOSURE DOOR



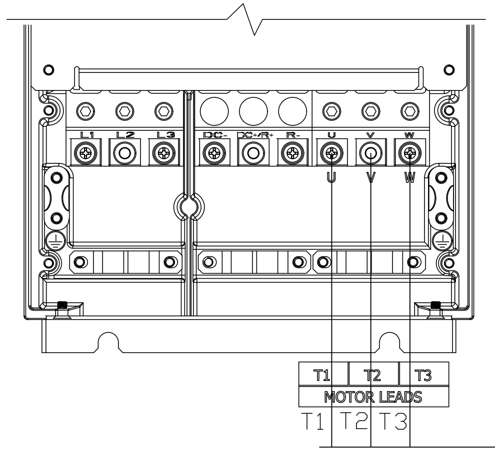
TBA FOR CUSTOMER CONTROL
CONNECTIONS- SEE NOTES







DG1 FRAME 3 POWER CONNECTIONS



TO MOTOR -SEE MOTOR
NAMEPLATE FOR RATINGS

NOTES

1. SEE SCHEMATIC FOR DETAILS AND CONTROL LOGIC - FACTORY WIRING DETAILS OMITTED.
2. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGES AND CURRENT RATINGS.
3. ENCLOSURE MUST BE GROUNDED USING INPUT AND OUTPUT STUDS PROVIDED.
4. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL STATE/LOCAL CODES.
5. USE MULTIPLE CONDUITS TO SEPARATE 120 CONTROL (TBA 101/102 & 106/104) WIRING FROM INCOMING POWER WIRING.
6. 4-20MA AUTO SPEED SIGNAL CONNECTIONS ARE MADE DIRECTLY TO VFD CONTROL MODULE.
7. DO NOT RUN LOGIC WIRES (TBA 213/214 VFD EXT FAULT) IN SAME CONDUIT AS 120V OR POWER WIRING.
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EGF0404D2300D00000*-RSP-4213
EGF0404D2300D00000*-RSP-4212
EGF0404D2300D00000*-RSP-4211
EGF0404D2300D00000*-RSP-4113
EGF0404D2300D00000*-RSP-4112
EGF0404D2300D00000*-RSP-4111

▲ 10/05/23; RELOCATED ETM
REV 4, KE

EATON

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONNECTION DIAGRAM

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2200787
REVISION 04
G.O. NUMBER LBS0031682
DWG NO. ENG-900500-12523
SHEET 1 OF 1

Master Document Index

Drives - Enclosed
Drives - Enclosed

	Drawing Description	Document Name	Rev
1	Master Drawing List	D00FTC3M01.DOC	4
2	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-000710-12410.DWG	02
3	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12543.DWG	03
4	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12543_SHT02.DWG	03
5	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-900500-12523.DWG	04

User **Karen Estrada**	**Date** **10/5/2023** **4:32:53 PM**	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.		Powering Business Worldwide
		D7580427X2K2		
		RSP-4211	**Construction Drawings**	
REVISION	DWG SIZE	G.O.	DWG	SHEET
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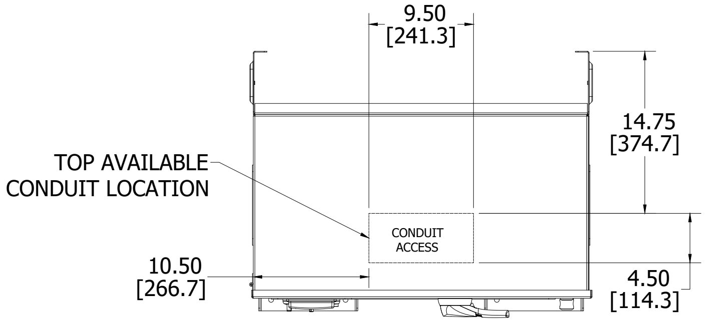
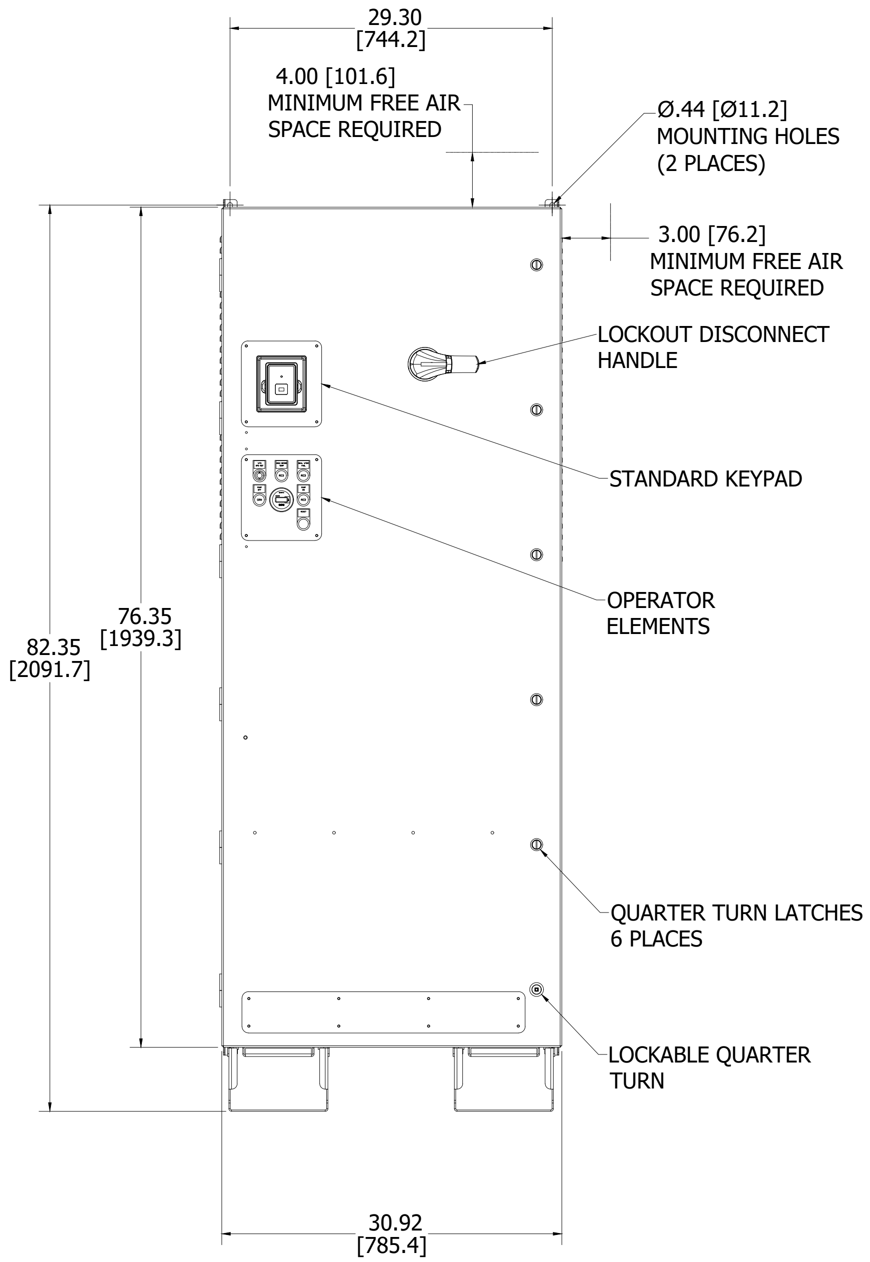
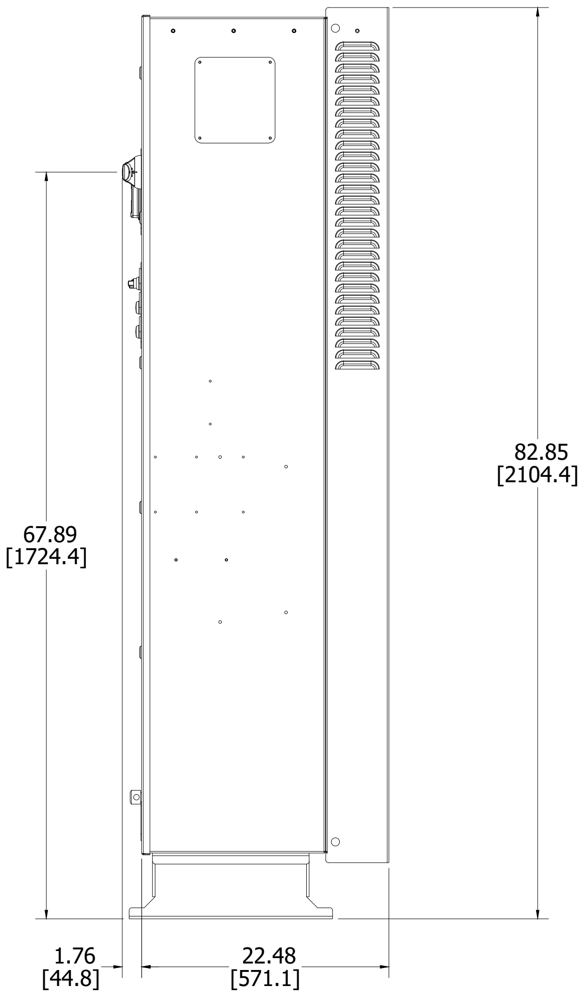
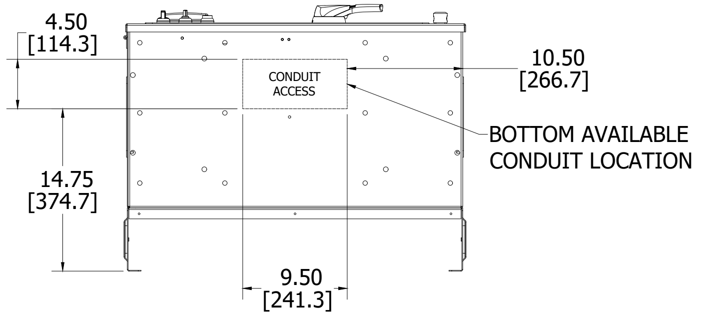


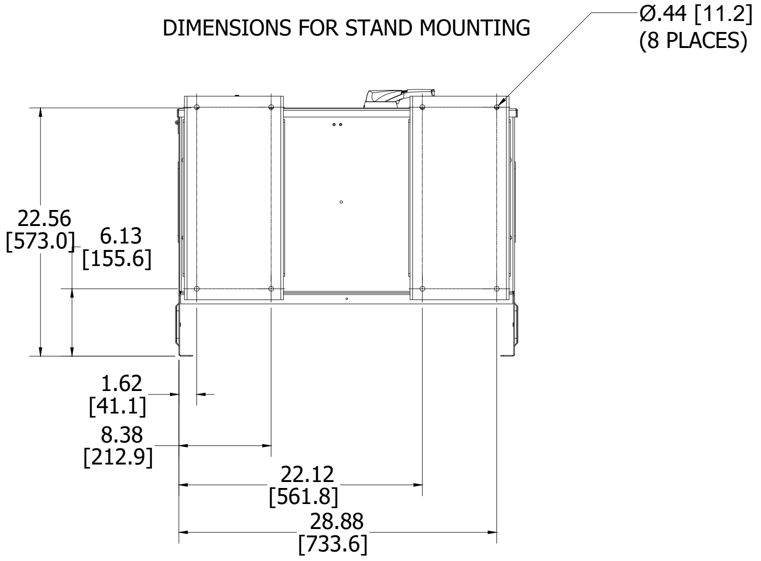




BOTTOM CONDUIT ACCESS LOCATION
SHOWN WITH FLOOR STANDS REMOVED



DIMENSIONS FOR STAND MOUNTING



NOTES:
FINISH: ENCLOSURE - ANSI 61 (LIGHT) GRAY.
WEIGHT: APPROXIMATELY 900 LBS. [408] KG.
MATERIAL: 14GA (0.0747) [1.90] CRS.
DIMENSIONS: INCHES, [MILLIMETERS].
CONSTRUCTION: NEMA TYPE 12 OVERSIZE

EGF0404D2300D00000*-RSP-4213
EGF0404D2300D00000*-RSP-4212
EGF0404D2300D00000*-RSP-4211
EGF0404D2300D00000*-RSP-4113
EGF0404D2300D00000*-RSP-4112
EGF0404D2300D00000*-RSP-4111

▲ 10/05/23; RELOCATED ETM
REV 02, KE

EATON

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE OUTLINE DIMENSION

THIRD ANGLE
PROJECTION

DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
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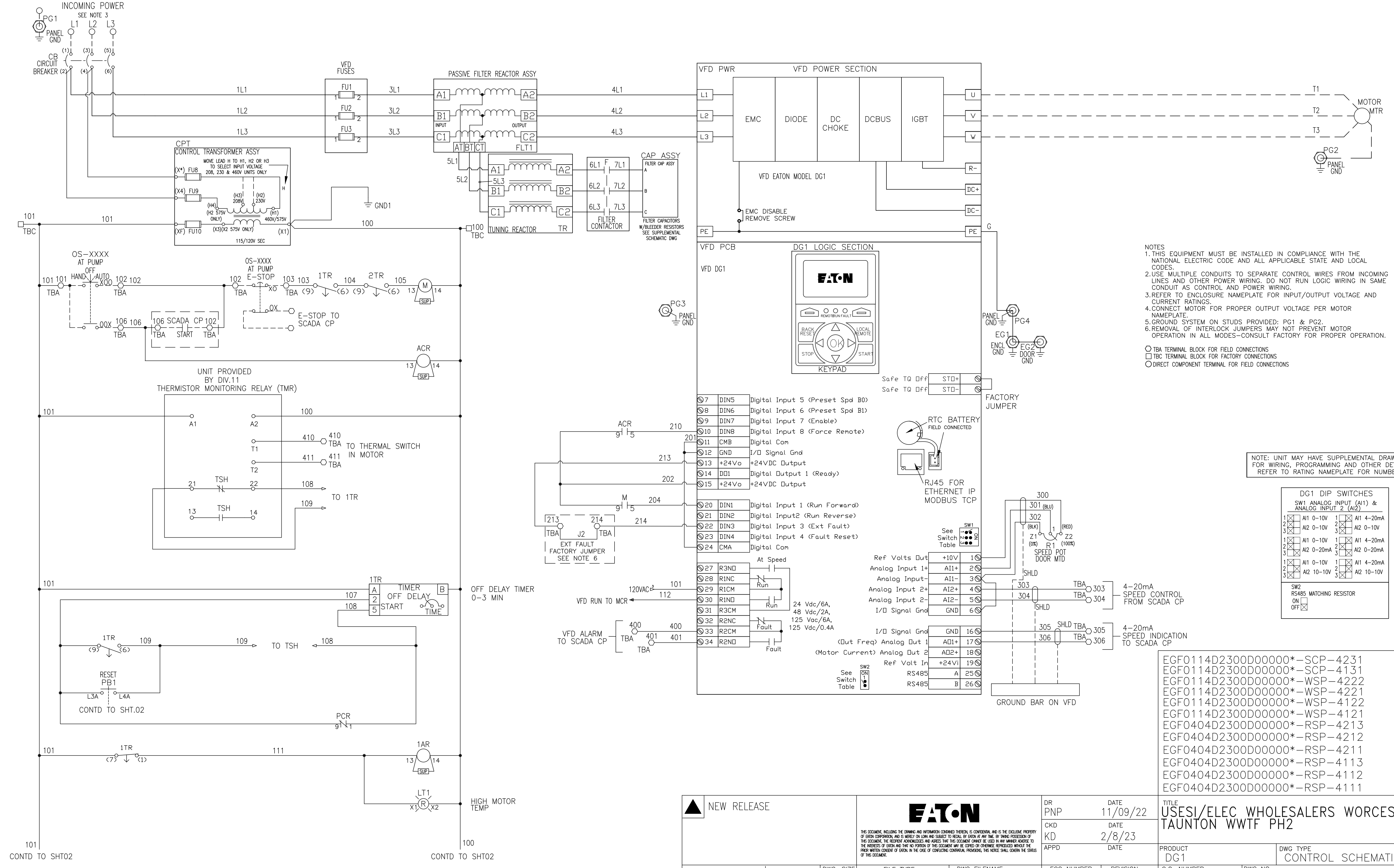


NOTES
1. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL APPLICABLE STATE AND LOCAL CODES.
2. USE MULTIPLE CONDUITS TO SEPARATE CONTROL WIRES FROM INCOMING LINES AND OTHER POWER WIRING. DO NOT RUN LOGIC WIRING IN SAME CONDUIT AS CONTROL AND POWER WIRING.
3. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGE AND CURRENT RATINGS.
4. CONNECT MOTOR FOR PROPER OUTPUT VOLTAGE PER MOTOR NAMEPLATE.
5. GROUND SYSTEM ON STUDS PROVIDED: PG1 & PG2.
6. REMOVAL OF INTERLOCK JUMPERS MAY NOT PREVENT MOTOR OPERATION IN ALL MODES—CONSULT FACTORY FOR PROPER OPERATION.

⬡ TBA TERMINAL BLOCK FOR FIELD CONNECTIONS
☐ TBC TERMINAL BLOCK FOR FACTORY CONNECTIONS
○ DIRECT COMPONENT TERMINAL FOR FIELD CONNECTIONS

NOTE: UNIT MAY HAVE SUPPLEMENTAL DRAWINGS FOR WIRING, PROGRAMMING AND OTHER DETAILS REFER TO RATING NAMEPLATE FOR NUMBERS

EGF0114D2300D00000*-SCP-4231
EGF0114D2300D00000*-SCP-4131
EGF0114D2300D00000*-WSP-4222
EGF0114D2300D00000*-WSP-4221
EGF0114D2300D00000*-WSP-4122
EGF0114D2300D00000*-WSP-4121
EGF0404D2300D00000*-RSP-4213
EGF0404D2300D00000*-RSP-4212
EGF0404D2300D00000*-RSP-4211
EGF0404D2300D00000*-RSP-4113
EGF0404D2300D00000*-RSP-4112
EGF0404D2300D00000*-RSP-4111

▲ NEW RELEASE

EATON

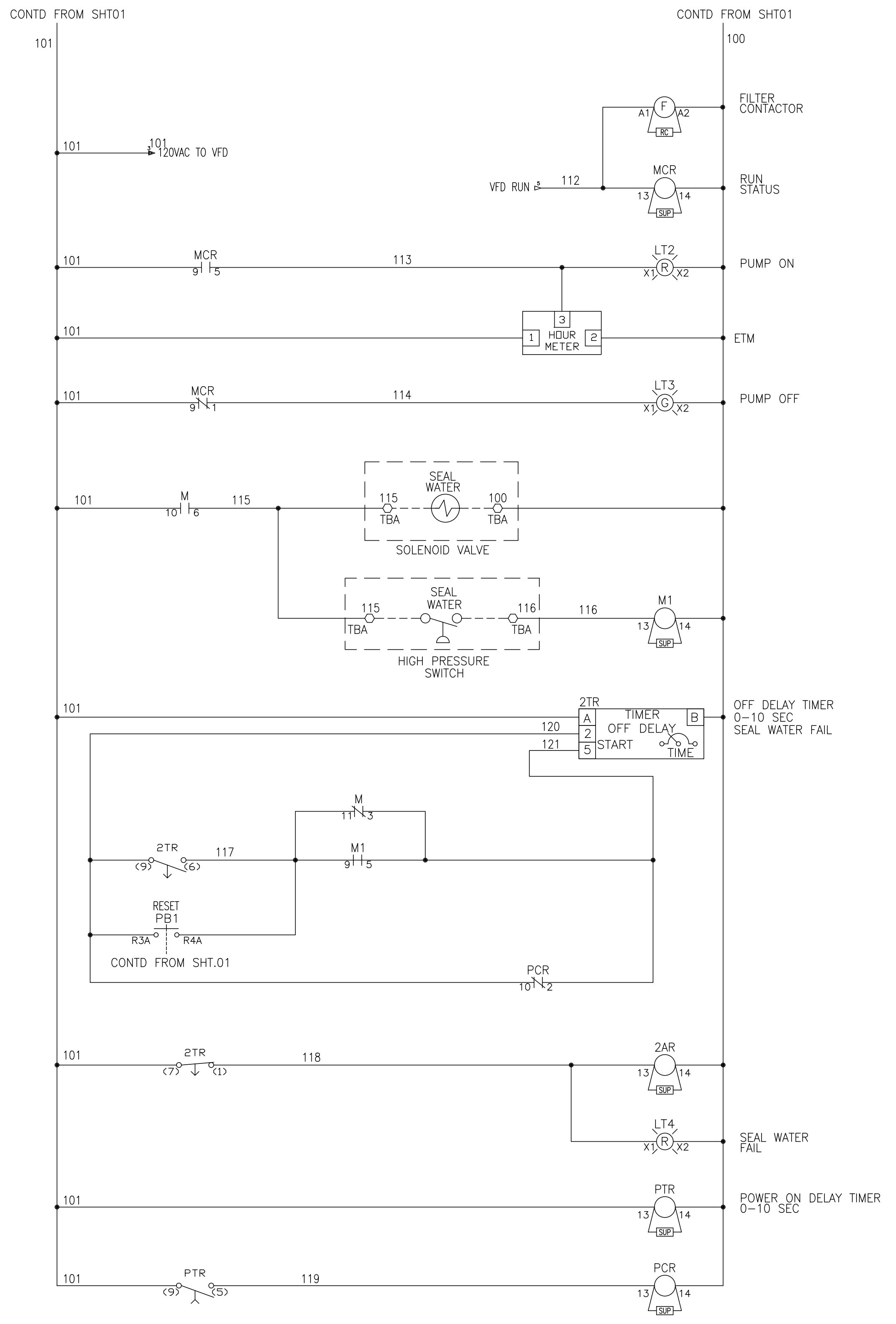
DR PNP DATE 11/09/22
CKD KD DATE 2/8/23
APPD DATE

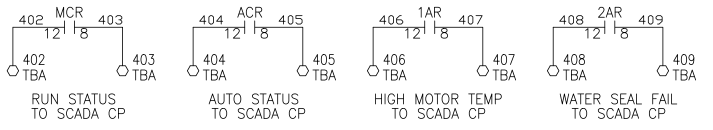
TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2300061
REVISION 02
G.O. NUMBER LBS0031682
DWG NO. ENG-090400-12543
SHEET 1 OF 2

468-1140
REV. 11/11





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EGF0404D2300D00000*-RSP-4113
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EGF0404D2300D00000*-RSP-4111

▲ SEE SHT.01

EATON

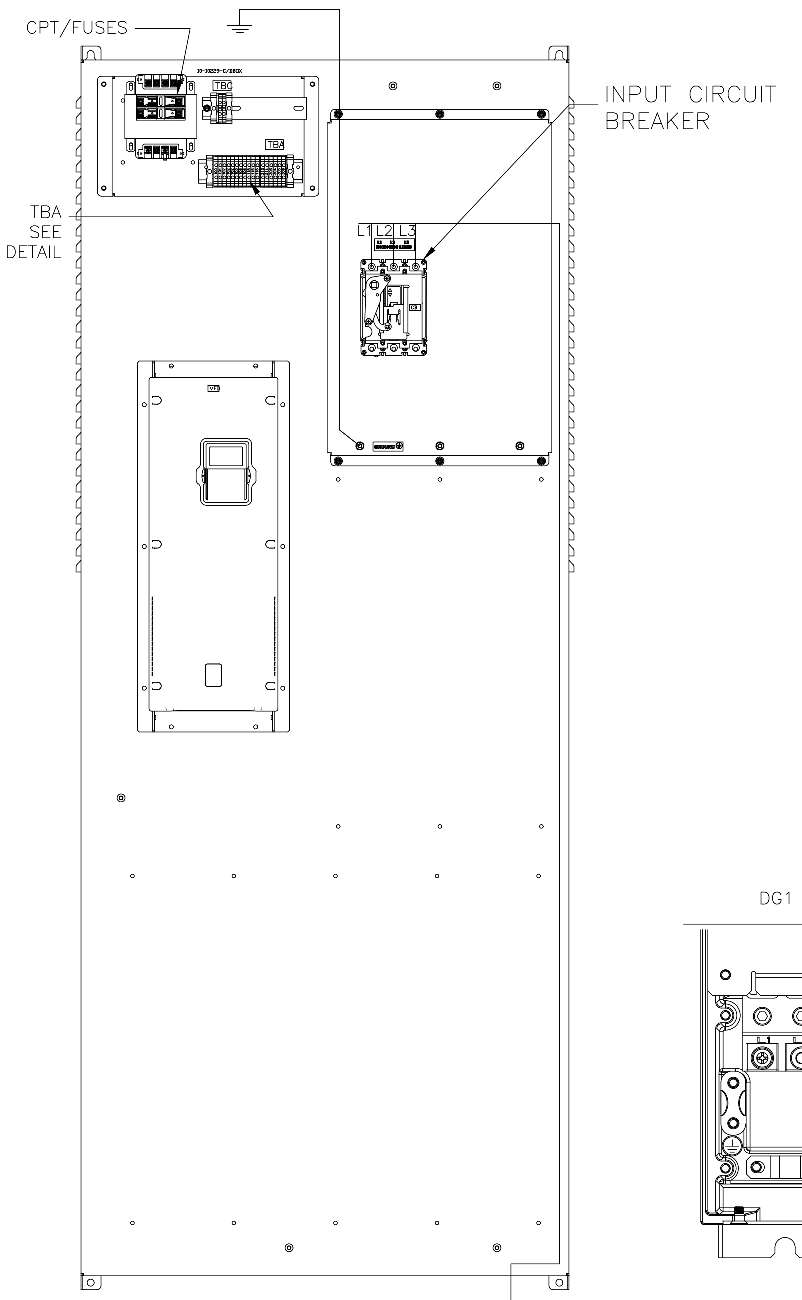
DR PNP DATE 11/09/22
CKD KD DATE 2/8/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

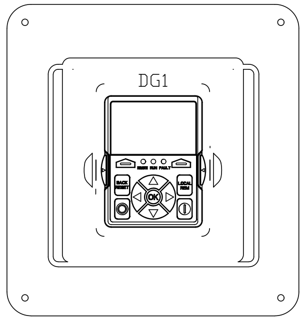
THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2300061
REVISION 02
G.O. NUMBER LBS0031682
DWG NO. ENG-090400-12543
SHEET 2 OF 2

468-1140
REV. 11/11

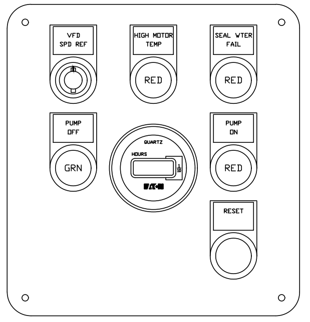


INCOMING POWER AND GROUND
SEE NAMEPLATE FOR RATINGS SEE NOTES

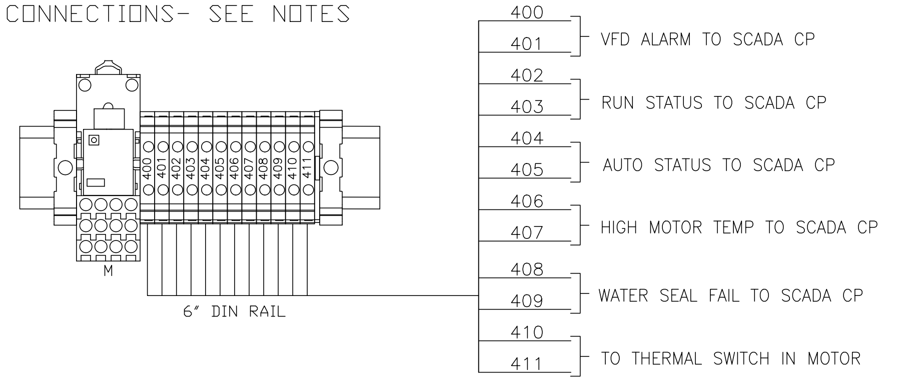
VFD KEYPAD
ON ENCLOSURE DOOR
10-10226-4211



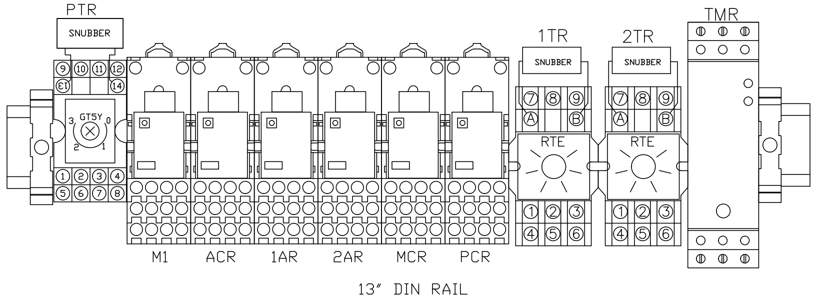
OPERATOR CONTROLS
ON ENCLOSURE DOOR

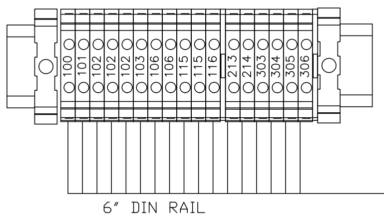


TBA FOR CUSTOMER CONTROL
CONNECTIONS- SEE NOTES



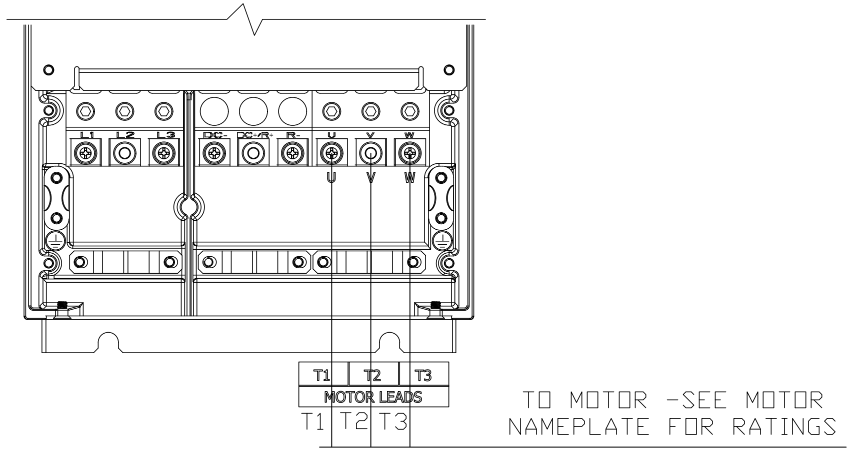
Terminals	Connection
400 401	VFD ALARM TO SCADA CP
402 403	RUN STATUS TO SCADA CP
404 405	AUTO STATUS TO SCADA CP
406 407	HIGH MOTOR TEMP TO SCADA CP
408 409	WATER SEAL FAIL TO SCADA CP
410 411	TO THERMAL SWITCH IN MOTOR





Terminals	Connection
100	SEAL WATER SOLENOID VALVE
101 102	TO REMOTE H-O-A
102	START FROM SCADA CP
102 103	REMOTE E-STOP
106	START FROM SCADA CP
106	TO REMOTE H-O-A
115	SEAL WATER SOLENOID VALVE
115 116	HIGH PRESSURE SWITCH
213 214	VFD EXTERNAL FAULT FACTORY JUMPERED
303 304	4-20mA SPEED CONTROL FROM SCADA CP
305 306	4-20mA SPEED INDICATION TO SCADA CP

DG1 FRAME 3 POWER CONNECTIONS



TO MOTOR -SEE MOTOR
NAMEPLATE FOR RATINGS

NOTES

1. SEE SCHEMATIC FOR DETAILS AND CONTROL LOGIC - FACTORY WIRING DETAILS OMITTED.
2. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGES AND CURRENT RATINGS.
3. ENCLOSURE MUST BE GROUNDED USING INPUT AND OUTPUT STUDS PROVIDED.
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5. USE MULTIPLE CONDUITS TO SEPARATE 120 CONTROL (TBA 101/102 & 106/104) WIRING FROM INCOMING POWER WIRING.
6. 4-20MA AUTO SPEED SIGNAL CONNECTIONS ARE MADE DIRECTLY TO VFD CONTROL MODULE.
7. DO NOT RUN LOGIC WIRES (TBA 213/214 VFD EXT FAULT) IN SAME CONDUIT AS 120V OR POWER WIRING.
8. REMOVAL OF INTERLOCKS (TBA 101/102,213/214) MAY NOT PREVENT MOTOR OPERATION IN ALL MODES-CONSULT FACTORY FOR DETAILS.

EGF0404D2300D00000*-RSP-4213
EGF0404D2300D00000*-RSP-4212
EGF0404D2300D00000*-RSP-4211
EGF0404D2300D00000*-RSP-4113
EGF0404D2300D00000*-RSP-4112
EGF0404D2300D00000*-RSP-4111

▲ 10/05/23; RELOCATED ETM
REV 4, KE

EATON

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONNECTION DIAGRAM

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2200787
REVISION 04
G.O. NUMBER LBS0031682
DWG NO. ENG-900500-12523
SHEET 1 OF 1

Master Document Index

Drives - Enclosed

Drives - Enclosed

	Drawing Description	Document Name	Rev
1	Master Drawing List	D00FTB6M01.DOC	4
2	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-000710-12410.DWG	02
3	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12543.DWG	03
4	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12543_SHT02.DWG	03
5	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-900500-12523.DWG	04

User **Karen** **Estrada**	**Date** **10/5/2023** **4:24:10 PM**	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.		Powering Business Worldwide
		D7580427X2K2		
		RSP-4212	**Construction Drawings**	
REVISION	DWG SIZE	G.O.	DWG	SHEET
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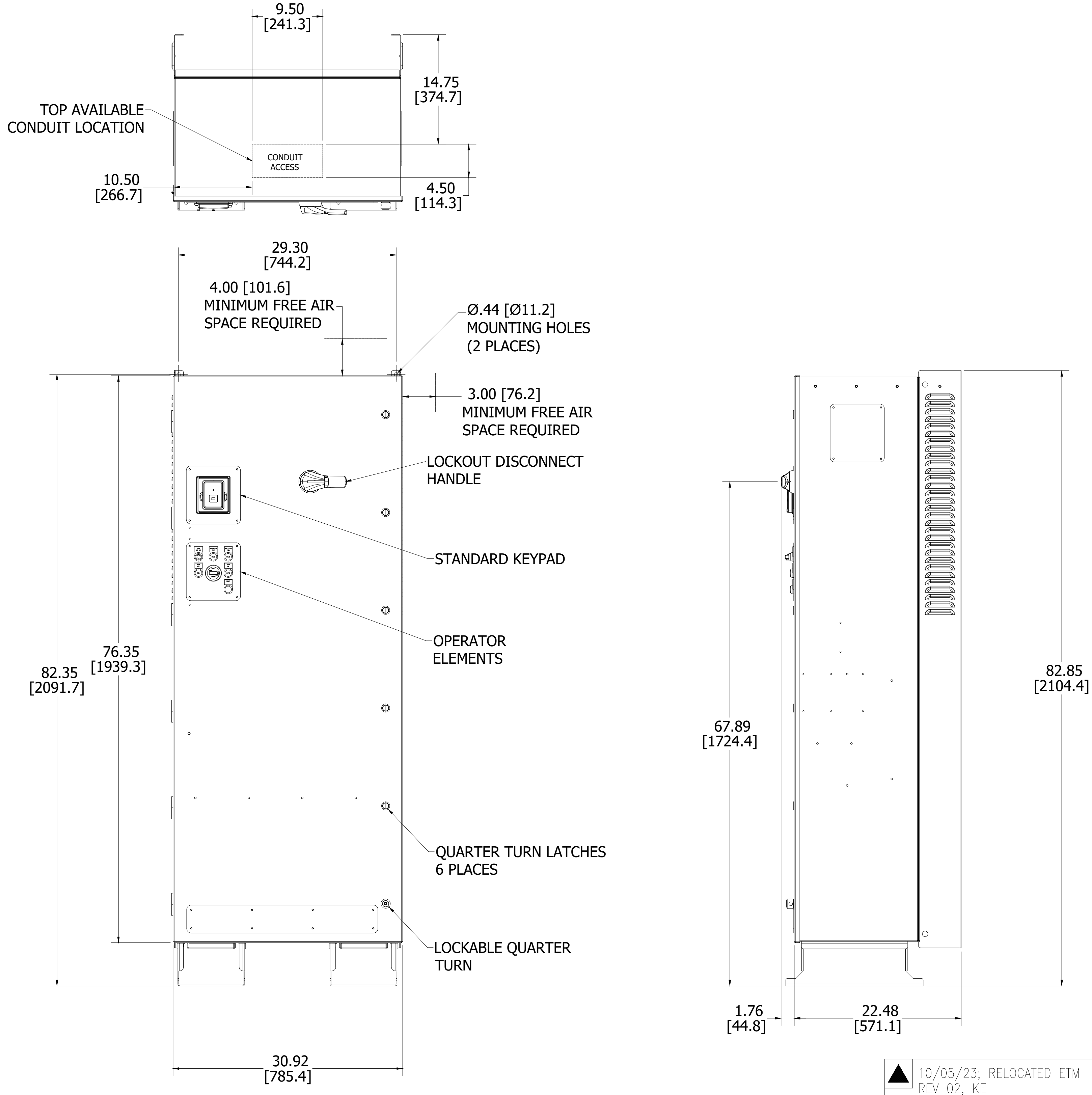
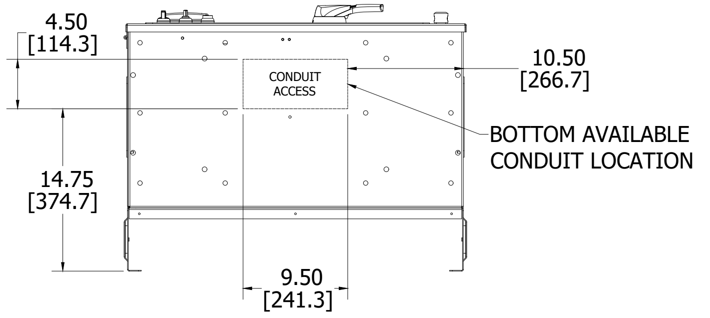
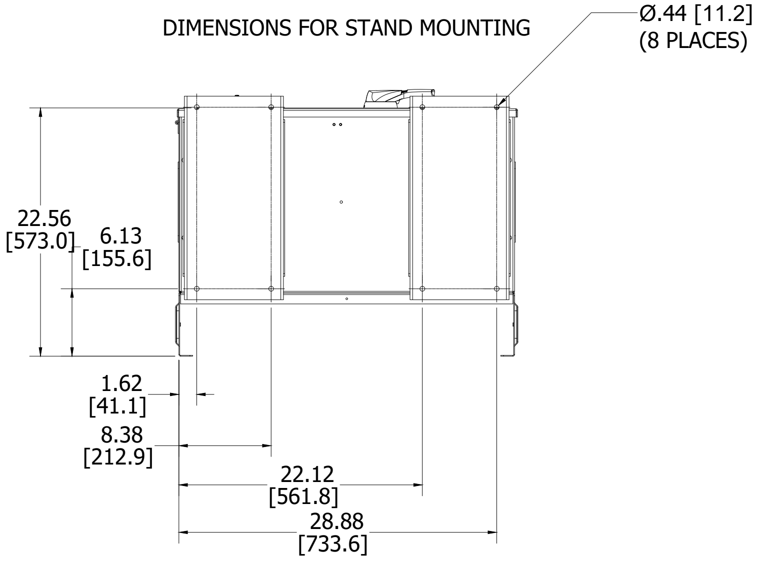


BOTTOM CONDUIT ACCESS LOCATION
SHOWN WITH FLOOR STANDS REMOVED



DIMENSIONS FOR STAND MOUNTING



NOTES:
FINISH: ENCLOSURE - ANSI 61 (LIGHT) GRAY.
WEIGHT: APPROXIMATELY 900 LBS. [408] KG.
MATERIAL: 14GA (0.0747) [1.90] CRS.
DIMENSIONS: INCHES, [MILLIMETERS].
CONSTRUCTION: NEMA TYPE 12 OVERSIZE

EGF0404D2300D00000*-RSP-4213
EGF0404D2300D00000*-RSP-4212
EGF0404D2300D00000*-RSP-4211
EGF0404D2300D00000*-RSP-4113
EGF0404D2300D00000*-RSP-4112
EGF0404D2300D00000*-RSP-4111

▲ 10/05/23; RELOCATED ETM
REV 02, KE

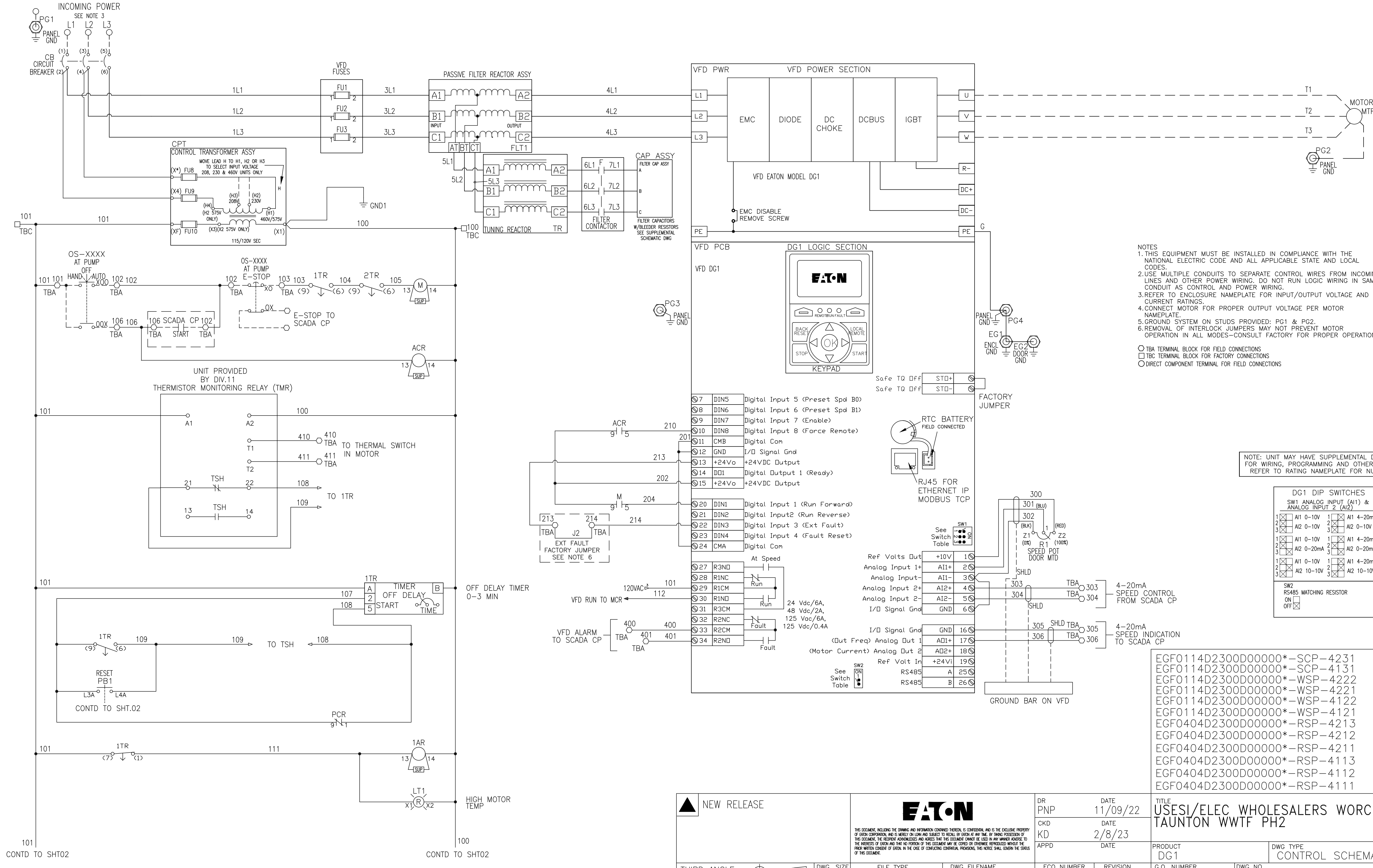
EATON

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE OUTLINE DIMENSION

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2200787
REVISION 02
G.O. NUMBER LBS0031682
DWG NO. ENG-000710-12410
SHEET 1 OF 1



NOTES
1. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL APPLICABLE STATE AND LOCAL CODES.
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3. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGE AND CURRENT RATINGS.
4. CONNECT MOTOR FOR PROPER OUTPUT VOLTAGE PER MOTOR NAMEPLATE.
5. GROUND SYSTEM ON STUDS PROVIDED: PG1 & PG2.
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⬡ TBA TERMINAL BLOCK FOR FIELD CONNECTIONS
☐ TBC TERMINAL BLOCK FOR FACTORY CONNECTIONS
○ DIRECT COMPONENT TERMINAL FOR FIELD CONNECTIONS

NOTE: UNIT MAY HAVE SUPPLEMENTAL DRAWINGS
FOR WIRING, PROGRAMMING AND OTHER DETAILS
REFER TO RATING NAMEPLATE FOR NUMBERS

DG1 DIP SWITCHES

SW1 ANALOG INPUT (AI1) & ANALOG INPUT 2 (AI2)

1 ☒☐ AI1 0-10V
2 ☒☐ AI2 0-10V
3 ☒☐

1 ☐☒ AI1 4-20mA
2 ☒☐ AI2 0-10V
3 ☒☐

1 ☒☐ AI1 0-10V
2 ☒☐ AI2 0-20mA
3 ☐☒

1 ☐☒ AI1 4-20mA
2 ☒☐ AI2 0-20mA
3 ☐☒

1 ☒☐ AI1 0-10V
2 ☐☒ AI2 10-10V
3 ☒☐

1 ☐☒ AI1 4-20mA
2 ☐☒ AI2 10-10V
3 ☒☐

SW2
RS485 MATCHING RESISTOR
ON ☐
OFF ☒

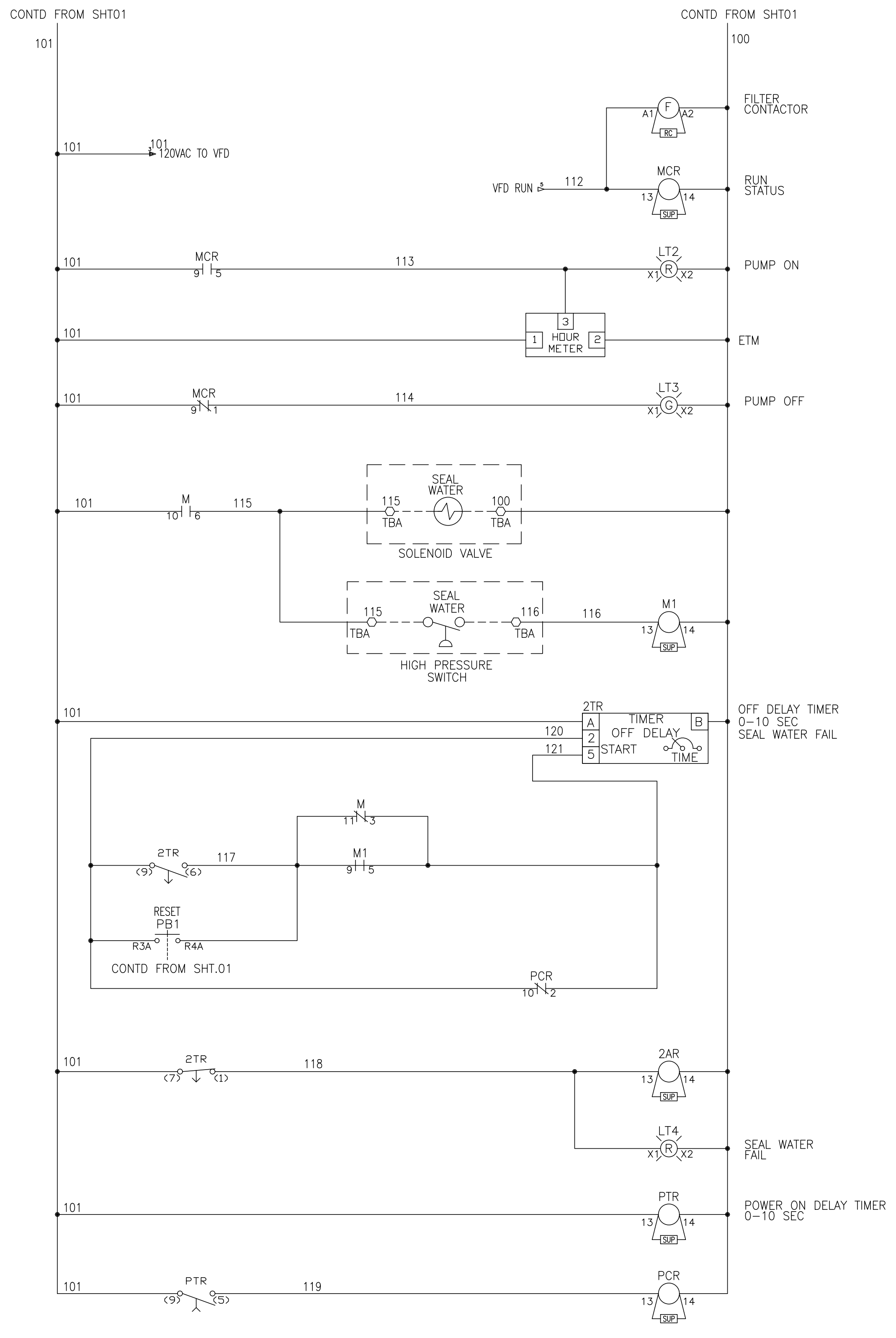
EGF0114D2300D00000*-SCP-4231
EGF0114D2300D00000*-SCP-4131
EGF0114D2300D00000*-WSP-4222
EGF0114D2300D00000*-WSP-4221
EGF0114D2300D00000*-WSP-4122
EGF0114D2300D00000*-WSP-4121
EGF0404D2300D00000*-RSP-4213
EGF0404D2300D00000*-RSP-4212
EGF0404D2300D00000*-RSP-4211
EGF0404D2300D00000*-RSP-4113
EGF0404D2300D00000*-RSP-4112
EGF0404D2300D00000*-RSP-4111

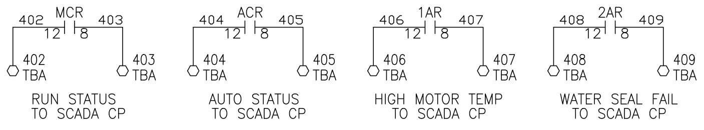
▲ NEW RELEASE

EATON

DR	DATE	TITLE
PNP	11/09/22	USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2
CKD	DATE	
KD	2/8/23	
APPD	DATE	PRODUCT DG1 — DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION	DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
	B	AutoCAD		2300061	02	LBS0031682	ENG-090400-12543	1 OF 2





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EGF0404D2300D00000*-RSP-4213
EGF0404D2300D00000*-RSP-4212
EGF0404D2300D00000*-RSP-4211
EGF0404D2300D00000*-RSP-4113
EGF0404D2300D00000*-RSP-4112
EGF0404D2300D00000*-RSP-4111

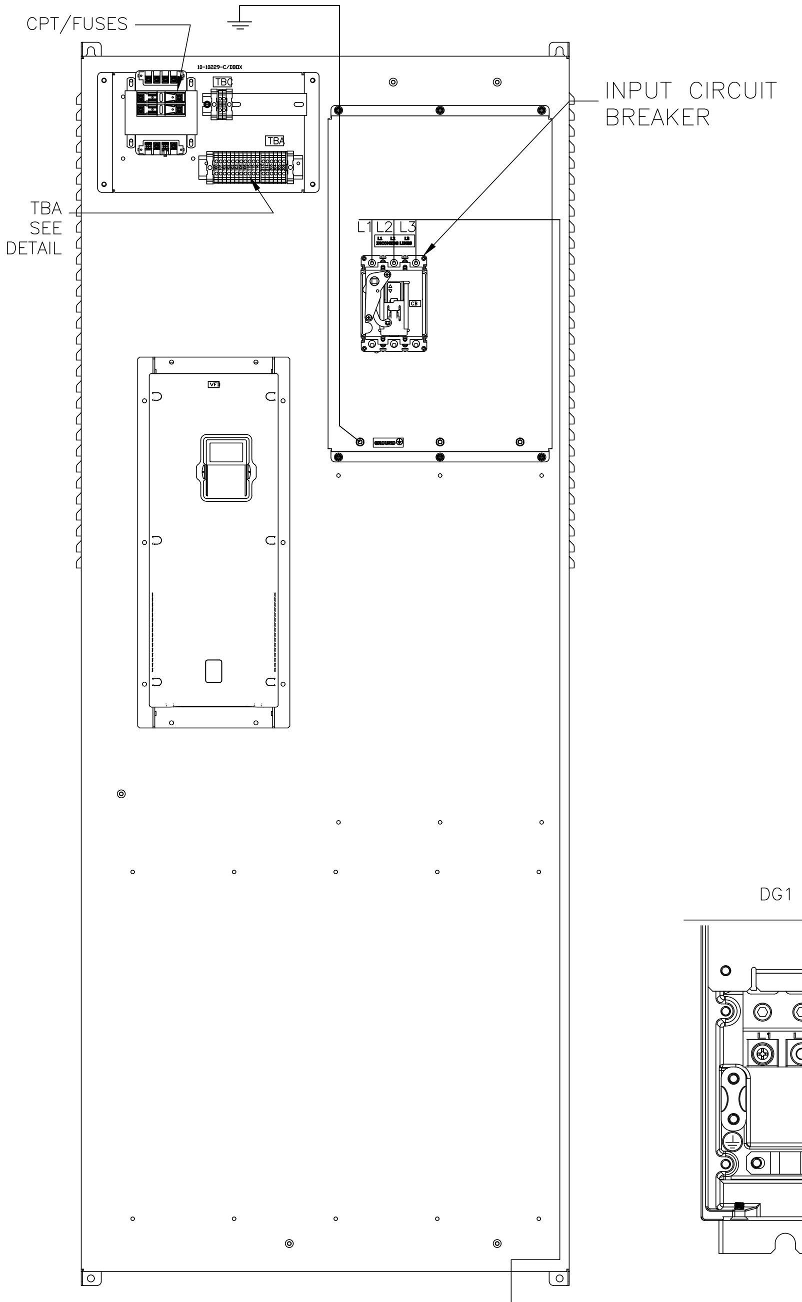
▲ SEE SHT.01

DR PNP DATE 11/09/22
CKD KD DATE 2/8/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

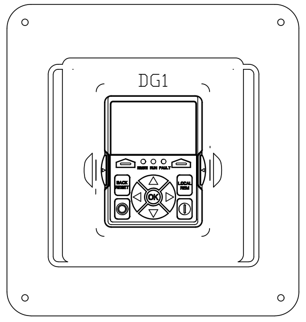
PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2300061
REVISION 02
G.O. NUMBER LBS0031682
DWG NO. ENG-090400-12543
SHEET 2 OF 2

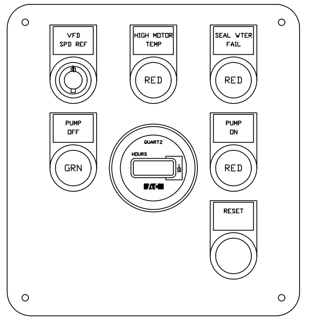


INCOMING POWER AND GROUND
SEE NAMEPLATE FOR RATINGS SEE NOTES

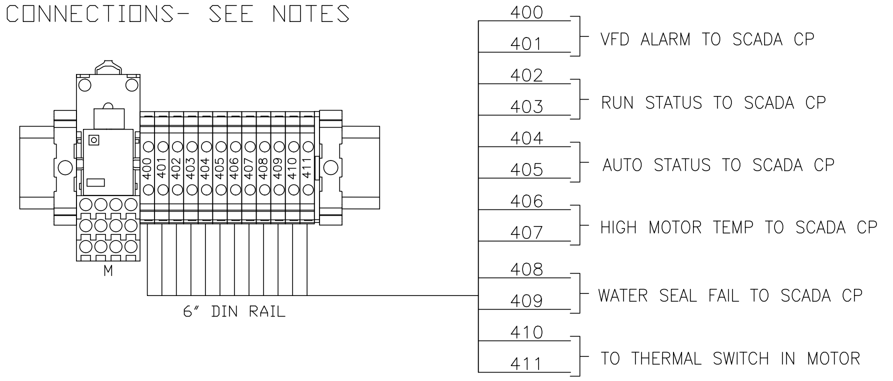
VFD KEYPAD
ON ENCLOSURE DOOR
10-10226-4211

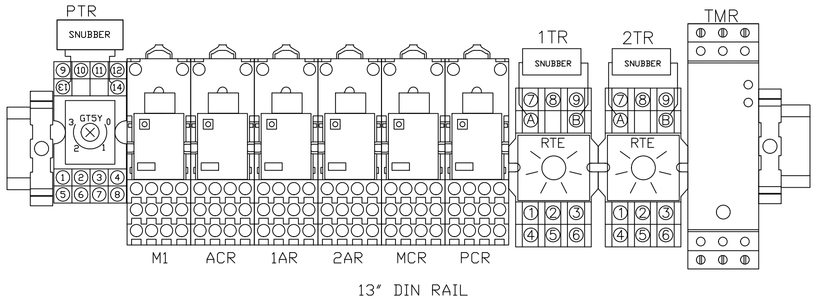


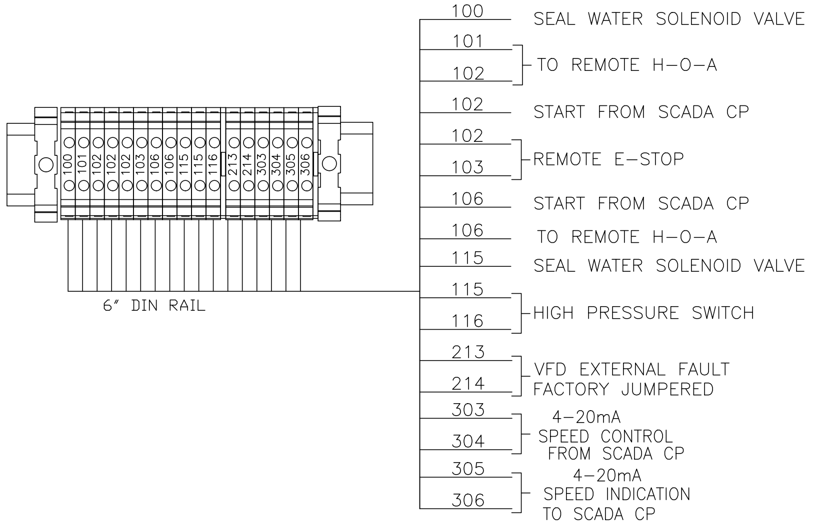
OPERATOR CONTROLS
ON ENCLOSURE DOOR



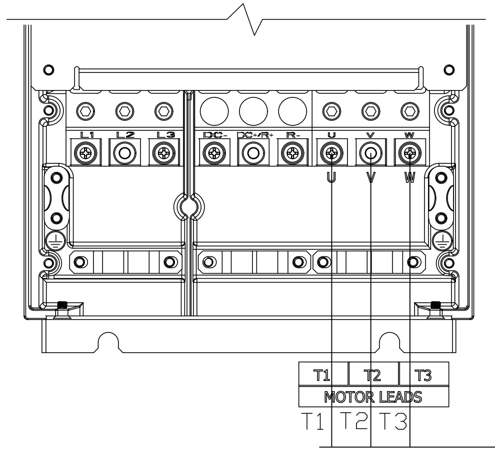
TBA FOR CUSTOMER CONTROL
CONNECTIONS- SEE NOTES







DG1 FRAME 3 POWER CONNECTIONS



TO MOTOR -SEE MOTOR
NAMEPLATE FOR RATINGS

NOTES

1. SEE SCHEMATIC FOR DETAILS AND CONTROL LOGIC - FACTORY WIRING DETAILS OMITTED.
2. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGES AND CURRENT RATINGS.
3. ENCLOSURE MUST BE GROUNDED USING INPUT AND OUTPUT STUDS PROVIDED.
4. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL STATE/LOCAL CODES.
5. USE MULTIPLE CONDUITS TO SEPARATE 120 CONTROL (TBA 101/102 & 106/104) WIRING FROM INCOMING POWER WIRING.
6. 4-20MA AUTO SPEED SIGNAL CONNECTIONS ARE MADE DIRECTLY TO VFD CONTROL MODULE.
7. DO NOT RUN LOGIC WIRES (TBA 213/214 VFD EXT FAULT) IN SAME CONDUIT AS 120V OR POWER WIRING.
8. REMOVAL OF INTERLOCKS (TBA 101/102,213/214) MAY NOT PREVENT MOTOR OPERATION IN ALL MODES-CONSULT FACTORY FOR DETAILS.

EGF0404D2300D00000*-RSP-4213
EGF0404D2300D00000*-RSP-4212
EGF0404D2300D00000*-RSP-4211
EGF0404D2300D00000*-RSP-4113
EGF0404D2300D00000*-RSP-4112
EGF0404D2300D00000*-RSP-4111

▲ 10/05/23; RELOCATED ETM
REV 4, KE

EATON

DR PNP	DATE 11/09/22	TITLE USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2	
CKD KD	DATE 1/11/23		
APPD	DATE	PRODUCT DG1	DWG TYPE CONNECTION DIAGRAM

THIRD ANGLE PROJECTION	DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
	B	AutoCAD		2200787	04	LBS0031682	ENG-900500-12523	1 OF 1

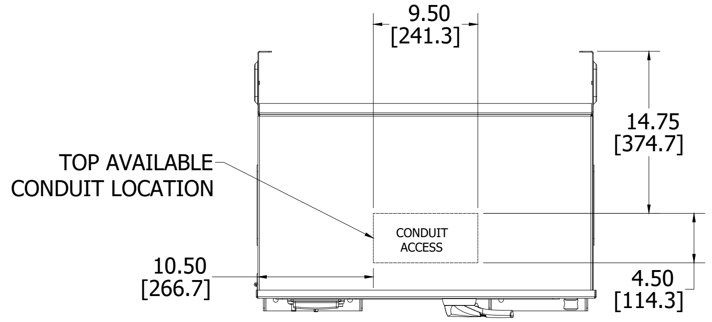
Master Document Index

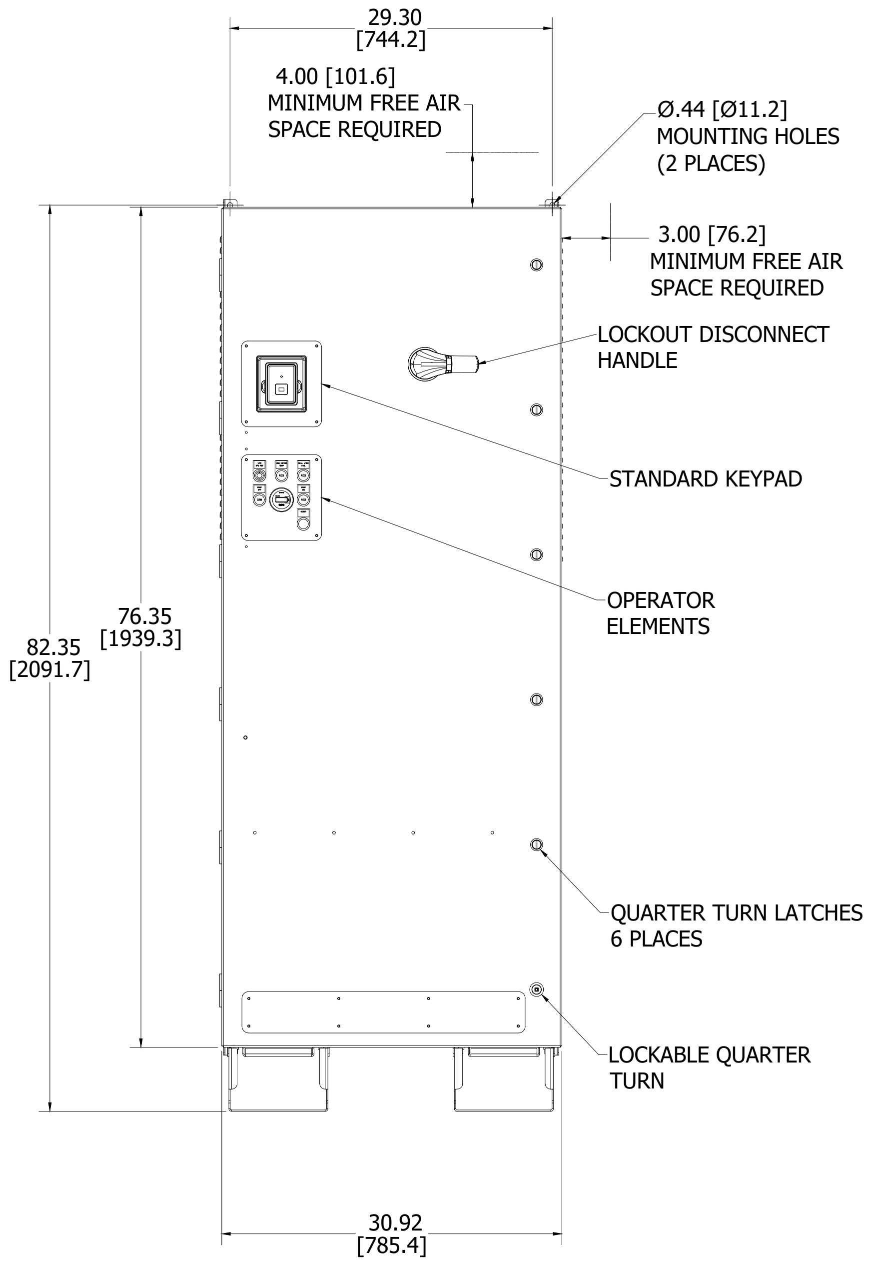
Drives - Enclosed

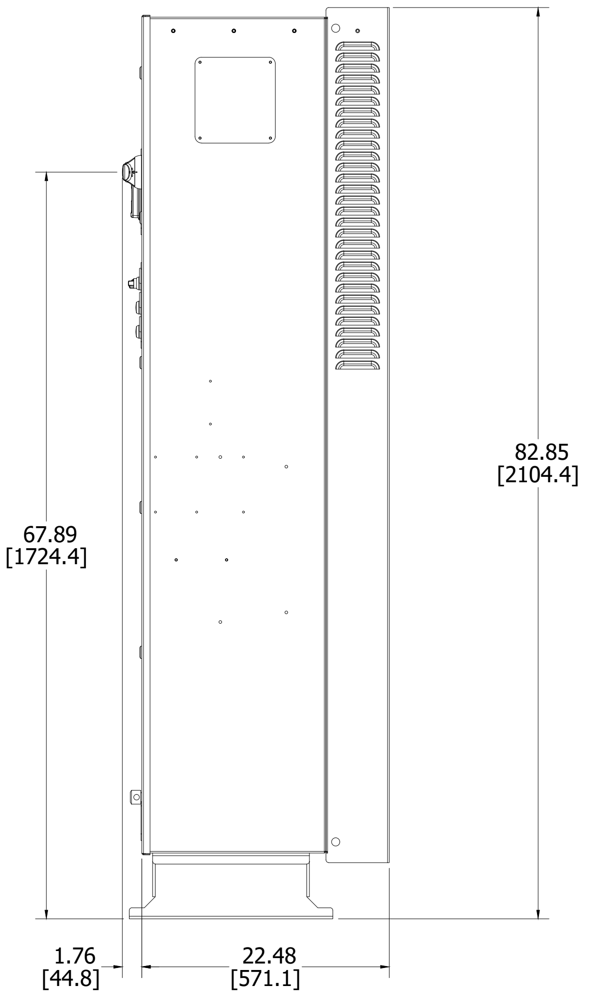
Drives - Enclosed

	Drawing Description	Document Name	Rev
1	Master Drawing List	D00FTB2M01.DOC	4
2	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-000710-12410.DWG	02
3	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12543.DWG	03
4	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12543_SHT02.DWG	03
5	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-900500-12523.DWG	04

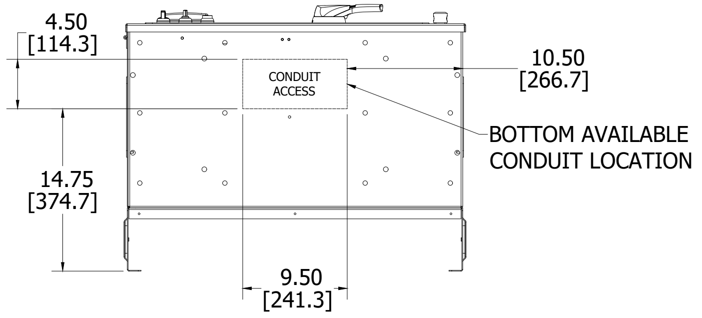
User **Karen Estrada**	**Date** **10/5/2023** **4:28:20 PM**	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.		EATON Powering Business Worldwide
		D7580427X2K2		
		RSP-4213	**Construction Drawings**	
REVISION	DWG SIZE	G.O.	DWG	SHEET
4	**A**	**LBS0031682-011**	**D00FTB2M01.DOC**	1 of 1



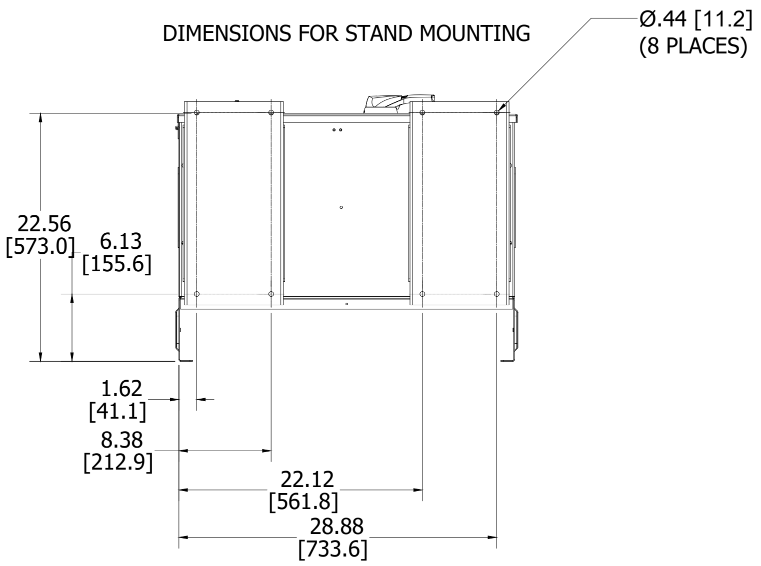




BOTTOM CONDUIT ACCESS LOCATION
SHOWN WITH FLOOR STANDS REMOVED



DIMENSIONS FOR STAND MOUNTING



NOTES:
FINISH: ENCLOSURE - ANSI 61 (LIGHT) GRAY.
WEIGHT: APPROXIMATELY 900 LBS. [408] KG.
MATERIAL: 14GA (0.0747) [1.90] CRS.
DIMENSIONS: INCHES, [MILLIMETERS].
CONSTRUCTION: NEMA TYPE 12 OVERSIZE

EGF0404D2300D00000*–RSP–4213
EGF0404D2300D00000*–RSP–4212
EGF0404D2300D00000*–RSP–4211
EGF0404D2300D00000*–RSP–4113
EGF0404D2300D00000*–RSP–4112
EGF0404D2300D00000*–RSP–4111

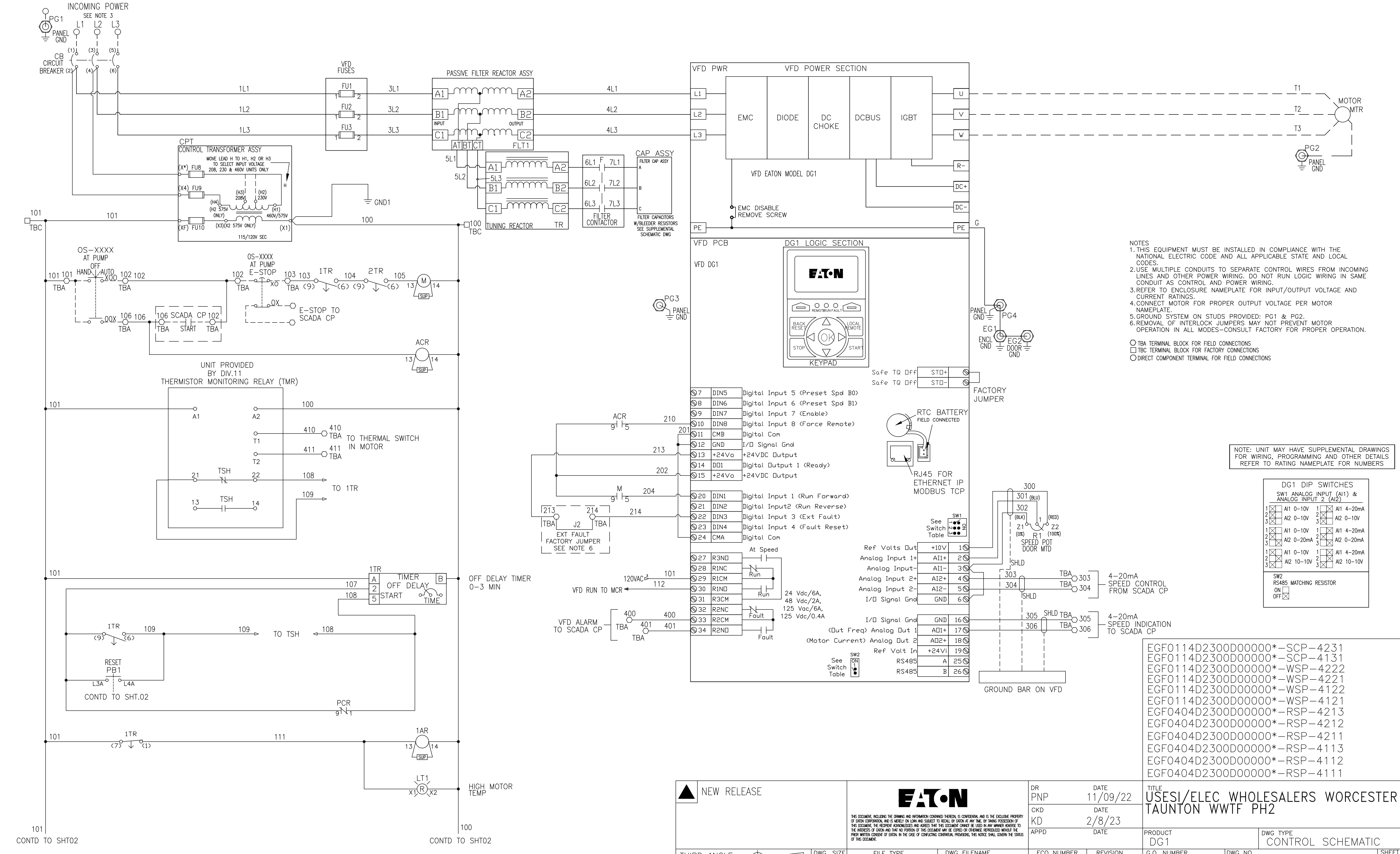
▲ 10/05/23; RELOCATED ETM
REV 02, KE

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE OUTLINE DIMENSION

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2200787
REVISION 02
G.O. NUMBER LBS0031682
DWG NO. ENG-000710-12410
SHEET 1 OF 1



NOTES
1. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL APPLICABLE STATE AND LOCAL CODES.
2. USE MULTIPLE CONDUITS TO SEPARATE CONTROL WIRES FROM INCOMING LINES AND OTHER POWER WIRING. DO NOT RUN LOGIC WIRING IN SAME CONDUIT AS CONTROL AND POWER WIRING.
3. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGE AND CURRENT RATINGS.
4. CONNECT MOTOR FOR PROPER OUTPUT VOLTAGE PER MOTOR NAMEPLATE.
5. GROUND SYSTEM ON STUDS PROVIDED: PG1 & PG2.
6. REMOVAL OF INTERLOCK JUMPERS MAY NOT PREVENT MOTOR OPERATION IN ALL MODES–CONSULT FACTORY FOR PROPER OPERATION.

⬡ TBA TERMINAL BLOCK FOR FIELD CONNECTIONS
☐ TBC TERMINAL BLOCK FOR FACTORY CONNECTIONS
○ DIRECT COMPONENT TERMINAL FOR FIELD CONNECTIONS

NOTE: UNIT MAY HAVE SUPPLEMENTAL DRAWINGS FOR WIRING, PROGRAMMING AND OTHER DETAILS REFER TO RATING NAMEPLATE FOR NUMBERS

DG1 DIP SWITCHES

SW1 ANALOG INPUT (AI1) & ANALOG INPUT 2 (AI2)

Switch	Setting	Switch	Setting
1 ☒☐ 2 ☒☐ 3 ☒☐	AI1 0–10V AI2 0–10V	1 ☐☒ 2 ☒☐ 3 ☒☐	AI1 4–20mA AI2 0–10V
1 ☒☐ 2 ☒☐ 3 ☐☒	AI1 0–10V AI2 0–20mA	1 ☐☒ 2 ☒☐ 3 ☐☒	AI1 4–20mA AI2 0–20mA
1 ☒☐ 2 ☐☒ 3 ☒☐	AI1 0–10V AI2 10–10V	1 ☐☒ 2 ☐☒ 3 ☒☐	AI1 4–20mA AI2 10–10V

SW2
RS485 MATCHING RESISTOR
ON ☐
OFF ☒

EGF0114D2300D00000*–SCP–4231
EGF0114D2300D00000*–SCP–4131
EGF0114D2300D00000*–WSP–4222
EGF0114D2300D00000*–WSP–4221
EGF0114D2300D00000*–WSP–4122
EGF0114D2300D00000*–WSP–4121
EGF0404D2300D00000*–RSP–4213
EGF0404D2300D00000*–RSP–4212
EGF0404D2300D00000*–RSP–4211
EGF0404D2300D00000*–RSP–4113
EGF0404D2300D00000*–RSP–4112
EGF0404D2300D00000*–RSP–4111

▲ NEW RELEASE

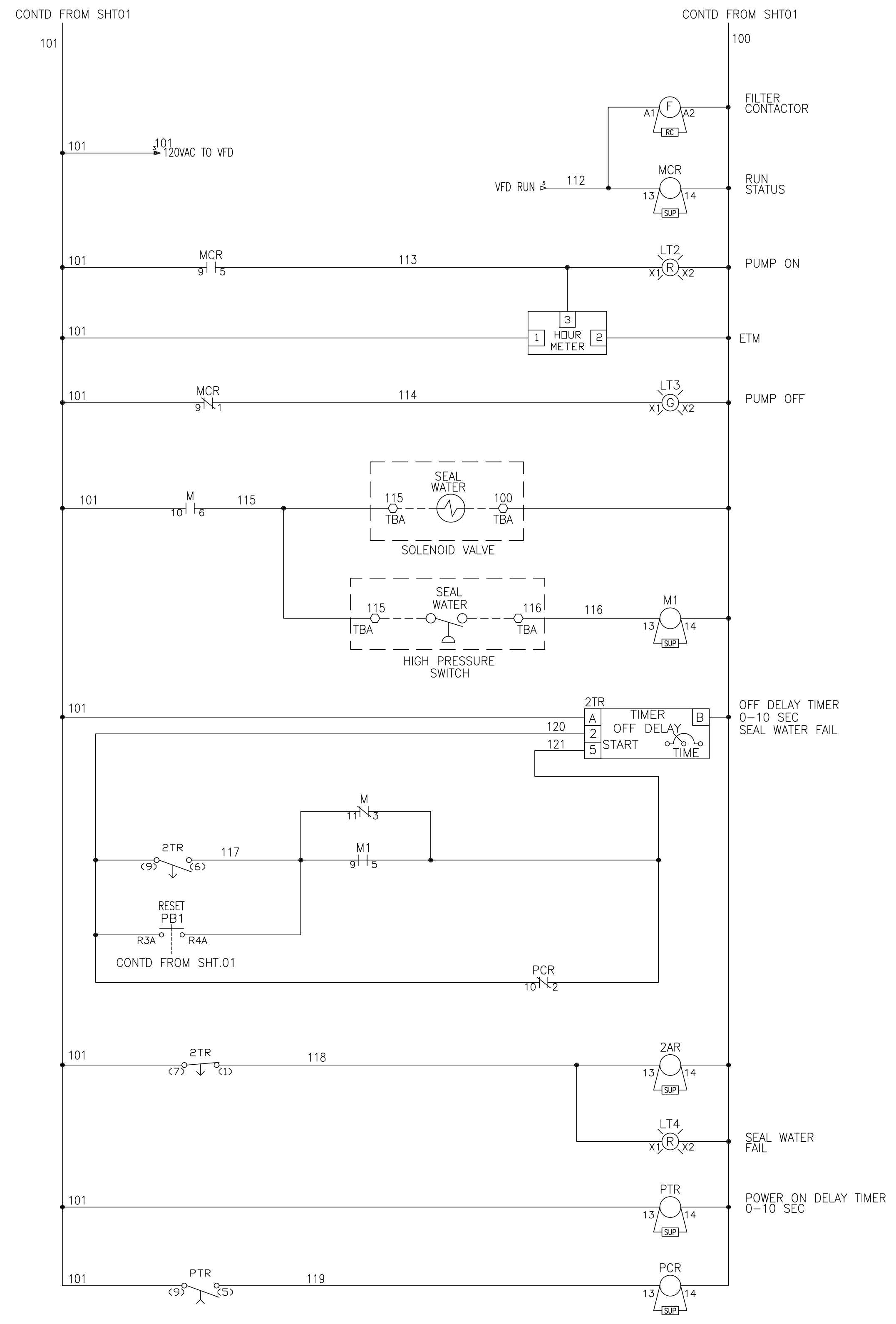
EATON

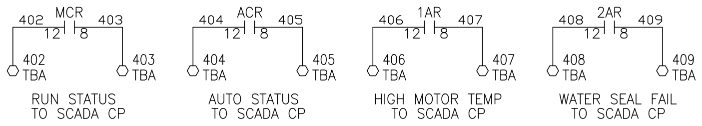
DR PNP DATE 11/09/22
CKD KD DATE 2/8/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2300061
REVISION 02
G.O. NUMBER LBS0031682
DWG NO. ENG-090400-12543
SHEET 1 OF 2





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EGF0114D2300D00000*-WSP-4122
EGF0114D2300D00000*-WSP-4121
EGF0404D2300D00000*-RSP-4213
EGF0404D2300D00000*-RSP-4212
EGF0404D2300D00000*-RSP-4211
EGF0404D2300D00000*-RSP-4113
EGF0404D2300D00000*-RSP-4112
EGF0404D2300D00000*-RSP-4111

▲ SEE SHT.01

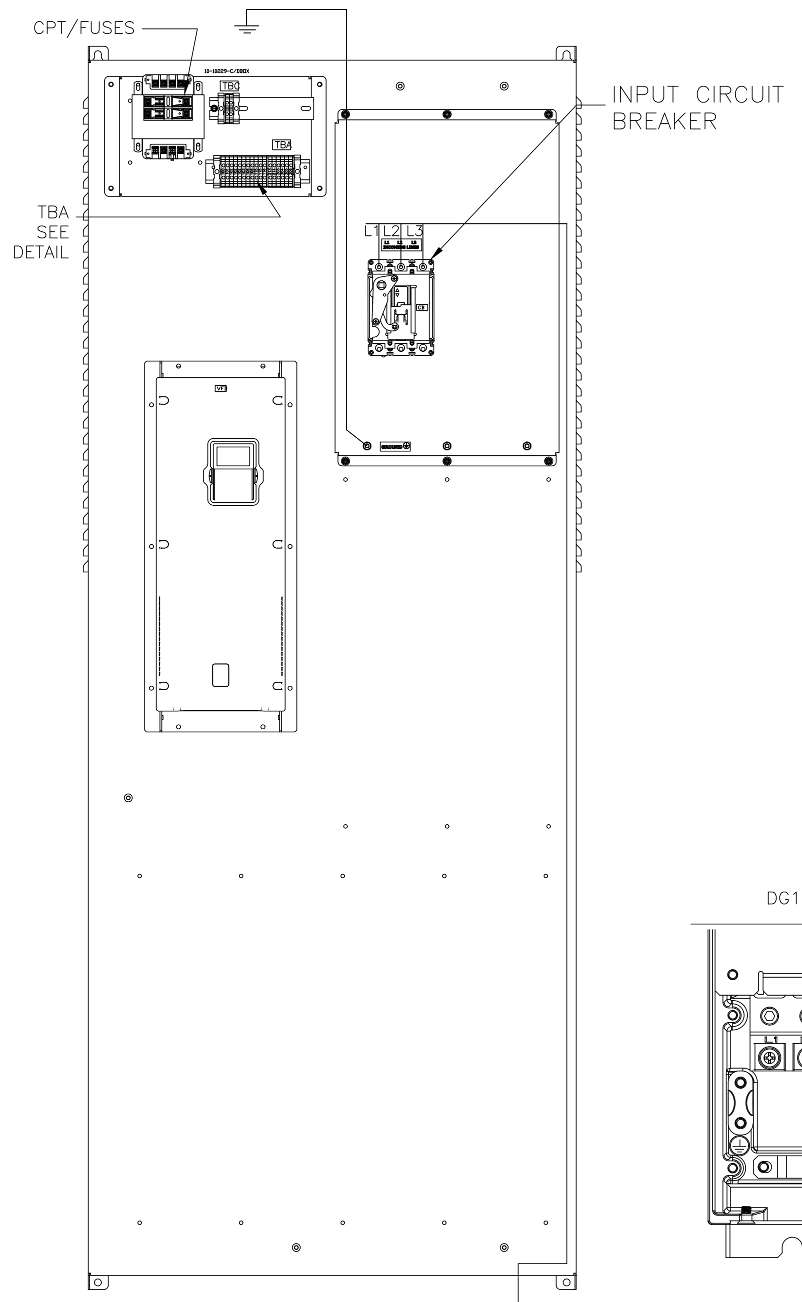
EATON

DR PNP
DATE 11/09/22
CKD KD
DATE 2/8/23
APPD
DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

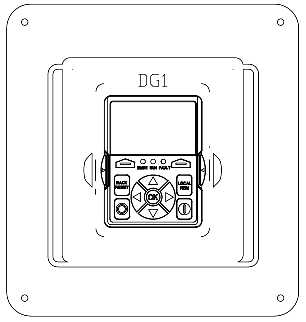
PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2300061
REVISION 02
G.O. NUMBER LBS0031682
DWG NO. ENG-090400-12543
SHEET 2 OF 2

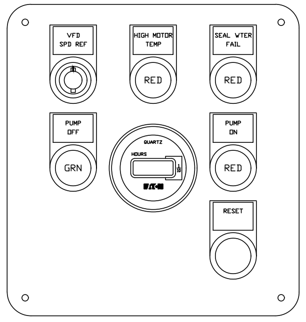


INCOMING POWER AND GROUND
SEE NAMEPLATE FOR RATINGS SEE NOTES

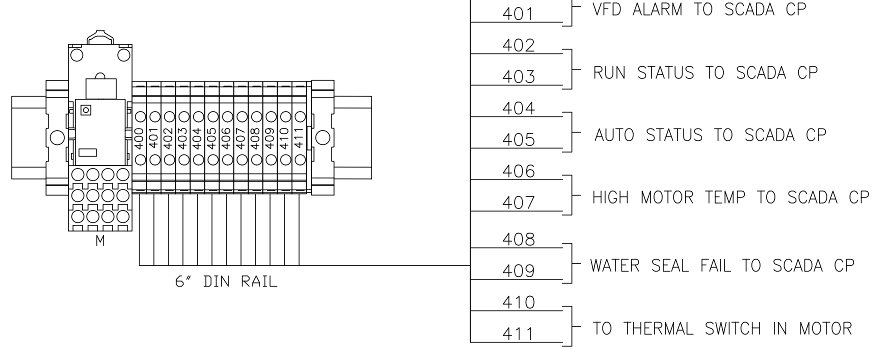
VFD KEYPAD
ON ENCLOSURE DOOR
10-10226-4211

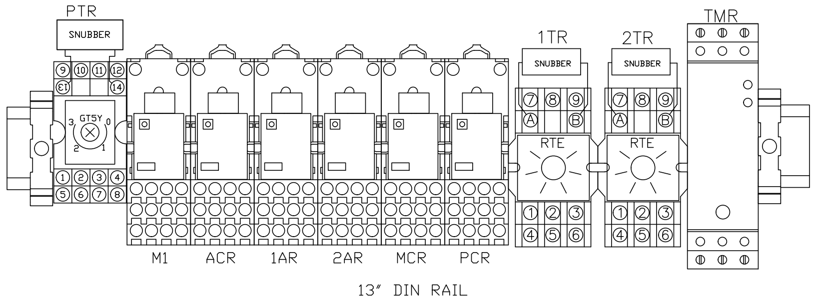


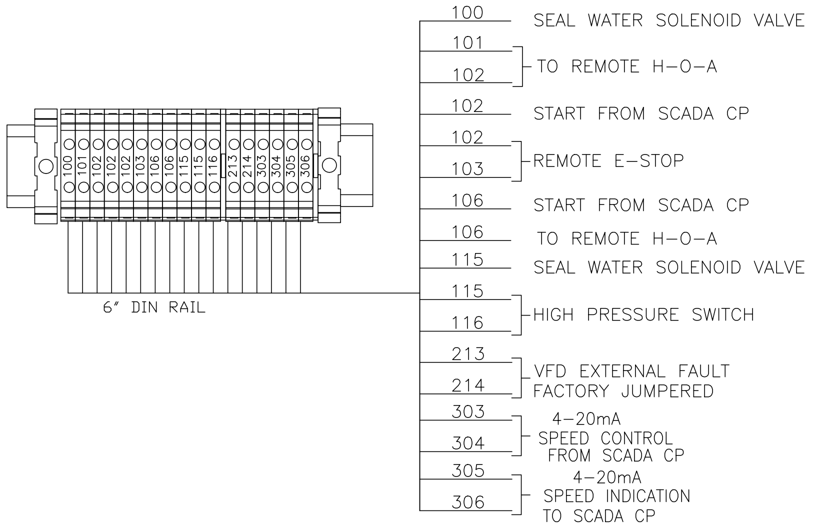
OPERATOR CONTROLS
ON ENCLOSURE DOOR

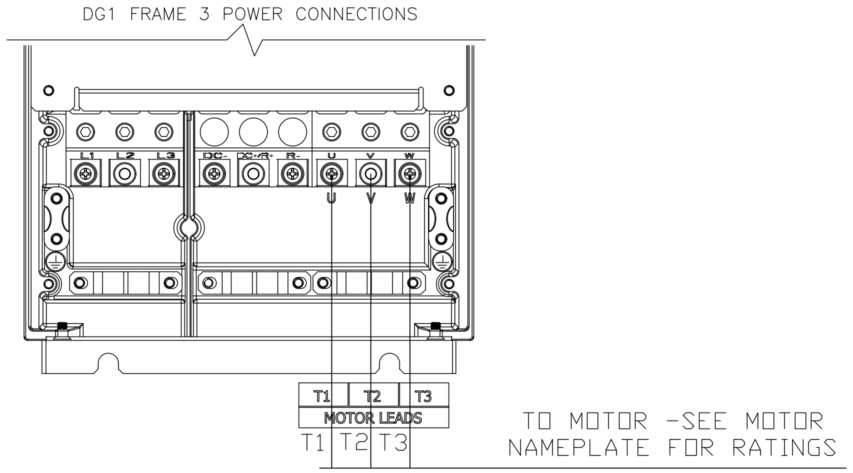


TBA FOR CUSTOMER CONTROL
CONNECTIONS- SEE NOTES









NOTES

1. SEE SCHEMATIC FOR DETAILS AND CONTROL LOGIC – FACTORY WIRING DETAILS OMITTED.
2. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGES AND CURRENT RATINGS.
3. ENCLOSURE MUST BE GROUNDED USING INPUT AND OUTPUT STUDS PROVIDED.
4. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL STATE/LOCAL CODES.
5. USE MULTIPLE CONDUITS TO SEPARATE 120 CONTROL (TBA 101/102 & 106/104) WIRING FROM INCOMING POWER WIRING.
6. 4-20MA AUTO SPEED SIGNAL CONNECTIONS ARE MADE DIRECTLY TO VFD CONTROL MODULE.
7. DO NOT RUN LOGIC WIRES (TBA 213/214 VFD EXT FAULT) IN SAME CONDUIT AS 120V OR POWER WIRING.
8. REMOVAL OF INTERLOCKS (TBA 101/102,213/214) MAY NOT PREVENT MOTOR OPERATION IN ALL MODES– CONSULT FACTORY FOR DETAILS.

EGF0404D2300D00000*–RSP–4213
EGF0404D2300D00000*–RSP–4212
EGF0404D2300D00000*–RSP–4211
EGF0404D2300D00000*–RSP–4113
EGF0404D2300D00000*–RSP–4112
EGF0404D2300D00000*–RSP–4111

▲ 10/05/23; RELOCATED ETM
REV 4, KE

EATON

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONNECTION DIAGRAM

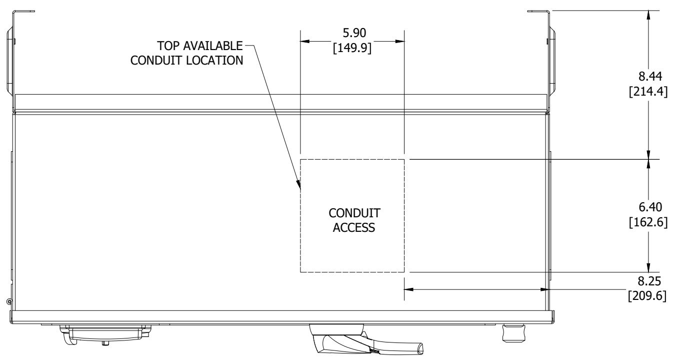
THIRD ANGLE PROJECTION	DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
	B	AutoCAD		2200787	04	LBS0031682	ENG-900500-12523	1 OF 1

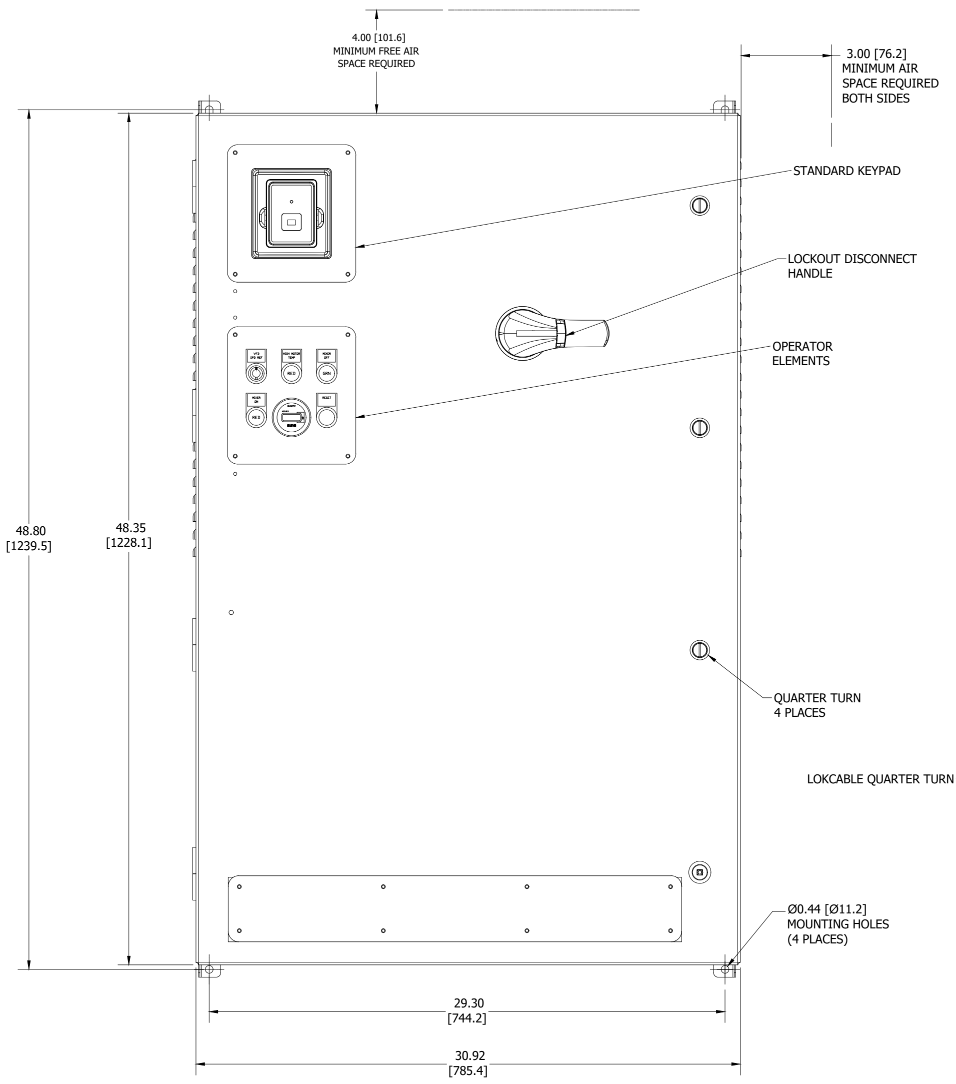
Master Document Index

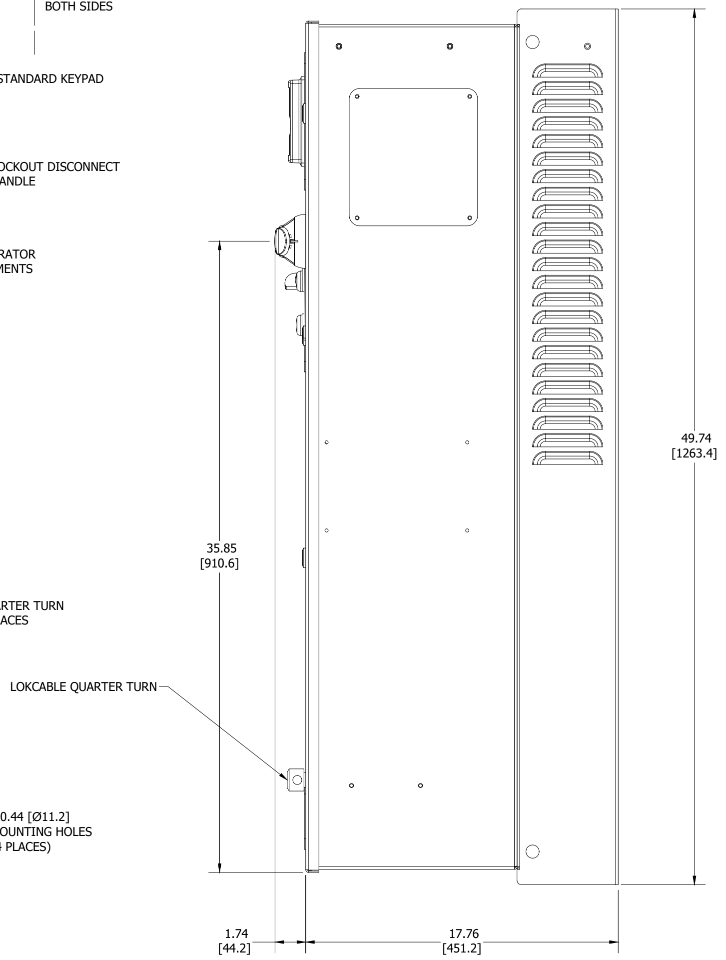
Drives - Enclosed
Drives - Enclosed

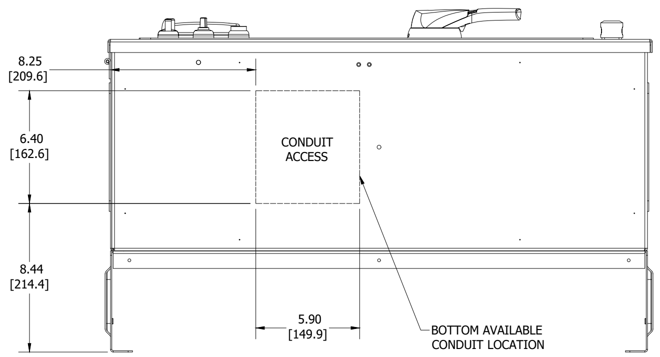
	Drawing Description	Document Name	Rev
1	Master Drawing List	D00FTB8M01.DOC	4
2	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-000710-12459.DWG	01
3	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12544.DWG	03
4	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12544_SHT02.DWG	03
5	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-900500-12571.DWG	01

User **Karen** **Estrada**	**Date** **10/5/2023** **4:22:31 PM**	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.		EATON Powering Business Worldwide
		D7580427X2K2		
		RAM-3141	**Construction Drawings**	
REVISION	DWG SIZE	G.O.	DWG	SHEET
4	**A**	**LBS0031682-012**	**D00FTB8M01.DOC**	1 of 1









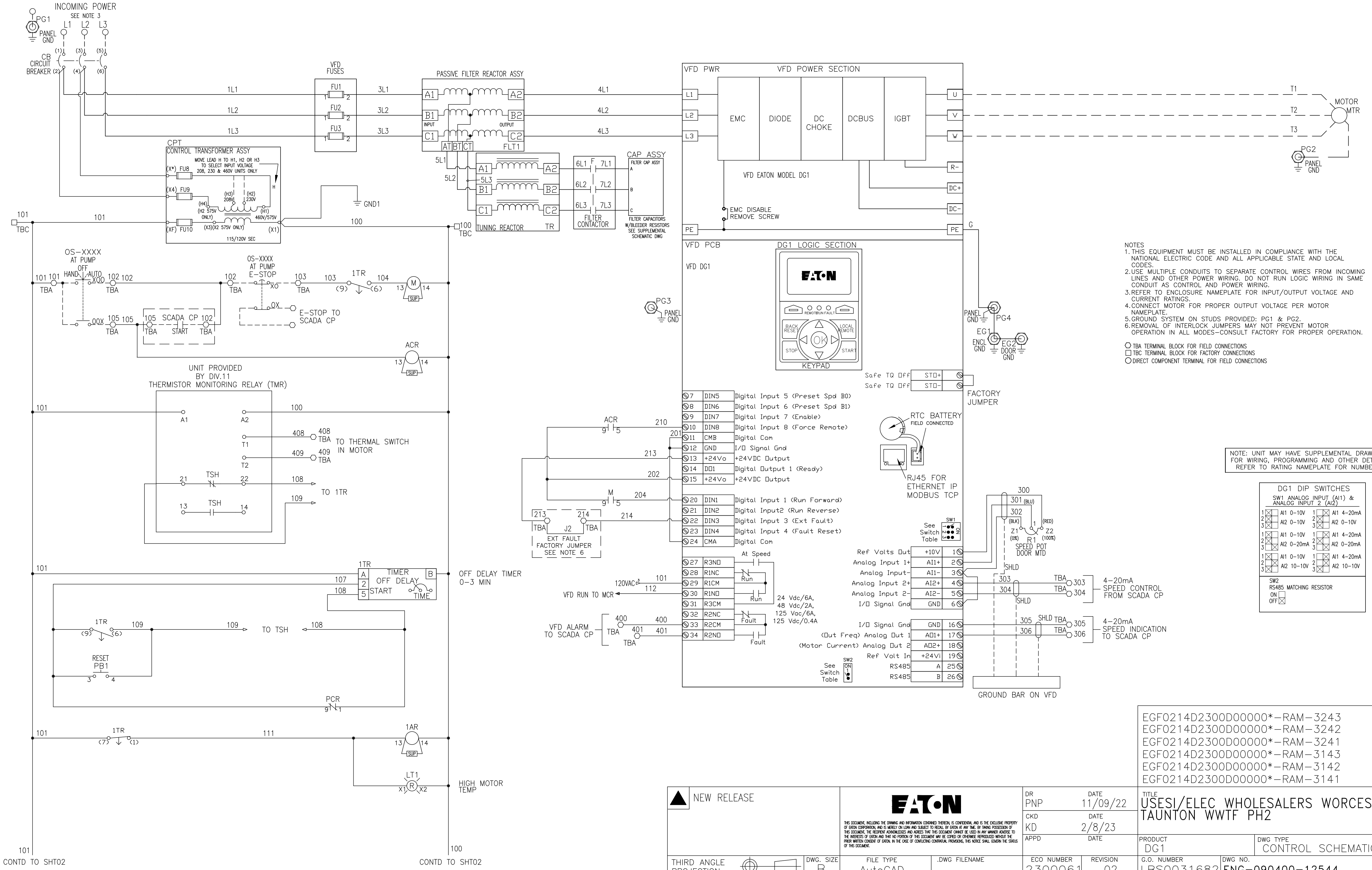
NOTES:
FINISH: ENCLOSURE - ANSI 61 (LIGHT) GRAY.
WEIGHT: APPROXIMATELY 350 LBS. [158] KG. 400 LBS [181] KG WITH STANDS.
MATERIAL: 14GA (0.0747) [1.90] CRS.
DIMENSIONS: INCHES, [MILLIMETERS].
CONSTRUCTION: NEMA TYPE 12 OVERSIZE

EGF0214D2300D00000*–RAM–3243
EGF0214D2300D00000*–RAM–3242
EGF0214D2300D00000*–RAM–3241
EGF0214D2300D00000*–RAM–3143
EGF0214D2300D00000*–RAM–3142
EGF0214D2300D00000*–RAM–3141

▲ NEW RELEASE

EATON

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE
TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2
PRODUCT DG1
DWG TYPE OUTLINE DIMENSION
THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2200787
REVISION 01
G.O. NUMBER LBS0031682
DWG NO. ENG–000710–12459
SHEET 1 OF 1



NOTES
1. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL APPLICABLE STATE AND LOCAL CODES.
2. USE MULTIPLE CONDUITS TO SEPARATE CONTROL WIRES FROM INCOMING LINES AND OTHER POWER WIRING. DO NOT RUN LOGIC WIRING IN SAME CONDUIT AS CONTROL AND POWER WIRING.
3. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGE AND CURRENT RATINGS.
4. CONNECT MOTOR FOR PROPER OUTPUT VOLTAGE PER MOTOR NAMEPLATE.
5. GROUND SYSTEM ON STUDS PROVIDED: PG1 & PG2.
6. REMOVAL OF INTERLOCK JUMPERS MAY NOT PREVENT MOTOR OPERATION IN ALL MODES—CONSULT FACTORY FOR PROPER OPERATION.

⬡ TBA TERMINAL BLOCK FOR FIELD CONNECTIONS
☐ TBC TERMINAL BLOCK FOR FACTORY CONNECTIONS
○ DIRECT COMPONENT TERMINAL FOR FIELD CONNECTIONS

NOTE: UNIT MAY HAVE SUPPLEMENTAL DRAWINGS FOR WIRING, PROGRAMMING AND OTHER DETAILS REFER TO RATING NAMEPLATE FOR NUMBERS

DG1 DIP SWITCHES

SW1 ANALOG INPUT (AI1) & ANALOG INPUT 2 (AI2)

1	☒	☐	AI1 0-10V	1	☐	☒	AI1 4-20mA
2	☒	☐	AI2 0-10V	2	☒	☐	AI2 0-10V
3	☒	☐		3	☒	☐	
1	☒	☐	AI1 0-10V	1	☐	☒	AI1 4-20mA
2	☒	☐	AI2 0-20mA	2	☒	☐	AI2 0-20mA
3	☐	☒		3	☐	☒	
1	☒	☐	AI1 0-10V	1	☐	☒	AI1 4-20mA
2	☐	☒	AI2 10-10V	2	☐	☒	AI2 10-10V
3	☒	☐		3	☒	☐	

SW2
RS485 MATCHING RESISTOR
ON ☐
OFF ☒

EGF0214D2300D00000*-RAM-3243
EGF0214D2300D00000*-RAM-3242
EGF0214D2300D00000*-RAM-3241
EGF0214D2300D00000*-RAM-3143
EGF0214D2300D00000*-RAM-3142
EGF0214D2300D00000*-RAM-3141

▲ NEW RELEASE

EATON

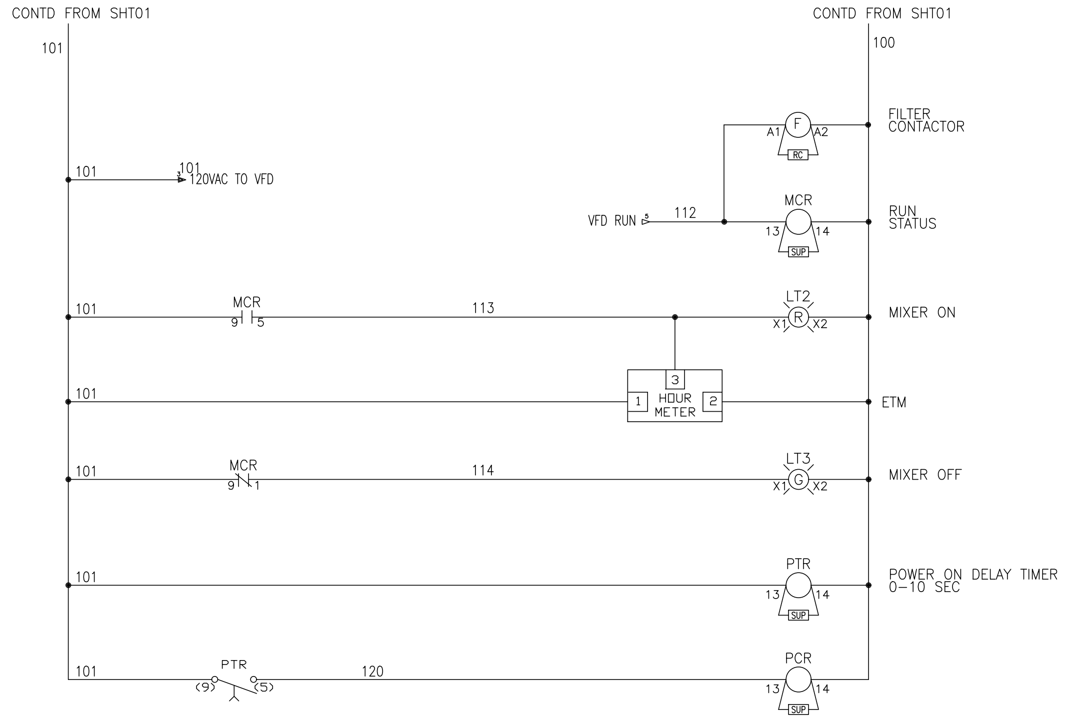
DR PNP DATE 11/09/22
CKD KD DATE 2/8/23
APPD DATE

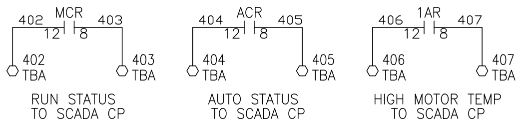
TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2300061
REVISION 02
G.O. NUMBER LBS0031682
DWG NO. ENG-090400-12544
SHEET 1 OF 2

468-1140
REV. 11/11





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EGF0214D2300D00000*–RAM–3143
EGF0214D2300D00000*–RAM–3142
EGF0214D2300D00000*–RAM–3141

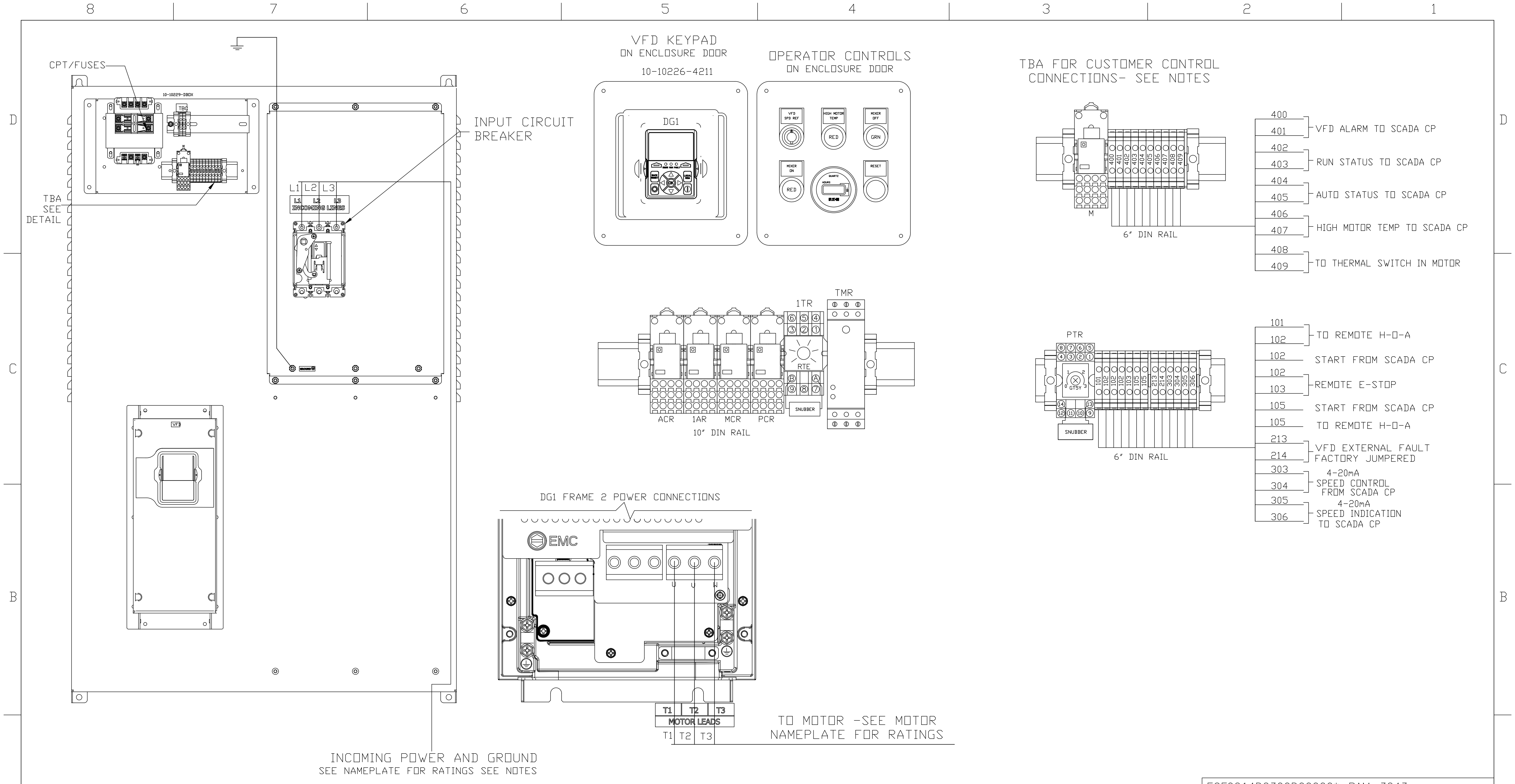
▲ SEE SHT.01

DR PNP DATE 11/09/22
CKD KD DATE 2/8/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2300061
REVISION 02
G.O. NUMBER LBS0031682
DWG NO. ENG–090400–12544
SHEET 2 OF 2



NOTES

1. SEE SCHEMATIC FOR DETAILS AND CONTROL LOGIC - FACTORY WIRING DETAILS OMITTED.
2. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGES AND CURRENT RATINGS.
3. ENCLOSURE MUST BE GROUNDED USING INPUT AND OUTPUT STUDS PROVIDED.
4. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL STATE/LOCAL CODES.
5. USE MULTIPLE CONDUITS TO SEPARATE 120 CONTROL (TBA 101/102 & 106/104) WIRING FROM INCOMING POWER WIRING.
6. 4-20MA AUTO SPEED SIGNAL CONNECTIONS ARE MADE DIRECTLY TO VFD CONTROL MODULE.
7. DO NOT RUN LOGIC WIRES (TBA 213/214 VFD EXT FAULT) IN SAME CONDUIT AS 120V OR POWER WIRING.
8. REMOVAL OF INTERLOCKS (TBA 101/102,213/214) MAY NOT PREVENT MOTOR OPERATION IN ALL MODES-CONSULT FACTORY FOR DETAILS.

EGF0214D2300D00000*-RAM-3243
EGF0214D2300D00000*-RAM-3242
EGF0214D2300D00000*-RAM-3241
EGF0214D2300D00000*-RAM-3143
EGF0214D2300D00000*-RAM-3142
EGF0214D2300D00000*-RAM-3141

▲ NEW RELEASE

EATON

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONNECTION DIAGRAM

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2200787
REVISION 01
G.O. NUMBER LBS0031682
DWG NO. ENG-900500-12571
SHEET 1 OF 1

468-1140
REV. 11/11

Master Document Index

Drives - Enclosed

Drives - Enclosed

	Drawing Description	Document Name	Rev
1	Master Drawing List	D00FTB7M01.DOC	3
2	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-000710-12459.DWG	01
3	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12544.DWG	02
4	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12544_SHT02.DWG	02
5	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-900500-12571.DWG	01

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		D7580427X2K2		
		RAM-3142	**Construction Drawings**	
REVISION	DWG SIZE	G.O.	DWG	SHEET
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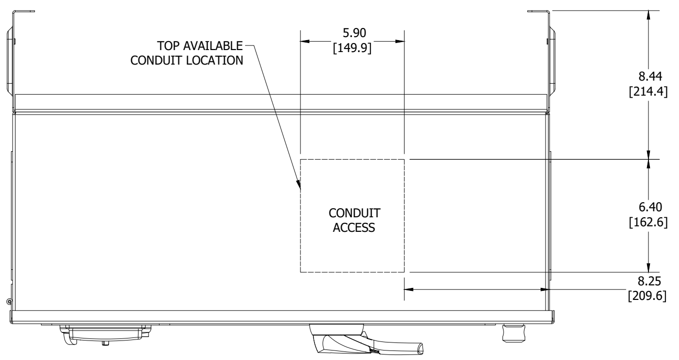
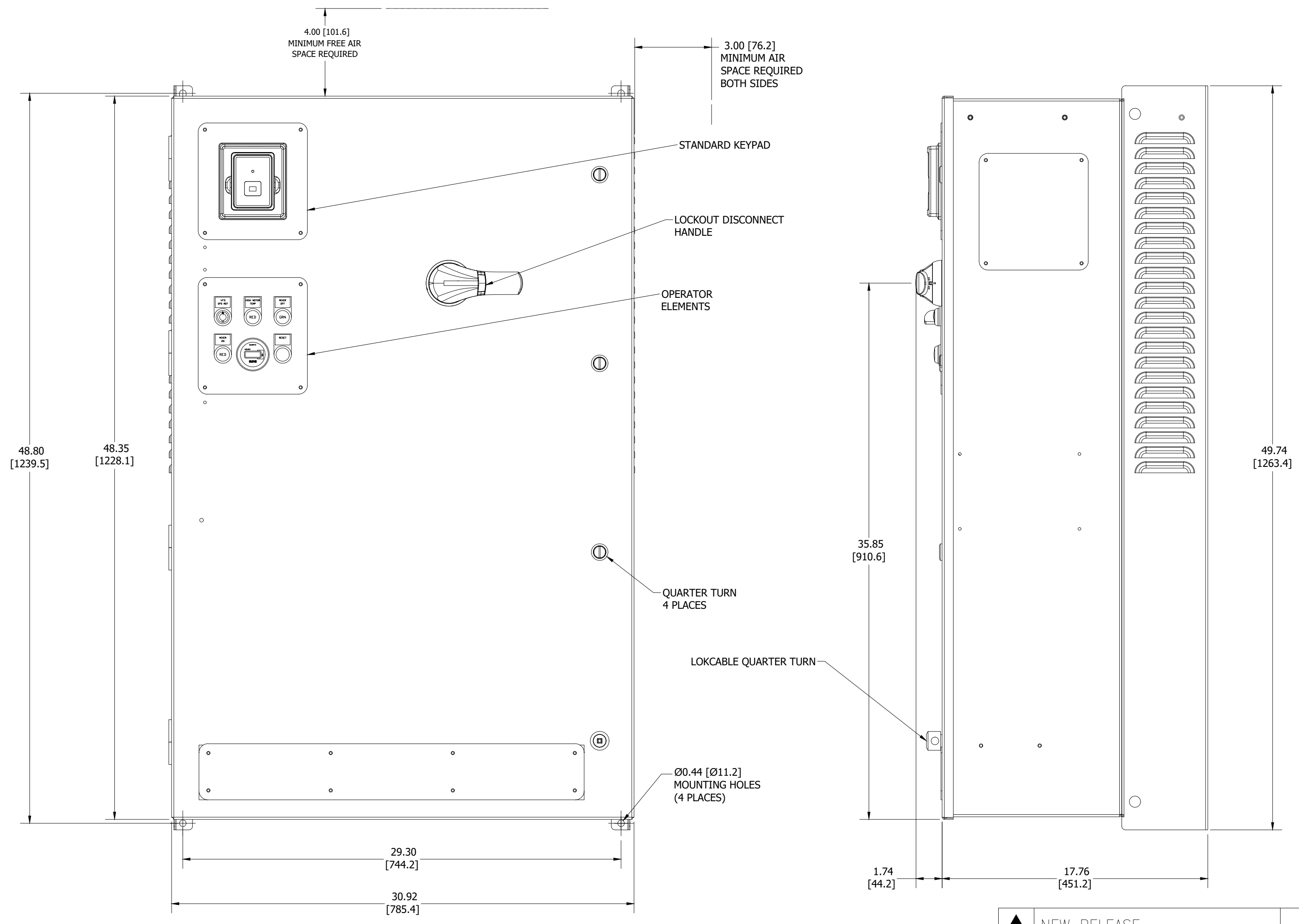
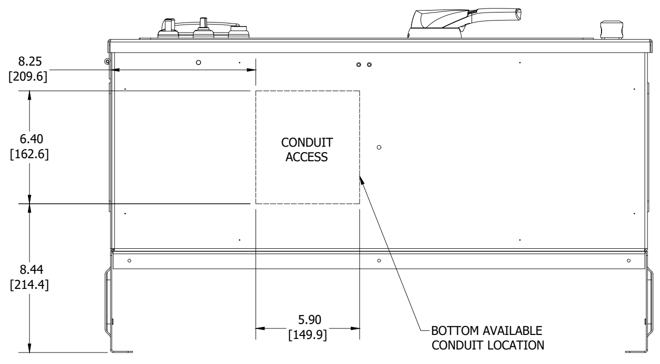






NOTES:
FINISH: ENCLOSURE - ANSI 61 (LIGHT) GRAY.
WEIGHT: APPROXIMATELY 350 LBS. [158] KG. 400 LBS [181] KG WITH STANDS.
MATERIAL: 14GA (0.0747) [1.90] CRS.
DIMENSIONS: INCHES, [MILLIMETERS].
CONSTRUCTION: NEMA TYPE 12 OVERSIZE

EGF0214D2300D00000*-RAM-3243
EGF0214D2300D00000*-RAM-3242
EGF0214D2300D00000*-RAM-3241
EGF0214D2300D00000*-RAM-3143
EGF0214D2300D00000*-RAM-3142
EGF0214D2300D00000*-RAM-3141

▲ NEW RELEASE

EATON

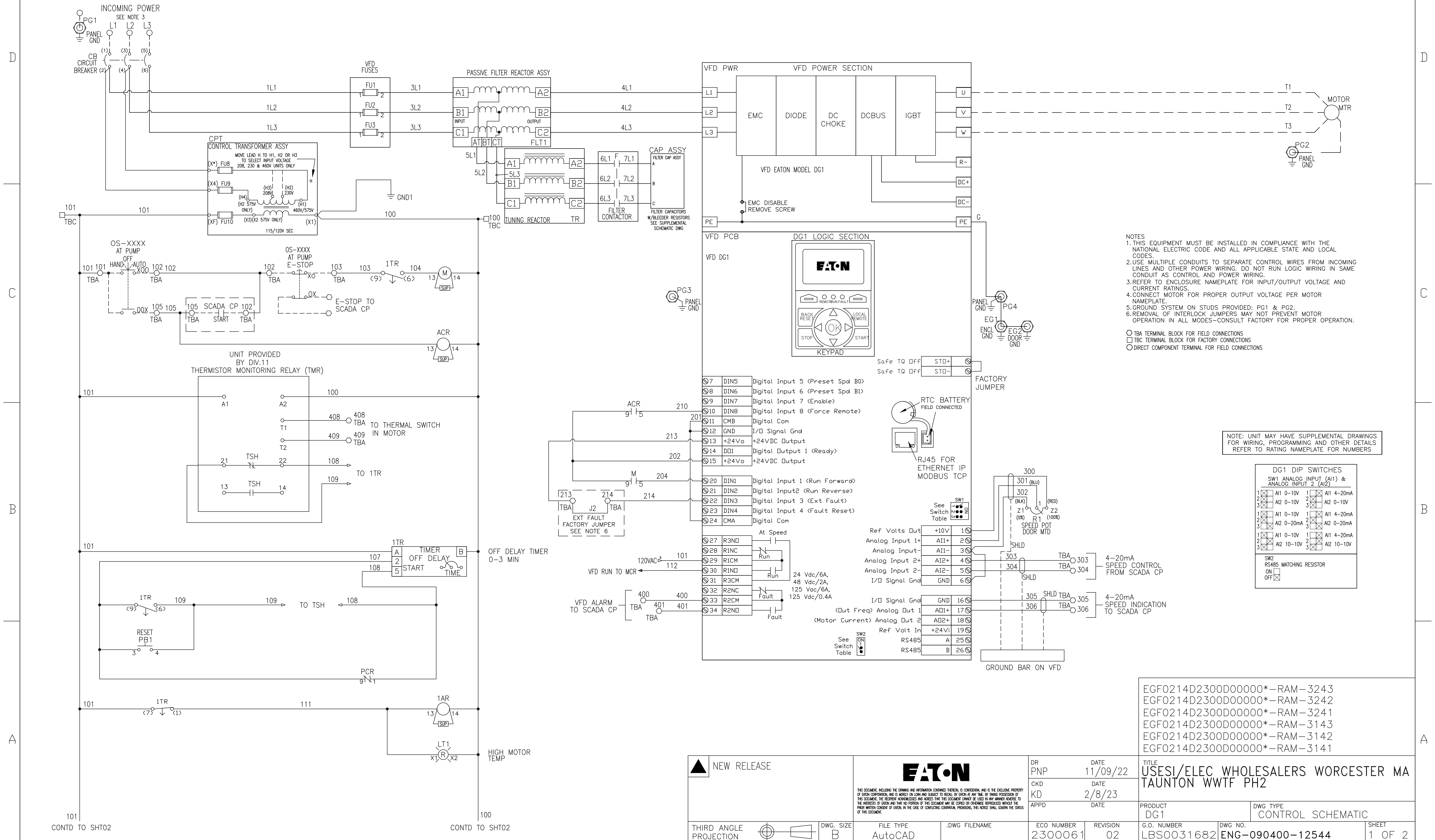
DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE OUTLINE DIMENSION

THIRD ANGLE
PROJECTION

DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2200787
REVISION 01
G.O. NUMBER LBS0031682
DWG NO. ENG-000710-12459
SHEET 1 OF 1



NOTES
1. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL APPLICABLE STATE AND LOCAL CODES.
2. USE MULTIPLE CONDUITS TO SEPARATE CONTROL WIRES FROM INCOMING LINES AND OTHER POWER WIRING. DO NOT RUN LOGIC WIRING IN SAME CONDUIT AS CONTROL AND POWER WIRING.
3. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGE AND CURRENT RATINGS.
4. CONNECT MOTOR FOR PROPER OUTPUT VOLTAGE PER MOTOR NAMEPLATE.
5. GROUND SYSTEM ON STUDS PROVIDED: PG1 & PG2.
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⬡ TBA TERMINAL BLOCK FOR FIELD CONNECTIONS
☐ TBC TERMINAL BLOCK FOR FACTORY CONNECTIONS
○ DIRECT COMPONENT TERMINAL FOR FIELD CONNECTIONS

EGF0214D2300D00000*—RAM—3243
EGF0214D2300D00000*—RAM—3242
EGF0214D2300D00000*—RAM—3241
EGF0214D2300D00000*—RAM—3143
EGF0214D2300D00000*—RAM—3142
EGF0214D2300D00000*—RAM—3141

▲ NEW RELEASE

EATON

DR	DATE	TITLE
PNP	11/09/22	USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2
CKD KD	DATE 2/8/23	
APPD	DATE	PRODUCT DG1 / DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION	DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
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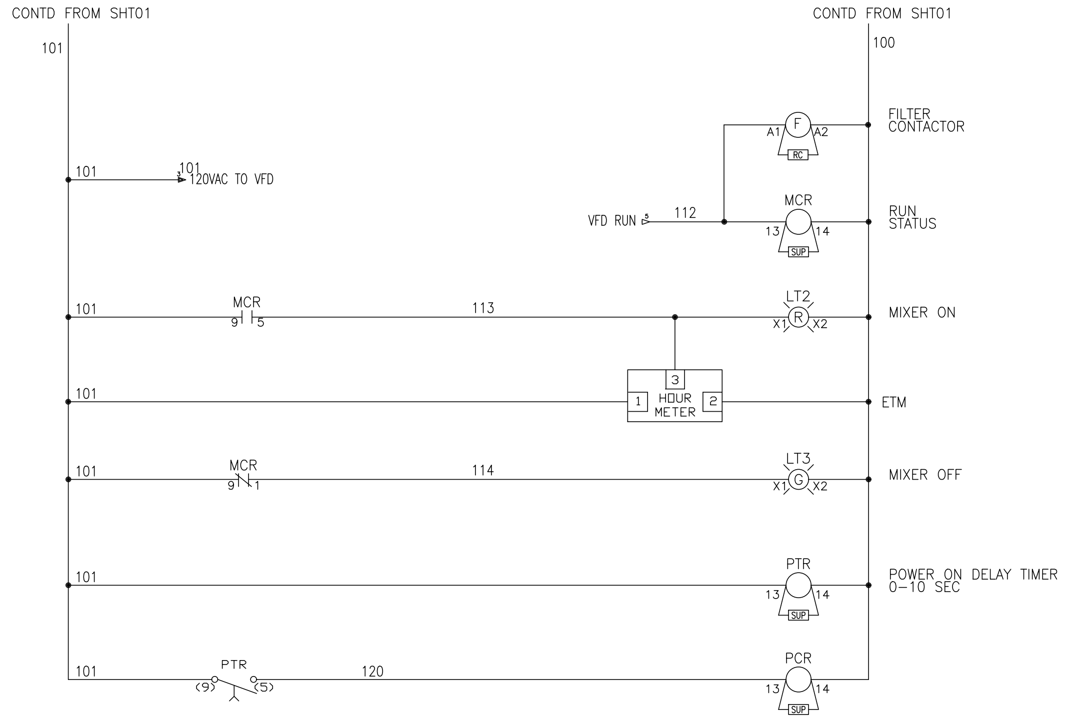

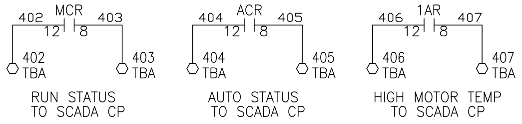

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EGF0214D2300D00000*–RAM–3241
EGF0214D2300D00000*–RAM–3143
EGF0214D2300D00000*–RAM–3142
EGF0214D2300D00000*–RAM–3141

▲ SEE SHT.01

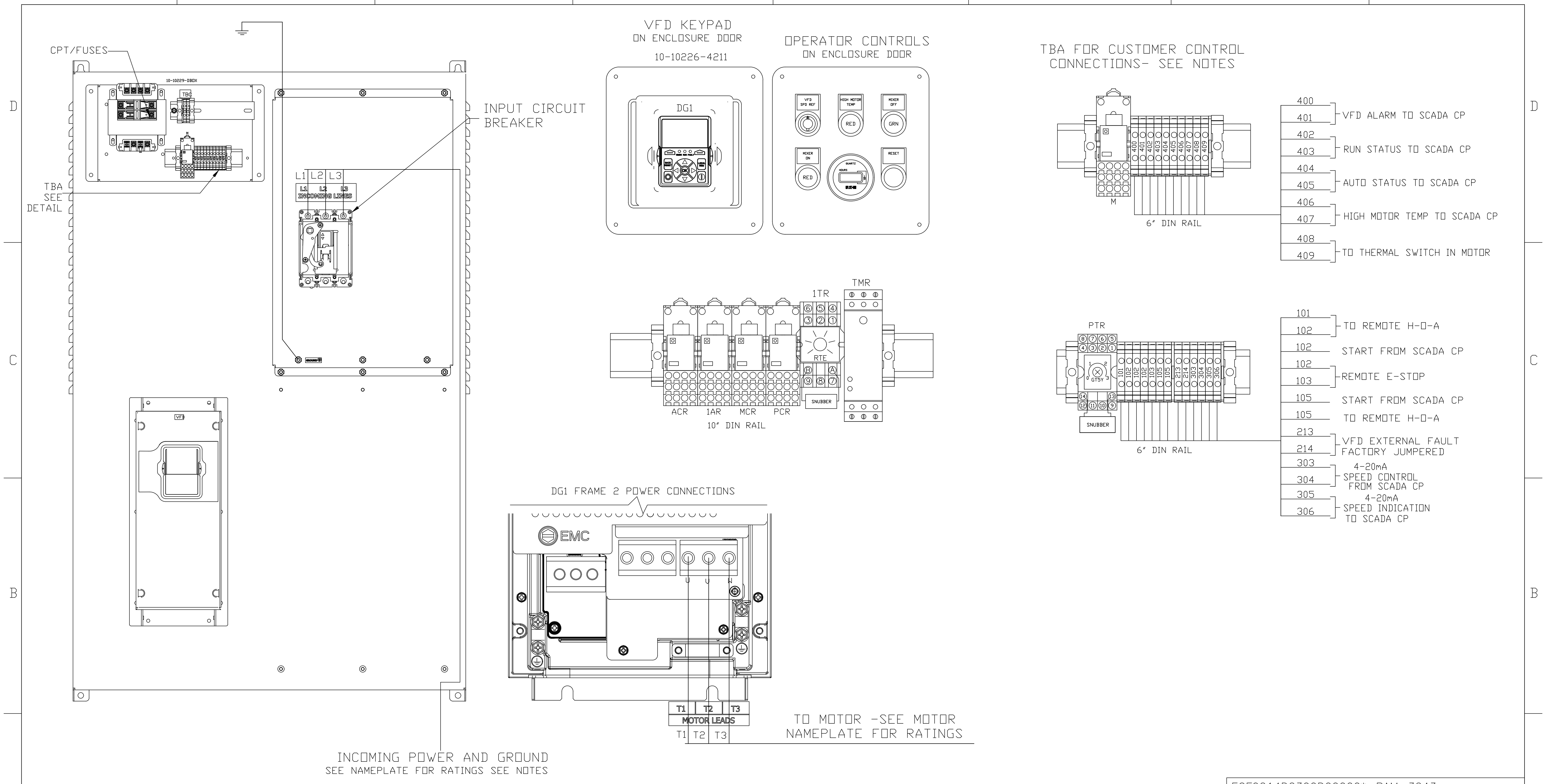
EATON

DR PNP DATE 11/09/22
CKD KD DATE 2/8/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2300061
REVISION 02
G.O. NUMBER LBS0031682
DWG NO. ENG–090400–12544
SHEET 2 OF 2



NOTES

1. SEE SCHEMATIC FOR DETAILS AND CONTROL LOGIC - FACTORY WIRING DETAILS OMITTED.
2. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGES AND CURRENT RATINGS.
3. ENCLOSURE MUST BE GROUNDED USING INPUT AND OUTPUT STUDS PROVIDED.
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EGF0214D2300D00000*-RAM-3243
EGF0214D2300D00000*-RAM-3242
EGF0214D2300D00000*-RAM-3241
EGF0214D2300D00000*-RAM-3143
EGF0214D2300D00000*-RAM-3142
EGF0214D2300D00000*-RAM-3141

▲ NEW RELEASE

EATON

DR	DATE
PNP	11/09/22
CKD	DATE
KD	1/11/23
APPD	DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT	DWG TYPE
DG1	CONNECTION DIAGRAM

THIRD ANGLE PROJECTION	DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
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468-1140
REV. 11/11

Master Document Index

Drives - Enclosed

Drives - Enclosed

	Drawing Description	Document Name	Rev
1	Master Drawing List	D00FTC5M01.DOC	3
2	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-000710-12459.DWG	01
3	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12544.DWG	02
4	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12544_SHT02.DWG	02
5	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-900500-12571.DWG	01

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		D7580427X2K2		
		RAM-3143	**Construction Drawings**	
REVISION	DWG SIZE	G.O.	DWG	SHEET
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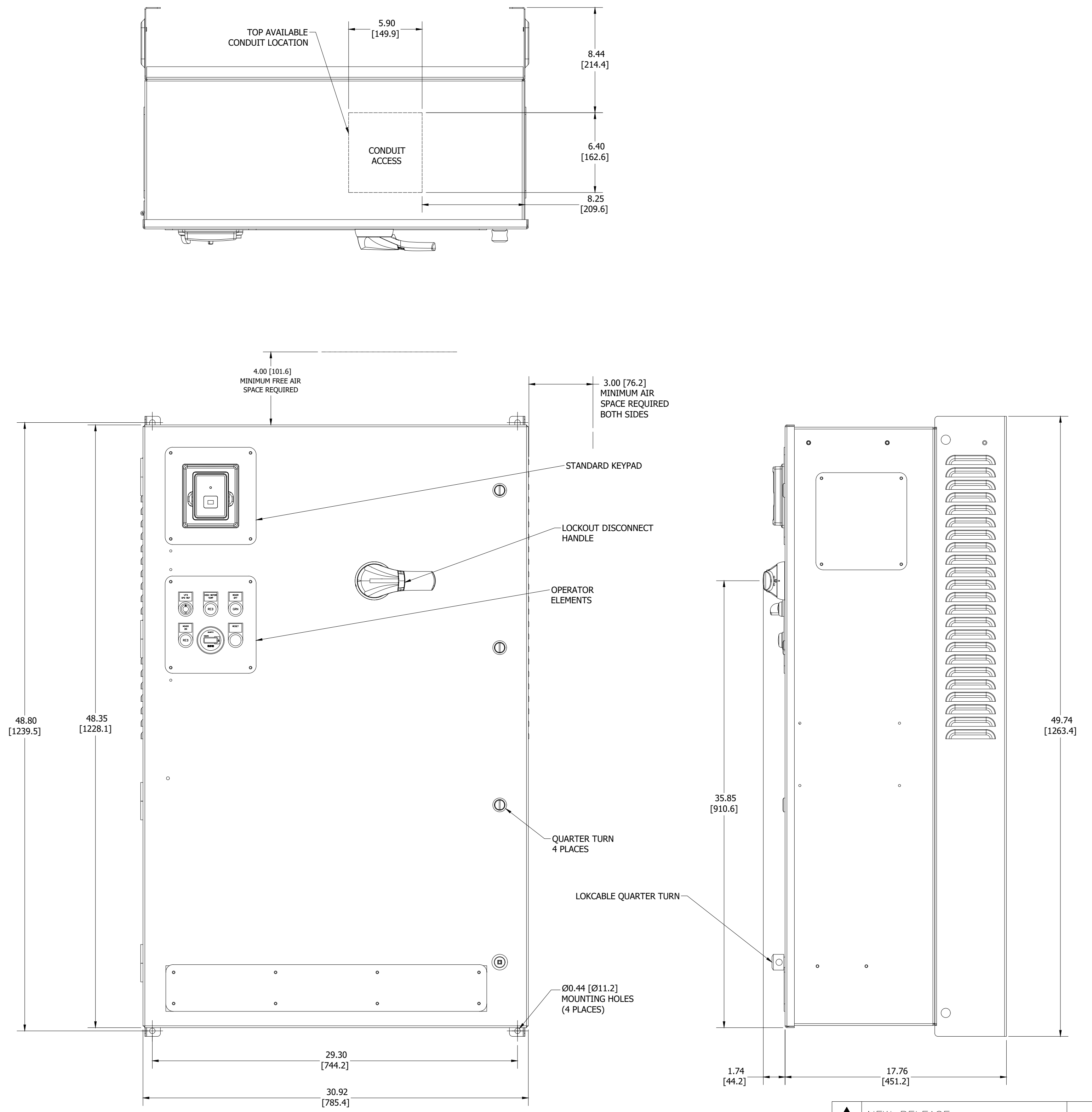
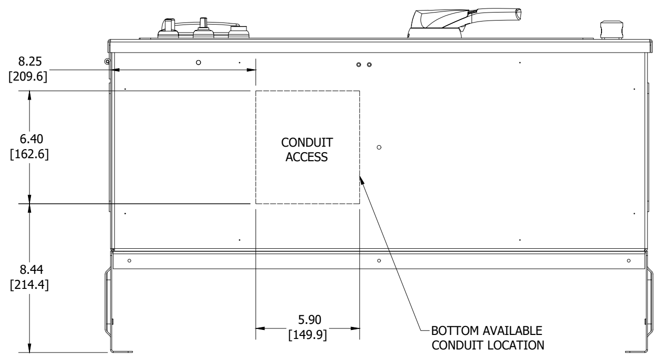




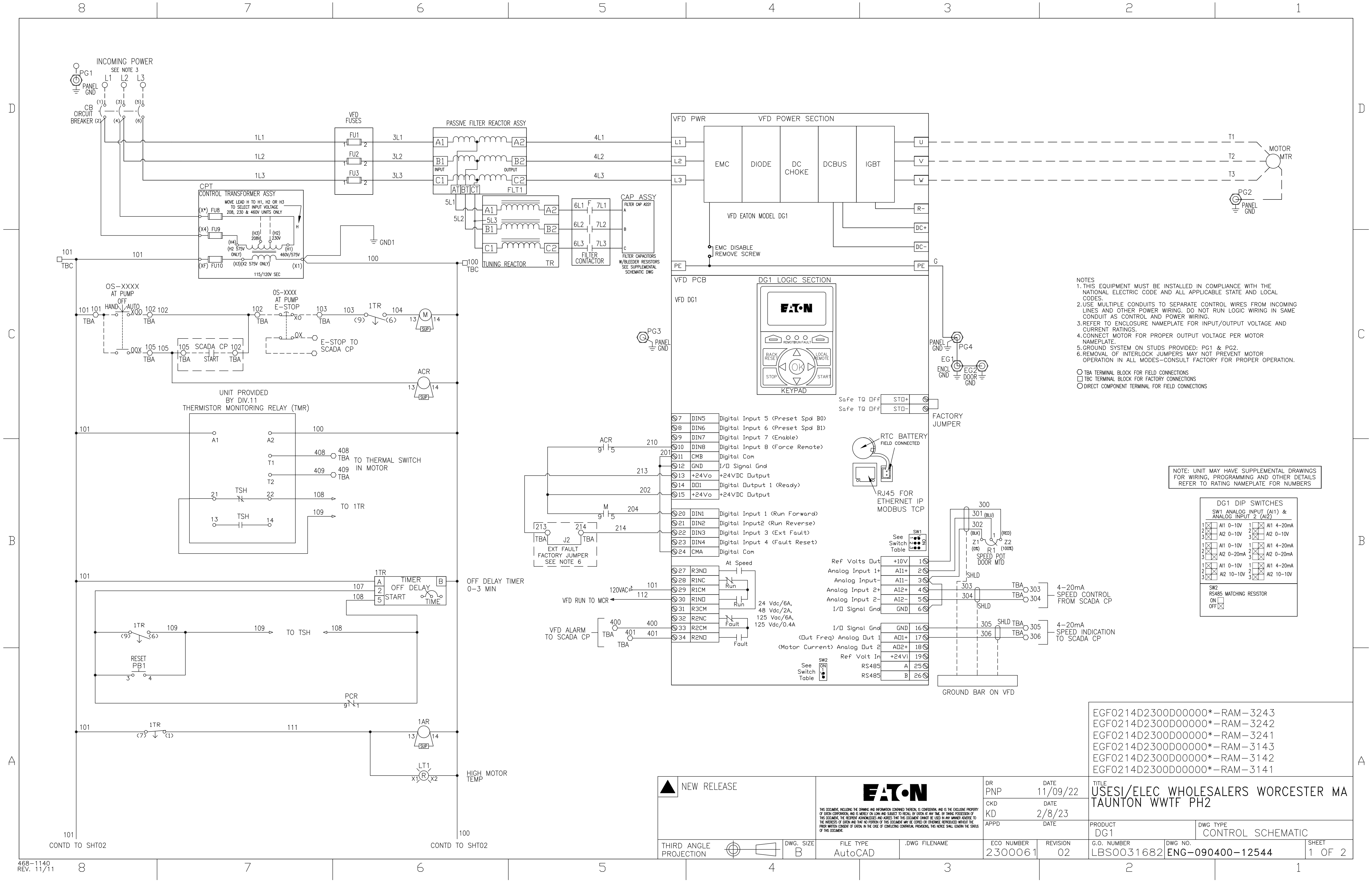
NOTES:
FINISH: ENCLOSURE - ANSI 61 (LIGHT) GRAY.
WEIGHT: APPROXIMATELY 350 LBS. [158] KG. 400 LBS [181] KG WITH STANDS.
MATERIAL: 14GA (0.0747) [1.90] CRS.
DIMENSIONS: INCHES, [MILLIMETERS].
CONSTRUCTION: NEMA TYPE 12 OVERSIZE

EGF0214D2300D00000*-RAM-3243
EGF0214D2300D00000*-RAM-3242
EGF0214D2300D00000*-RAM-3241
EGF0214D2300D00000*-RAM-3143
EGF0214D2300D00000*-RAM-3142
EGF0214D2300D00000*-RAM-3141

▲ NEW RELEASE

EATON

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE
TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2
PRODUCT DG1
DWG TYPE OUTLINE DIMENSION
THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2200787
REVISION 01
G.O. NUMBER LBS0031682
DWG NO. ENG-000710-12459
SHEET 1 OF 1



NOTES

1. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL APPLICABLE STATE AND LOCAL CODES.
2. USE MULTIPLE CONDUITS TO SEPARATE CONTROL WIRES FROM INCOMING LINES AND OTHER POWER WIRING. DO NOT RUN LOGIC WIRING IN SAME CONDUIT AS CONTROL AND POWER WIRING.
3. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGE AND CURRENT RATINGS.
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⬡ TBA TERMINAL BLOCK FOR FIELD CONNECTIONS
☐ TBC TERMINAL BLOCK FOR FACTORY CONNECTIONS
○ DIRECT COMPONENT TERMINAL FOR FIELD CONNECTIONS

NOTE: UNIT MAY HAVE SUPPLEMENTAL DRAWINGS FOR WIRING, PROGRAMMING AND OTHER DETAILS REFER TO RATING NAMEPLATE FOR NUMBERS

DG1 DIP SWITCHES

SW1 ANALOG INPUT (AI1) & ANALOG INPUT 2 (AI2)

1	☒ ☐	AI1 0-10V	1	☐ ☒	AI1 4-20mA
2	☒ ☐	AI2 0-10V	2	☒ ☐	AI2 0-10V
3	☒ ☐		3	☒ ☐	
1	☒ ☐	AI1 0-10V	1	☐ ☒	AI1 4-20mA
2	☒ ☐	AI2 0-20mA	2	☒ ☐	AI2 0-20mA
3	☐ ☒		3	☐ ☒	
1	☒ ☐	AI1 0-10V	1	☐ ☒	AI1 4-20mA
2	☐ ☒	AI2 10-10V	2	☐ ☒	AI2 10-10V
3	☒ ☐		3	☒ ☐	

SW2
RS485 MATCHING RESISTOR
ON ☐
OFF ☒

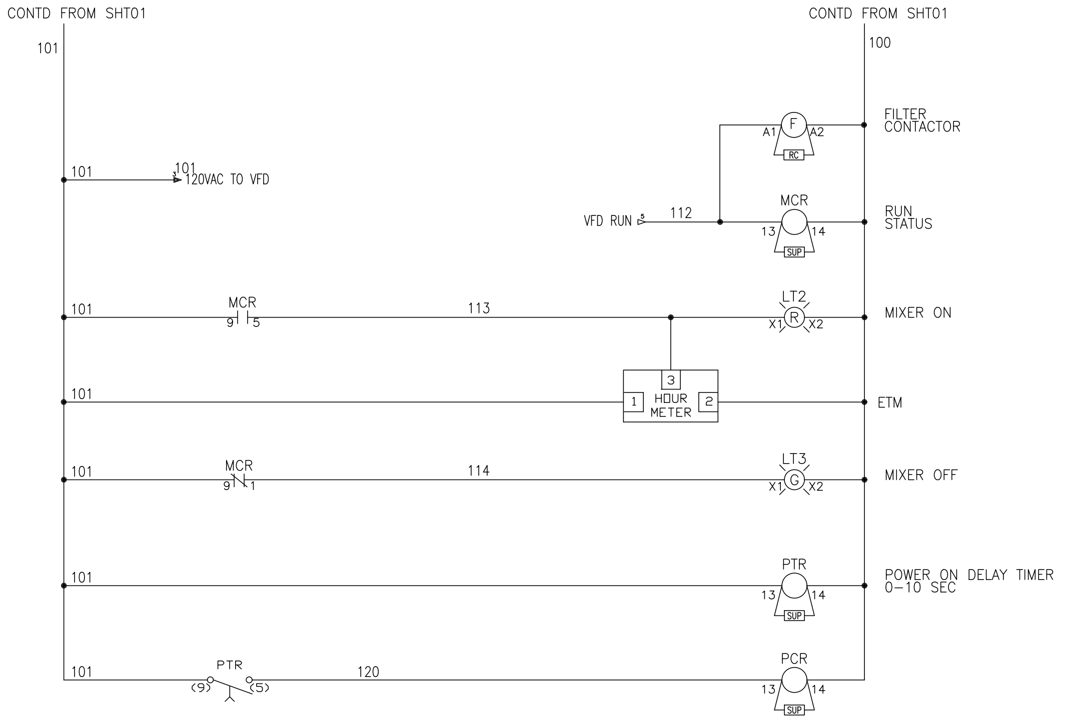
EGF0214D2300D00000*-RAM-3243
EGF0214D2300D00000*-RAM-3242
EGF0214D2300D00000*-RAM-3241
EGF0214D2300D00000*-RAM-3143
EGF0214D2300D00000*-RAM-3142
EGF0214D2300D00000*-RAM-3141

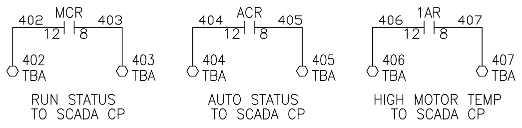
▲ NEW RELEASE

EATON

DR PNP	DATE 11/09/22	TITLE USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2
CKD KD	DATE 2/8/23	
APPD	DATE	PRODUCT DG1
		DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION	DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
	B	AutoCAD		2300061	02	LBS0031682	ENG-090400-12544	1 OF 2





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EGF0214D2300D00000*–RAM–3142
EGF0214D2300D00000*–RAM–3141

▲ SEE SHT.01

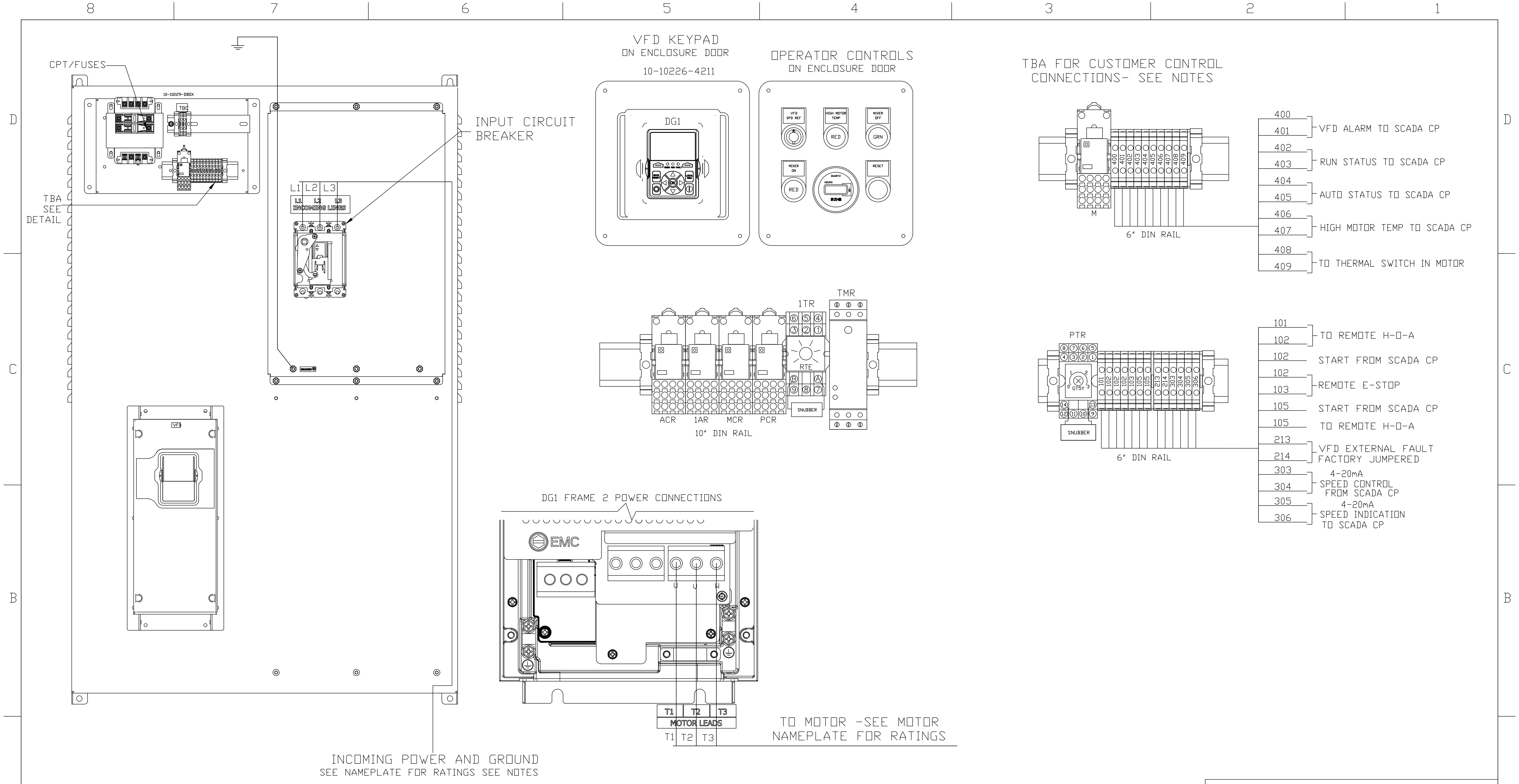
EATON

DR PNP DATE 11/09/22
CKD KD DATE 2/8/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2300061
REVISION 02
G.O. NUMBER LBS0031682
DWG NO. ENG–090400–12544
SHEET 2 OF 2



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EGF0214D2300D00000*-RAM-3242
EGF0214D2300D00000*-RAM-3241
EGF0214D2300D00000*-RAM-3143
EGF0214D2300D00000*-RAM-3142
EGF0214D2300D00000*-RAM-3141

NOTES

1. SEE SCHEMATIC FOR DETAILS AND CONTROL LOGIC - FACTORY WIRING DETAILS OMITTED.
2. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGES AND CURRENT RATINGS.
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5. USE MULTIPLE CONDUITS TO SEPARATE 120 CONTROL (TBA 101/102 & 106/104) WIRING FROM INCOMING POWER WIRING.
6. 4-20MA AUTO SPEED SIGNAL CONNECTIONS ARE MADE DIRECTLY TO VFD CONTROL MODULE.
7. DO NOT RUN LOGIC WIRES (TBA 213/214 VFD EXT FAULT) IN SAME CONDUIT AS 120V OR POWER WIRING.
8. REMOVAL OF INTERLOCKS (TBA 101/102,213/214) MAY NOT PREVENT MOTOR OPERATION IN ALL MODES- CONSULT FACTORY FOR DETAILS.

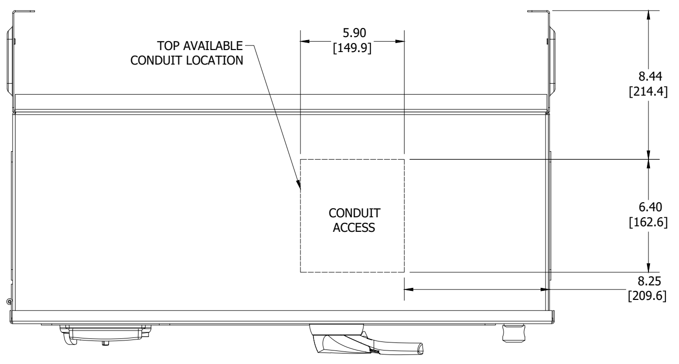
▲ NEW RELEASE	EATON	DR PNP	DATE 11/09/22	TITLE USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2	
		CKD KD	DATE 1/11/23		
		APPD	DATE	PRODUCT DG1	DWG TYPE CONNECTION DIAGRAM
THIRD ANGLE PROJECTION	DWG. SIZE B	FILE TYPE AutoCAD	.DWG FILENAME	ECO NUMBER 2200787	REVISION 01
G.O. NUMBER LBS0031682	DWG NO. ENG-900500-12571	SHEET 1 OF 1			

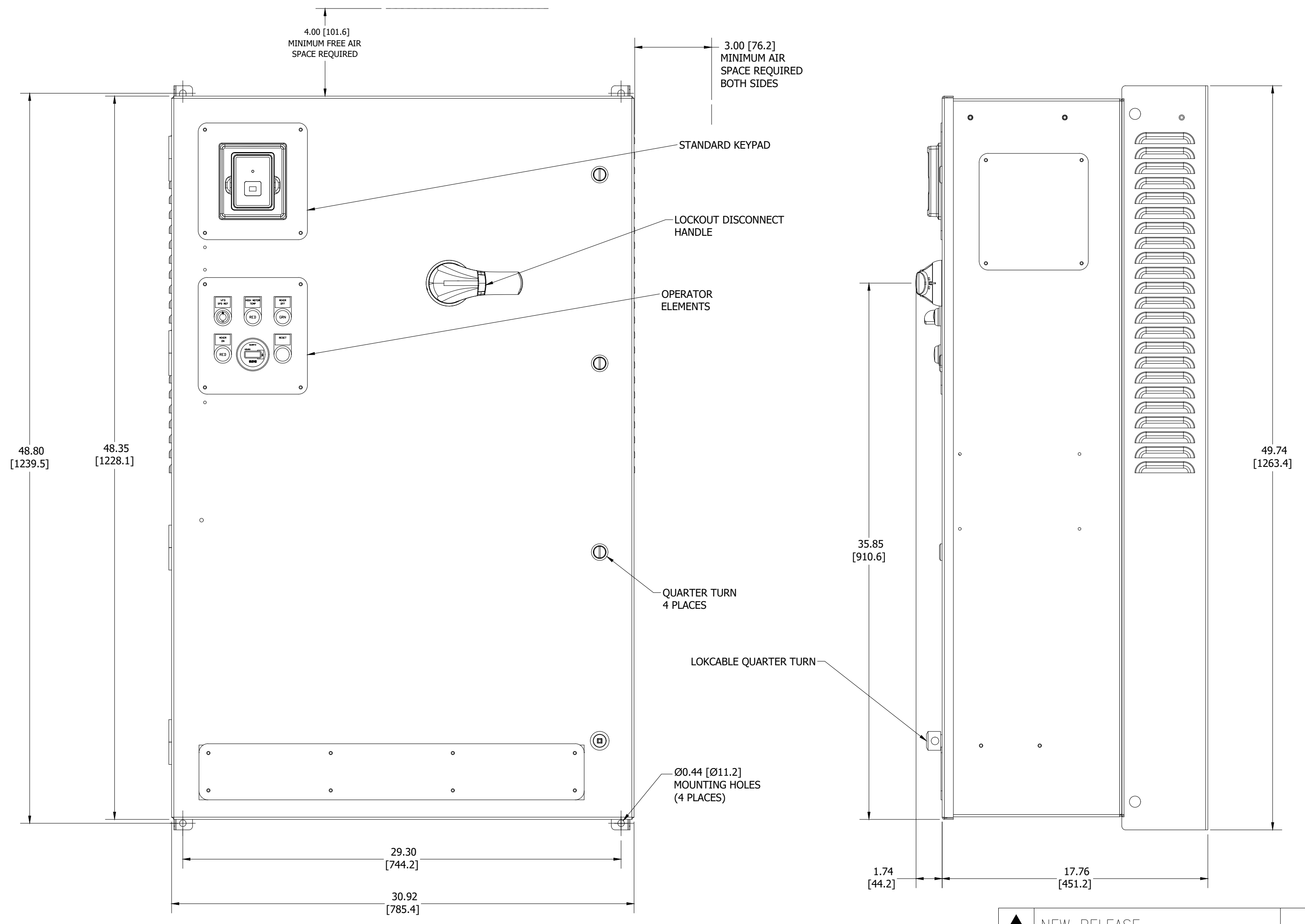
Master Document Index

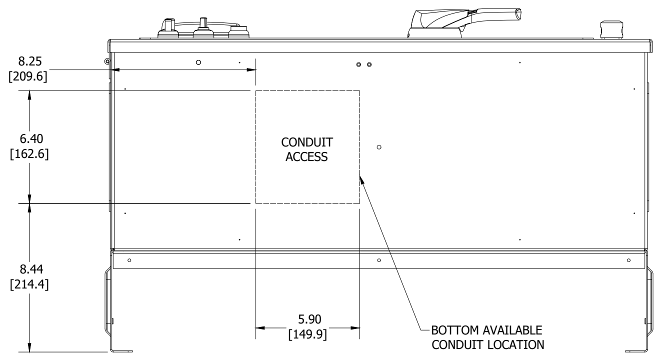
Drives - Enclosed
Drives - Enclosed

	Drawing Description	Document Name	Rev
1	Master Drawing List	D00FTC2M01.DOC	3
2	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-000710-12459.DWG	01
3	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12544.DWG	02
4	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12544_SHT02.DWG	02
5	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-900500-12571.DWG	01

User **Karla Devora Maldonado**	**Date** **2/8/2023 10:16:46 AM**	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.		EATON Powering Business Worldwide
		D7580427X2K2		
		RAM-3241	**Construction Drawings**	
REVISION	DWG SIZE	G.O.	DWG	SHEET
3	**A**	**LBS0031682-015**	**D00FTC2M01.DOC**	1 of 1







NOTES:
FINISH: ENCLOSURE - ANSI 61 (LIGHT) GRAY.
WEIGHT: APPROXIMATELY 350 LBS. [158] KG. 400 LBS [181] KG WITH STANDS.
MATERIAL: 14GA (0.0747) [1.90] CRS.
DIMENSIONS: INCHES, [MILLIMETERS].
CONSTRUCTION: NEMA TYPE 12 OVERSIZE

EGF0214D2300D00000*-RAM-3243
EGF0214D2300D00000*-RAM-3242
EGF0214D2300D00000*-RAM-3241
EGF0214D2300D00000*-RAM-3143
EGF0214D2300D00000*-RAM-3142
EGF0214D2300D00000*-RAM-3141

▲ NEW RELEASE

EATON

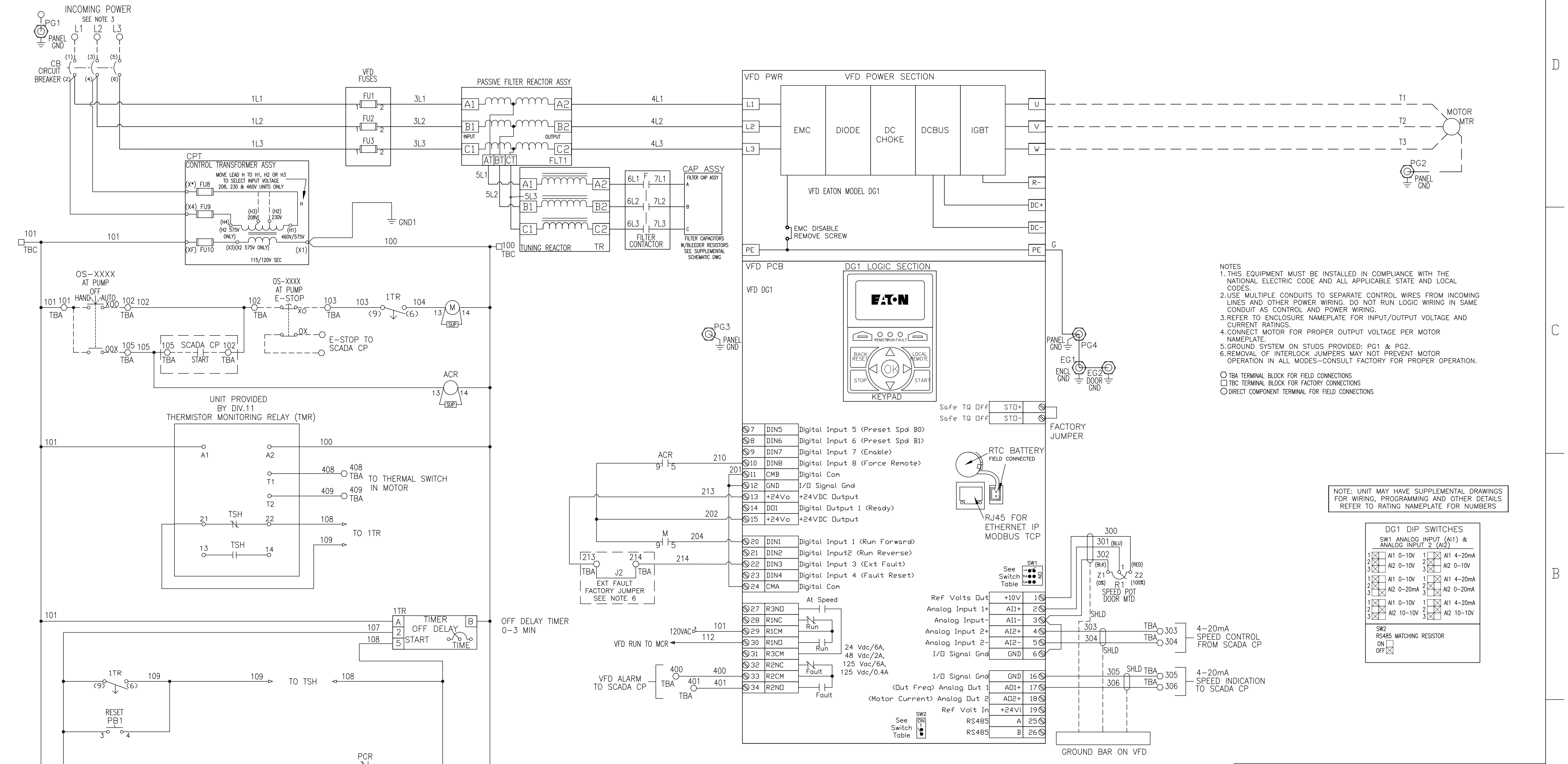
DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE OUTLINE DIMENSION

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2200787
REVISION 01
G.O. NUMBER LBS0031682
DWG NO. ENG-000710-12459
SHEET 1 OF 1

468-1140
REV. 11/11



NOTES
1. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL APPLICABLE STATE AND LOCAL CODES.
2. USE MULTIPLE CONDUITS TO SEPARATE CONTROL WIRES FROM INCOMING LINES AND OTHER POWER WIRING. DO NOT RUN LOGIC WIRING IN SAME CONDUIT AS CONTROL AND POWER WIRING.
3. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGE AND CURRENT RATINGS.
4. CONNECT MOTOR FOR PROPER OUTPUT VOLTAGE PER MOTOR NAMEPLATE.
5. GROUND SYSTEM ON STUDS PROVIDED: PG1 & PG2.
6. REMOVAL OF INTERLOCK JUMPERS MAY NOT PREVENT MOTOR OPERATION IN ALL MODES—CONSULT FACTORY FOR PROPER OPERATION.

⬡ TBA TERMINAL BLOCK FOR FIELD CONNECTIONS
☐ TBC TERMINAL BLOCK FOR FACTORY CONNECTIONS
○ DIRECT COMPONENT TERMINAL FOR FIELD CONNECTIONS

NOTE: UNIT MAY HAVE SUPPLEMENTAL DRAWINGS
FOR WIRING, PROGRAMMING AND OTHER DETAILS
REFER TO RATING NAMEPLATE FOR NUMBERS

DG1 DIP SWITCHES

SW1 ANALOG INPUT (AI1) & ANALOG INPUT 2 (AI2)

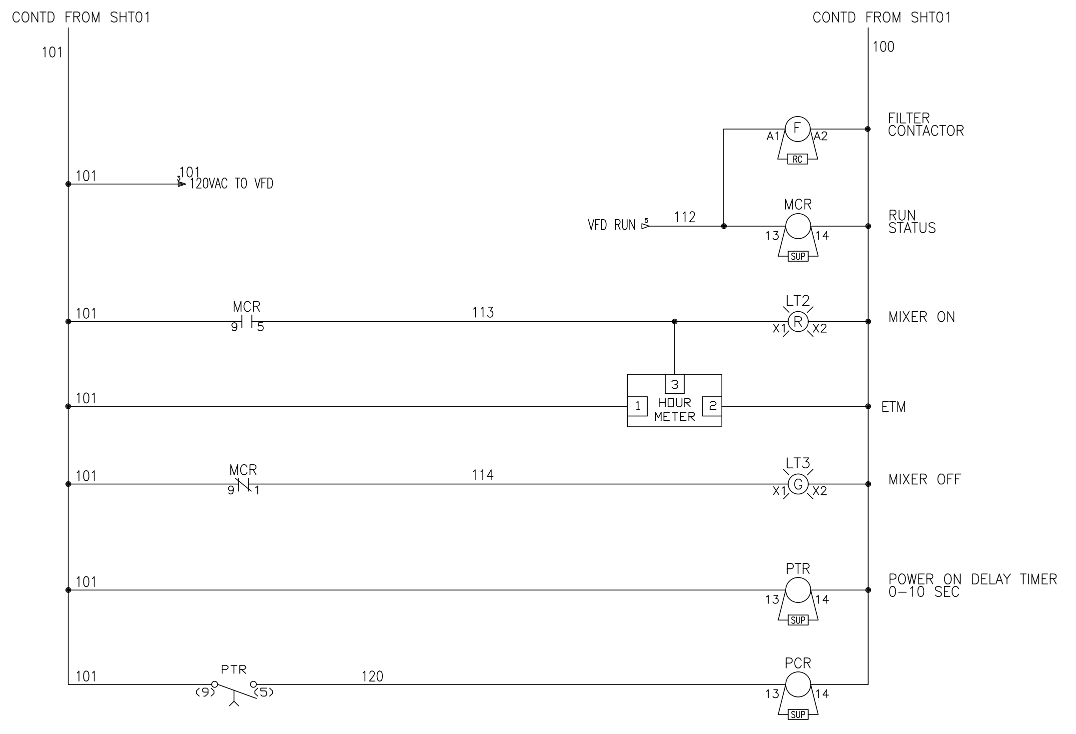
AI1 0–10V AI2 0–10V	AI1 4–20mA AI2 0–10V
AI1 0–10V AI2 0–20mA	AI1 4–20mA AI2 0–20mA
AI1 0–10V AI2 10–10V	AI1 4–20mA AI2 10–10V

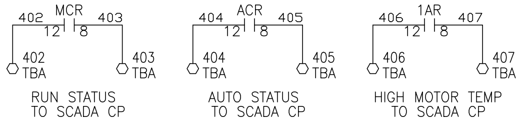
SW2
RS485 MATCHING RESISTOR
ON ☐
OFF ☒

EGF0214D2300D00000*–RAM–3243
EGF0214D2300D00000*–RAM–3242
EGF0214D2300D00000*–RAM–3241
EGF0214D2300D00000*–RAM–3143
EGF0214D2300D00000*–RAM–3142
EGF0214D2300D00000*–RAM–3141

▲ NEW RELEASE	EATON	DR PNP DATE 11/09/22 CKD KD DATE 2/8/23 APPD DATE	TITLE USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2	
			PRODUCT DG1	DWG TYPE CONTROL SCHEMATIC
THIRD ANGLE PROJECTION DWG. SIZE B	FILE TYPE AutoCAD .DWG FILENAME	ECO NUMBER 2300061 REVISION 02	G.O. NUMBER LBS0031682 DWG NO. ENG–090400–12544	SHEET 1 OF 2

468–1140
REV. 11/11





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EGF0214D2300D00000*–RAM–3242
EGF0214D2300D00000*–RAM–3241
EGF0214D2300D00000*–RAM–3143
EGF0214D2300D00000*–RAM–3142
EGF0214D2300D00000*–RAM–3141

▲ SEE SHT.01

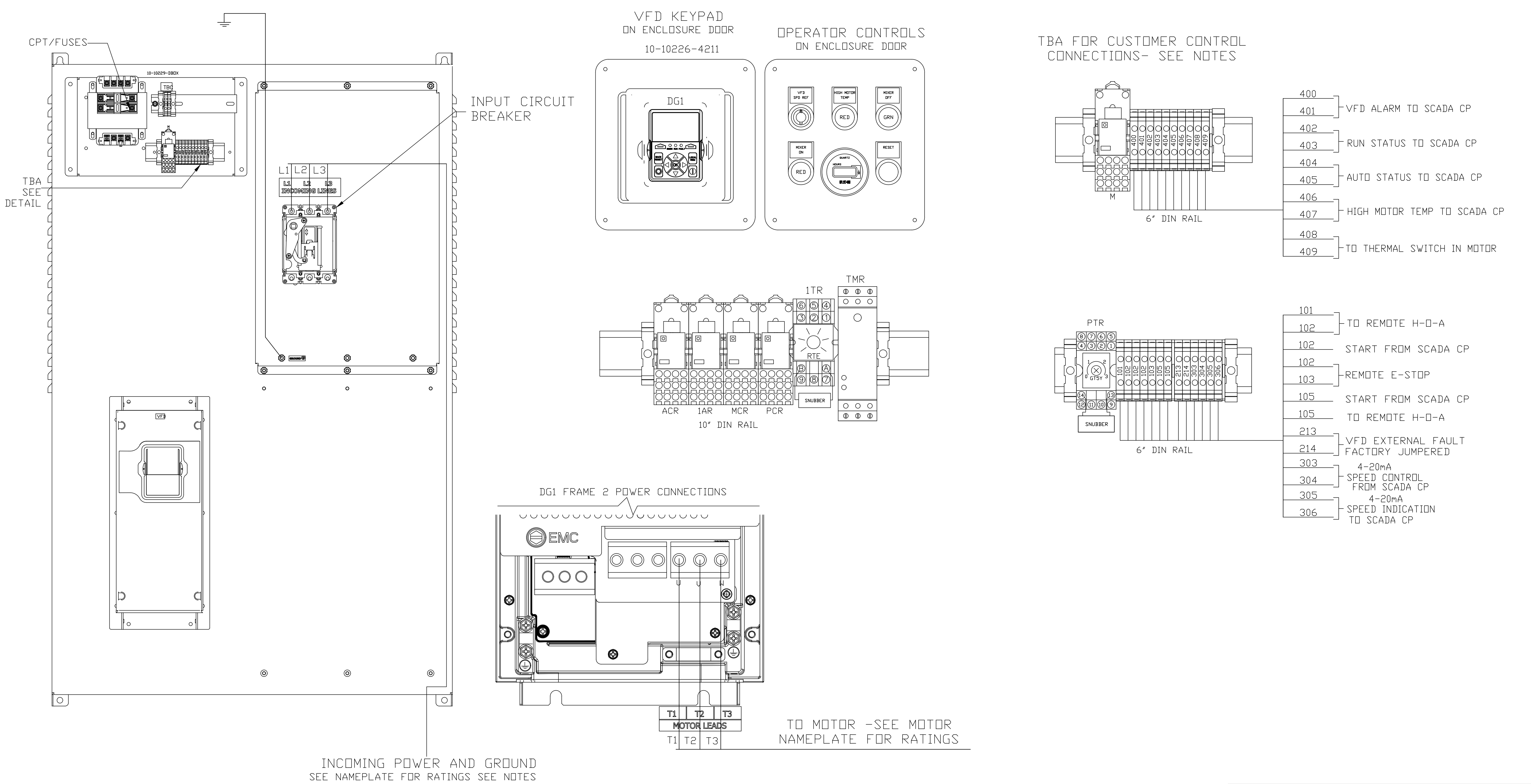
EATON

DR PNP DATE 11/09/22
CKD KD DATE 2/8/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2300061
REVISION 02
G.O. NUMBER LBS0031682
DWG NO. ENG–090400–12544
SHEET 2 OF 2



NOTES

1. SEE SCHEMATIC FOR DETAILS AND CONTROL LOGIC - FACTORY WIRING DETAILS OMITTED.
2. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGES AND CURRENT RATINGS.
3. ENCLOSURE MUST BE GROUNDED USING INPUT AND OUTPUT STUDS PROVIDED.
4. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL STATE/LOCAL CODES.
5. USE MULTIPLE CONDUITS TO SEPARATE 120 CONTROL (TBA 101/102 & 106/104) WIRING FROM INCOMING POWER WIRING.
6. 4-20MA AUTO SPEED SIGNAL CONNECTIONS ARE MADE DIRECTLY TO VFD CONTROL MODULE.
7. DO NOT RUN LOGIC WIRES (TBA 213/214 VFD EXT FAULT) IN SAME CONDUIT AS 120V OR POWER WIRING.
8. REMOVAL OF INTERLOCKS (TBA 101/102,213/214) MAY NOT PREVENT MOTOR OPERATION IN ALL MODES- CONSULT FACTORY FOR DETAILS.

EGF0214D2300D00000*-RAM-3243
EGF0214D2300D00000*-RAM-3242
EGF0214D2300D00000*-RAM-3241
EGF0214D2300D00000*-RAM-3143
EGF0214D2300D00000*-RAM-3142
EGF0214D2300D00000*-RAM-3141

▲ NEW RELEASE

EATON

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONNECTION DIAGRAM

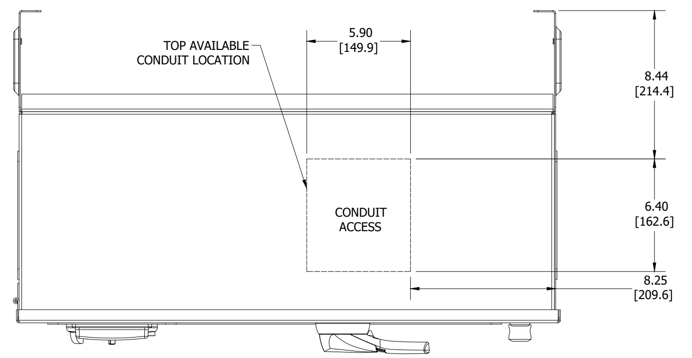
THIRD ANGLE PROJECTION	DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
	B	AutoCAD		2200787	01	LBS0031682	ENG-900500-12571	1 OF 1

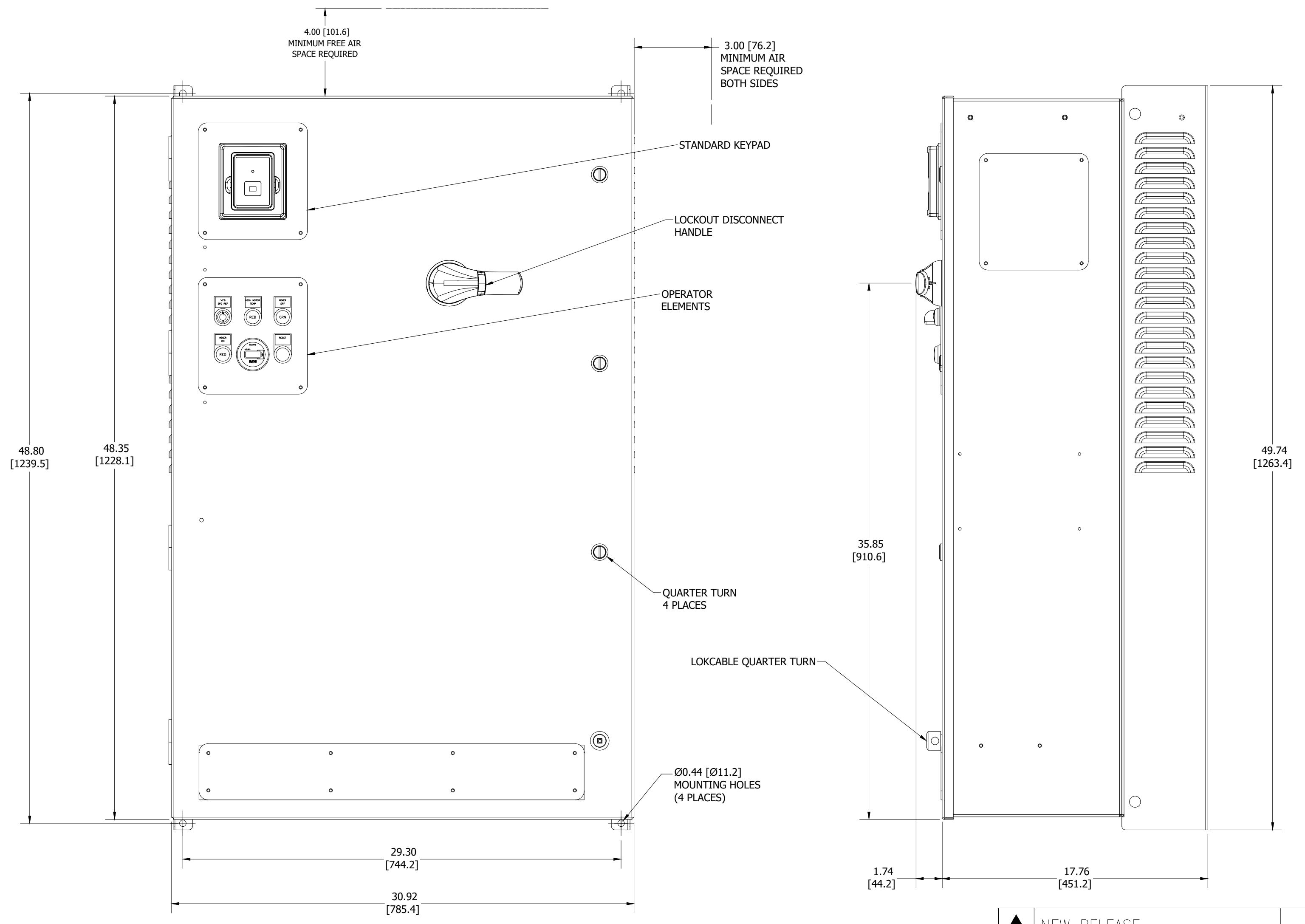
Master Document Index

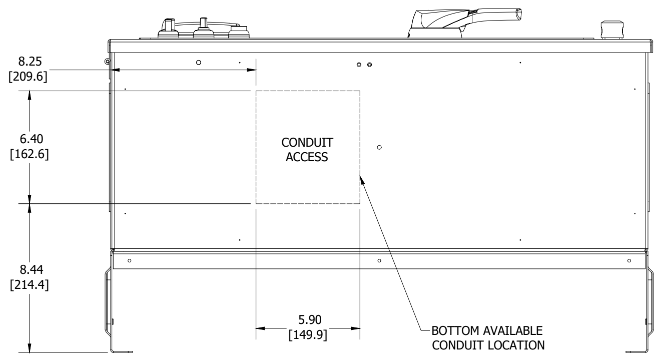
Drives - Enclosed
Drives - Enclosed

	Drawing Description	Document Name	Rev
1	Master Drawing List	D00FTC9M01.DOC	3
2	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-000710-12459.DWG	01
3	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12544.DWG	02
4	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12544_SHT02.DWG	02
5	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-900500-12571.DWG	01

User **Karla Devora Maldonado**	**Date** **2/8/2023 10:25:29 AM**	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.		EATON Powering Business Worldwide
		D7580427X2K2		
		RAM-3242	**Construction Drawings**	
REVISION	DWG SIZE	G.O.	DWG	SHEET
3	**A**	**LBS0031682-016**	**D00FTC9M01.DOC**	1 of 1







NOTES:
FINISH: ENCLOSURE - ANSI 61 (LIGHT) GRAY.
WEIGHT: APPROXIMATELY 350 LBS. [158] KG. 400 LBS [181] KG WITH STANDS.
MATERIAL: 14GA (0.0747) [1.90] CRS.
DIMENSIONS: INCHES, [MILLIMETERS].
CONSTRUCTION: NEMA TYPE 12 OVERSIZE

EGF0214D2300D00000*-RAM-3243
EGF0214D2300D00000*-RAM-3242
EGF0214D2300D00000*-RAM-3241
EGF0214D2300D00000*-RAM-3143
EGF0214D2300D00000*-RAM-3142
EGF0214D2300D00000*-RAM-3141

▲ NEW RELEASE

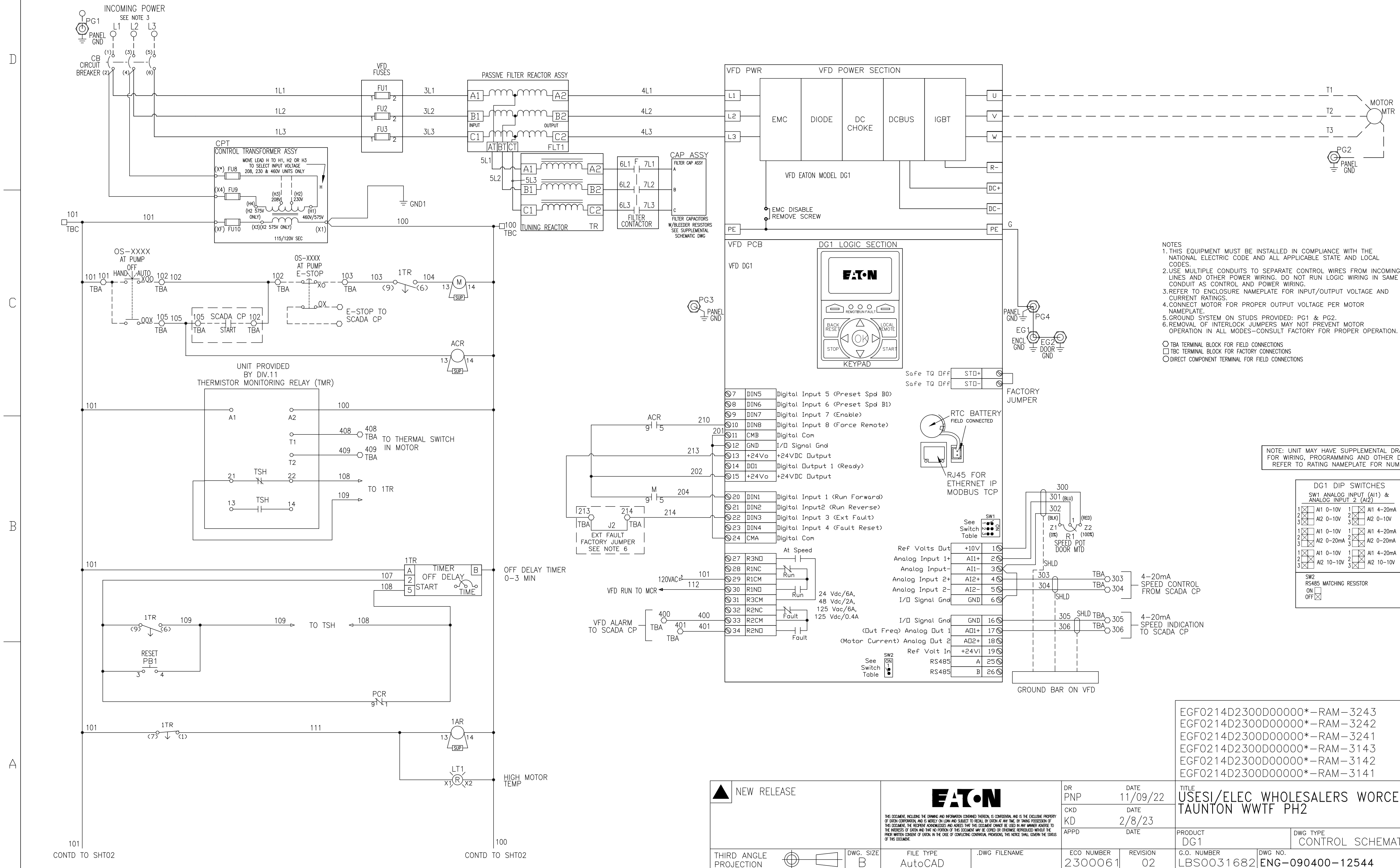
EATON

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE OUTLINE DIMENSION

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2200787
REVISION 01
G.O. NUMBER LBS0031682
DWG NO. ENG-000710-12459
SHEET 1 OF 1



NOTES
1. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL APPLICABLE STATE AND LOCAL CODES.
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⬡ TBA TERMINAL BLOCK FOR FIELD CONNECTIONS
☐ TBC TERMINAL BLOCK FOR FACTORY CONNECTIONS
○ DIRECT COMPONENT TERMINAL FOR FIELD CONNECTIONS

NOTE: UNIT MAY HAVE SUPPLEMENTAL DRAWINGS FOR WIRING, PROGRAMMING AND OTHER DETAILS REFER TO RATING NAMEPLATE FOR NUMBERS

DG1 DIP SWITCHES

SW1 ANALOG INPUT (AI1) & ANALOG INPUT 2 (AI2)

1 ☒☐ 2 ☒☐ 3 ☒☐	AI1 0–10V AI2 0–10V	1 ☐☒ 2 ☒☐ 3 ☒☐	AI1 4–20mA AI2 0–10V
1 ☒☐ 2 ☒☐ 3 ☐☒	AI1 0–10V AI2 0–20mA	1 ☐☒ 2 ☒☐ 3 ☐☒	AI1 4–20mA AI2 0–20mA
1 ☒☐ 2 ☐☒ 3 ☒☐	AI1 0–10V AI2 10–10V	1 ☐☒ 2 ☐☒ 3 ☒☐	AI1 4–20mA AI2 10–10V

SW2
RS485 MATCHING RESISTOR
ON ☐
OFF ☒

EGF0214D2300D00000*–RAM–3243
EGF0214D2300D00000*–RAM–3242
EGF0214D2300D00000*–RAM–3241
EGF0214D2300D00000*–RAM–3143
EGF0214D2300D00000*–RAM–3142
EGF0214D2300D00000*–RAM–3141

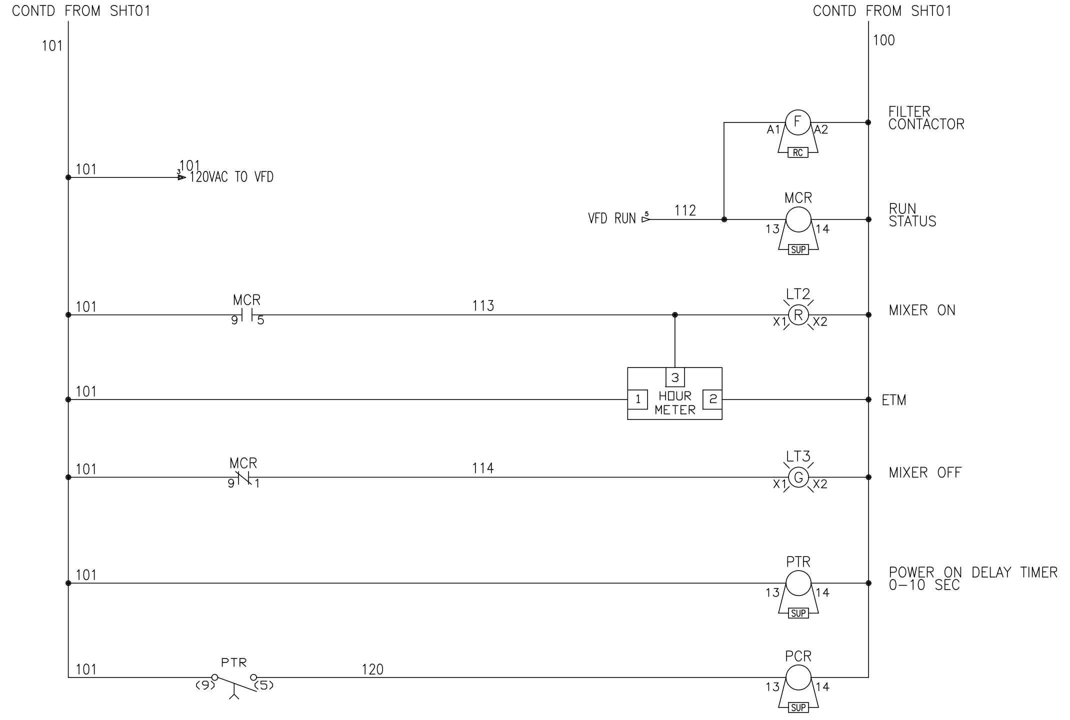
▲ NEW RELEASE

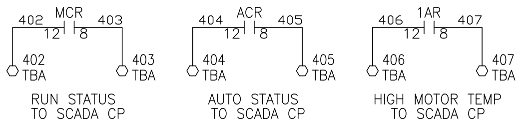
EATON

DR PNP	DATE 11/09/22	TITLE USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2	
CKD KD	DATE 2/8/23		
APPD	DATE	PRODUCT DG1	DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION	DWG. SIZE B	FILE TYPE AutoCAD	.DWG FILENAME	ECO NUMBER 2300061	REVISION 02	G.O. NUMBER LBS0031682	DWG NO. ENG-090400-12544	SHEET 1 OF 2	

468-1140
REV. 11/11





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EGF0214D2300D00000*-RAM-3242
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EGF0214D2300D00000*-RAM-3142
EGF0214D2300D00000*-RAM-3141

▲ SEE SHT.01

EATON

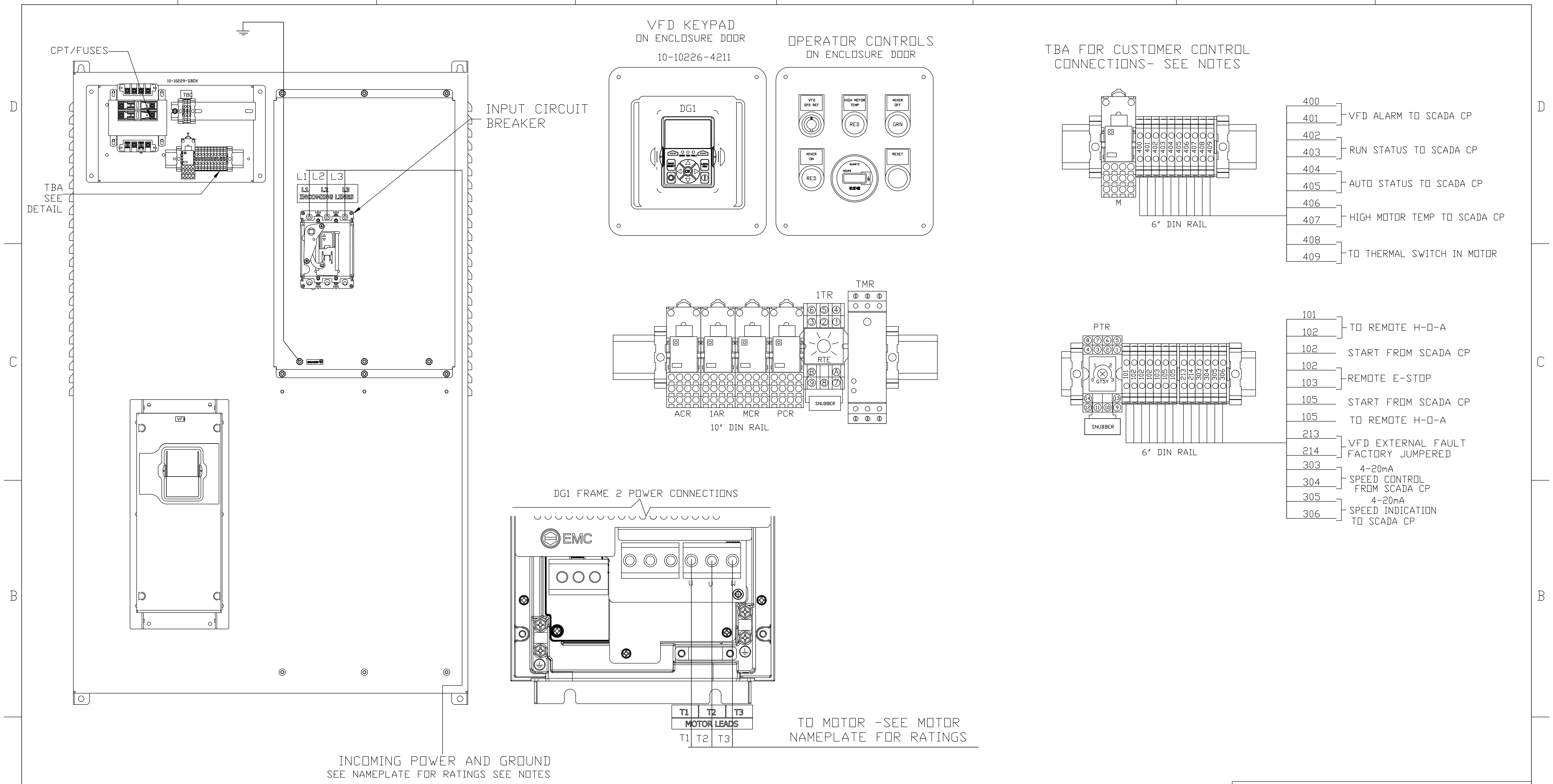
DR PNP DATE 11/09/22
CKD KD DATE 2/8/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2300061
REVISION 02
G.O. NUMBER LBS0031682
DWG NO. ENG-090400-12544
SHEET 2 OF 2

468-1140
REV. 11/11



NOTES

1. SEE SCHEMATIC FOR DETAILS AND CONTROL LOGIC - FACTORY WIRING DETAILS OMITTED.
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EGF0214D2300D00000*-RAM-3243
EGF0214D2300D00000*-RAM-3242
EGF0214D2300D00000*-RAM-3241
EGF0214D2300D00000*-RAM-3143
EGF0214D2300D00000*-RAM-3142
EGF0214D2300D00000*-RAM-3141

▲ NEW RELEASE

EATON

DR	DATE	CKD	DATE	APPD	DATE
PNP	11/09/22	KD	1/11/23		

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONNECTION DIAGRAM

THIRD ANGLE PROJECTION	DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
	B	AutoCAD		2200787	01	LBS0031682	ENG-900500-12571	1 OF 1

Master Document Index

Drives - Enclosed

Drives - Enclosed

	Drawing Description	Document Name	Rev
1	Master Drawing List	D00FTC7M01.DOC	3
2	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-000710-12459.DWG	01
3	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12544.DWG	02
4	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12544_SHT02.DWG	02
5	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-900500-12571.DWG	01

User **Karla Devora Maldonado**	**Date** **2/8/2023 10:22:08 AM**	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.		EATON Powering Business Worldwide
		D7580427X2K2		
		RAM-3243	**Construction Drawings**	
REVISION	DWG SIZE	G.O.	DWG	SHEET
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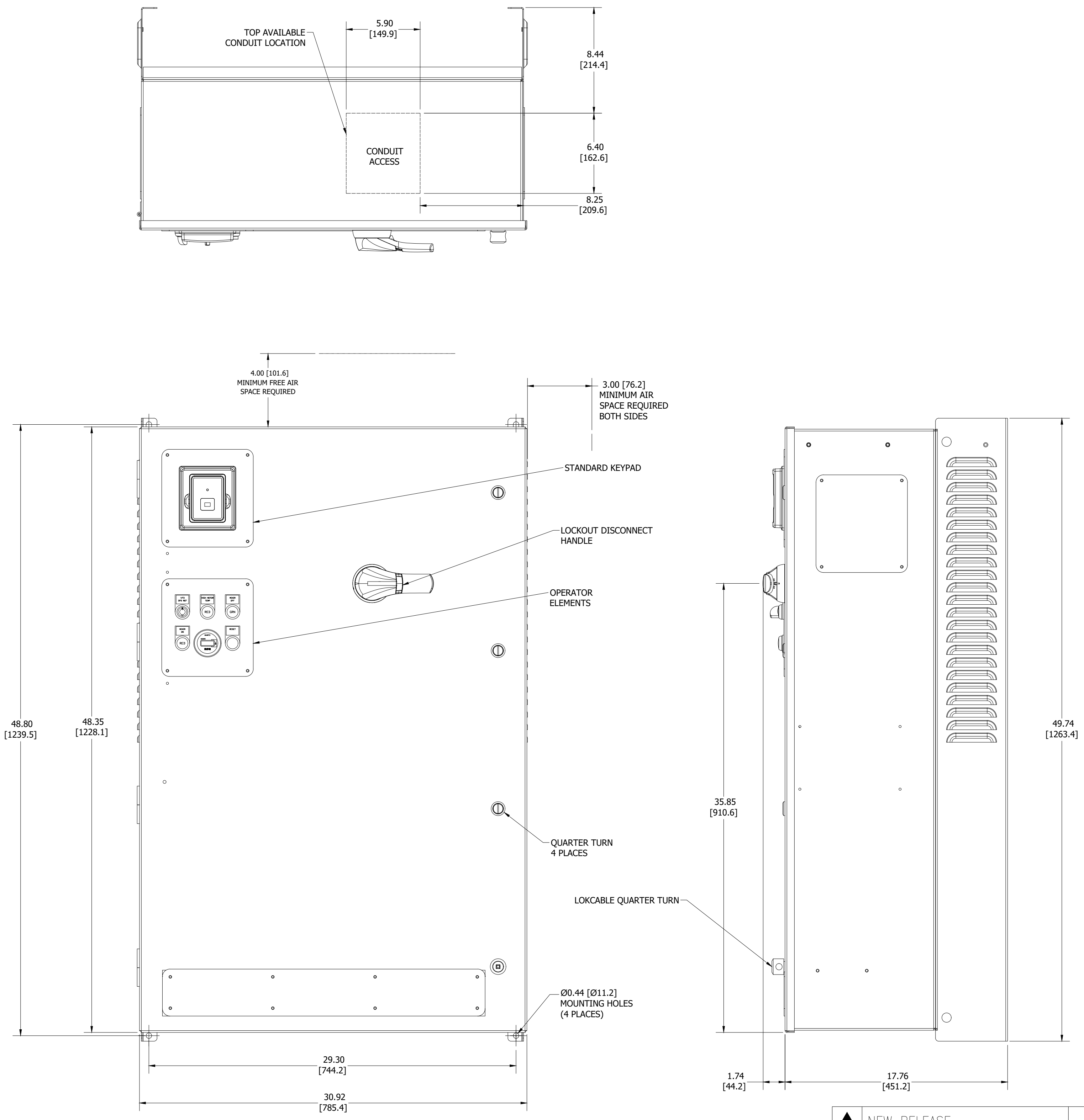

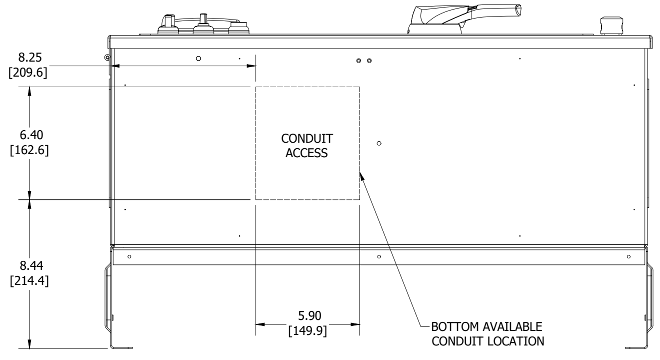

NOTES:
FINISH: ENCLOSURE - ANSI 61 (LIGHT) GRAY.
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MATERIAL: 14GA (0.0747) [1.90] CRS.
DIMENSIONS: INCHES, [MILLIMETERS].
CONSTRUCTION: NEMA TYPE 12 OVERSIZE

EGF0214D2300D00000*-RAM-3243
EGF0214D2300D00000*-RAM-3242
EGF0214D2300D00000*-RAM-3241
EGF0214D2300D00000*-RAM-3143
EGF0214D2300D00000*-RAM-3142
EGF0214D2300D00000*-RAM-3141

▲ NEW RELEASE

EATON

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE OUTLINE DIMENSION

THIRD ANGLE
PROJECTION

DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
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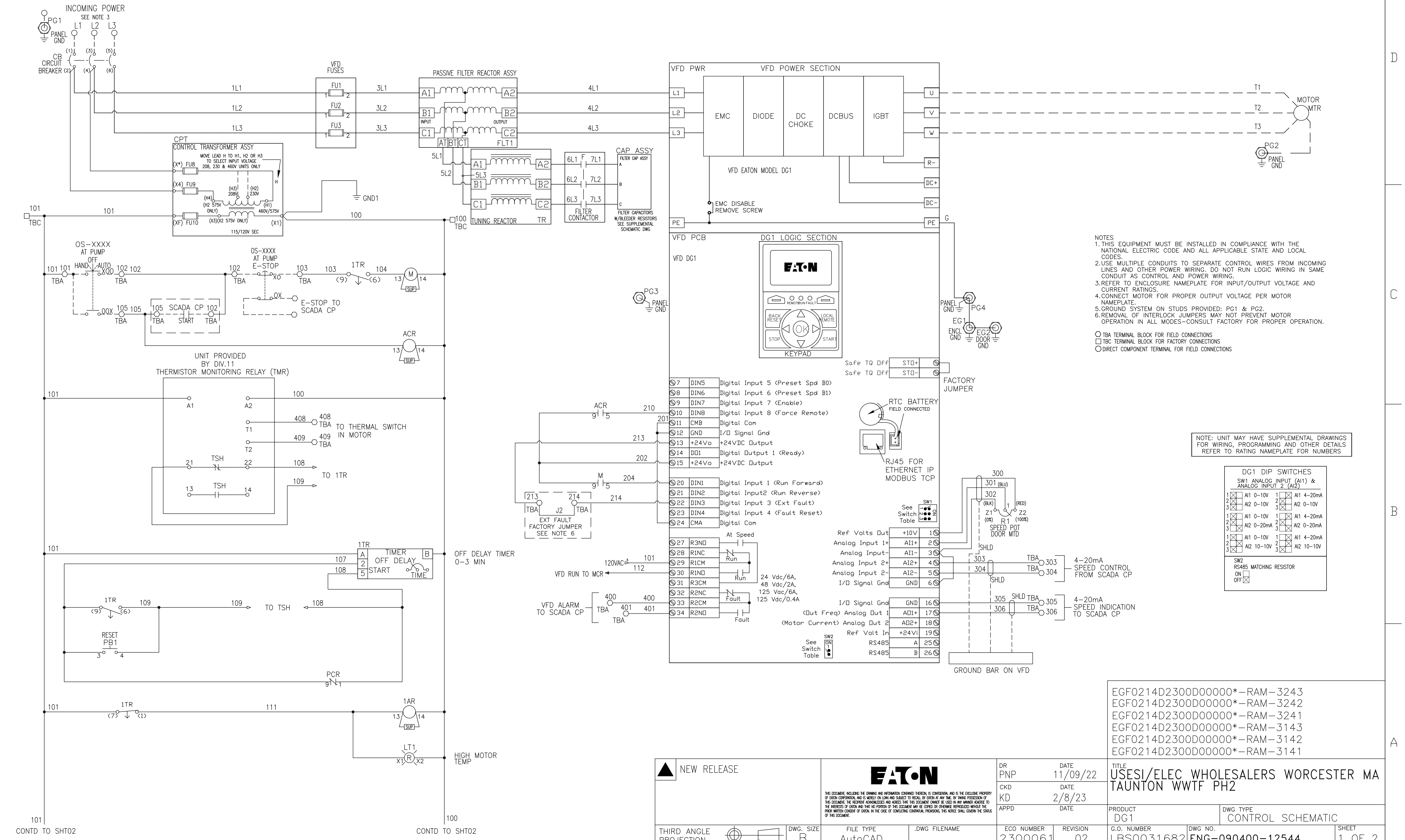

NOTES
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☐ TBC TERMINAL BLOCK FOR FACTORY CONNECTIONS
○ DIRECT COMPONENT TERMINAL FOR FIELD CONNECTIONS

NOTE: UNIT MAY HAVE SUPPLEMENTAL DRAWINGS FOR WIRING, PROGRAMMING AND OTHER DETAILS REFER TO RATING NAMEPLATE FOR NUMBERS

EGF0214D2300D00000*-RAM-3243
EGF0214D2300D00000*-RAM-3242
EGF0214D2300D00000*-RAM-3241
EGF0214D2300D00000*-RAM-3143
EGF0214D2300D00000*-RAM-3142
EGF0214D2300D00000*-RAM-3141

▲ NEW RELEASE

EATON

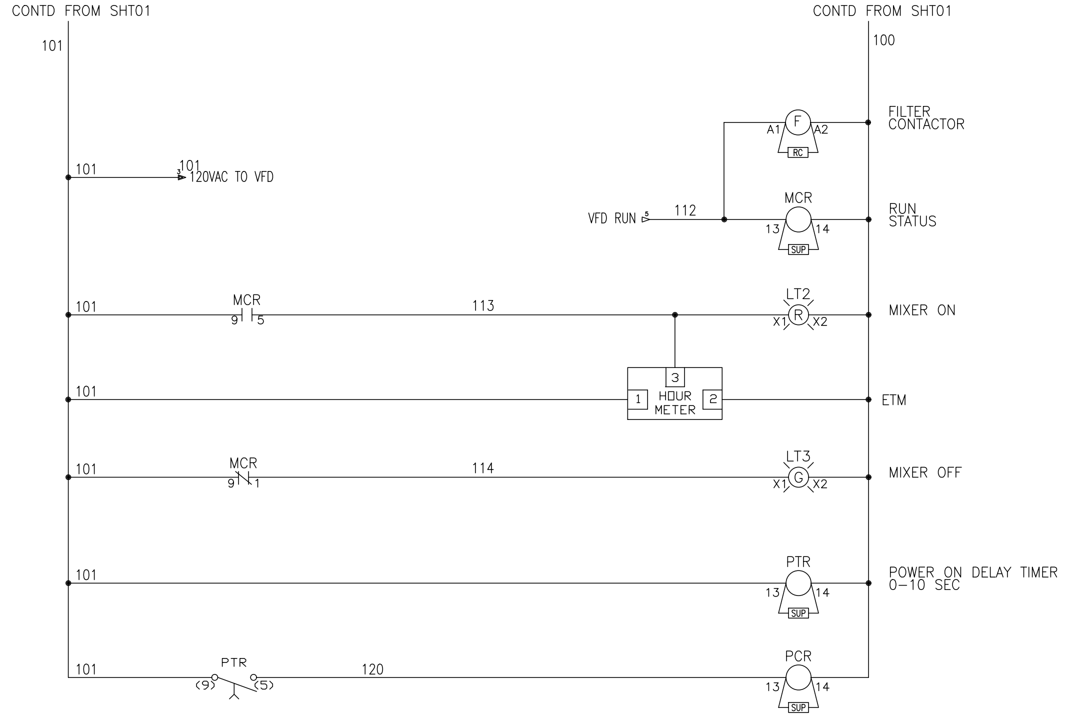
DR PNP DATE 11/09/22
CKD KD DATE 2/8/23
APPD DATE

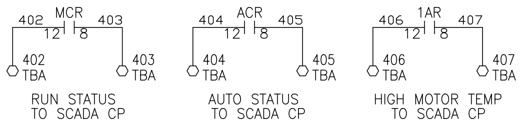
TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2300061
REVISION 02
G.O. NUMBER LBS0031682
DWG NO. ENG-090400-12544
SHEET 1 OF 2

468-1140
REV. 11/11





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EGF0214D2300D00000*-RAM-3242
EGF0214D2300D00000*-RAM-3241
EGF0214D2300D00000*-RAM-3143
EGF0214D2300D00000*-RAM-3142
EGF0214D2300D00000*-RAM-3141

▲ SEE SHT.01

EATON

DR PNP DATE 11/09/22
CKD KD DATE 2/8/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION	DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
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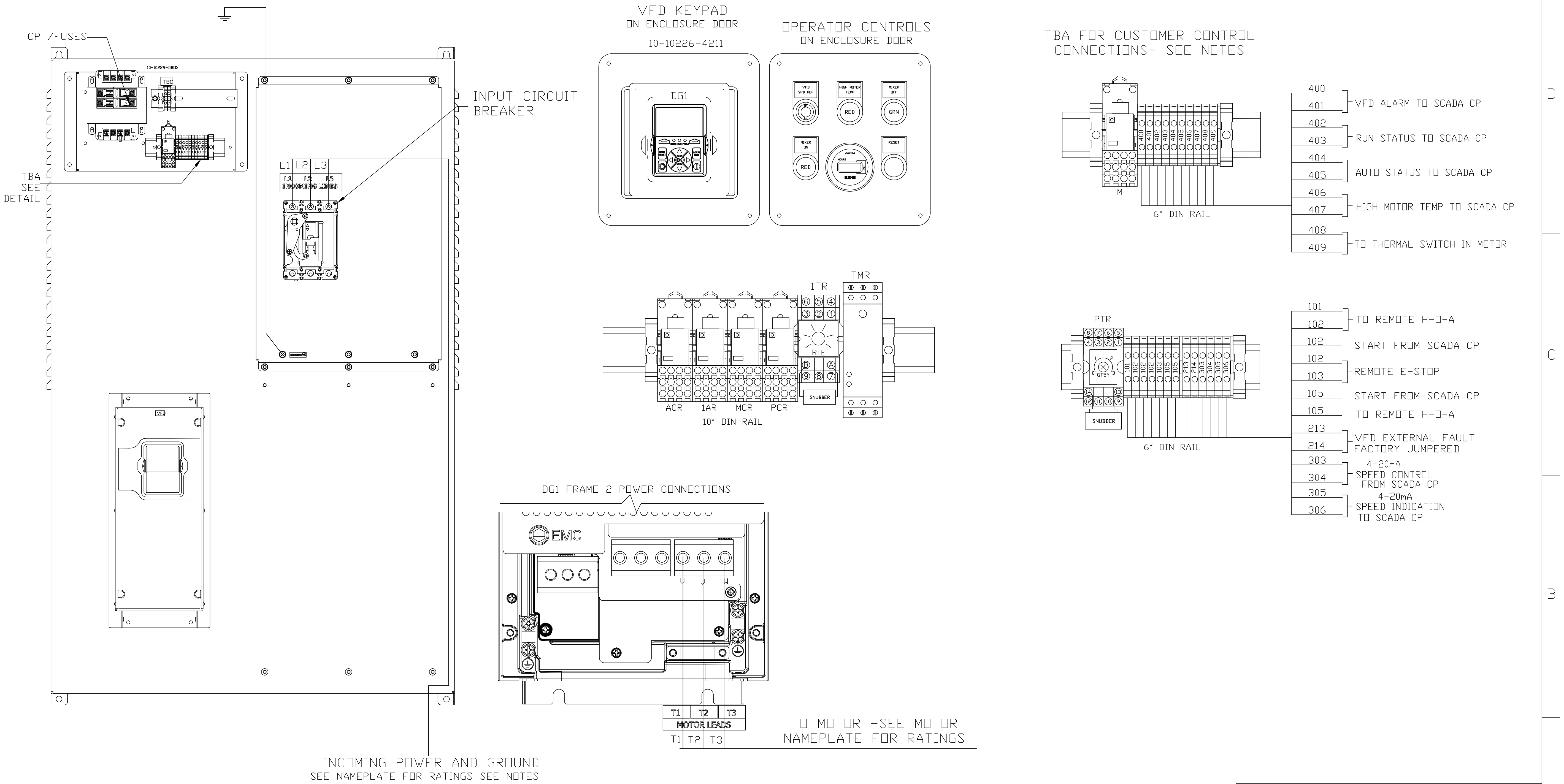

NOTES

1. SEE SCHEMATIC FOR DETAILS AND CONTROL LOGIC - FACTORY WIRING DETAILS OMITTED.
2. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGES AND CURRENT RATINGS.
3. ENCLOSURE MUST BE GROUNDED USING INPUT AND OUTPUT STUDS PROVIDED.
4. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL STATE/LOCAL CODES.
5. USE MULTIPLE CONDUITS TO SEPARATE 120 CONTROL (TBA 101/102 & 106/104) WIRING FROM INCOMING POWER WIRING.
6. 4-20MA AUTO SPEED SIGNAL CONNECTIONS ARE MADE DIRECTLY TO VFD CONTROL MODULE.
7. DO NOT RUN LOGIC WIRES (TBA 213/214 VFD EXT FAULT) IN SAME CONDUIT AS 120V OR POWER WIRING.
8. REMOVAL OF INTERLOCKS (TBA 101/102,213/214) MAY NOT PREVENT MOTOR OPERATION IN ALL MODES-CONSULT FACTORY FOR DETAILS.

EGF0214D2300D00000*-RAM-3243
EGF0214D2300D00000*-RAM-3242
EGF0214D2300D00000*-RAM-3241
EGF0214D2300D00000*-RAM-3143
EGF0214D2300D00000*-RAM-3142
EGF0214D2300D00000*-RAM-3141

▲ NEW RELEASE

EATON

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONNECTION DIAGRAM

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2200787
REVISION 01
G.O. NUMBER LBS0031682
DWG NO. ENG-900500-12571
SHEET 1 OF 1

468-1140
REV. 11/11

Master Document Index

Drives - Enclosed

Drives - Enclosed

	Drawing Description	Document Name	Rev
1	Master Drawing List	D00FTC1M01.DOC	3
2	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-000710-12460.DWG	01
3	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12543.DWG	02
4	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12543_SHT02.DWG	02
5	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-900500-12572.DWG	01

User **Karla Devora Maldonado**	**Date** **2/8/2023 10:26:36 AM**	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.		EATON Powering Business Worldwide
		D7580427X2K2		
		WSP-4121	**Construction Drawings**	
REVISION	DWG SIZE	G.O.	DWG	SHEET
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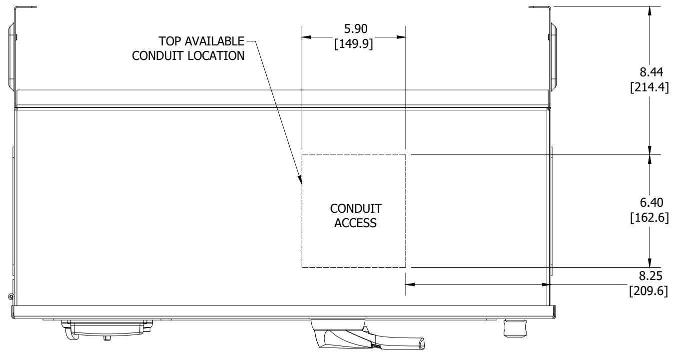
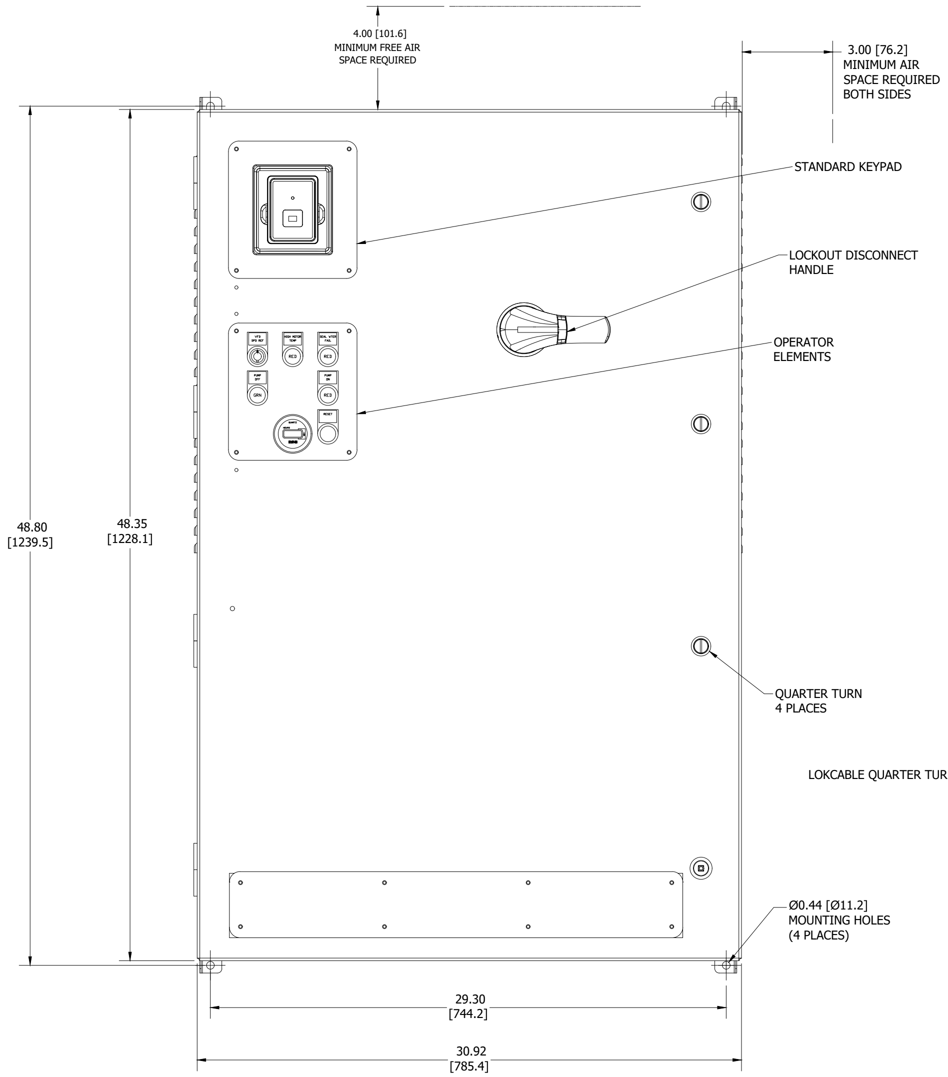
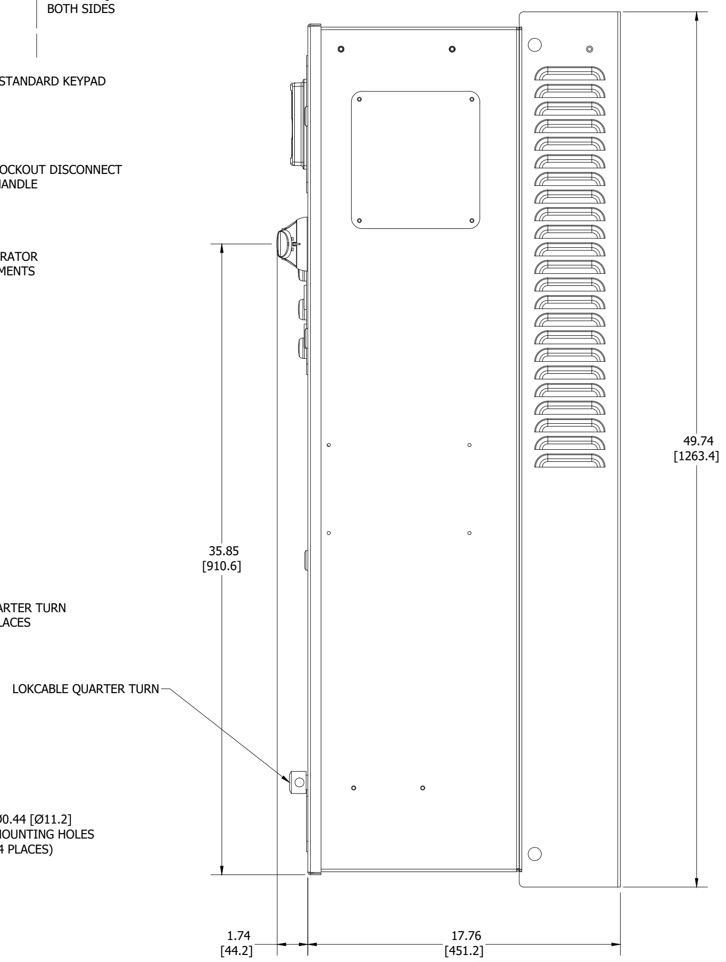
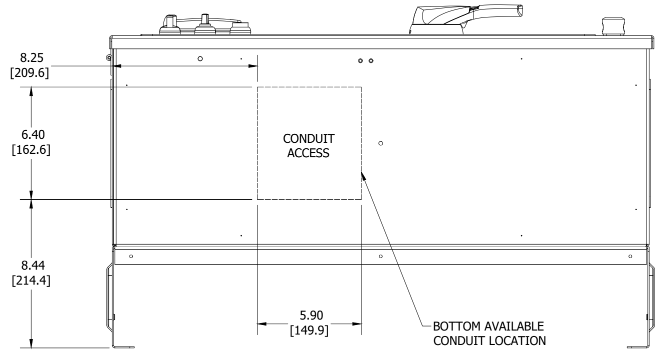








NOTES:
FINISH: ENCLOSURE - ANSI 61 (LIGHT) GRAY.
WEIGHT: APPROXIMATELY 350 LBS. [158] KG. 400 LBS [181] KG WITH STANDS.
MATERIAL: 14GA (0.0747) [1.90] CRS.
DIMENSIONS: INCHES, [MILLIMETERS].
CONSTRUCTION: NEMA TYPE 12 OVERSIZE

EGF0114D2300D00000*-SCP-4231
EGF0114D2300D00000*-SCP-4131
EGF0114D2300D00000*-WSP-4222
EGF0114D2300D00000*-WSP-4221
EGF0114D2300D00000*-WSP-4122
EGF0114D2300D00000*-WSP-4121

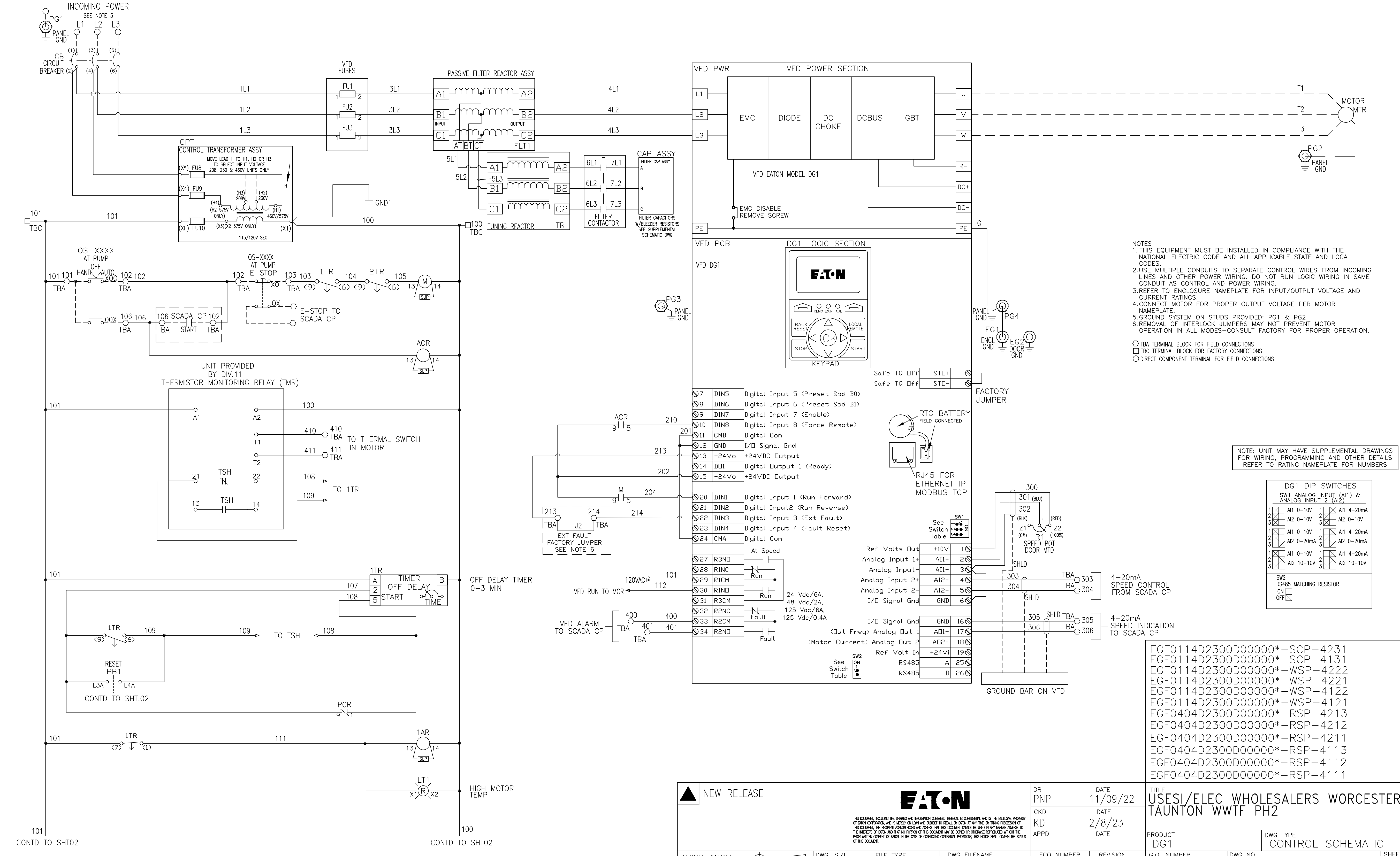
▲ NEW RELEASE

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE OUTLINE DIMENSION

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2200787
REVISION 01
G.O. NUMBER LBS0031682
DWG NO. ENG-000710-12460
SHEET 1 OF 1



NOTES
1. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL APPLICABLE STATE AND LOCAL CODES.
2. USE MULTIPLE CONDUITS TO SEPARATE CONTROL WIRES FROM INCOMING LINES AND OTHER POWER WIRING. DO NOT RUN LOGIC WIRING IN SAME CONDUIT AS CONTROL AND POWER WIRING.
3. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGE AND CURRENT RATINGS.
4. CONNECT MOTOR FOR PROPER OUTPUT VOLTAGE PER MOTOR NAMEPLATE.
5. GROUND SYSTEM ON STUDS PROVIDED: PG1 & PG2.
6. REMOVAL OF INTERLOCK JUMPERS MAY NOT PREVENT MOTOR OPERATION IN ALL MODES—CONSULT FACTORY FOR PROPER OPERATION.

⬡ TBA TERMINAL BLOCK FOR FIELD CONNECTIONS
☐ TBC TERMINAL BLOCK FOR FACTORY CONNECTIONS
○ DIRECT COMPONENT TERMINAL FOR FIELD CONNECTIONS

NOTE: UNIT MAY HAVE SUPPLEMENTAL DRAWINGS FOR WIRING, PROGRAMMING AND OTHER DETAILS REFER TO RATING NAMEPLATE FOR NUMBERS

EGF0114D2300D00000*-SCP-4231
EGF0114D2300D00000*-SCP-4131
EGF0114D2300D00000*-WSP-4222
EGF0114D2300D00000*-WSP-4221
EGF0114D2300D00000*-WSP-4122
EGF0114D2300D00000*-WSP-4121
EGF0404D2300D00000*-RSP-4213
EGF0404D2300D00000*-RSP-4212
EGF0404D2300D00000*-RSP-4211
EGF0404D2300D00000*-RSP-4113
EGF0404D2300D00000*-RSP-4112
EGF0404D2300D00000*-RSP-4111

▲ NEW RELEASE

EATON

DR PNP	DATE 11/09/22	TITLE USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2	
CKD KD	DATE 2/8/23		
APPD	DATE	PRODUCT DG1	DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION	DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
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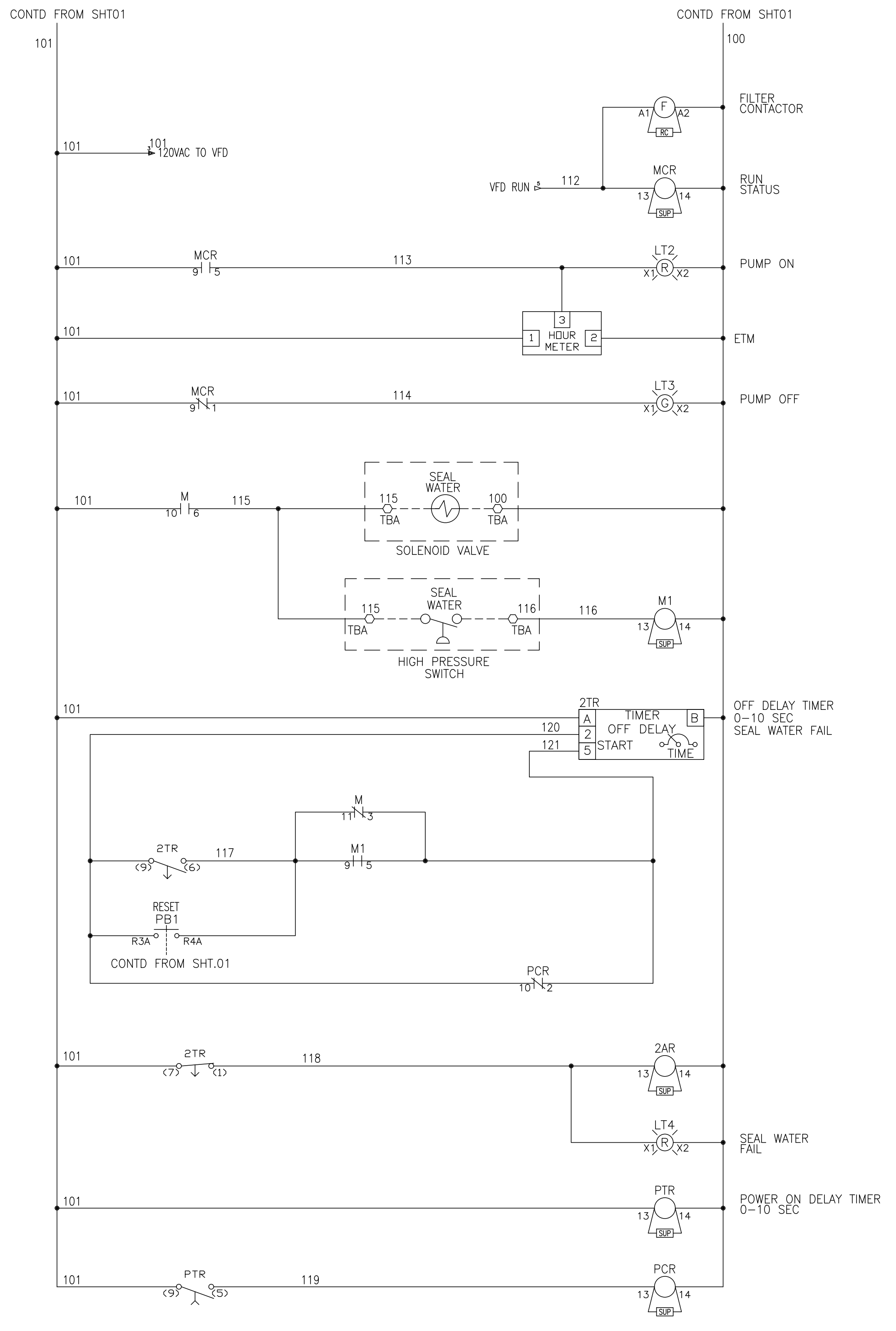

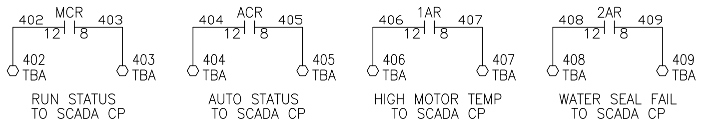

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EGF0114D2300D00000*–WSP–4222
EGF0114D2300D00000*–WSP–4221
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EGF0114D2300D00000*–WSP–4121
EGF0404D2300D00000*–RSP–4213
EGF0404D2300D00000*–RSP–4212
EGF0404D2300D00000*–RSP–4211
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EGF0404D2300D00000*–RSP–4111

▲ SEE SHT.01

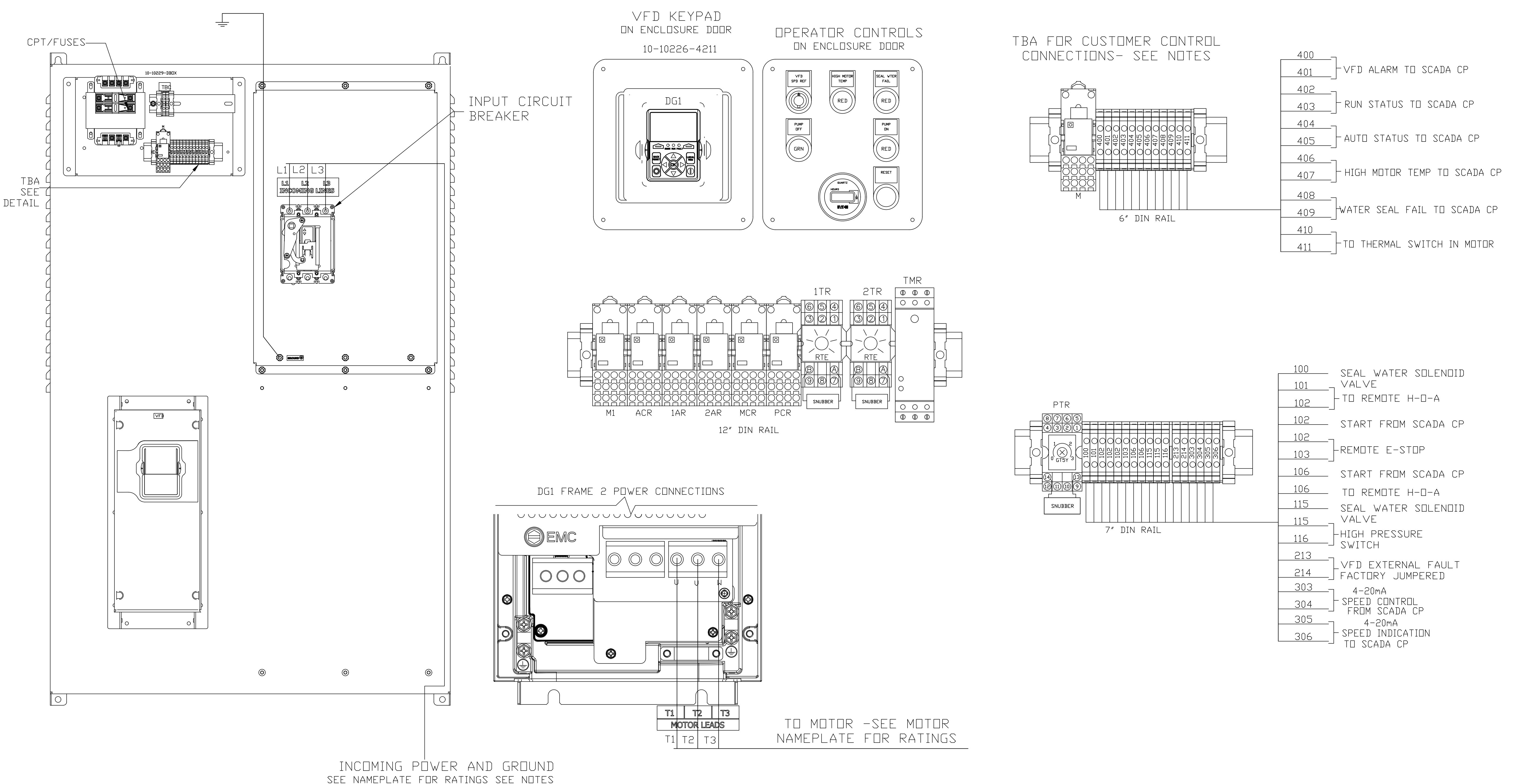
EATON

DR PNP DATE 11/09/22
CKD KD DATE 2/8/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2300061
REVISION 02
G.O. NUMBER LBS0031682
DWG NO. ENG–090400–12543
SHEET 2 OF 2



NOTES

1. SEE SCHEMATIC FOR DETAILS AND CONTROL LOGIC - FACTORY WIRING DETAILS OMITTED.
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6. 4-20MA AUTO SPEED SIGNAL CONNECTIONS ARE MADE DIRECTLY TO VFD CONTROL MODULE.
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EGF0114D2300D00000*-SCP-4231
EGF0114D2300D00000*-SCP-4131
EGF0114D2300D00000*-WSP-4222
EGF0114D2300D00000*-WSP-4221
EGF0114D2300D00000*-WSP-4122
EGF0114D2300D00000*-WSP-4121

▲ NEW RELEASE

EATON

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONNECTION DIAGRAM

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2200787
REVISION 01
G.O. NUMBER LBS0031682
DWG NO. ENG-900500-12572
SHEET 1 OF 1

Master Document Index

Drives - Enclosed
Drives - Enclosed

	Drawing Description	Document Name	Rev
1	Master Drawing List	D00FTB5M01.DOC	3
2	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-000710-12460.DWG	01
3	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12543.DWG	02
4	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12543_SHT02.DWG	02
5	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-900500-12572.DWG	01

User **Karla Devora Maldonado**	**Date** **2/8/2023 10:28:45 AM**	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.		EATON Powering Business Worldwide
		D7580427X2K2		
		WSP-4122	**Construction Drawings**	
REVISION	DWG SIZE	G.O.	DWG	SHEET
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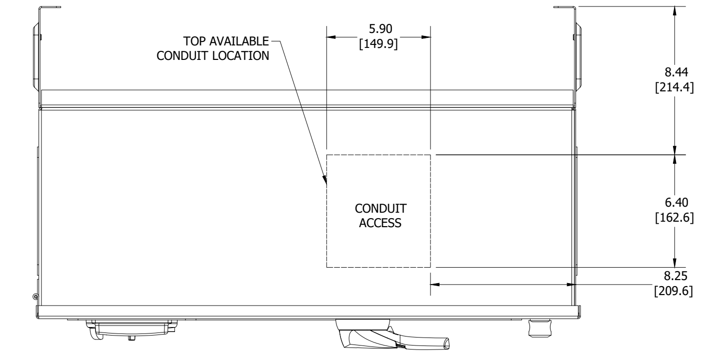

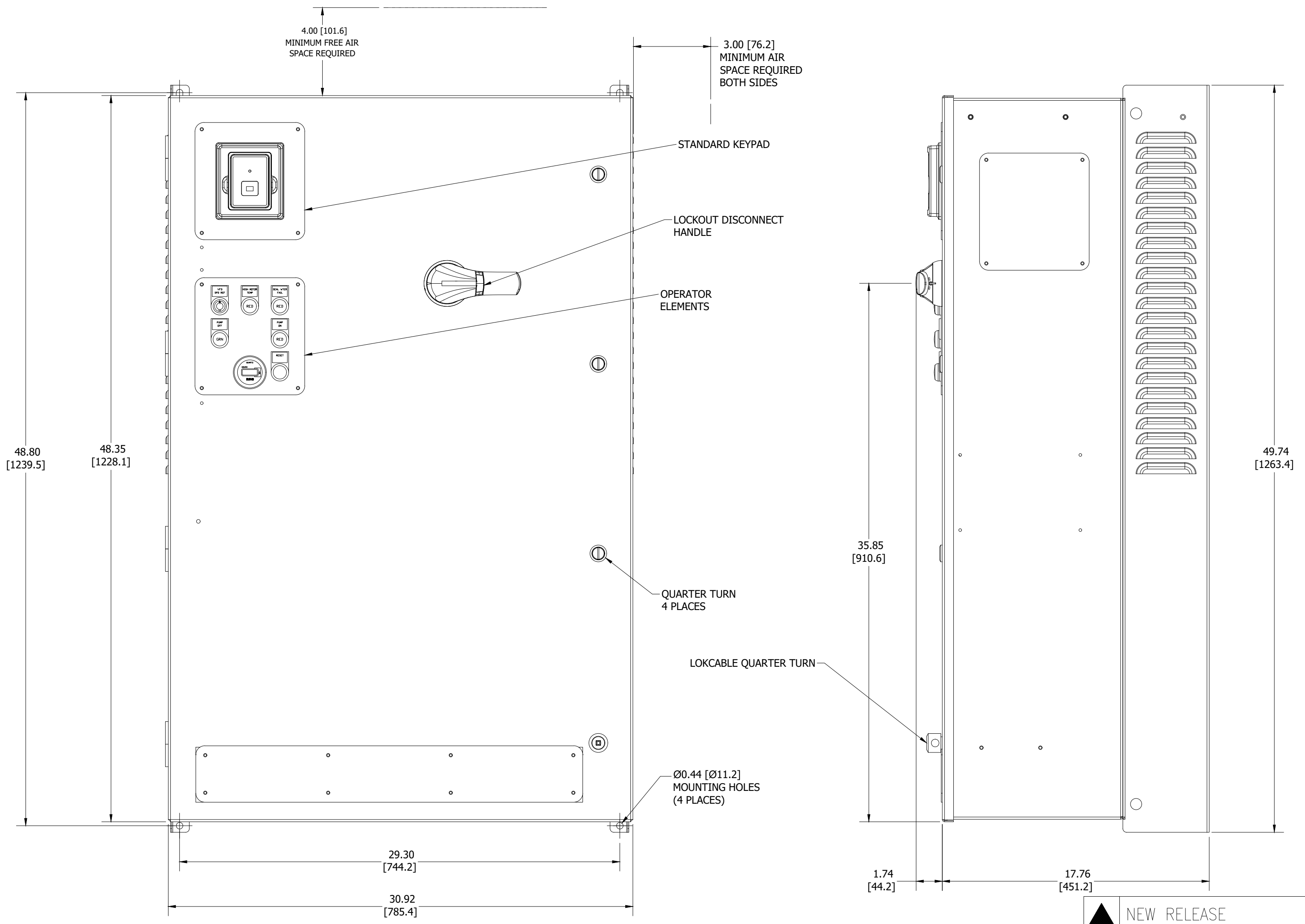

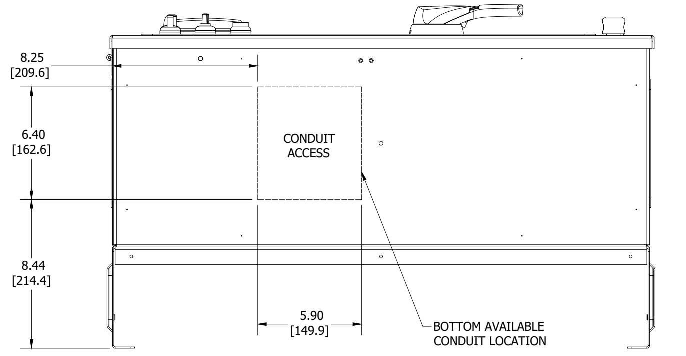

NOTES:
FINISH: ENCLOSURE - ANSI 61 (LIGHT) GRAY.
WEIGHT: APPROXIMATELY 350 LBS. [158] KG. 400 LBS [181] KG WITH STANDS.
MATERIAL: 14GA (0.0747) [1.90] CRS.
DIMENSIONS: INCHES, [MILLIMETERS].
CONSTRUCTION: NEMA TYPE 12 OVERSIZE

EGF0114D2300D00000*-SCP-4231
EGF0114D2300D00000*-SCP-4131
EGF0114D2300D00000*-WSP-4222
EGF0114D2300D00000*-WSP-4221
EGF0114D2300D00000*-WSP-4122
EGF0114D2300D00000*-WSP-4121

▲ NEW RELEASE

EATON

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE OUTLINE DIMENSION

THIRD ANGLE PROJECTION	DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
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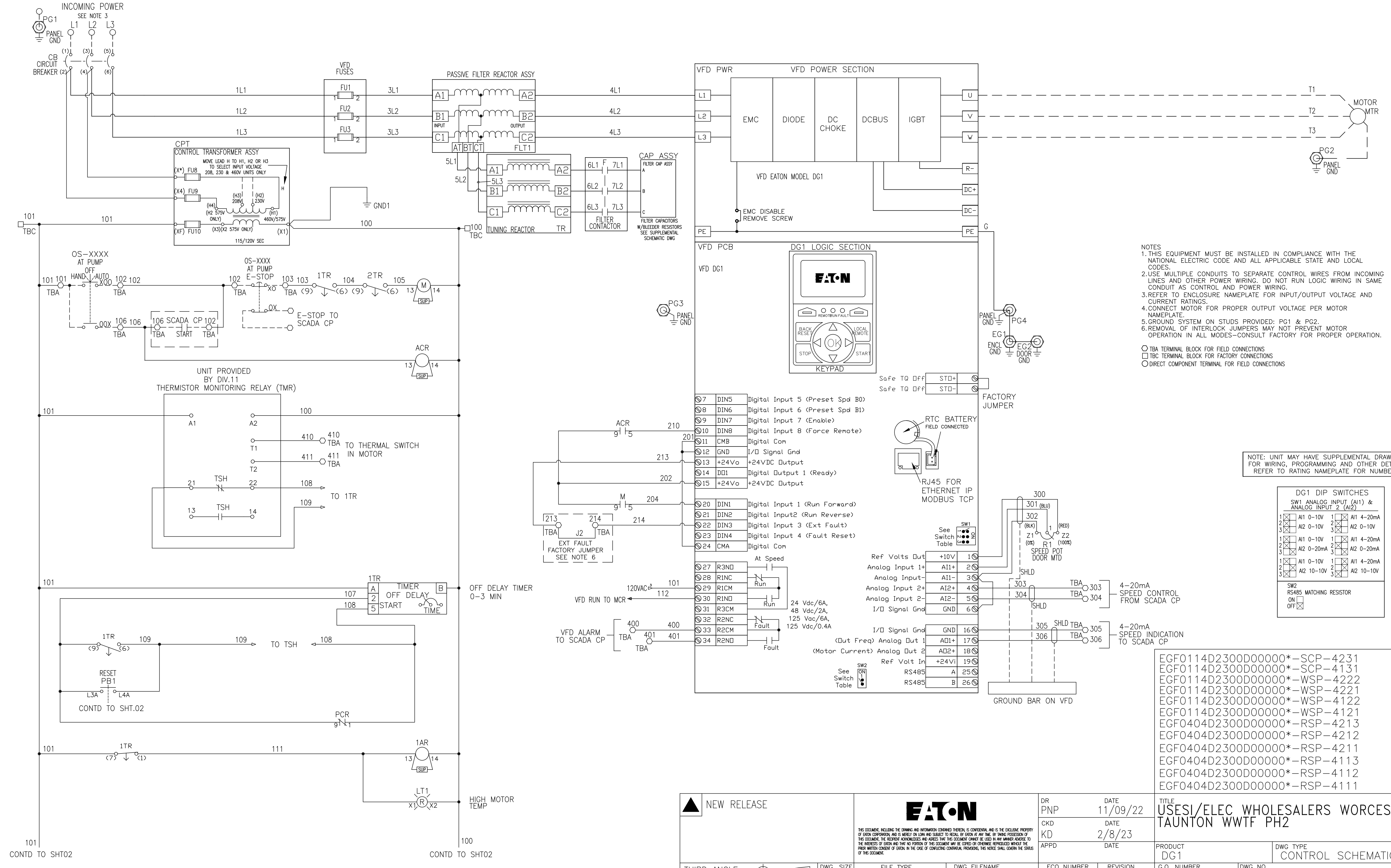
468-1140
REV. 11/11



NOTES
1. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL APPLICABLE STATE AND LOCAL CODES.
2. USE MULTIPLE CONDUITS TO SEPARATE CONTROL WIRES FROM INCOMING LINES AND OTHER POWER WIRING. DO NOT RUN LOGIC WIRING IN SAME CONDUIT AS CONTROL AND POWER WIRING.
3. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGE AND CURRENT RATINGS.
4. CONNECT MOTOR FOR PROPER OUTPUT VOLTAGE PER MOTOR NAMEPLATE.
5. GROUND SYSTEM ON STUDS PROVIDED: PG1 & PG2.
6. REMOVAL OF INTERLOCK JUMPERS MAY NOT PREVENT MOTOR OPERATION IN ALL MODES—CONSULT FACTORY FOR PROPER OPERATION.

⬡ TBA TERMINAL BLOCK FOR FIELD CONNECTIONS
☐ TBC TERMINAL BLOCK FOR FACTORY CONNECTIONS
○ DIRECT COMPONENT TERMINAL FOR FIELD CONNECTIONS

NOTE: UNIT MAY HAVE SUPPLEMENTAL DRAWINGS FOR WIRING, PROGRAMMING AND OTHER DETAILS REFER TO RATING NAMEPLATE FOR NUMBERS

DG1 DIP SWITCHES

SW1 ANALOG INPUT (AI1) & ANALOG INPUT 2 (AI2)

1	☒ ☐	AI1 0-10V	1	☐ ☒	AI1 4-20mA
2	☒ ☐	AI2 0-10V	2	☒ ☐	AI2 0-10V
3	☒ ☐		3	☒ ☐	
1	☒ ☐	AI1 0-10V	1	☐ ☒	AI1 4-20mA
2	☒ ☐	AI2 0-20mA	2	☒ ☐	AI2 0-20mA
3	☐ ☒		3	☐ ☒	
1	☒ ☐	AI1 0-10V	1	☐ ☒	AI1 4-20mA
2	☐ ☒	AI2 10-10V	2	☐ ☒	AI2 10-10V
3	☒ ☐		3	☒ ☐	

SW2
RS485 MATCHING RESISTOR
ON ☐
OFF ☒

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EGF0114D2300D00000*-SCP-4131
EGF0114D2300D00000*-WSP-4222
EGF0114D2300D00000*-WSP-4221
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EGF0114D2300D00000*-WSP-4121
EGF0404D2300D00000*-RSP-4213
EGF0404D2300D00000*-RSP-4212
EGF0404D2300D00000*-RSP-4211
EGF0404D2300D00000*-RSP-4113
EGF0404D2300D00000*-RSP-4112
EGF0404D2300D00000*-RSP-4111

▲ NEW RELEASE

EATON

DR	DATE	TITLE
PNP	11/09/22	USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2
CKD	DATE	
KD	2/8/23	
APPD	DATE	

PRODUCT: DG1
DWG TYPE: CONTROL SCHEMATIC

THIRD ANGLE PROJECTION	DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
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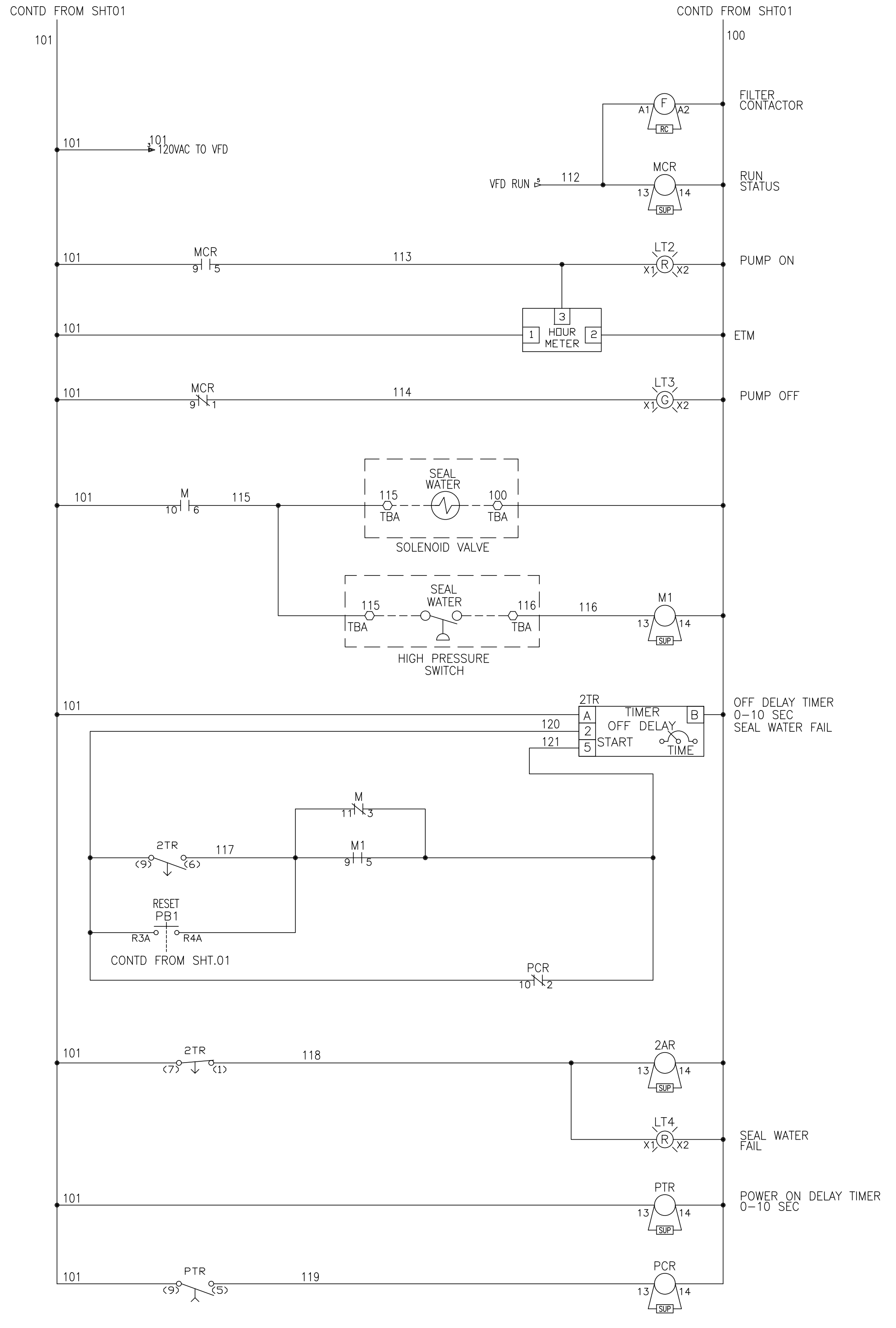

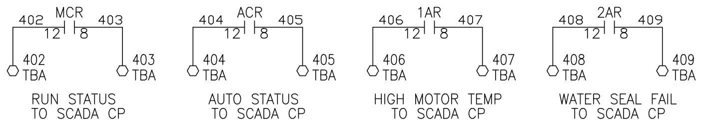

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EGF0114D2300D00000*-WSP-4222
EGF0114D2300D00000*-WSP-4221
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EGF0114D2300D00000*-WSP-4121
EGF0404D2300D00000*-RSP-4213
EGF0404D2300D00000*-RSP-4212
EGF0404D2300D00000*-RSP-4211
EGF0404D2300D00000*-RSP-4113
EGF0404D2300D00000*-RSP-4112
EGF0404D2300D00000*-RSP-4111

▲ SEE SHT.01

EATON

DR PNP DATE 11/09/22
CKD KD DATE 2/8/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION

DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
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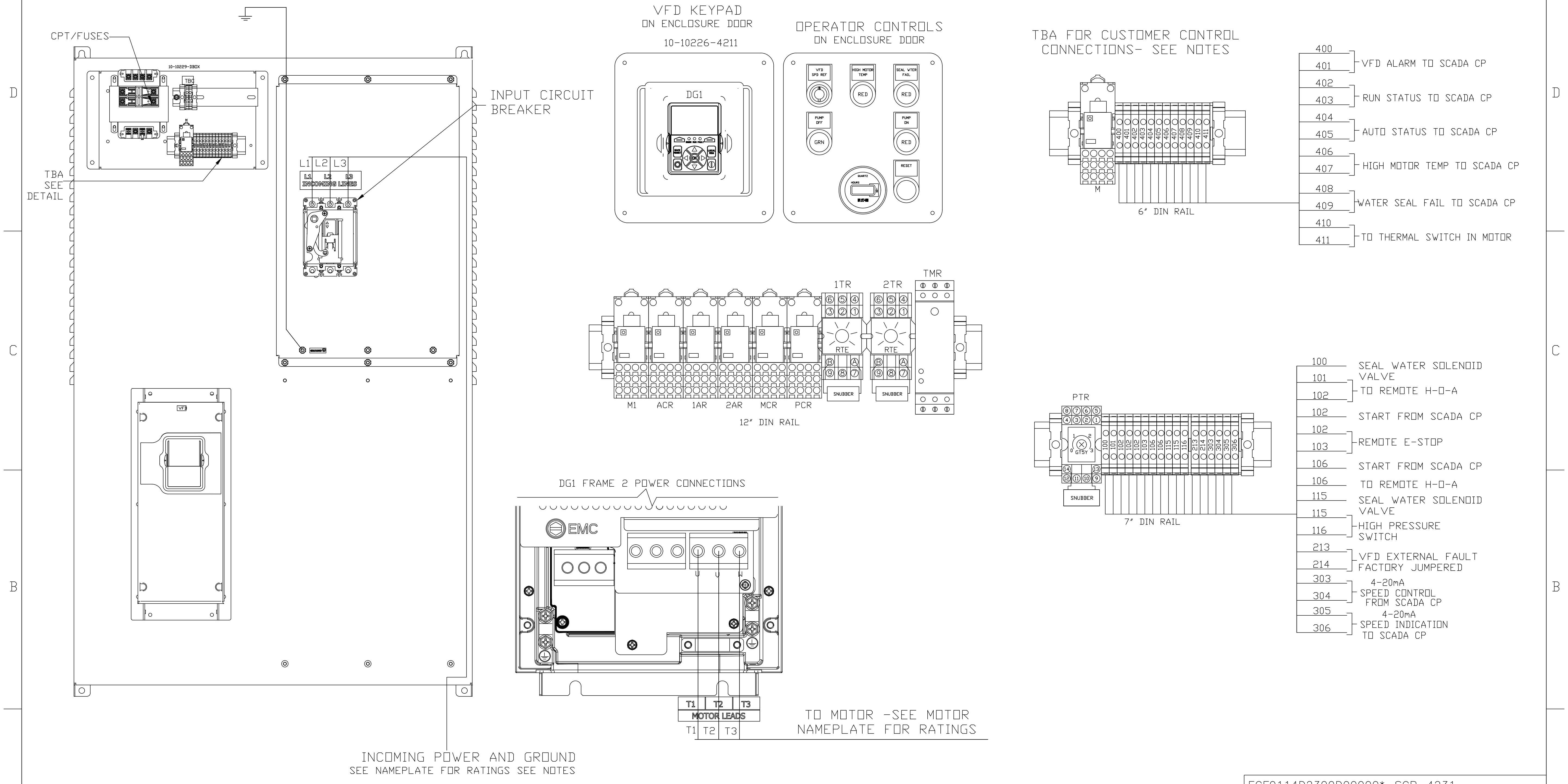
468-1140
REV. 11/11



NOTES

1. SEE SCHEMATIC FOR DETAILS AND CONTROL LOGIC - FACTORY WIRING DETAILS OMITTED.
2. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGES AND CURRENT RATINGS.
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6. 4-20MA AUTO SPEED SIGNAL CONNECTIONS ARE MADE DIRECTLY TO VFD CONTROL MODULE.
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EGF0114D2300D00000*-SCP-4231
EGF0114D2300D00000*-SCP-4131
EGF0114D2300D00000*-WSP-4222
EGF0114D2300D00000*-WSP-4221
EGF0114D2300D00000*-WSP-4122
EGF0114D2300D00000*-WSP-4121

▲ NEW RELEASE

EATON

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONNECTION DIAGRAM

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2200787
REVISION 01
G.O. NUMBER LBS0031682
DWG NO. ENG-900500-12572
SHEET 1 OF 1

468-1140
REV. 11/11

Master Document Index

Drives - Enclosed
Drives - Enclosed

	Drawing Description	Document Name	Rev
1	Master Drawing List	D00FTB4M01.DOC	3
2	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-000710-12460.DWG	01
3	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12543.DWG	02
4	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12543_SHT02.DWG	02
5	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-900500-12572.DWG	01

User **Karla** **Devora** **Maldonado**	**Date** **2/8/2023** **10:35:07** **AM**	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.		EATON Powering Business Worldwide
		D7580427X2K2		
		SCP-4131	**Construction Drawings**	
REVISION	DWG SIZE	G.O.	DWG	SHEET
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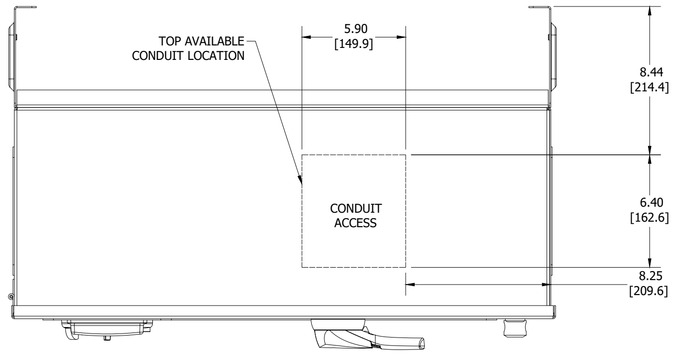
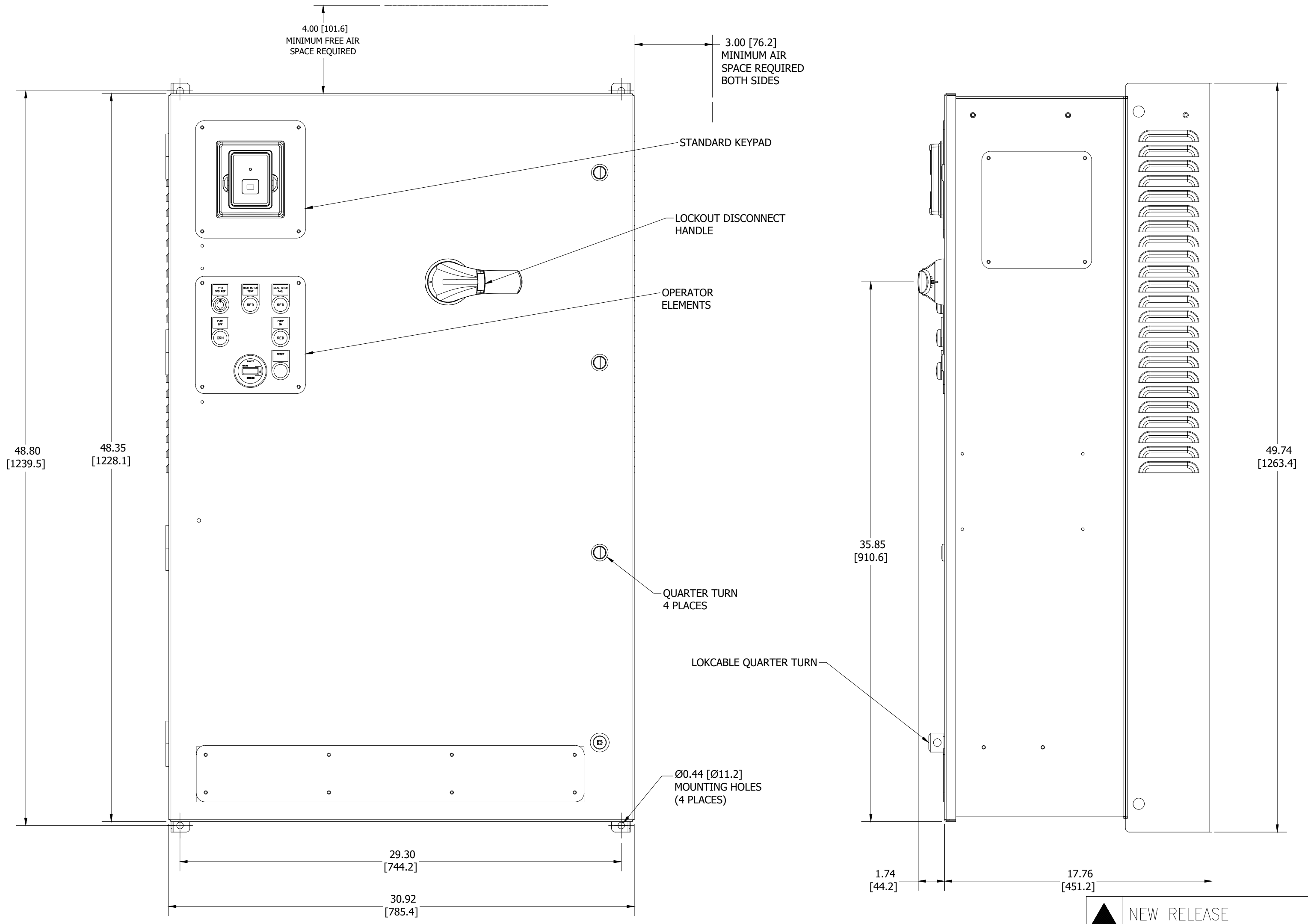
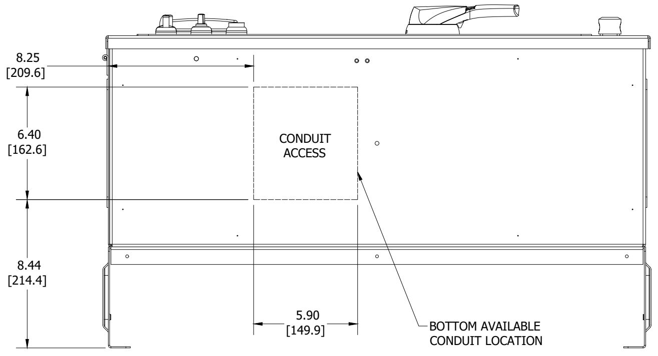






NOTES:
FINISH: ENCLOSURE - ANSI 61 (LIGHT) GRAY.
WEIGHT: APPROXIMATELY 350 LBS. [158] KG. 400 LBS [181] KG WITH STANDS.
MATERIAL: 14GA (0.0747) [1.90] CRS.
DIMENSIONS: INCHES, [MILLIMETERS].
CONSTRUCTION: NEMA TYPE 12 OVERSIZE

EGF0114D2300D00000*-SCP-4231
EGF0114D2300D00000*-SCP-4131
EGF0114D2300D00000*-WSP-4222
EGF0114D2300D00000*-WSP-4221
EGF0114D2300D00000*-WSP-4122
EGF0114D2300D00000*-WSP-4121

▲ NEW RELEASE

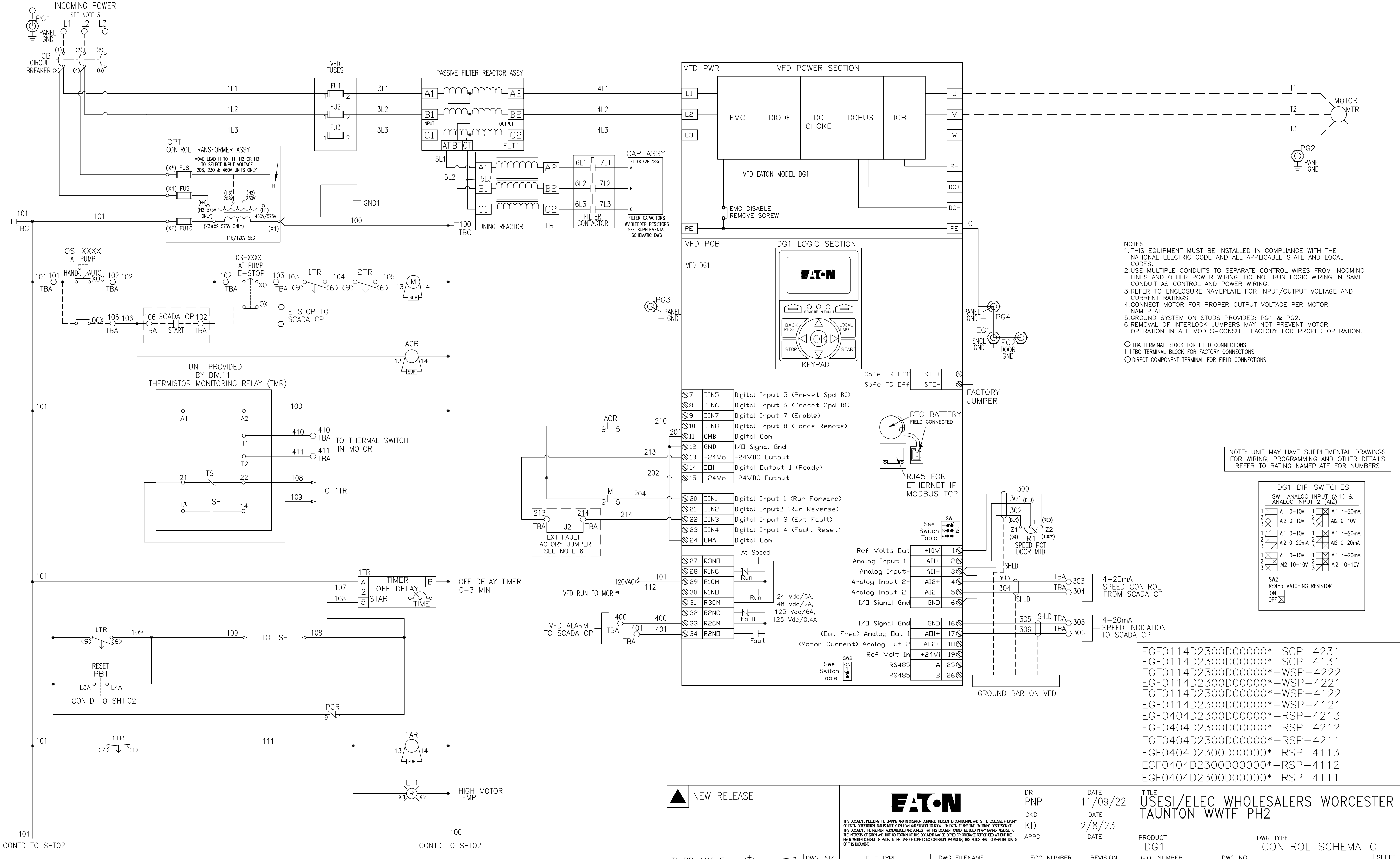
EATON

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE OUTLINE DIMENSION

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2200787
REVISION 01
G.O. NUMBER LBS0031682
DWG NO. ENG-000710-12460
SHEET 1 OF 1



NOTES
1. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL APPLICABLE STATE AND LOCAL CODES.
2. USE MULTIPLE CONDUITS TO SEPARATE CONTROL WIRES FROM INCOMING LINES AND OTHER POWER WIRING. DO NOT RUN LOGIC WIRING IN SAME CONDUIT AS CONTROL AND POWER WIRING.
3. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGE AND CURRENT RATINGS.
4. CONNECT MOTOR FOR PROPER OUTPUT VOLTAGE PER MOTOR NAMEPLATE.
5. GROUND SYSTEM ON STUDS PROVIDED: PG1 & PG2.
6. REMOVAL OF INTERLOCK JUMPERS MAY NOT PREVENT MOTOR OPERATION IN ALL MODES–CONSULT FACTORY FOR PROPER OPERATION.

⬡ TBA TERMINAL BLOCK FOR FIELD CONNECTIONS
☐ TBC TERMINAL BLOCK FOR FACTORY CONNECTIONS
○ DIRECT COMPONENT TERMINAL FOR FIELD CONNECTIONS

NOTE: UNIT MAY HAVE SUPPLEMENTAL DRAWINGS FOR WIRING, PROGRAMMING AND OTHER DETAILS REFER TO RATING NAMEPLATE FOR NUMBERS

DG1 DIP SWITCHES

SW1 ANALOG INPUT (AI1) & ANALOG INPUT 2 (AI2)

AI1 0-10V / AI2 0-10V
AI1 4-20mA / AI2 0-10V
AI1 0-10V / AI2 0-20mA
AI1 4-20mA / AI2 0-20mA
AI1 0-10V / AI2 10-10V
AI1 4-20mA / AI2 10-10V

SW2
RS485 MATCHING RESISTOR
ON ☐
OFF ☒

EGF0114D2300D00000*-SCP-4231
EGF0114D2300D00000*-SCP-4131
EGF0114D2300D00000*-WSP-4222
EGF0114D2300D00000*-WSP-4221
EGF0114D2300D00000*-WSP-4122
EGF0114D2300D00000*-WSP-4121
EGF0404D2300D00000*-RSP-4213
EGF0404D2300D00000*-RSP-4212
EGF0404D2300D00000*-RSP-4211
EGF0404D2300D00000*-RSP-4113
EGF0404D2300D00000*-RSP-4112
EGF0404D2300D00000*-RSP-4111

NEW RELEASE

EATON

DR	DATE	TITLE
PNP	11/09/22	USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2
CKD KD	DATE 2/8/23	
APPD	DATE	PRODUCT DG1 / DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION	DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
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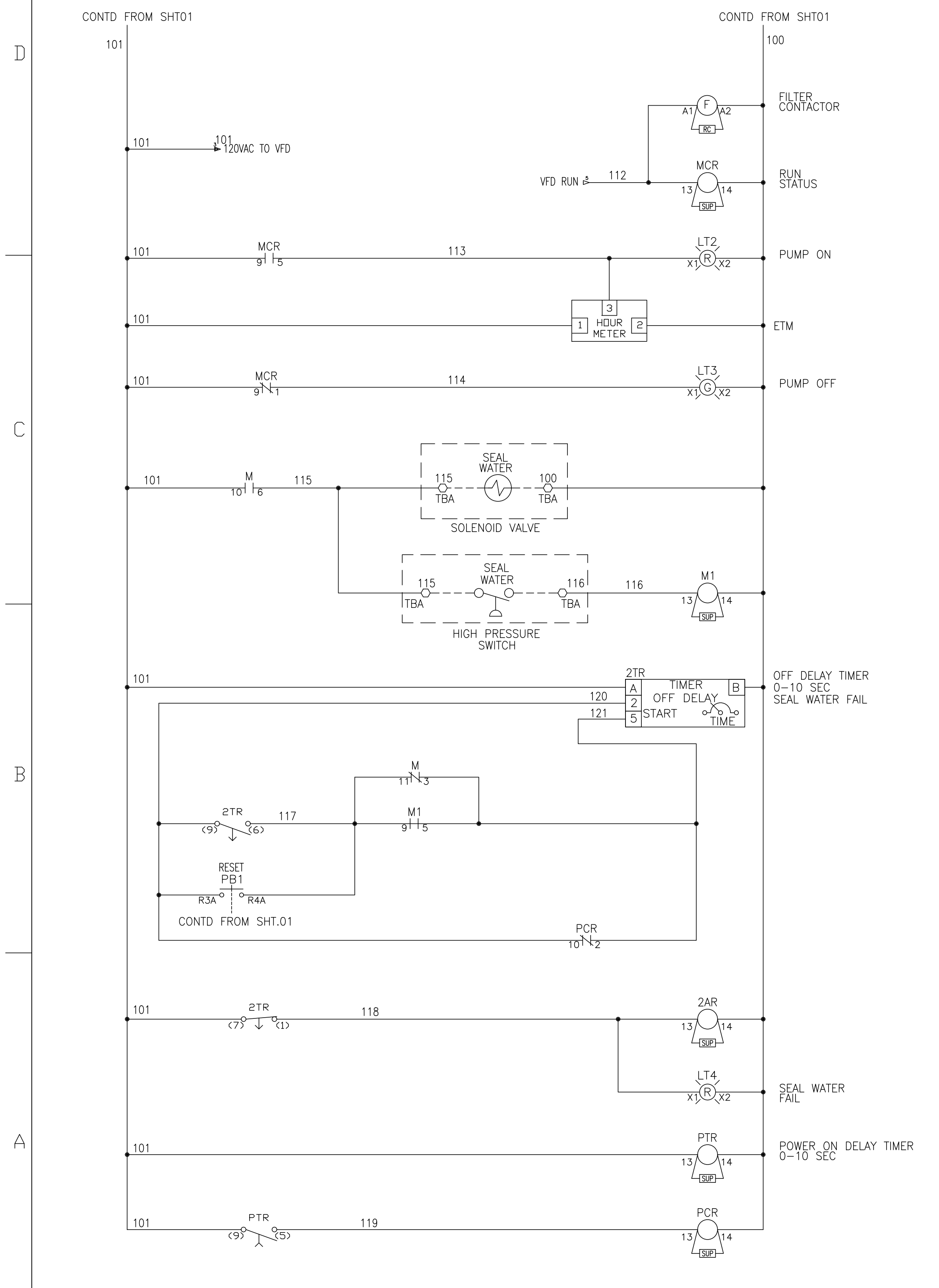
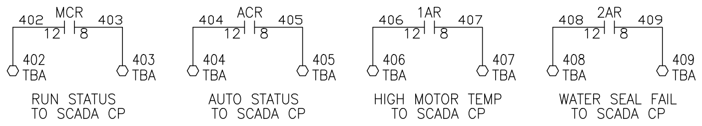
468-1140
REV. 11/11





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EGF0404D2300D00000*-RSP-4111

▲ SEE SHT.01

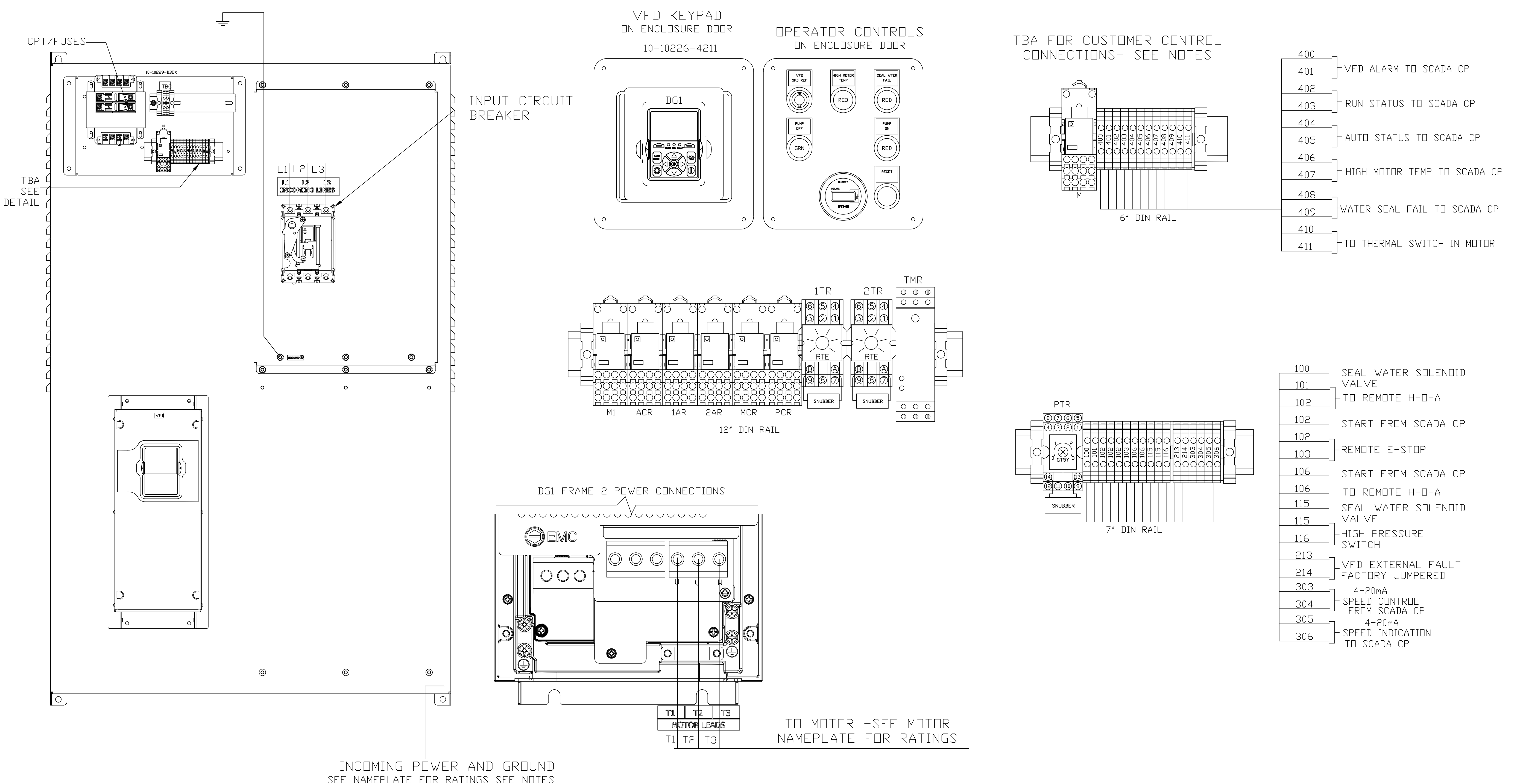
EATON

DR PNP
DATE 11/09/22
CKD KD
DATE 2/8/23
APPD
DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2300061
REVISION 02
G.O. NUMBER LBS0031682
DWG NO. ENG-090400-12543
SHEET 2 OF 2



NOTES

1. SEE SCHEMATIC FOR DETAILS AND CONTROL LOGIC - FACTORY WIRING DETAILS OMITTED.
2. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGES AND CURRENT RATINGS.
3. ENCLOSURE MUST BE GROUNDED USING INPUT AND OUTPUT STUDS PROVIDED.
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5. USE MULTIPLE CONDUITS TO SEPARATE 120 CONTROL (TBA 101/102 & 106/104) WIRING FROM INCOMING POWER WIRING.
6. 4-20MA AUTO SPEED SIGNAL CONNECTIONS ARE MADE DIRECTLY TO VFD CONTROL MODULE.
7. DO NOT RUN LOGIC WIRES (TBA 213/214 VFD EXT FAULT) IN SAME CONDUIT AS 120V OR POWER WIRING.
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EGF0114D2300D00000*-SCP-4231
EGF0114D2300D00000*-SCP-4131
EGF0114D2300D00000*-WSP-4222
EGF0114D2300D00000*-WSP-4221
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▲ NEW RELEASE

EATON

DR	DATE	TITLE
PNP	11/09/22	USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2
CKD	DATE	
KD	1/11/23	
APPD	DATE	PRODUCT: DG1 — DWG TYPE: CONNECTION DIAGRAM

THIRD ANGLE PROJECTION	DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
	B	AutoCAD		2200787	01	LBS0031682	ENG-900500-12572	1 OF 1

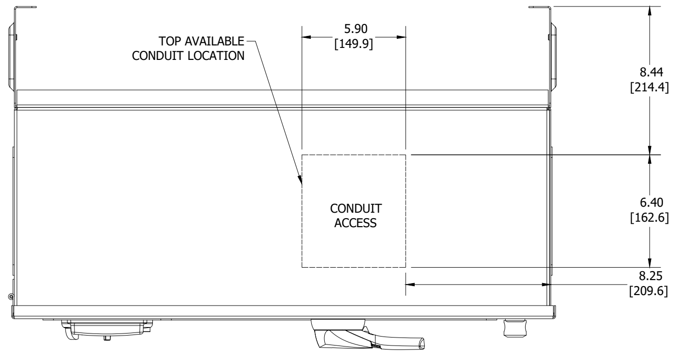
Master Document Index

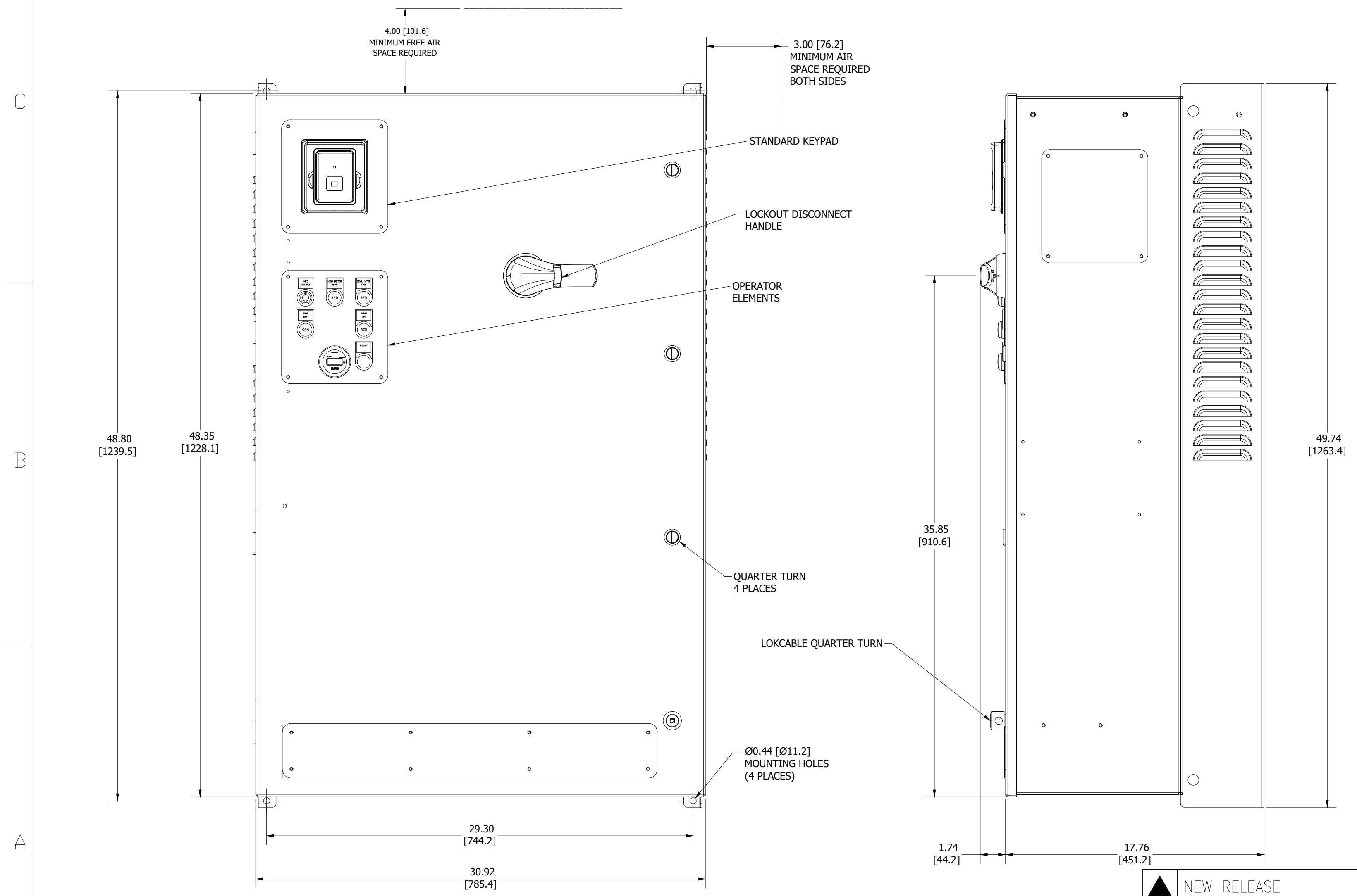
Drives - Enclosed

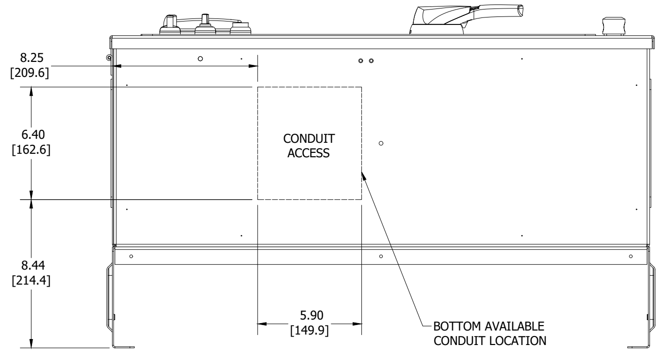
Drives - Enclosed

	Drawing Description	**Document Name**	**Rev**
1	Master Drawing List	D00FTC6M01.DOC	3
2	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-000710-12460.DWG	01
3	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12543.DWG	02
4	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12543_SHT02.DWG	02
5	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-900500-12572.DWG	01

User **Karla** **Devora** **Maldonado**	**Date** **2/8/2023** **10:29:51** **AM**			EATON Powering Business Worldwide
		D7580427X2K2		
		WSP-4221	**Construction Drawings**	
REVISION	DWG SIZE	G.O.	DWG	SHEET
3	**A**	**LBS0031682-021**	**D00FTC6M01.DOC**	1 of 1







NOTES:
FINISH: ENCLOSURE - ANSI 61 (LIGHT) GRAY.
WEIGHT: APPROXIMATELY 350 LBS. [158] KG. 400 LBS [181] KG WITH STANDS.
MATERIAL: 14GA (0.0747) [1.90] CRS.
DIMENSIONS: INCHES, [MILLIMETERS].
CONSTRUCTION: NEMA TYPE 12 OVERSIZE

EGF0114D2300D00000*-SCP-4231
EGF0114D2300D00000*-SCP-4131
EGF0114D2300D00000*-WSP-4222
EGF0114D2300D00000*-WSP-4221
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EGF0114D2300D00000*-WSP-4121

▲ NEW RELEASE

EATON

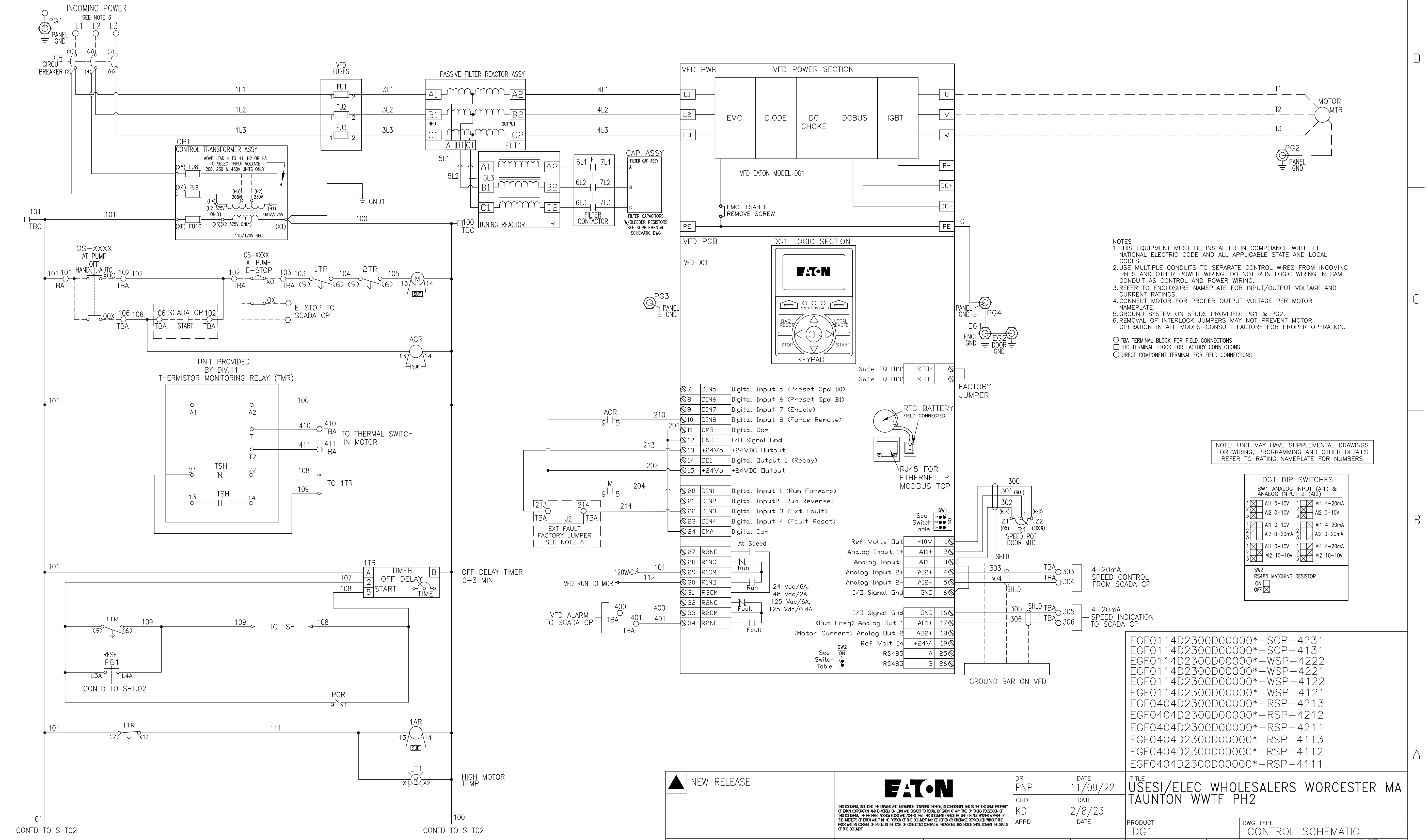
DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE OUTLINE DIMENSION

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2200787
REVISION 01
G.O. NUMBER LBS0031682
DWG NO. ENG-000710-12460
SHEET 1 OF 1

468-1140
REV. 11/11



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DG1 DIP SWITCHES
SW1 ANALOG INPUT (AI1) & ANALOG INPUT 2 (AI2)

1 2 3		1 2 3	
☒☐ ☒☐ ☒☐	AI1 0-10V AI2 0-10V	☐☒ ☒☐ ☒☐	AI1 4-20mA AI2 0-10V
☒☐ ☒☐ ☐☒	AI1 0-10V AI2 0-20mA	☐☒ ☒☐ ☐☒	AI1 4-20mA AI2 0-20mA
☒☐ ☐☒ ☒☐	AI1 0-10V AI2 10-10V	☐☒ ☐☒ ☒☐	AI1 4-20mA AI2 10-10V

SW2
RS485 MATCHING RESISTOR
ON ☐
OFF ☒

EGF0114D2300D00000*-SCP-4231
EGF0114D2300D00000*-SCP-4131
EGF0114D2300D00000*-WSP-4222
EGF0114D2300D00000*-WSP-4221
EGF0114D2300D00000*-WSP-4122
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EGF0404D2300D00000*-RSP-4213
EGF0404D2300D00000*-RSP-4212
EGF0404D2300D00000*-RSP-4211
EGF0404D2300D00000*-RSP-4113
EGF0404D2300D00000*-RSP-4112
EGF0404D2300D00000*-RSP-4111

▲ NEW RELEASE

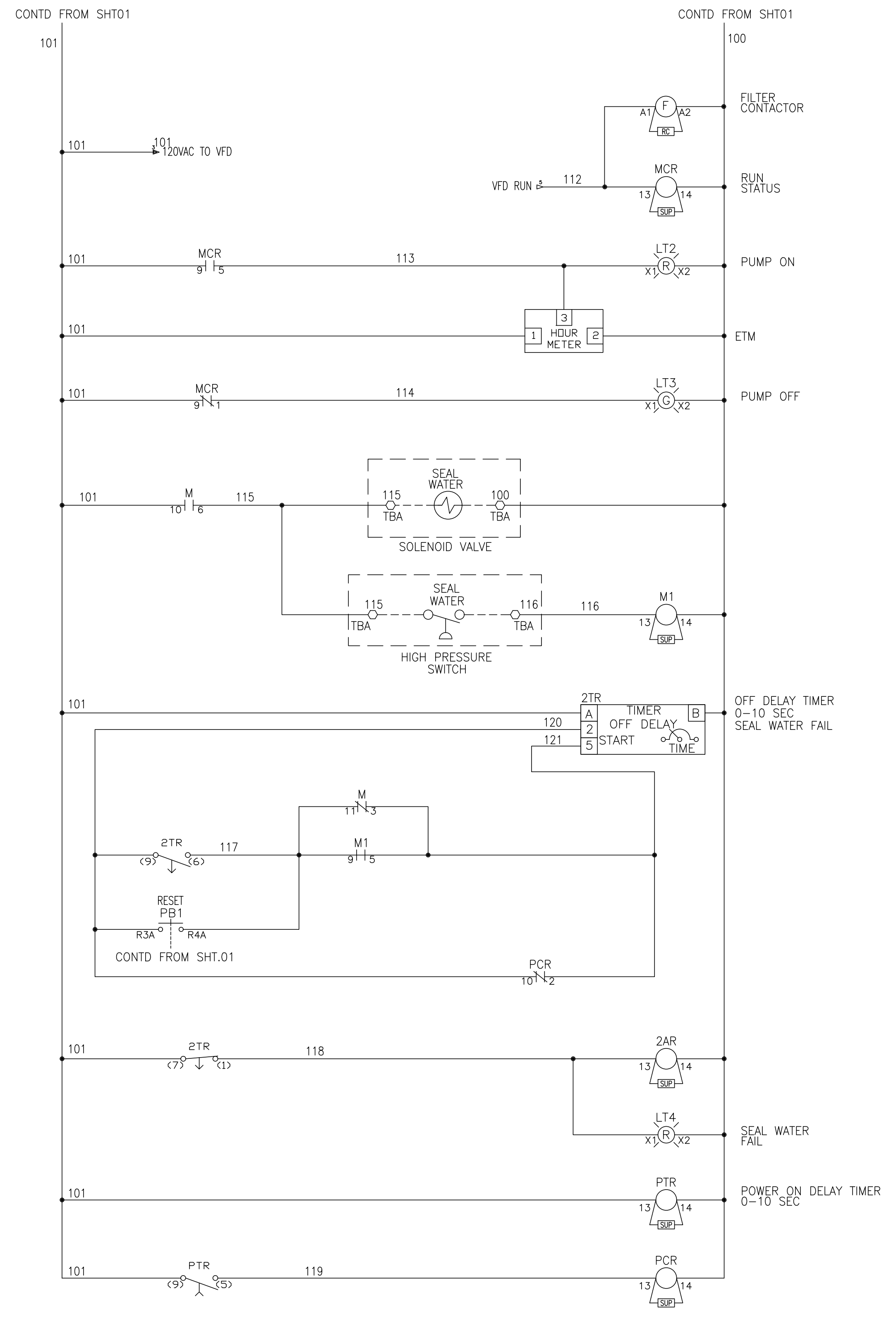
EATON

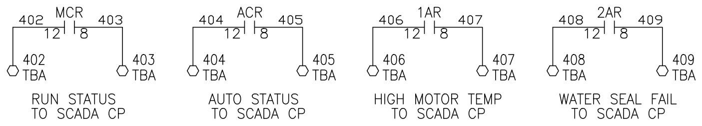
DR PNP DATE 11/09/22
CKD KD DATE 2/8/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2300061
REVISION 02
G.O. NUMBER LBS0031682
DWG NO. ENG-090400-12543
SHEET 1 OF 2





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▲ SEE SHT.01

EATON

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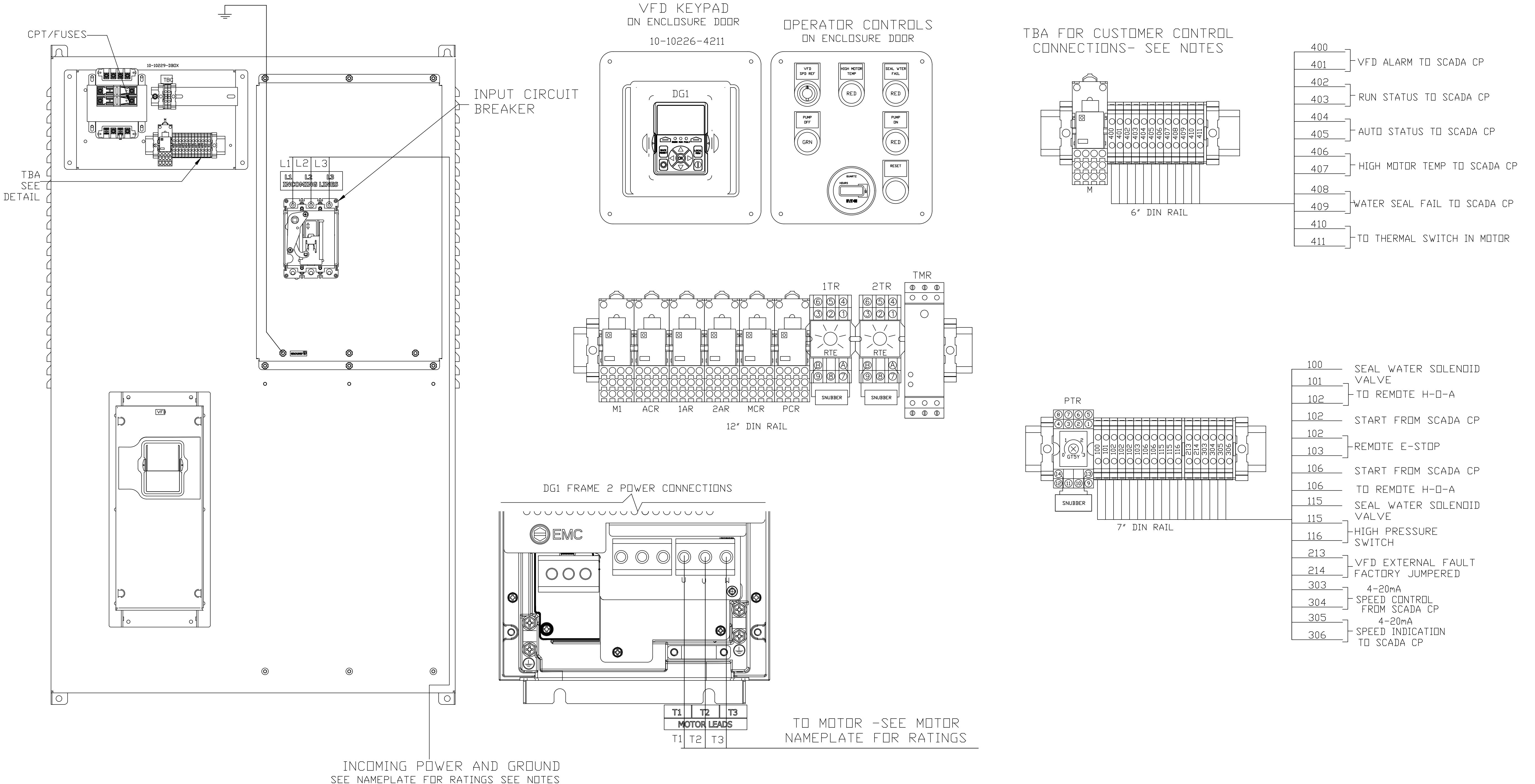
SHEET 2 OF 2



NOTES

1. SEE SCHEMATIC FOR DETAILS AND CONTROL LOGIC - FACTORY WIRING DETAILS OMITTED.
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PRODUCT DG1
DWG TYPE CONNECTION DIAGRAM

THIRD ANGLE PROJECTION
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G.O. NUMBER LBS0031682
DWG NO. ENG-900500-12572
SHEET 1 OF 1

468-1140
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Master Document Index

Drives - Enclosed
Drives - Enclosed

	Drawing Description	Document Name	Rev
1	Master Drawing List	D00FTB3M01.DOC	3
2	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-000710-12460.DWG	01
3	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12543.DWG	02
4	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12543_SHT02.DWG	02
5	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-900500-12572.DWG	01

User **Karla Devora Maldonado**	**Date** **2/8/2023 10:38:31 AM**	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.		Powering Business Worldwide
		D7580427X2K2		
		WSP-4222	**Construction Drawings**	
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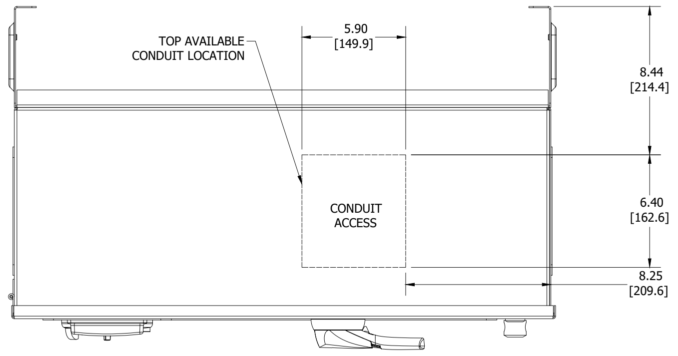

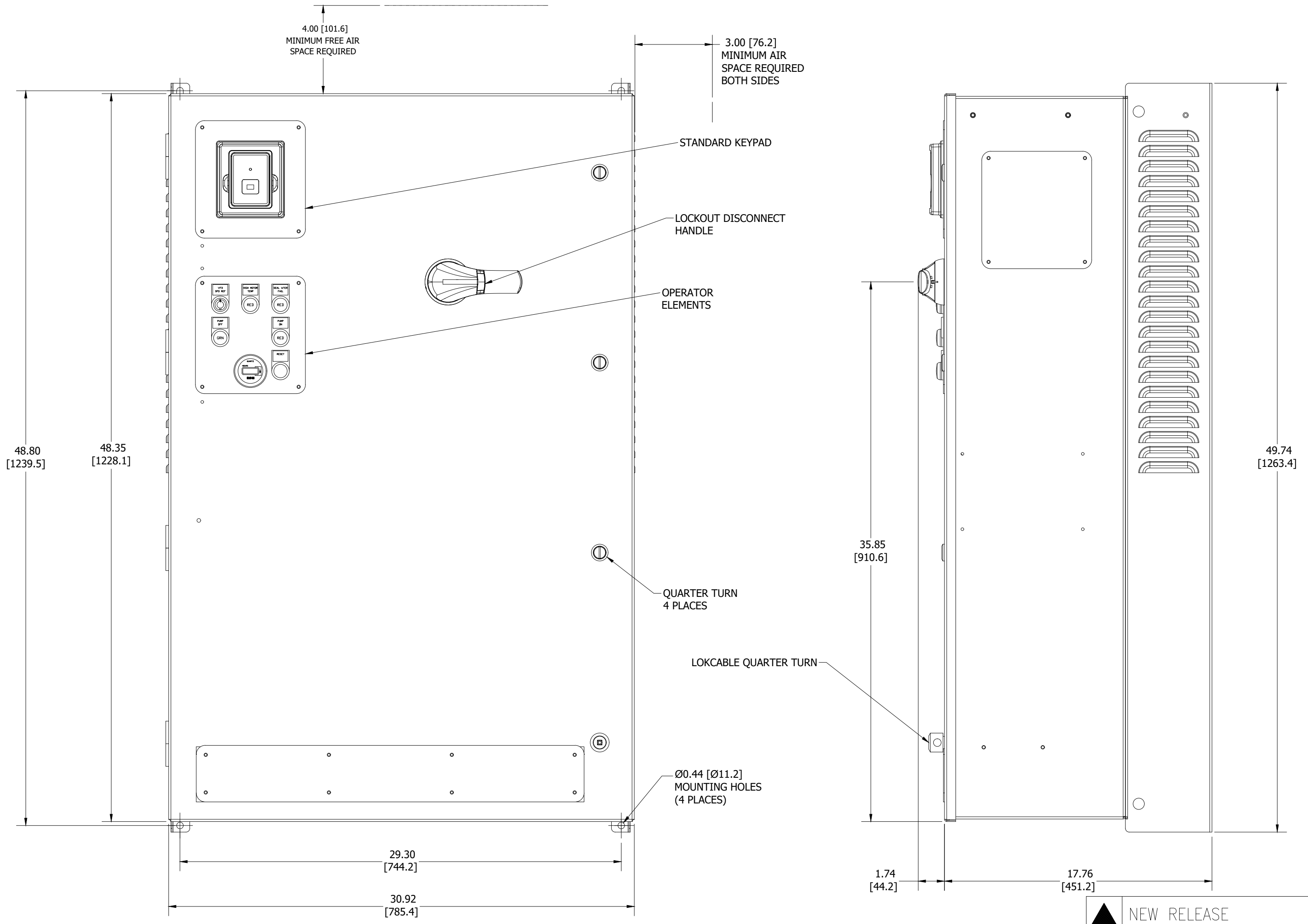

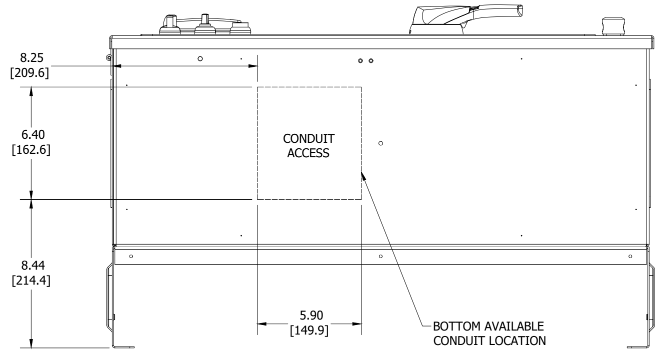

NOTES:
FINISH: ENCLOSURE - ANSI 61 (LIGHT) GRAY.
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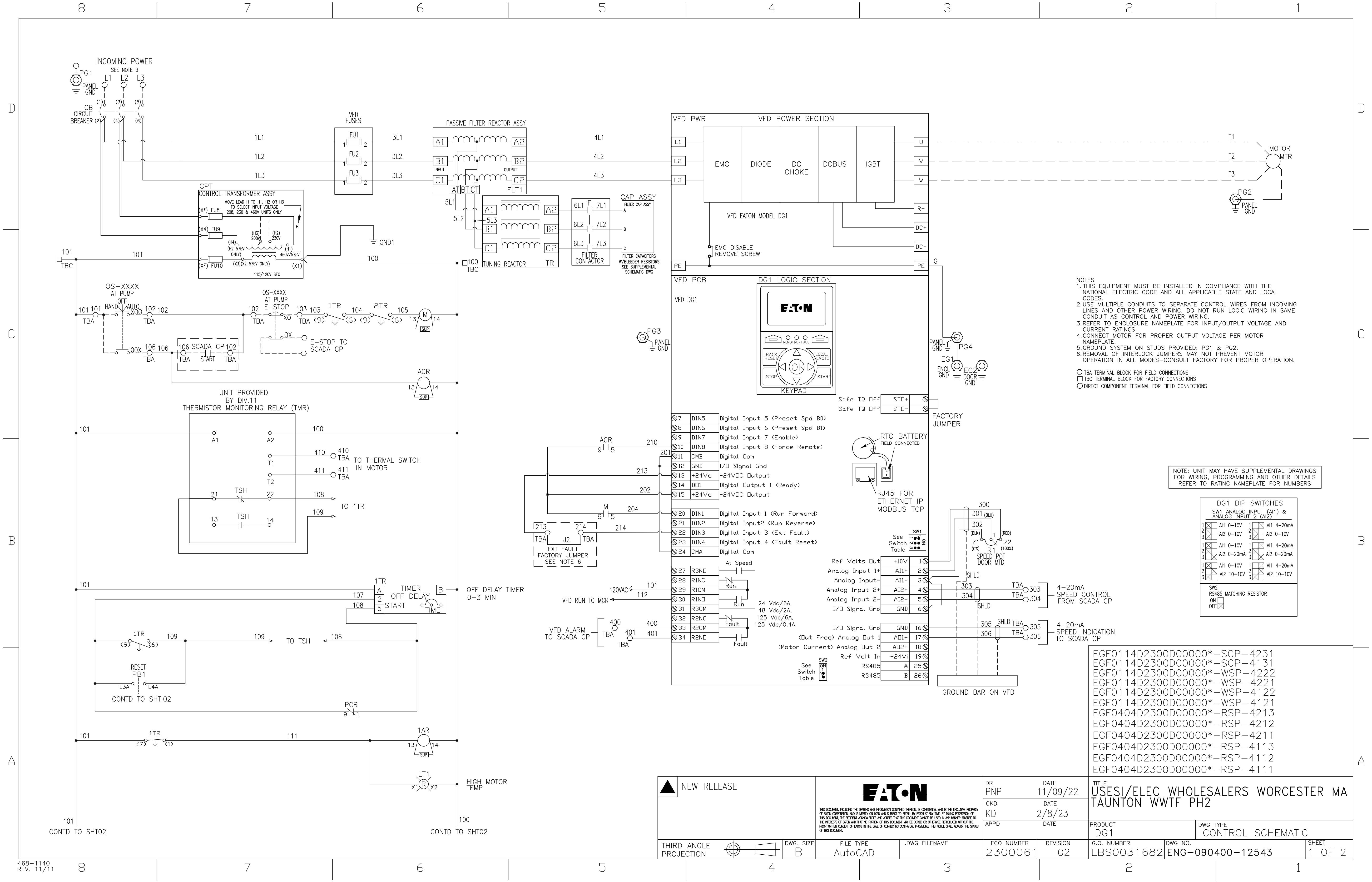
SHEET 1 OF 1



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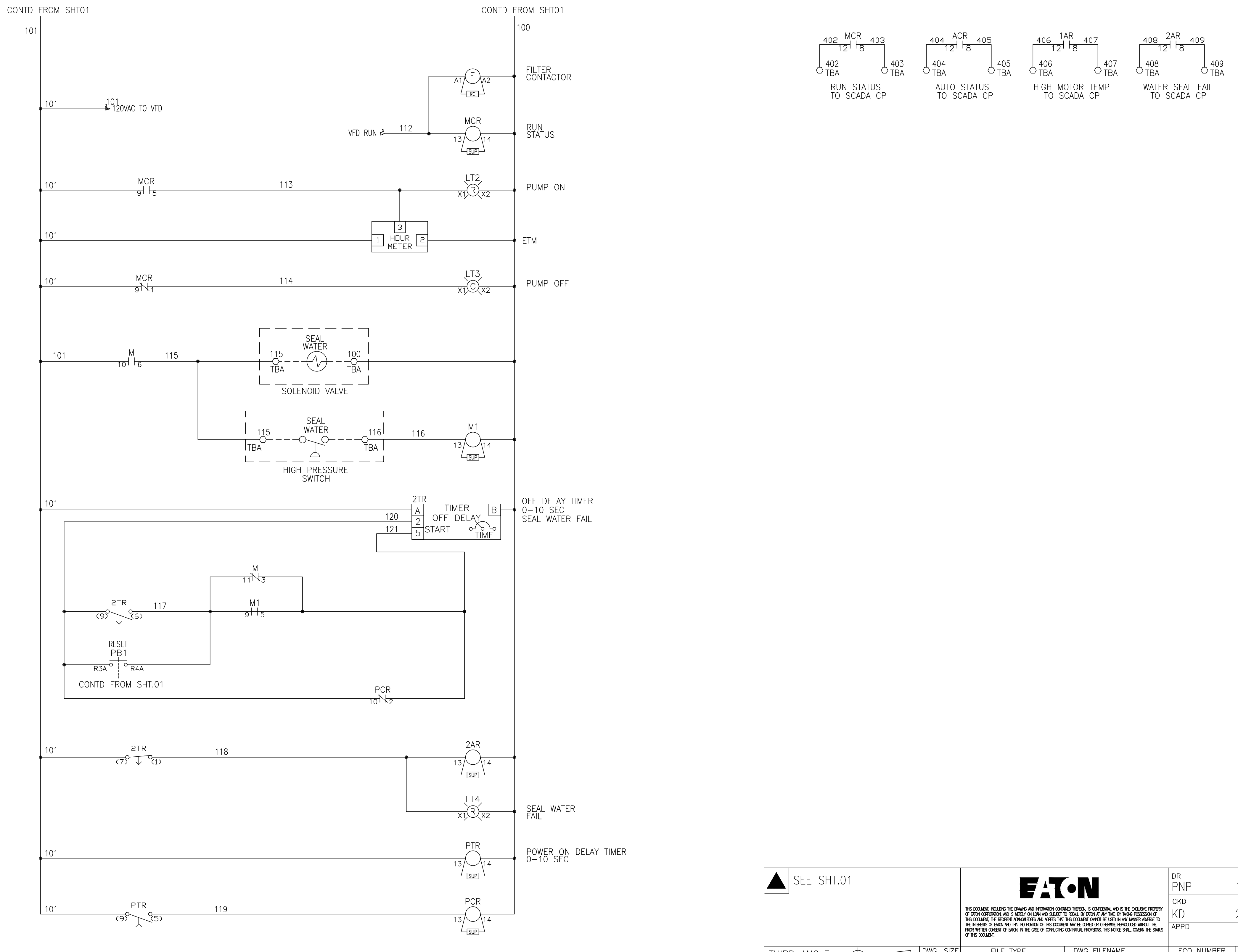
SHEET 1 OF 2

468-1140
REV. 11/11



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▲ SEE SHT.01

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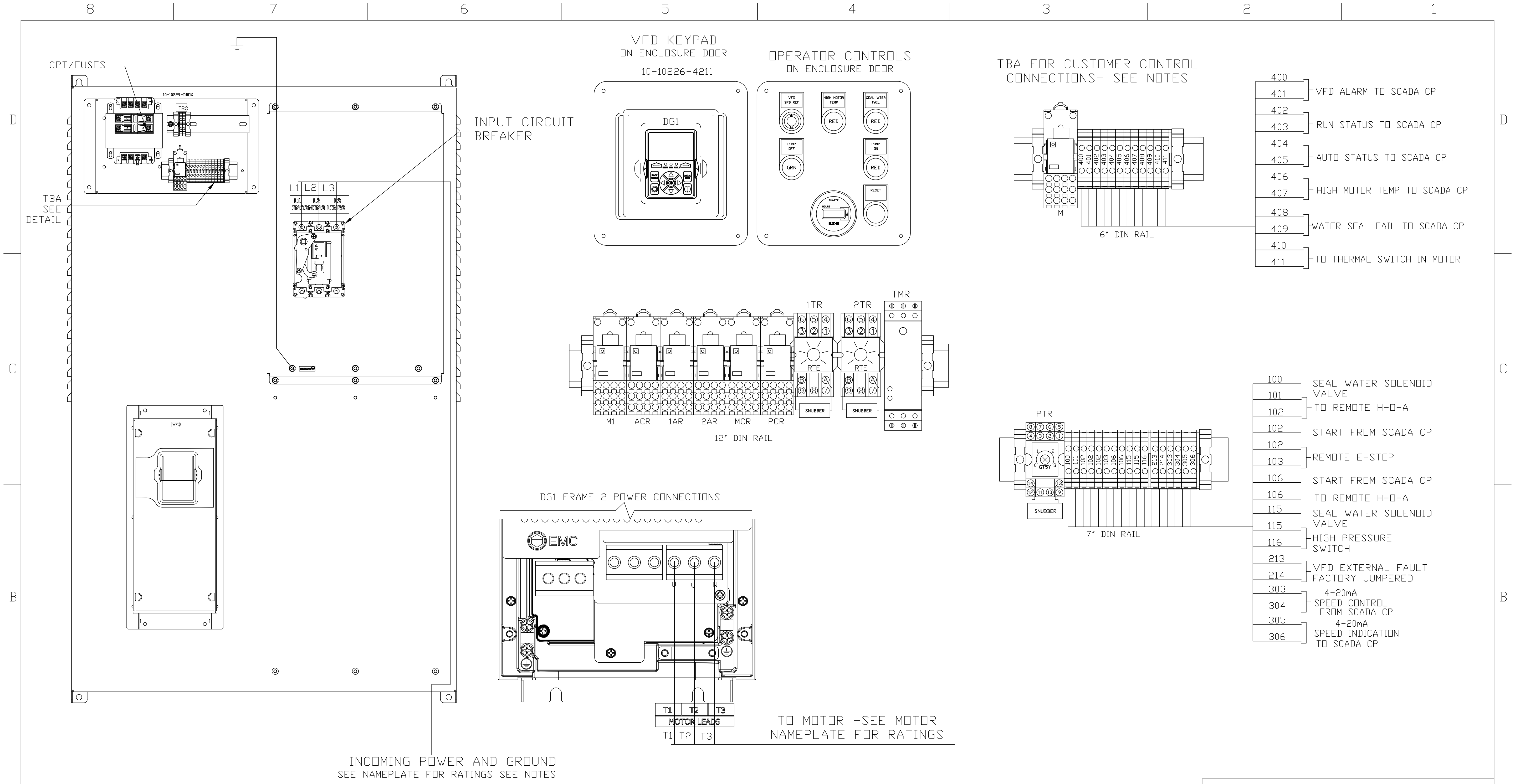
SHEET 2 OF 2



NOTES

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3. ENCLOSURE MUST BE GROUNDED USING INPUT AND OUTPUT STUDS PROVIDED.
4. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL STATE/LOCAL CODES.
5. USE MULTIPLE CONDUITS TO SEPARATE 120 CONTROL (TBA 101/102 & 106/104) WIRING FROM INCOMING POWER WIRING.
6. 4-20MA AUTO SPEED SIGNAL CONNECTIONS ARE MADE DIRECTLY TO VFD CONTROL MODULE.
7. DO NOT RUN LOGIC WIRES (TBA 213/214 VFD EXT FAULT) IN SAME CONDUIT AS 120V OR POWER WIRING.
8. REMOVAL OF INTERLOCKS (TBA 101/102,213/214) MAY NOT PREVENT MOTOR OPERATION IN ALL MODES-CONSULT FACTORY FOR DETAILS.

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EGF0114D2300D00000*-SCP-4131
EGF0114D2300D00000*-WSP-4222
EGF0114D2300D00000*-WSP-4221
EGF0114D2300D00000*-WSP-4122
EGF0114D2300D00000*-WSP-4121

▲ NEW RELEASE

EATON

DR PNP	DATE 11/09/22	TITLE USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2	
CKD KD	DATE 1/11/23		
APPD	DATE	PRODUCT DG1	DWG TYPE CONNECTION DIAGRAM
ECO NUMBER 2200787	REVISION 01	G.O. NUMBER LBS0031682	DWG NO. ENG-900500-12572

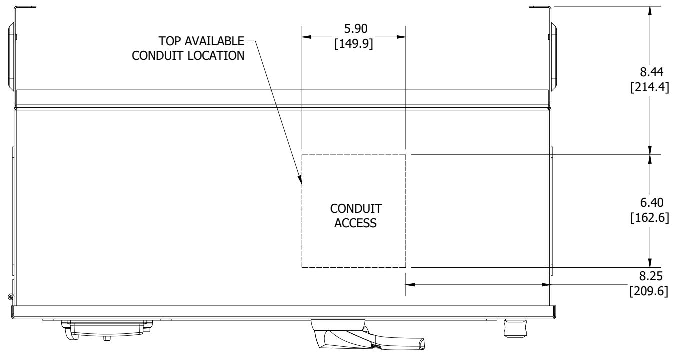
THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
SHEET 1 OF 1

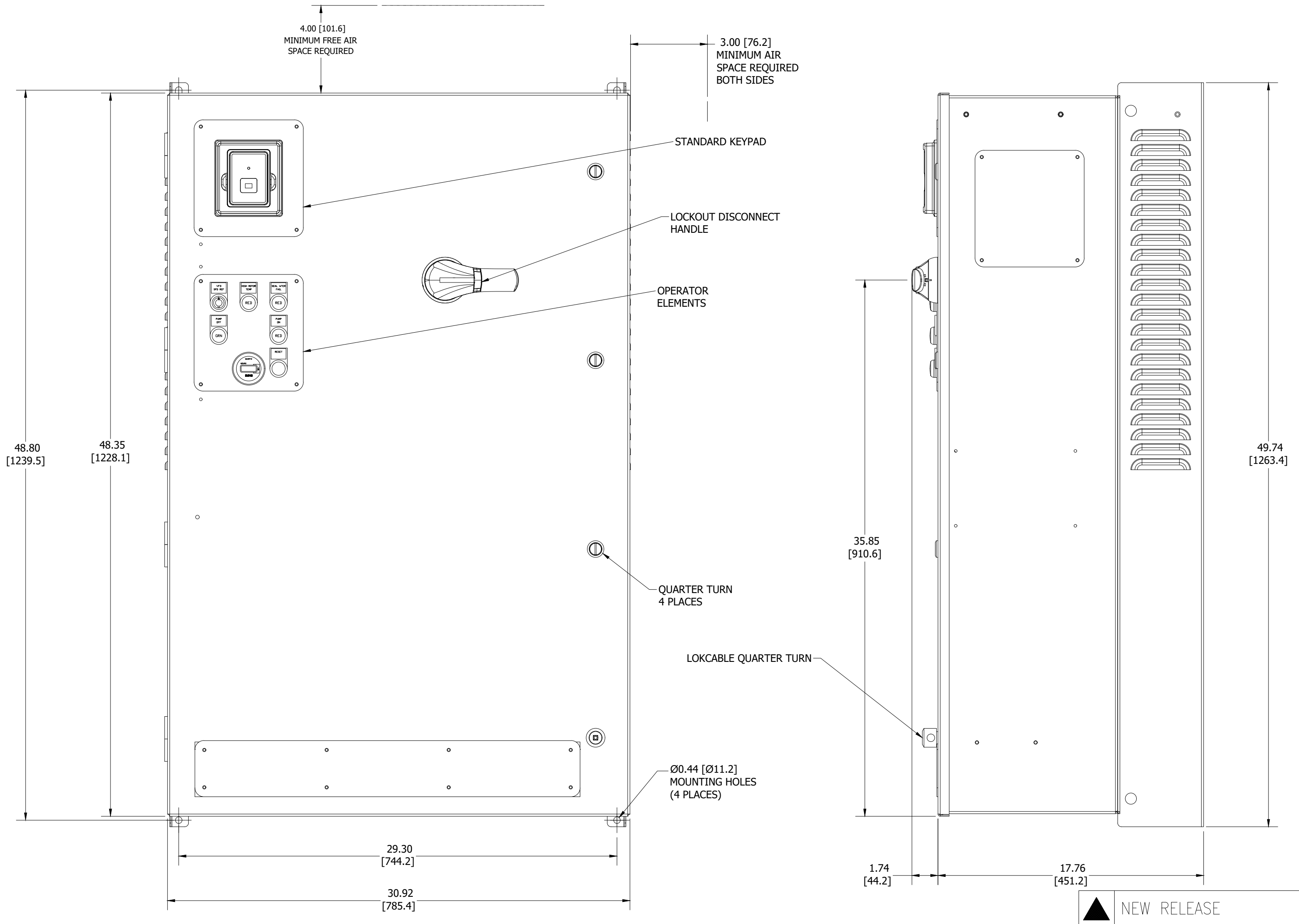
Master Document Index

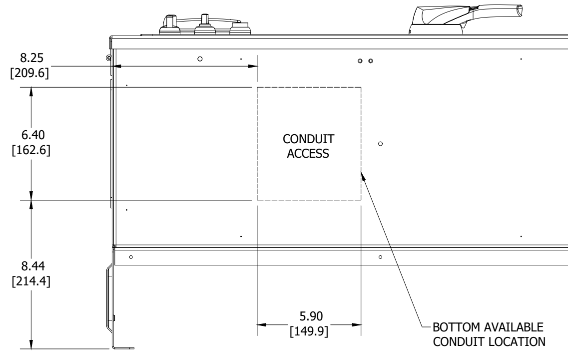
Drives - Enclosed
Drives - Enclosed

	Drawing Description	Document Name	Rev
1	Master Drawing List	D00FTC4M01.DOC	3
2	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-000710-12460.DWG	01
3	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12543.DWG	02
4	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-090400-12543_SHT02.DWG	02
5	LBS0031682 USESI/ELEC WHOLESALERS WORCESTER MA	ENG-900500-12572.DWG	01

User **Karla Devora Maldonado**	**Date** **2/8/2023 10:37:24 AM**	THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.		Powering Business Worldwide
		D7580427X2K2		
		SCP-4231	**Construction Drawings**	
REVISION	DWG SIZE	G.O.	DWG	SHEET
3	**A**	**LBS0031682-023**	**D00FTC4M01.DOC**	1 of 1







NOTES:
FINISH: ENCLOSURE - ANSI 61 (LIGHT) GRAY.
WEIGHT: APPROXIMATELY 350 LBS. [158] KG. 400 LBS [181] KG WITH STANDS.
MATERIAL: 14GA (0.0747) [1.90] CRS.
DIMENSIONS: INCHES, [MILLIMETERS].
CONSTRUCTION: NEMA TYPE 12 OVERSIZE

EGF0114D2300D00000*-SCP-4231
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EGF0114D2300D00000*-WSP-4222
EGF0114D2300D00000*-WSP-4221
EGF0114D2300D00000*-WSP-4122
EGF0114D2300D00000*-WSP-4121

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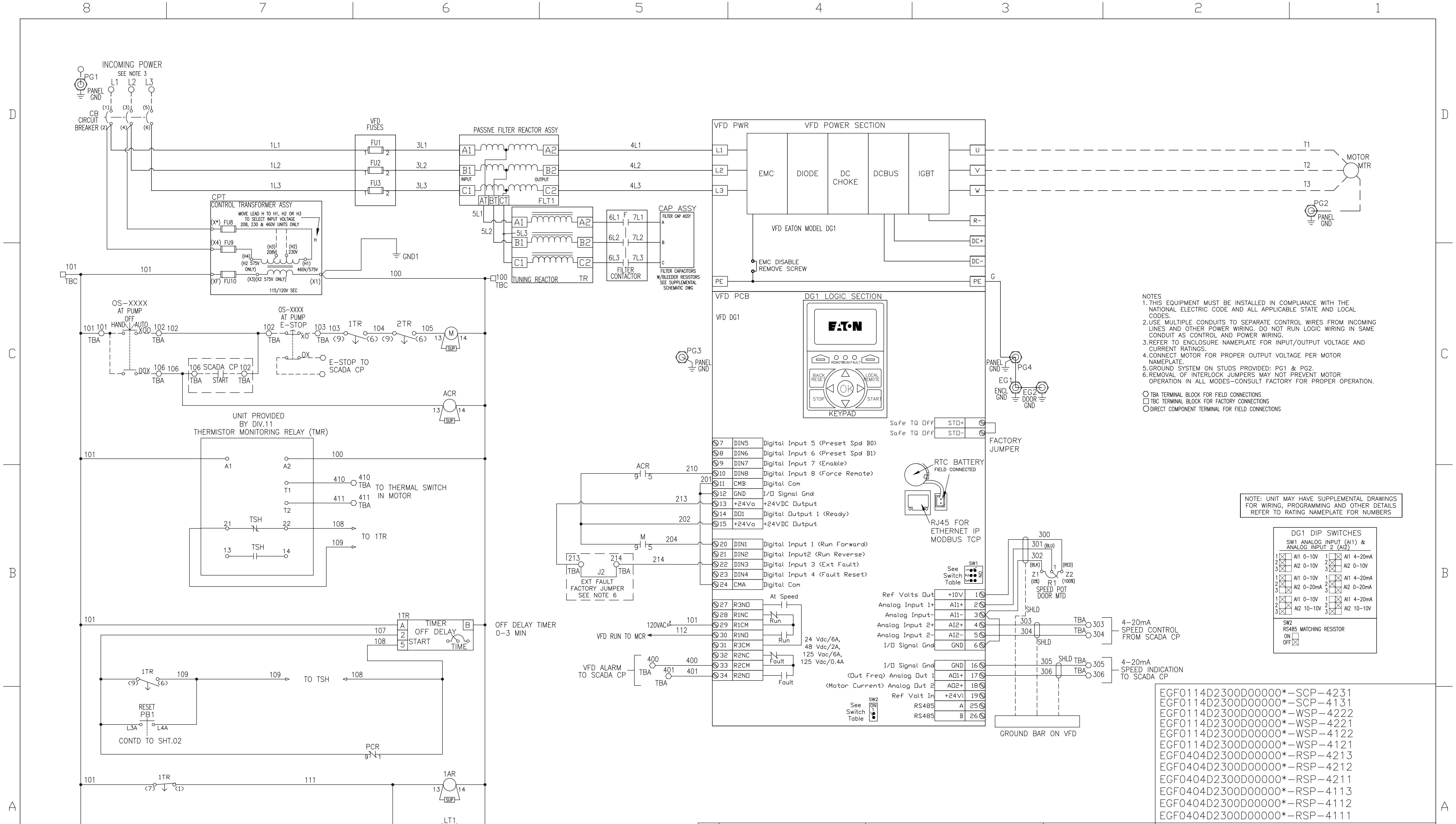
EATON

DR PNP DATE 11/09/22
CKD KD DATE 1/11/23
APPD DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE OUTLINE DIMENSION

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2200787
REVISION 01
G.O. NUMBER LBS0031682
DWG NO. ENG-000710-12460
SHEET 1 OF 1



NOTES
1. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL APPLICABLE STATE AND LOCAL CODES.
2. USE MULTIPLE CONDUITS TO SEPARATE CONTROL WIRES FROM INCOMING LINES AND OTHER POWER WIRING. DO NOT RUN LOGIC WIRING IN SAME CONDUIT AS CONTROL AND POWER WIRING.
3. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGE AND CURRENT RATINGS.
4. CONNECT MOTOR FOR PROPER OUTPUT VOLTAGE PER MOTOR NAMEPLATE.
5. GROUND SYSTEM ON STUDS PROVIDED: PG1 & PG2.
6. REMOVAL OF INTERLOCK JUMPERS MAY NOT PREVENT MOTOR OPERATION IN ALL MODES–CONSULT FACTORY FOR PROPER OPERATION.

⬡ TBA TERMINAL BLOCK FOR FIELD CONNECTIONS
☐ TBC TERMINAL BLOCK FOR FACTORY CONNECTIONS
○ DIRECT COMPONENT TERMINAL FOR FIELD CONNECTIONS

NOTE: UNIT MAY HAVE SUPPLEMENTAL DRAWINGS FOR WIRING, PROGRAMMING AND OTHER DETAILS REFER TO RATING NAMEPLATE FOR NUMBERS

EGF0114D2300D00000*–SCP–4231
EGF0114D2300D00000*–SCP–4131
EGF0114D2300D00000*–WSP–4222
EGF0114D2300D00000*–WSP–4221
EGF0114D2300D00000*–WSP–4122
EGF0114D2300D00000*–WSP–4121
EGF0404D2300D00000*–RSP–4213
EGF0404D2300D00000*–RSP–4212
EGF0404D2300D00000*–RSP–4211
EGF0404D2300D00000*–RSP–4113
EGF0404D2300D00000*–RSP–4112
EGF0404D2300D00000*–RSP–4111

▲ NEW RELEASE

EATON

DR	DATE	TITLE
PNP	11/09/22	USESI/ELEC WHOLESALERS WORCESTER MA TAUNTON WWTF PH2
CKD KD	DATE 2/8/23	
APPD	DATE	PRODUCT DG1 — DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION	DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
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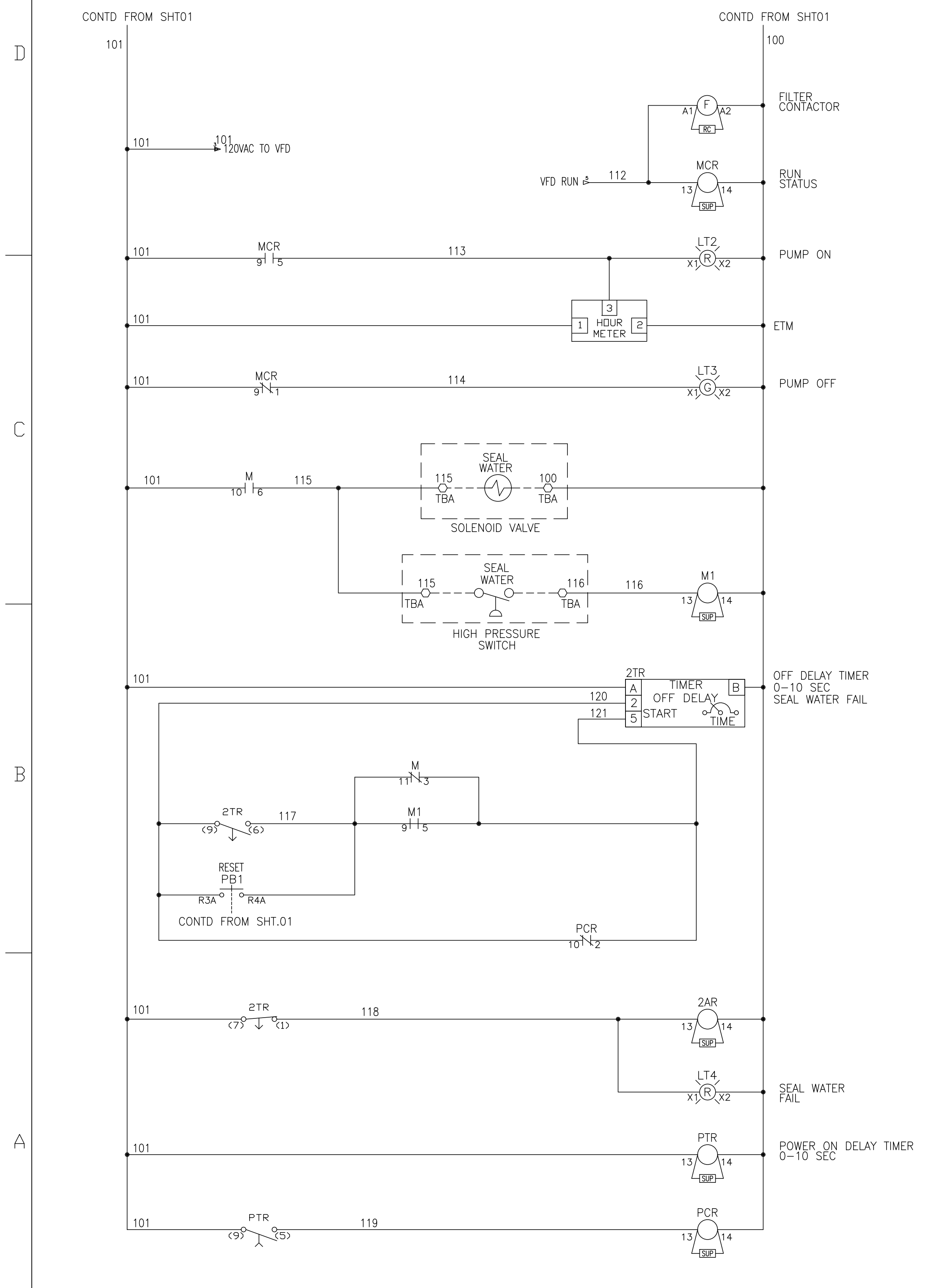
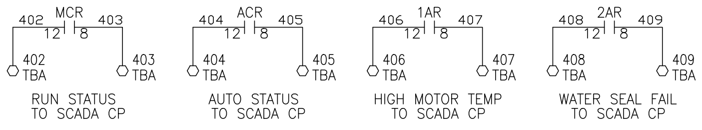
468–1140
REV. 11/11





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EGF0114D2300D00000*-SCP-4131
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EGF0114D2300D00000*-WSP-4122
EGF0114D2300D00000*-WSP-4121
EGF0404D2300D00000*-RSP-4213
EGF0404D2300D00000*-RSP-4212
EGF0404D2300D00000*-RSP-4211
EGF0404D2300D00000*-RSP-4113
EGF0404D2300D00000*-RSP-4112
EGF0404D2300D00000*-RSP-4111

▲ SEE SHT.01

EATON

DR	DATE
PNP	11/09/22
CKD	DATE
KD	2/8/23
APPD	DATE

TITLE
USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONTROL SCHEMATIC

THIRD ANGLE PROJECTION	DWG. SIZE	FILE TYPE	.DWG FILENAME	ECO NUMBER	REVISION	G.O. NUMBER	DWG NO.	SHEET
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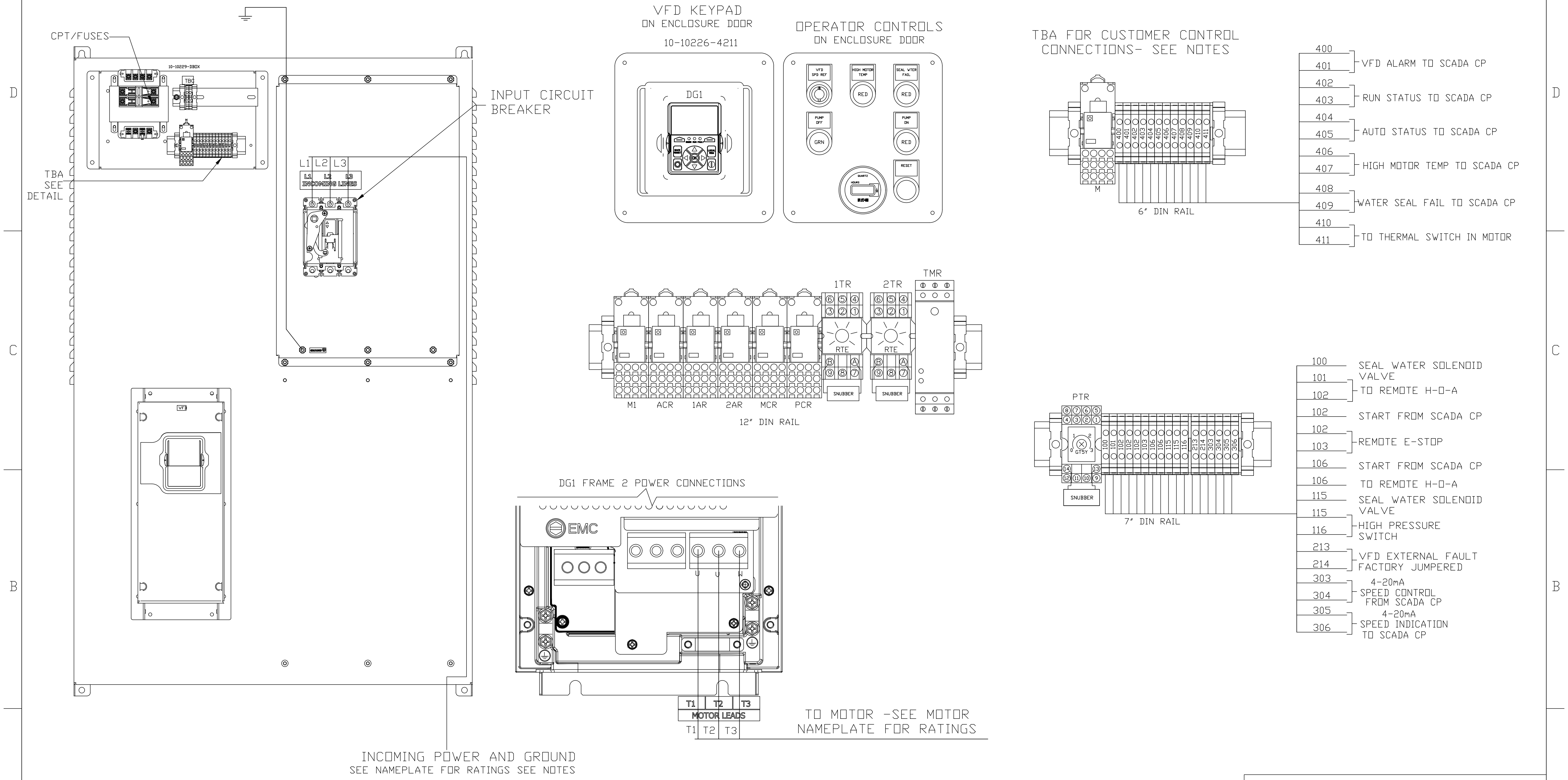
468-1140
REV. 11/11



NOTES

1. SEE SCHEMATIC FOR DETAILS AND CONTROL LOGIC - FACTORY WIRING DETAILS OMITTED.
2. REFER TO ENCLOSURE NAMEPLATE FOR INPUT/OUTPUT VOLTAGES AND CURRENT RATINGS.
3. ENCLOSURE MUST BE GROUNDED USING INPUT AND OUTPUT STUDS PROVIDED.
4. THIS EQUIPMENT MUST BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE AND ALL STATE/LOCAL CODES.
5. USE MULTIPLE CONDUITS TO SEPARATE 120 CONTROL (TBA 101/102 & 106/104) WIRING FROM INCOMING POWER WIRING.
6. 4-20MA AUTO SPEED SIGNAL CONNECTIONS ARE MADE DIRECTLY TO VFD CONTROL MODULE.
7. DO NOT RUN LOGIC WIRES (TBA 213/214 VFD EXT FAULT) IN SAME CONDUIT AS 120V OR POWER WIRING.
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DR PNP DATE 11/09/22
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USESI/ELEC WHOLESALERS WORCESTER MA
TAUNTON WWTF PH2

PRODUCT DG1
DWG TYPE CONNECTION DIAGRAM

THIRD ANGLE PROJECTION
DWG. SIZE B
FILE TYPE AutoCAD
.DWG FILENAME
ECO NUMBER 2200787
REVISION 01
G.O. NUMBER LBS0031682
DWG NO. ENG-900500-12572
SHEET 1 OF 1

468-1140
REV. 11/11

Powering Business Worldwide

Instruction Data

Effective July 2022
Supersedes January 2022

Installation manual
(original instructions)

Powering Business Worldwide

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The information, recommendations, descriptions, and safety notations in this document are based on manufacturer's experience and judgment and may not cover all contingencies. If further information is required, a sales representative should be consulted. Sale of the product shown in this literature is subject to the terms and conditions outlined in appropriate manufacturer selling policies or other contractual agreement between manufacturer and the purchaser.

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Cover Photo: Eaton PowerXL Series Drive

Support services

Support services

The goal of Eaton is to ensure your greatest possible satisfaction with the operation of our products.
We are dedicated to providing fast, friendly, and accurate assistance. That is why we offer you so many ways to get the support you need. Whether it is by phone, fax, or email, you can access Eaton's support information 24 hours a day, seven days a week.

Our wide range of services is listed below.

You should contact your local distributor for product pricing, availability, ordering, expediting, and repairs.

Website

Use the Eaton Website to find product information.
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Website address

Eaton.com/drives

EatonCare Customer Support Center

Call the EatonCare Support Center if you need assistance with placing an order, stock availability or proof of shipment, expediting an existing order, emergency shipments, product price information, returns other than warranty returns, and information on local distributors or sales offices.

Voice: 877-ETN-CARE (386-2273) (8:00 a.m.–6:00 p.m. EST)
After-Hours Emergency: 800-543-7038 (6:00 p.m.–8:00 a.m. EST)

Drives Technical Resource Center

Voice: 877-ETN-CARE (386-2273) option 2, option 6
(8:00 a.m.–5:00 p.m. Central Time U.S. [UTC –6])
email: TRCDrives@Eaton.com

For customers in Europe, contact

Phone: +49 (0) 228 6 02-3640
Hotline: +49 (0) 180 5 223822
email: AfterSalesEGBonn@Eaton.com
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Table of contents

SAFETY

CHAPTER 1—POWERXL SERIES OVERVIEW

CHAPTER 2—ENGINEERING CONSIDERATIONS

CHAPTER 3—PRODUCT OVERVIEW

CHAPTER 4—SAFETY AND SWITCHING

CHAPTER 5—MOTOR AND APPLICATION

Table of contents, continued

CHAPTER 6—INSTALLATION REQUIREMENTS

CHAPTER 7—EMC INSTALLATION

APPENDIX A—TECHNICAL DATA AND SPECIFICATIONS

APPENDIX B—INSTALLATION GUIDELINES

APPENDIX C—DIMENSION DRAWINGS

APPENDIX D—SAFETY INSTRUCTIONS FOR UL AND CUL

APPENDIX E—STO FUNCTION

APPENDIX F—CERTIFICATION AND COMPLIANCE INFORMATION

List of figures

List of tables

List of tables, continued

Safety

⚠ WARNING

DANGEROUS ELECTRICAL VOLTAGE!

Before commencing the installation

- Disconnect the power supply of the device
- Ensure that devices cannot be accidentally restarted
- Verify isolation from the supply
- Earth and short circuit the device
- Cover or enclose any adjacent live components
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/system
- Before installation and before touching the device ensure that you are free of electrostatic charge
- The functional earth (FE, PES) must be connected to the protective earth (PE) or the potential equalization. The system installer is responsible for implementing this connection
- Connecting cables and signal lines should be installed so that inductive or capacitive interference does not impair the automation functions
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation
- Suitable safety hardware and software measures should be implemented for the I/O interface so that an open circuit on the signal side does not result in undefined states in the automation devices
- Ensure a reliable electrical isolation of the extra-low voltage of the 24 V supply. Only use power supply units complying with IEC 60364-4-41 (VDE 0100 Part 410) or HD384.4.41 S2
- Deviations of the input voltage from the rated value must not exceed the tolerance limits given in the specifications, otherwise this may cause malfunction and dangerous operation
- Emergency stop devices complying with IEC/EN 60204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency-stop devices must not cause a restart
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been installed and with the housing closed. Desktop or portable units must only be operated and controlled in enclosed housings
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency-stop devices should be implemented
- Wherever faults in the automation system may cause injury or material damage, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks, and so on)
- Depending on their degree of protection, adjustable frequency drives may contain live bright metal parts, moving or rotating components, or hot surfaces during and immediately after operation
- Removal of the required covers, improper installation, or incorrect operation of motor or adjustable frequency drive may cause the failure of the device and may lead to serious injury or damage
- The applicable national accident prevention and safety regulations apply to all work carried out on live adjustable frequency drives
- The electrical installation must be carried out in accordance with the relevant regulations (for example, with regard to cable cross sections, fuses, PE)
- Transport, installation, commissioning, and maintenance work must be carried out only by qualified personnel (IEC 60364, HD 384 and national occupational safety regulations)
- Installations containing adjustable frequency drives must be provided with additional monitoring and protective devices in accordance with the applicable safety regulations. Modifications to the adjustable frequency drives using the operating software are permitted
- All covers and doors must be kept closed during operation
- To reduce hazards for people or equipment, the user must include in the machine design measures that restrict the consequences of a malfunction or failure of the drive (increased motor speed or sudden standstill of motor). These measures include:
- Other independent devices for monitoring safety-related variables (speed, travel, end positions, and so on)
- Electrical or non-electrical system-wide measures (electrical or mechanical interlocks)
- Never touch live parts or cable connections of the adjustable frequency drive after it has been disconnected from the power supply. Due to the charge in the capacitors, these parts may still be live after disconnection. Fit appropriate warning signs

Read this manual thoroughly and make sure you understand the procedures before you attempt to install, set up, operate or carry out any maintenance work on this PowerXL Adjustable Frequency Drive.

Definitions and symbols

⚠ WARNING

THIS SYMBOL INDICATES HIGH VOLTAGE. IT CALLS YOUR ATTENTION TO ITEMS OR OPERATIONS THAT COULD BE DANGEROUS TO YOU AND OTHER PERSONS OPERATING THIS EQUIPMENT. READ THE MESSAGE AND FOLLOW THE INSTRUCTIONS CAREFULLY.

⚠

THIS SYMBOL IS THE “SAFETY ALERT SYMBOL.” IT OCCURS WITH EITHER OF TWO SIGNAL WORDS: CAUTION OR WARNING, AS DESCRIBED BELOW.

⚠ WARNING

INDICATES A POTENTIALLY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, CAN RESULT IN SERIOUS INJURY OR DEATH.

⚠ CAUTION

INDICATES A POTENTIALLY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, CAN RESULT IN MINOR TO MODERATE INJURY, OR SERIOUS DAMAGE TO THE PRODUCT. THE SITUATION DESCRIBED IN THE CAUTION MAY, IF NOT AVOIDED, LEAD TO SERIOUS RESULTS. IMPORTANT SAFETY MEASURES ARE DESCRIBED IN CAUTION (AS WELL AS WARNING).

Hazardous high voltage

⚠ WARNING

MOTOR CONTROL EQUIPMENT AND ELECTRONIC CONTROLLERS ARE CONNECTED TO HAZARDOUS LINE VOLTAGES. WHEN SERVICING DRIVES AND ELECTRONIC CONTROLLERS, THERE MAY BE EXPOSED COMPONENTS WITH HOUSINGS OR PROTRUSIONS AT OR ABOVE LINE POTENTIAL. EXTREME CARE SHOULD BE TAKEN TO PROTECT AGAINST SHOCK.

- STAND ON AN INSULATING PAD AND MAKE IT A HABIT TO USE ONLY ONE HAND WHEN CHECKING COMPONENTS
- ALWAYS WORK WITH ANOTHER PERSON IN CASE AN EMERGENCY OCCURS
- DISCONNECT POWER BEFORE CHECKING CONTROLLERS OR PERFORMING MAINTENANCE
- BE SURE EQUIPMENT IS PROPERLY EARTHED
- WEAR SAFETY GLASSES WHENEVER WORKING ON ELECTRONIC CONTROLLERS OR ROTATING MACHINERY

⚠ WARNING

THE COMPONENTS IN THE DRIVE’S POWER SECTION REMAIN ENERGIZED AFTER THE SUPPLY VOLTAGE HAS BEEN SWITCHED OFF. AFTER DISCONNECTING THE SUPPLY, WAIT AT LEAST FIVE MINUTES BEFORE REMOVING THE COVER TO ALLOW THE INTERMEDIATE CIRCUIT CAPACITORS TO DISCHARGE.

PAY ATTENTION TO HAZARD WARNINGS!

⚠

DANGER
5 MIN

⚠ WARNING

ELECTRIC SHOCK HAZARD—RISK OF INJURIES! CARRY OUT WIRING WORK ONLY IF THE UNIT IS DE-ENERGIZED.

⚠ WARNING

DO NOT PERFORM ANY MODIFICATIONS ON THE AC DRIVE WHEN IT IS CONNECTED TO MAINS.

Warnings and cautions

⚠ WARNING

BE SURE TO GROUND THE UNIT FOLLOWING THE INSTRUCTIONS IN THIS MANUAL. UNGROUNDED UNITS MAY CAUSE ELECTRIC SHOCK AND/OR FIRE.

⚠ WARNING

THIS EQUIPMENT SHOULD ONLY BE INSTALLED, ADJUSTED, AND SERVICED BY QUALIFIED ELECTRICAL MAINTENANCE PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS TYPE OF EQUIPMENT AND THE HAZARDS INVOLVED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN DEATH OR SEVERE INJURY.

⚠ WARNING

COMPONENTS WITHIN THE DRIVE ARE LIVE WHEN IT IS CONNECTED TO POWER. CONTACT WITH THIS VOLTAGE IS EXTREMELY DANGEROUS AND MAY CAUSE DEATH OR SEVERE INJURY.

⚠ WARNING

LINE TERMINALS (L1, L2, L3), MOTOR TERMINALS (U, V, W) AND THE DC LINK/BRAKE RESISTOR TERMINALS (DC–, DC+/R+, R–) ARE LIVE WHEN THE DRIVE IS CONNECTED TO POWER, EVEN IF THE MOTOR IS NOT RUNNING. CONTACT WITH THIS VOLTAGE IS EXTREMELY DANGEROUS AND MAY CAUSE DEATH OR SEVERE INJURY.

⚠ WARNING

EVEN THOUGH THE CONTROL I/O-TERMINALS ARE ISOLATED FROM LINE VOLTAGE, THE RELAY OUTPUTS AND OTHER I/O-TERMINALS MAY HAVE DANGEROUS VOLTAGE PRESENT EVEN WHEN THE DRIVE IS DISCONNECTED FROM POWER. CONTACT WITH THIS VOLTAGE IS EXTREMELY DANGEROUS AND MAY CAUSE DEATH OR SEVERE INJURY.

⚠ WARNING

THIS EQUIPMENT HAS A LARGE CAPACITIVE LEAKAGE CURRENT DURING OPERATION, WHICH CAN CAUSE ENCLOSURE PARTS TO BE ABOVE GROUND POTENTIAL. PROPER GROUNDING, AS DESCRIBED IN THIS MANUAL, IS REQUIRED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN DEATH OR SEVERE INJURY.

⚠ WARNING

BEFORE APPLYING POWER TO THIS DRIVE, MAKE SURE THAT THE FRONT AND CABLE COVERS ARE CLOSED AND FASTENED TO PREVENT EXPOSURE TO POTENTIAL ELECTRICAL FAULT CONDITIONS. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN DEATH OR SEVERE INJURY.

⚠ WARNING

AN UPSTREAM DISCONNECT/PROTECTIVE DEVICE MUST BE PROVIDED AS REQUIRED BY THE NATIONAL ELECTRIC CODET (NECT). FAILURE TO FOLLOW THIS PRECAUTION MAY RESULT IN DEATH OR SEVERE INJURY.

⚠ WARNING

THIS DRIVE CAN CAUSE A DC CURRENT IN THE PROTECTIVE EARTHING CONDUCTOR. WHERE A RESIDUAL CURRENT-OPERATED PROTECTIVE (RCD) OR MONITORING (RCM) DEVICE IS USED FOR PROTECTION IN CASE OF DIRECT OR INDIRECT CONTACT, ONLY AN RCD OR RCM OF TYPE B IS ALLOWED ON THE SUPPLY SIDE OF THIS PRODUCT.

⚠ WARNING

CARRY OUT WIRING WORK ONLY AFTER THE DRIVE HAS BEEN CORRECTLY MOUNTED AND SECURED.

⚠ WARNING

BEFORE OPENING THE DRIVE COVERS:

- DISCONNECT ALL POWER TO THE DRIVE, INCLUDING EXTERNAL CONTROL POWER THAT MAY BE PRESENT
- WAIT A MINIMUM OF FIVE MINUTES AFTER ALL THE LIGHTS ON THE KEYPAD ARE OFF. THIS ALLOWS TIME FOR THE DC BUS CAPACITORS TO DISCHARGE
- A HAZARD VOLTAGE MAY STILL REMAIN IN THE DC BUS CAPACITORS EVEN IF THE POWER HAS BEEN TURNED OFF. CONFIRM THAT THE CAPACITORS HAVE FULLY DISCHARGED BY MEASURING THEIR VOLTAGE USING A MULTIMETER SET TO MEASURE THE DC VOLTAGE

FAILURE TO FOLLOW THESE PRECAUTIONS MAY CAUSE DEATH OR SEVERE INJURY.

⚠ WARNING

THE OPENING OF THE BRANCH-CIRCUIT PROTECTIVE DEVICE MAY BE AN INDICATION THAT A FAULT CURRENT HAS BEEN INTERRUPTED. TO REDUCE THE RISK OF FIRE OR ELECTRIC SHOCK, CURRENT-CARRYING PARTS AND OTHER COMPONENTS OF THE CONTROLLER SHOULD BE EXAMINED AND REPLACED IF DAMAGED. IF BURNOUT OF THE CURRENT ELEMENT OF AN OVERLOAD RELAY OCCURS, THE COMPLETE OVERLOAD RELAY MUST BE REPLACED.

⚠ WARNING

OPERATION OF THIS EQUIPMENT REQUIRES DETAILED INSTALLATION AND OPERATION INSTRUCTIONS PROVIDED IN THE INSTALLATION/OPERATION MANUAL INTENDED FOR USE WITH THIS PRODUCT. IT SHOULD BE RETAINED WITH THIS DEVICE AT ALL TIMES. A HARD COPY OF THIS INFORMATION MAY BE ORDERED FROM LITERATURE FULFILLMENT.

⚠ WARNING

BEFORE SERVICING THE DRIVE:

- DISCONNECT ALL POWER TO THE DRIVE, INCLUDING EXTERNAL CONTROL POWER THAT MAY BE PRESENT
- PLACE A “DO NOT TURN ON” LABEL ON THE DISCONNECT DEVICE
- LOCK THE DISCONNECT DEVICE IN THE OPEN POSITION

FAILURE TO FOLLOW THESE INSTRUCTIONS WILL RESULT IN DEATH OR SERIOUS INJURY.

⚠ WARNING

THE DRIVE OUTPUTS (U, V, W) MUST NOT BE CONNECTED TO THE INPUT VOLTAGE OR THE UTILITY LINE POWER AS SEVERE DAMAGE TO THE DEVICE MAY OCCUR AND THERE MAY BE A RISK OF FIRE.

⚠ WARNING

THE HEAT SINK AND/OR OUTER ENCLOSURE MAY REACH A HIGH TEMPERATURE.

PAY ATTENTION TO HAZARD WARNINGS!

HOT SURFACE—RISK OF BURN. DO NOT TOUCH!

⚠ WARNING

IN A DOMESTIC ENVIRONMENT, THIS PRODUCT MAY CAUSE RADIO INTERFERENCE, IN WHICH CASE SUPPLEMENTARY MITIGATION MEASURES MAY BE REQUIRED.

⚠ CAUTION

ANY ELECTRICAL OR MECHANICAL MODIFICATION TO THIS DRIVE WITHOUT PRIOR WRITTEN CONSENT OF MANUFACTURER WILL VOID ALL WARRANTIES AND MAY RESULT IN A SAFETY HAZARD IN ADDITION AND VOIDING OF THE ULT LISTING.

⚠ CAUTION

INSTALL THIS DRIVE ON FLAME-RESISTANT MATERIAL SUCH AS A STEEL PLATE TO REDUCE THE RISK OF FIRE

⚠ CAUTION

INSTALL THIS DRIVE ON A PERPENDICULAR SURFACE THAT IS ABLE TO SUPPORT THE WEIGHT OF THE DRIVE AND IS NOT SUBJECT TO VIBRATION, TO LESSEN THE RISK OF THE DRIVE FALLING AND BEING DAMAGED AND/OR CAUSING PERSONAL INJURY.

⚠ CAUTION

PREVENT FOREIGN MATERIAL SUCH AS WIRE CLIPPINGS OR METAL SHAVINGS FROM ENTERING THE DRIVE ENCLOSURE, AS THIS MAY CAUSE ARCING DAMAGE AND FIRE.

⚠ CAUTION

INSTALL THIS DRIVE IN A WELL-VENTILATED ROOM THAT IS NOT SUBJECT TO TEMPERATURE EXTREMES, HIGH HUMIDITY, OR CONDENSATION, AND AVOID LOCATIONS THAT ARE DIRECTLY EXPOSED TO SUNLIGHT, OR HAVE HIGH CONCENTRATIONS OF DUST, CORROSIVE GAS, EXPLOSIVE GAS, INFLAMMABLE GAS, GRINDING FLUID MIST, ETC. IMPROPER INSTALLATION MAY RESULT IN A FIRE HAZARD.

⚠ CAUTION

WHEN SELECTING THE CABLE CROSS-SECTION, TAKE THE VOLTAGE DROP UNDER LOAD CONDITIONS INTO ACCOUNT. THE CONSIDERATION OF OTHER STANDARDS IS THE RESPONSIBILITY OF THE USER.

THE USER IS RESPONSIBLE FOR COMPLIANCE WITH ALL INTERNATIONAL AND NATIONAL ELECTRICAL STANDARDS IN FORCE CONCERNING PROTECTIVE GROUNDING OF ALL EQUIPMENT.

⚠ CAUTION

THE SPECIFIED MINIMUM PE CONDUCTOR CROSS-SECTIONS IN THIS MANUAL MUST BE MAINTAINED.

TOUCH CURRENT IN THIS EQUIPMENT EXCEEDS 3.5 MA (AC). THE MINIMUM SIZE OF THE PROTECTIVE EARTHING CONDUCTOR SHALL COMPLY WITH THE REQUIREMENTS OF EN 61800-5-1 AND/OR THE LOCAL SAFETY REGULATIONS.

⚠ CAUTION

TOUCH CURRENTS IN THIS FREQUENCY INVERTER ARE GREATER THAN 3.5 MA (AC). ACCORDING TO PRODUCT STANDARD IEC/EN 61800-5-1, AN ADDITIONAL EQUIPMENT GROUNDING CONDUCTOR OF THE SAME CROSS-SECTIONAL AREA AS THE ORIGINAL PROTECTIVE EARTHING CONDUCTOR MUST BE CONNECTED, OR THE CROSS-SECTION OF THE EQUIPMENT GROUNDING CONDUCTOR MUST BE AT LEAST 10 MM^2 CU. DRIVE REQUIRES THAT ONLY COPPER CONDUCTOR SHOULD BE USED.

⚠ CAUTION

DEBOUNCED INPUTS MAY NOT BE USED IN THE SAFETY CIRCUIT DIAGRAM. RESIDUAL CURRENT CIRCUIT BREAKERS (RCD) ARE ONLY TO BE INSTALLED BETWEEN THE AC POWER SUPPLY NETWORK AND THE DRIVE.

⚠ CAUTION

DEBOUNCED INPUTS MAY NOT BE USED IN THE SAFETY CIRCUIT DIAGRAM. IF YOU ARE CONNECTING MULTIPLE MOTORS ON ONE DRIVE, YOU MUST DESIGN THE CONTACTORS FOR THE INDIVIDUAL MOTORS ACCORDING TO UTILIZATION CATEGORY AC-3.

SELECTING THE MOTOR CONTACTOR IS DONE ACCORDING TO THE RATED OPERATIONAL CURRENT OF THE MOTOR TO BE CONNECTED.

⚠ CAUTION

DEBOUNCED INPUTS MAY NOT BE USED IN THE SAFETY CIRCUIT DIAGRAM. A CHANGEOVER BETWEEN THE DRIVE AND THE INPUT SUPPLY MUST TAKE PLACE IN A VOLTAGE-FREE STATE.

⚠ CAUTION

DEBOUNCED INPUTS MAY NOT BE USED IN THE SAFETY CIRCUIT DIAGRAM. FIRE HAZARD!

ONLY USE CABLES, PROTECTIVE SWITCHES, AND CONTACTORS THAT FEATURE THE INDICATED PERMISSIBLE NOMINAL CURRENT VALUE.

⚠ CAUTION

BEFORE CONNECTING THE DRIVE TO AC MAINS MAKE SURE THAT THE EMC PROTECTION CLASS SETTINGS OF THE DRIVE ARE APPROPRIATELY MADE ACCORDING TO INSTRUCTIONS IN THIS MANUAL.

⚠ CAUTION

BEFORE CONNECTING THE DRIVE TO AC MAINS MAKE SURE THAT THE EMC PROTECTION CLASS SETTINGS OF THE DRIVE ARE APPROPRIATELY MADE ACCORDING TO INSTRUCTIONS IN THIS MANUAL.

- IF THE DRIVE IS TO BE USED IN A FLOATING DISTRIBUTION NETWORK, REMOVE SCREWS AT MOV AND EMC. SEE “INSTALLATION IN CORNER-GROUNDED NETWORK” ON PAGE 53 AND “INSTALLATION IN IT SYSTEM” ON PAGE 53 RESPECTIVELY
- DISCONNECT THE INTERNAL EMC FILTER WHEN INSTALLING THE DRIVE ON AN IT SYSTEM (AN UNGROUNDED POWER SYSTEM OR A HIGH-RESISTANCE-GROUNDED [OVER 30 OHM] POWER SYSTEM), OTHERWISE THE SYSTEM WILL BE CONNECTED TO GROUND POTENTIAL THROUGH THE EMC FILTER CAPACITORS. THIS MAY CAUSE DANGER, OR DAMAGE THE DRIVE
- DISCONNECT THE INTERNAL EMC FILTER WHEN INSTALLING THE DRIVE ON A CORNER GROUNDED TN SYSTEM, OTHERWISE THE DRIVE WILL BE DAMAGED

NOTICE

WHEN THE INTERNAL EMC FILTER IS DISCONNECTED, THE DRIVE MIGHT BE NOT EMC COMPATIBLE.

- DO NOT ATTEMPT TO INSTALL OR REMOVE THE MOV OR EMC SCREWS WHILE POWER IS APPLIED TO THE DRIVE'S INPUT TERMINALS

Motor and equipment safety

⚠ CAUTION

DO NOT PERFORM ANY MEGGAR OR VOLTAGE WITHSTAND TESTS ON ANY PART OF THE DRIVE OR ITS COMPONENTS. IMPROPER TESTING MAY RESULT IN DAMAGE.

⚠ CAUTION

PRIOR TO ANY TESTS OR MEASUREMENTS OF THE MOTOR OR THE MOTOR CABLE, DISCONNECT THE MOTOR CABLE AT THE DRIVE OUTPUT TERMINALS (U, V, W) TO AVOID DAMAGING THE DRIVE DURING MOTOR OR CABLE TESTING.

⚠ CAUTION

DO NOT TOUCH ANY COMPONENTS ON THE CIRCUIT BOARDS. STATIC VOLTAGE DISCHARGE MAY DAMAGE THE COMPONENTS.

⚠ CAUTION

BEFORE STARTING THE MOTOR, CHECK THAT THE MOTOR IS MOUNTED PROPERLY AND ALIGNED WITH THE DRIVEN EQUIPMENT. ENSURE THAT STARTING THE MOTOR WILL NOT CAUSE PERSONAL INJURY OR DAMAGE EQUIPMENT CONNECTED TO THE MOTOR.

⚠ CAUTION

SET THE MAXIMUM MOTOR SPEED (FREQUENCY) IN THE DRIVE ACCORDING TO THE REQUIREMENTS OF THE MOTOR AND THE EQUIPMENT CONNECTED TO IT. INCORRECT MAXIMUM FREQUENCY SETTINGS CAN CAUSE MOTOR OR EQUIPMENT DAMAGE AND PERSONAL INJURY.

⚠ CAUTION

BEFORE REVERSING THE MOTOR ROTATION DIRECTION, ENSURE THAT THIS WILL NOT CAUSE PERSONAL INJURY OR EQUIPMENT DAMAGE.

⚠ CAUTION

MAKE SURE THAT NO POWER CORRECTION CAPACITORS ARE CONNECTED TO THE DRIVE OUTPUT OR THE MOTOR TERMINALS TO PREVENT DRIVE MALFUNCTION AND POTENTIAL DAMAGE.

⚠ CAUTION

MAKE SURE THAT THE DRIVE OUTPUT TERMINALS (U, V, W) ARE NOT CONNECTED TO THE UTILITY LINE POWER AS SEVERE DAMAGE TO THE DRIVE MAY OCCUR.

⚠ CAUTION

WHEN THE CONTROL TERMINALS OF TWO OR MORE DRIVE UNITS ARE CONNECTED IN PARALLEL, THE AUXILIARY VOLTAGE FOR THESE CONTROL CONNECTIONS MUST BE TAKEN FROM A SINGLE SOURCE WHICH CAN EITHER BE ONE OF THE UNITS OR AN EXTERNAL SUPPLY.

⚠ CAUTION

THE DRIVE WILL START UP AUTOMATICALLY AFTER AN INPUT VOLTAGE INTERRUPTION IF THE EXTERNAL RUN COMMAND IS ON.

⚠ CAUTION

DO NOT CONTROL THE MOTOR WITH THE DISCONNECTING DEVICE (DISCONNECTING MEANS); INSTEAD, USE THE CONTROL PANEL START AND STOP KEYS AND, OR COMMANDS VIA THE I/O BOARD OF THE DRIVE. THE MAXIMUM ALLOWED NUMBER OF CHARGING CYCLES OF THE DC CAPACITORS (I.E. POWER-UPS BY APPLYING POWER) IS FIVE IN TEN MINUTES.

⚠ CAUTION

IMPROPER DRIVE OPERATION:

- IF THE DRIVE IS NOT TURNED ON FOR A LONG PERIOD, THE PERFORMANCE OF ITS ELECTROLYTIC CAPACITORS WILL BE REDUCED
- IF IT IS STOPPED FOR A PROLONGED PERIOD, TURN THE DRIVE ON AT LEAST EVERY SIX MONTHS FOR AT LEAST 5 HOURS TO RESTORE THE PERFORMANCE OF THE CAPACITORS, AND THEN CHECK ITS OPERATION. IT IS RECOMMENDED THAT THE DRIVE IS NOT CONNECTED DIRECTLY TO THE LINE VOLTAGE. THE VOLTAGE SHOULD BE INCREASED GRADUALLY USING AN ADJUSTABLE AC SOURCE

FAILURE TO FOLLOW THESE INSTRUCTIONS CAN RESULT IN INJURY AND/OR EQUIPMENT DAMAGE.

For more technical information, contact the factory or your local sales representative..

Sécurité

⚠ AVERTISSEMENT

TENSION ÉLECTRIQUE DANGEREUSE !

Avant de commencer l’installation

- Débrancher l’alimentation de l’appareil
- S’assurer que les dispositifs ne peuvent pas être accidentellement redémarrés
- Vérifier l’isolement de l’alimentation
- Mettre l’appareil à la terre et le protéger contre les courts-circuits
- Couvrir ou enfermer tout composant sous tension adjacent
- Seul le personnel qualifié conformément à la norme EN 50110-1/-2 (VDE 0105 Partie 100) peut travailler sur cet appareil/ce système
- Avant l’installation et avant de toucher l’appareil, s’assurer de ne porter aucune charge électrostatique
- La terre fonctionnelle (FE, PSE) doit être raccordée à la terre de protection (PE) ou la compensation de potentiel. L’installateur du système a la responsabilité d’assurer cette connexion
- Les câbles de connexion et les lignes de signal doivent être installés de façon à ce que les interférences capacitives ou inductives ne compromettent pas les fonctions d’automatisation
- Installer les appareils d’automatisation et les éléments de fonctionnement associés de manière à ce qu’ils soient bien protégés contre tout fonctionnement accidentel
- Des dispositifs de sécurité matériels et logiciels appropriés doivent être utilisés en rapport avec l’interface des E/S afin qu’un circuit ouvert sur le côté signal ne résulte pas en états indéfinis dans les dispositifs d’automatisation
- Assurer une isolation électrique fiable sur le côté tension extra basse de l’alimentation 24 V. Utiliser uniquement des blocs d’alimentation conformes à la norme CEI 60364-4-41 (VDE 0100, partie 410) ou HD384.4.41 S2
- Les écarts entre la tension d’entrée et la tension nominale ne doivent pas dépasser les limites de tolérance indiquées dans les spécifications, au risque de provoquer un mauvais fonctionnement et une utilisation dangereuse du système
- Les dispositifs d’arrêt d’urgence conformes à la norme CEI/EN 60204-1 doivent être efficace dans tous les modes de fonctionnement des dispositifs d’automatisation. Le déverrouillage des dispositifs d’arrêt d’urgence ne doit pas entraîner un redémarrage
- Les dispositifs conçus pour un montage dans des boîtiers ou armoires de commande ne doivent être utilisés et contrôlés qu’après avoir été installés et avec le boîtier fermé. Les unités de bureau ou portatives ne doivent être utilisées et contrôlées que dans leurs boîtiers fermés
- Des mesures doivent être prises pour assurer un bon redémarrage des programmes interrompus après une chute ou une panne de tension. Ceci ne doit pas causer des états de fonctionnement dangereux, même pour un court laps de temps. Si nécessaire, des dispositifs d’arrêt d’urgence doivent être utilisés
- Quand des défaillances du système d’automatisation peuvent entraîner des blessures ou des dommages matériels, des mesures externes doivent être appliquées pour assurer un état de fonctionnement sans danger en cas de panne ou de mauvais fonctionnement (par exemple au moyen de disjoncteurs séparés, de verrouillages mécaniques, etc.)
- En fonction de leur degré de protection, les entraînements à fréquence variable peuvent contenir des pièces métalliques sous tension, des composants rotatifs ou en mouvement et des surfaces brûlantes, pendant le fonctionnement et immédiatement après l’arrêt
- Le retrait des protections requises, une installation incorrecte ou un mauvais fonctionnement du moteur ou de l’entraînement à fréquence variable peuvent causer la défaillance de l’appareil et entraîner des blessures graves et des dommages importants
- La réglementation nationale applicable en matière de sécurité et de prévention des accidents s’applique à tous les travaux effectués sur les entraînements à fréquence variable sous tension
- L’installation électrique doit être effectuée conformément aux réglementations applicables (par exemple, en ce qui concerne les sections transversales des câbles, les fusibles, la mise à la terre de protection)
- Le transport, l’installation, la mise en service et les travaux de maintenance doivent être effectués uniquement par un personnel qualifié (IEC 60364, HD 384 et règles de sécurité du travail)
- Les installations contenant des entraînements à fréquence variable doivent être équipées de dispositifs de surveillance et de protection, conformément aux réglementations applicables en matière de sécurité. Les modifications des entraînements à fréquence variable réalisées à l’aide du logiciel d’exploitation sont autorisées
- Toutes les protections et les portes doivent être maintenues fermées pendant le fonctionnement

- Pour réduire les risques d'accidents et de dommages matériels, l'utilisateur doit inclure dans la conception de la machine des mesures limitant les conséquences de panne ou de mauvais fonctionnement de l'entraînement (augmentation de la vitesse ou arrêt soudain du moteur). Ces mesures comprennent:
  - Autres dispositifs indépendants de surveillance des variables en rapport avec la sécurité (vitesse, voyages, positions d'extrémité, etc.)
  - Mesures électriques ou non électriques appliquées à l'ensemble du système (verrouillages électriques ou mécaniques)
  - Ne jamais toucher les pièces sous tension ni les connexions des câbles de l'entraînement à fréquence variable après leur déconnexion de l'alimentation. En raison de la charge dans les condensateurs, ces pièces peuvent être encore sous tension après la déconnexion. Installer les panneaux d'avertissement appropriés.

Lire ce manuel en entier et s'assurer de bien comprendre les procédures avant de tenter d'installer, de configurer, d'utiliser et d'effectuer tout travail d'entretien sur cet entraînement à fréquence variable PowerXL.

Définitions et symboles

⚠ AVERTISSEMENT

(CE SYMBOLE INDIQUE UNE HAUTE TENSION. IL ATTIRE L'ATTENTION SUR LES ÉLÉMENTS OU LES OPÉRATIONS QUI POURRAIENT ÊTRE DANGEREUX POUR LES PERSONNES UTILISANT CET ÉQUIPEMENT. LIRE ATTENTIVEMENT LE MESSAGE ET SUIVRE ATTENTIVEMENT LES INSTRUCTIONS.

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CE SYMBOLE EST LE « SYMBOLE D'ALERTE DE SÉCURITÉ ». IL ACCOMPAGNE LES DEUX TERMES D'AVERTISSEMENT SUIVANTS : MISE EN GARDE OU AVERTISSEMENT, COMME DÉCRIT CI-DESSOUS.

⚠ AVERTISSEMENT

INDIQUE UNE SITUATION POTENTIELLEMENT DANGEREUSE QUI, SI ELLE N'EST PAS ÉVITÉE, PEUT ENTRAÎNER DES BLESSURES GRAVES OU LA MORT.

⚠ MISE EN GARDE

INDIQUE UNE SITUATION POTENTIELLEMENT DANGEREUSE QUI, SI ELLE N'EST PAS ÉVITÉE, PEUT ENTRAÎNER DES BLESSURES LÉGÈRES À MODÉRÉES ET D'IMPORTANTS DÉGÂTS MATÉRIELS. LA SITUATION DÉCRITE DANS LA MISE EN GARDE PEUT, SI ELLE N'EST PAS ÉVITÉE, ENTRAÎNER DES CONSÉQUENCES GRAVES. DES MESURES DE SÉCURITÉ IMPORTANTES SONT DÉCRITES DANS LES MISES EN GARDE (AINSI QUE DANS LES AVERTISSEMENTS).

Haute tension dangereuse

⚠ AVERTISSEMENT

L'ÉQUIPEMENT DE CONTRÔLE DU MOTEUR ET LES CONTRÔLEURS ÉLECTRONIQUES SONT BRANCHÉS SUR DES TENSIONS SECTEUR DANGEREUSES. LORS DE L'ENTRETIEN DES ENTRAÎNEMENTS ET DES CONTRÔLEURS ÉLECTRONIQUES, IL PEUT Y AVOIR DES COMPOSANTS EXPOSÉS AVEC DES BOÎTIERS OU DES PROTUBÉRANCES AU NIVEAU DU POTENTIEL DU RÉSEAU OU AU-DESSUS. TOUTES LES PRÉCAUTIONS DOIVENT ÊTRE PRISES POUR SE PROTÉGER CONTRE LES CHOCS ÉLECTRIQUES.

- SE TENIR SUR UN TAPIS ISOLANT ET PRENDRE L'HABITUDE DE N'UTILISER QU'UNE SEULE MAIN POUR VÉRIFIER LES COMPOSANTS
- TOUJOURS TRAVAILLER AVEC UNE AUTRE PERSONNE LORSQU'UNE SITUATION D'URGENCE SE PRODUIT
- DÉBRANCHER L'ALIMENTATION AVANT DE VÉRIFIER LES CONTRÔLEURS OU D'EFFECTUER DES TRAVAUX D'ENTRETIEN
- S'ASSURER QUE L'ÉQUIPEMENT EST CORRECTEMENT RELIÉ À LA TERRE
- PORTER DES LUNETTES DE SÉCURITÉ LORS DES TRAVAUX SUR LES CONTRÔLEURS ÉLECTRONIQUES OU LES MACHINES ROTATIVES

⚠ AVERTISSEMENT

LES COMPOSANTS DE LA SECTION D'ALIMENTATION DE L'ENTRAÎNEMENT RESTENT SOUS TENSION APRÈS LA COUPURE DE LA TENSION D'ALIMENTATION. APRÈS LA DÉCONNEXION DE L'ALIMENTATION, ATTENDRE AU MOINS CINQ MINUTES AVANT DE RETIRER LE COUVERCLE POUR PERMETTRE LA DÉCHARGE DES CONDENSATEURS DU CIRCUIT INTERMÉDIAIRE.

PRÊTER ATTENTION AUX AVERTISSEMENTS SIGNALANT DES DANGERS !

⚠

DANGER
5 MIN

⚠ AVERTISSEMENT

RISQUE DE CHOC ÉLECTRIQUE - RISQUE DE BLESSURES ! EFFECTUER LE CÂBLAGE UNIQUEMENT SI L'UNITÉ N'EST PLUS SOUS TENSION.

⚠ AVERTISSEMENT

NE PAS EFFECTUER DE MODIFICATIONS SUR L'ENTRAÎNEMENT CA LORSQU'IL EST CONNECTÉ À L'ALIMENTATION SECTEUR.

Avertissements et mises en garde

⚠ AVERTISSEMENT

S'ASSURER DE METTRE L'APPAREIL À LA TERRE EN SUIVANT LES INSTRUCTIONS DE CE MANUEL. LES UNITÉS NON MISES À LA TERRE PEUVENT CAUSER DES CHOCS ÉLECTRIQUES ET DES INCENDIES.

⚠ AVERTISSEMENT

CET ÉQUIPEMENT NE DOIT ÊTRE INSTALLÉ, RÉGLÉ ET ENTRETENU QUE PAR UN PERSONNEL D'ENTRETIEN ÉLECTRIQUE QUALIFIÉ CONNAISSANT LA CONSTRUCTION ET LE FONCTIONNEMENT DE CE TYPE D'ÉQUIPEMENT, AINSI QUE LES RISQUES ENCOURUS. LE NON-RESPECT DE CETTE PRÉCAUTION PEUT ENTRAÎNER LA MORT OU DES BLESSURES GRAVES.

⚠ AVERTISSEMENT

LES COMPOSANTS À L'INTÉRIEUR DE L'ENTRAÎNEMENT SONT SOUS TENSION LORSQUE L'ENTRAÎNEMENT EST BRANCHÉ À L'ALIMENTATION. LE CONTACT AVEC CETTE TENSION EST EXTRÊMEMENT DANGEREUX ET PEUT CAUSER LA MORT OU DES BLESSURES GRAVES.

⚠ AVERTISSEMENT

LES BORNES DE PHASE (L1, L2, L3), LES BORNES DU MOTEUR (U, V, W) ET LES BORNES DE RÉSISTANCE DE LIAISON CC/FREIN (DC-, DC+ /R+, R-) SONT SOUS TENSION LORSQUE L'ENTRAÎNEMENT EST BRANCHÉ À L'ALIMENTATION, MÊME SI LE MOTEUR NE TOURNE PAS. LE CONTACT AVEC CETTE TENSION EST EXTRÊMEMENT DANGEREUX ET PEUT CAUSER LA MORT OU DES BLESSURES GRAVES.

⚠ AVERTISSEMENT

MÊME SI LES BORNES E/S DE COMMANDE SONT ISOLÉES DE LA TENSION SECTEUR, LES SORTIES DE RELAIS ET LES AUTRES BORNES E/S PEUVENT PRÉSENTER UNE TENSION DANGEREUSE MÊME LORSQUE L'ENTRAÎNEMENT EST DÉBRANCHÉ. LE CONTACT AVEC CETTE TENSION EST EXTRÊMEMENT DANGEREUX ET PEUT CAUSER LA MORT OU DES BLESSURES GRAVES.

⚠ AVERTISSEMENT

CET ÉQUIPEMENT A UN GRAND COURANT DE FUITE CAPACITIF PENDANT LE FONCTIONNEMENT, CE QUI PEUT METTRE LES PIÈCES DU BOÎTIER À UN NIVEAU SUPÉRIEUR AU POTENTIEL DE TERRE. UNE MISE À LA TERRE APPROPRIÉE, TELLE QUE DÉCRITE DANS CE MANUEL, EST NÉCESSAIRE. LE NON-RESPECT DE CETTE PRÉCAUTION PEUT ENTRAÎNER LA MORT OU DES BLESSURES GRAVES.

⚠ AVERTISSEMENT

AVANT DE METTRE L'ENTRAÎNEMENT SOUS TENSION, S'ASSURER QUE LES PROTECTIONS AVANT ET DES CÂBLES SONT FERMÉES ET ATTACHÉES POUR EMPÊCHER L'EXPOSITION À D'ÉVENTUELLES DÉFAILLANCES ÉLECTRIQUES. LE NON-RESPECT DE CETTE PRÉCAUTION PEUT ENTRAÎNER LA MORT OU DES BLESSURES GRAVES.

⚠ AVERTISSEMENT

UN DISPOSITIF DE PROTECTION/DÉCONNEXION EN AMONT DOIT ÊTRE FOURNI, TEL QUE REQUIS PAR LE CODE ÉLECTRIQUE NATIONAL (NECT). LE NON-RESPECT DE CETTE PRÉCAUTION PEUT ENTRAÎNER LA MORT OU DES BLESSURES GRAVES.

⚠ AVERTISSEMENT

CET ENTRAÎNEMENT PEUT CAUSER UN COURANT CC DANS LE CONDUCTEUR DE MISE À LA TERRE DE PROTECTION. LORSQU'UN DISPOSITIF DE PROTECTION OU DE SURVEILLANCE À COURANT RÉSIDUEL EST UTILISÉ POUR LA PROTECTION EN CAS DE CONTACT DIRECT OU INDIRECT, SEUL UN DISPOSITIF DE TYPE B EST AUTORISÉ SUR LE CÔTÉ ALIMENTATION DE CE PRODUIT.

⚠ AVERTISSEMENT

NE TRAVAILLER SUR LE CÂBLAGE QU'APRÈS QUE L'ENTRAÎNEMENT A ÉTÉ CORRECTEMENT MONTÉ ET ATTACHÉ.

⚠ AVERTISSEMENT

AVANT D'OUVRIR LES COUVERCLES DE L'ENTRAÎNEMENT :

- DÉBRANCHER TOUTE L'ALIMENTATION ALLANT À L'ENTRAÎNEMENT, Y COMPRIS L'ALIMENTATION DE COMMANDE EXTERNE POUVANT ÊTRE PRÉSENTE
- ATTENDRE UN MINIMUM DE CINQ MINUTES APRÈS L'EXTINCTION DE TOUS LES VOYANTS DU CLAVIER. CELA PERMET AUX CONDENSATEURS DE BUS CC DE SE DÉCHARGER
- UNE TENSION DANGEREUSE PEUT RESTER DANS LES CONDENSATEURS DE BUS CC MÊME SI L'ALIMENTATION A ÉTÉ COUPÉE. CONFIRMER QUE LES CONDENSATEURS SONT ENTIÈREMENT DÉCHARGÉS EN MESURANT LA TENSION À L'AIDE D'UN MULTIMÈTRE RÉGLÉ POUR MESURER LA TENSION CC

LE NON-RESPECT DE CETTE PRÉCAUTION PEUT ENTRAÎNER LA MORT OU DES BLESSURES GRAVES.

⚠ AVERTISSEMENT

L'OUVERTURE DU DISPOSITIF DE PROTECTION DU CIRCUIT DE DÉRIVATION PEUT INDIQUER QUE LE COURANT DE DÉFAUT A ÉTÉ INTERROMPU. POUR RÉDUIRE LE RISQUE D'INCENDIE OU DE CHOC ÉLECTRIQUE, LES PIÈCES PORTEUSES DE COURANT ET LES AUTRES COMPOSANTS DU CONTRÔLEUR DOIVENT ÊTRE EXAMINÉS ET REMPLACÉS S'ILS SONT ENDOMMAGÉS. SI L'ÉLÉMENT DE COURANT D'UN RELAIS DE SURCHARGE A GRILLÉ, LE RELAIS DE SURCHARGE DOIT ÊTRE INTÉGRALEMENT REMPLACÉ.

⚠ AVERTISSEMENT

LE FONCTIONNEMENT DE CET ÉQUIPEMENT NÉCESSITE LE RESPECT DES INSTRUCTIONS D'INSTALLATION ET DE FONCTIONNEMENT DÉTAILLÉES FOURNIES DANS LE MANUEL D'INSTALLATION/DE FONCTIONNEMENT DESTINÉ À ÊTRE UTILISÉ AVEC CE PRODUIT. CE SUPPORT DOIT ÊTRE CONSERVÉ AVEC CET APPAREIL À TOUT MOMENT.

⚠ AVERTISSEMENT

AVANT DE PROCÉDER À L'ENTRETIEN DE L'ENTRAÎNEMENT :

- DÉBRANCHER TOUTE L'ALIMENTATION ALLANT À L'ENTRAÎNEMENT, Y COMPRIS L'ALIMENTATION DE COMMANDE EXTERNE POUVANT ÊTRE PRÉSENTE
- PLACER UNE ÉTIQUETTE « NE PAS UTILISER » SUR LE DISPOSITIF DE DÉCONNEXION
- VERROUILLER LE DISPOSITIF DE DÉCONNEXION EN POSITION OUVERTE

LE NON-RESPECT DE CES INSTRUCTIONS PEUT ENTRAÎNER LA MORT OU DES BLESSURES GRAVES.

⚠ AVERTISSEMENT

LES SORTIES DE L'ENTRAÎNEMENT (U, V, W) NE DOIVENT PAS ÊTRE CONNECTÉES À LA TENSION D'ENTRÉE NI À L'ALIMENTATION SECTEUR, CAR CECI POURRAIT GRAVEMENT ENDOMMAGER L'APPAREIL ET CAUSER UN INCENDIE.

⚠ AVERTISSEMENT

LE DISSIPATEUR DE CHALEUR ET/OU LE BOÎTIER EXTERNE PEUVENT ATTEINDRE UNE TEMPÉRATURE ÉLEVÉE.

PRÊTER ATTENTION AUX AVERTISSEMENTS SIGNALANT DES DANGERS !

SURFACE BRÛLANTE - RISQUE DE BRÛLURE. NE PAS TOUCHER !!

⚠ MISE EN GARDE

TOUTE MODIFICATION ÉLECTRIQUE OU MÉCANIQUE DE CET ENTRAÎNEMENT SANS CONSENTEMENT ÉCRIT PRÉALABLE ANNULE TOUTES LES GARANTIES, PEUT ENTRAÎNER UN DANGER POUR LA SÉCURITÉ ET ANNULER L'HOMOLOGATION UL®.

⚠ MISE EN GARDE

INSTALLER CET ENTRAÎNEMENT SUR UNE MATIÈRE RÉSISTANTE AUX FLAMMES, TELLE QU'UNE PLAQUE D'ACIER, POUR RÉDUIRE LES RISQUES D'INCENDIE.

⚠ MISE EN GARDE

INSTALLER CET ENTRAÎNEMENT SUR UNE SURFACE PERPENDICULAIRE CAPABLE DE SUPPORTER LE POIDS DE L'ENTRAÎNEMENT ET NON SOUMISE À DES VIBRATIONS AFIN DE DIMINUER LES RISQUES DE CHUTE ET DE DOMMAGE DE L'ENTRAÎNEMENT, AINSI QUE LES RISQUES DE BLESSURES.

⚠ MISE EN GARDE

EMPÊCHER LA PÉNÉTRATION DE CORPS ÉTRANGERS, TELS QUE MORCEAUX DE FILS ET COPEAUX MÉTALLIQUES, DANS LE BOÎTIER DE L'ENTRAÎNEMENT, CAR CECI POURRAIT PROVOQUER LA FORMATION D'UN ARC ÉLECTRIQUE ET UN INCENDIE.

⚠ MISE EN GARDE

INSTALLER CET ENTRAÎNEMENT DANS UNE PIÈCE BIEN AÉRÉE NON SOUMISE À DES TEMPÉRATURES EXTRÊMES, À UNE FORTE HUMIDITÉ OU À LA CONDENSATION. ÉVITER LES ENDROITS DIRECTEMENT EXPOSÉS AU SOLEIL OU PRÉSENTANT DE FORTES CONCENTRATIONS DE POUSSIÈRES, DES GAZ CORROSIFS, DES GAZ EXPLOSIFS, DES GAZ INFLAMMABLES, OU DES VAPEURS DE LIQUIDE DE MEULAGE, ETC. UNE INSTALLATION INADÉQUATE PEUT ENTRAÎNER UN RISQUE D'INCENDIE.

⚠ MISE EN GARDE

LORS DE LA SÉLECTION DE LA SECTION TRANSVERSALE DES CÂBLES, PRENDRE EN COMPTE LA CHUTE DE TENSION DANS DES CONDITIONS DE CHARGE. LA PRISE EN COMPTE D'AUTRES PARAMÈTRES RELÈVE DE LA RESPONSABILITÉ DE L'UTILISATEUR.

IL RELÈVE DE LA RESPONSABILITÉ DE L'UTILISATEUR DE RESPECTER TOUTES LES NORMES ÉLECTRIQUES NATIONALES ET INTERNATIONALES EN VIGUEUR CONCERNANT LA MISE À LA TERRE DE PROTECTION DE L'ENSEMBLE DE L'ÉQUIPEMENT.

⚠ MISE EN GARDE

LES SPÉCIFICATIONS MINIMUM RELATIVES AUX SECTIONS TRANSVERSALES DES CONDUCTEURS DE TERRE DE PROTECTION INDIQUÉES DANS CE MANUEL DOIVENT ÊTRE RESPECTÉES.

LE COURANT DE FUITE DE CET ÉQUIPEMENT DÉPASSE 3,5 MA (CA). LA TAILLE MINIMUM DU CONDUCTEUR DE LA MISE À LA TERRE DE PROTECTION DOIT ÊTRE CONFORME AUX EXIGENCES DE LA NORME EN 61800-5-1 ET/OU AUX RÉGLEMENTATIONS DE SÉCURITÉ LOCALES.

⚠ MISE EN GARDE

LES COURANTS DE FUITE DE CE CONVERTISSEUR DE FRÉQUENCE SONT SUPÉRIEURES À 3,5 MA (CA). CONFORMÉMENT À LA NORME CEI/EN 61800-5-1, UN CONDUCTEUR DE MISE À LA TERRE DE L'ÉQUIPEMENT SUPPLÉMENTAIRE POSSÉDANT LA MÊME SUPERFICIE DE COUPE TRANSVERSALE QUE LE CONDUCTEUR DE MISE À LA TERRE DE PROTECTION D'ORIGINE DOIT ÊTRE BRANCHÉ, OU LA SECTION TRANSVERSALE DU CONDUCTEUR DE MISE À LA TERRE DE L'ÉQUIPEMENT DOIT ÊTRE D'AU MOINS 10 MM^2 CU. SEUL UN CONDUCTEUR EN CUIVRE DOIT ÊTRE UTILISÉ AVEC CET ENTRAÎNEMENT.

⚠ MISE EN GARDE

LES ENTRÉES ANTI-REBOND NE SONT PAS PERMISES DANS LE SCHÉMA DU CIRCUIT DE SÉCURITÉ. DES DISJONCTEURS DE COURANT RÉSIDUEL (RCD) NE PEUVENT ÊTRE INSTALLÉS QU'ENTRE LE RÉSEAU DE COURANT ALTERNATIF ET L'ENTRAÎNEMENT.

⚠ MISE EN GARDE

LES ENTRÉES ANTI-REBOND NE SONT PAS PERMISES DANS LE SCHÉMA DU CIRCUIT DE SÉCURITÉ. DES DISJONCTEURS DE COURANT RÉSIDUEL (RCD) NE PEUVENT ÊTRE INSTALLÉS QU'ENTRE LE RÉSEAU DE COURANT ALTERNATIF ET L'ENTRAÎNEMENT.

⚠ MISE EN GARDE

LES ENTRÉES ANTI-REBOND NE SONT PAS PERMISES DANS LE SCHÉMA DU CIRCUIT DE SÉCURITÉ. SI PLUSIEURS MOTEURS SONT CONNECTÉS À UN ENTRAÎNEMENT, DES CONTACTEURS DOIVENT ÊTRE CONÇUS POUR LES MOTEURS INDIVIDUELS CONFORMÉMENT À LA CATÉGORIE D'UTILISATION AC-3.

SÉLECTIONNER DU CONTACTEUR DU MOTEUR EN FONCTION DU COURANT DE FONCTIONNEMENT NOMINAL DU MOTEUR À CONNECTER.

⚠ MISE EN GARDE

LES ENTRÉES ANTI-REBOND NE SONT PAS PERMISES DANS LE SCHÉMA DU CIRCUIT DE SÉCURITÉ. UNE COMMUTATION ENTRE L'ENTRAÎNEMENT ET L'ALIMENTATION D'ENTRÉE DOIT AVOIR LIEU DANS UN ÉTAT SANS TENSION.

⚠ MISE EN GARDE

LES ENTRÉES ANTI-REBOND NE SONT PAS PERMISES DANS LE SCHÉMA DU CIRCUIT DE SÉCURITÉ. RISQUE D'INCENDIE !

UTILISER UNIQUEMENT DES CÂBLES, DES INTERRUPTEURS DE PROTECTION ET DES CONTACTEURS INDIQUANT LE COURANT NOMINAL PERMIS.

⚠ MISE EN GARDE

AVANT DE CONNECTER L'ENTRAÎNEMENT À L'ALIMENTATION SECTEUR CA, S'ASSURER QUE LES RÉGLAGES DE LA CLASSE DE PROTECTION CEM SONT CORRECTEMENT EFFECTUÉS SELON LES INSTRUCTIONS DE CE MANUEL.

- SI L'ENTRAÎNEMENT DOIT ÊTRE UTILISÉ DANS UN RÉSEAU DE DISTRIBUTION FLOTTANT, RETIRER LES VIS AU NIVEAU DES VOM ET CEM. VOIR « INSTALLATION DANS UN RÉSEAU À UNE PHASE CONNECTÉE À LA TERRE (CORNER-GROUNDED) » À LA PAGE 53 ET « INSTALLATION DANS UN RÉSEAU IT » À LA PAGE 53 RESPECTIVEMENT
- DÉBRANCHER LE FILTRE CEM INTERNE LORS DE L'INSTALLATION DE L'ENTRAÎNEMENT SUR UN RÉSEAU IT (SYSTÈME D'ALIMENTATION NON MIS À LA TERRE OU SYSTÈME D'ALIMENTATION ÉLECTRIQUE MIS À LA TERRE HAUTE RÉSISTANCE [PLUS DE 30 OHMS]) POUR NE PAS QUE LE SYSTÈME SOIT CONNECTÉ AU POTENTIEL DE TERRE VIA LES CONDENSATEURS DU FILTRE CEM. CECI PEUT ÊTRE UNE CAUSE DE DANGERS OU ENDOMMAGER L'ENTRAÎNEMENT
- DÉBRANCHER LE FILTRE CEM INTERNE LORS DE L'INSTALLATION DE L'ENTRAÎNEMENT SUR UN SYSTÈME TN À UNE PHASE CONNECTÉE À LA TERRE POUR NE PAS ENDOMMAGER L'ENTRAÎNEMENT
  REMARQUE: LORSQUE LE FILTRE CEM INTERNE EST DÉBRANCHÉ, L'ENTRAÎNEMENT PEUT NE PAS ÊTRE CONFORME AUX NORMES DE COMPATIBILITÉ ÉLECTROMAGNÉTIQUE.
- NE PAS TENTER D'INSTALLER OU DE RETIRER LES VIS DES VOM ET CEM LORSQUE L'ALIMENTATION EST APPLIQUÉE AUX BORNES D'ENTRÉE DE L'ENTRAÎNEMENT.

Sécurité du moteur et de l'équipement

⚠ MISE EN GARDE

N'EFFECTUER AUCUN TEST DE RÉSISTANCE DE TENSION OU AU MÉGOHMMÈTRE SUR TOUTE PARTIE DE L'ENTRAÎNEMENT OU DE SES COMPOSANTS. UN TEST INADÉQUAT PEUT ENTRAÎNER DES DOMMAGES.

⚠ MISE EN GARDE

AVANT TOUT TEST OU MESURE DU MOTEUR OU DU CÂBLE DU MOTEUR, DÉBRANCHER LE CÂBLE DU MOTEUR AU NIVEAU DES BORNES DE SORTIE DE L'ENTRAÎNEMENT (U, V, W) POUR ÉVITER D'ENDOMMAGER CE DERNIER LORS DES TESTS.

⚠ MISE EN GARDE

NE TOUCHER AUCUN COMPOSANT SUR LES CARTES DE CIRCUIT. LES DÉCHARGES D'ÉLECTRICITÉ STATIQUE PEUVENT ENDOMMAGER LES COMPOSANTS.

⚠ MISE EN GARDE

AVANT DE METTRE LE MOTEUR EN MARCHE, VÉRIFIER QU'IL EST CORRECTEMENT MONTÉ ET ALIGNÉ AVEC L'ÉQUIPEMENT ENTRAÎNÉ. S'ASSURER QUE LE DÉMARRAGE DU MOTEUR NE RISQUE PAS DE PROVOQUER DES BLESSURES OU D'ENDOMMAGER L'ÉQUIPEMENT CONNECTÉ AU MOTEUR.

⚠ MISE EN GARDE

RÉGLER LA VITESSE MAXIMALE DU MOTEUR (FRÉQUENCE) DANS L'ENTRAÎNEMENT CONFORMÉMENT AUX EXIGENCES DU MOTEUR ET DE L'ÉQUIPEMENT QUI LUI EST CONNECTÉ. DES RÉGLAGES DE FRÉQUENCE MAXIMUM INCORRECTS PEUVENT ENDOMMAGER LE MOTEUR OU L'ÉQUIPEMENT ET CAUSER DES BLESSURES.

⚠ MISE EN GARDE

AVANT D'INVERSER LE SENS DE ROTATION DU MOTEUR, VEILLER À CE QUE CELA NE RISQUE PAS DE PROVOQUER DES BLESSURES OU DES DOMMAGES MATÉRIELS.

⚠ MISE EN GARDE

S'ASSURER QU'AUCUN CONDENSATEUR DE CORRECTION DE PUISSANCE N'EST CONNECTÉ À LA SORTIE DE L'ENTRAÎNEMENT OU AUX BORNES DU MOTEUR POUR ÉVITER UN MAUVAIS FONCTIONNEMENT DE L'ENTRAÎNEMENT ET DES DOMMAGES POTENTIELS.

⚠ MISE EN GARDE

S'ASSURER QUE LES BORNES DE SORTIE DE L'ENTRAÎNEMENT (U, V, W) NE SONT PAS CONNECTÉES À L'ALIMENTATION SECTEUR, CE QUI POURRAIT CAUSER DE GRAVES DOMMAGES À L'ENTRAÎNEMENT.

⚠ MISE EN GARDE

LORSQUE LES BORNES DE COMMANDE DE DEUX OU PLUSIEURS UNITÉS D'ENTRAÎNEMENT SONT RACCORDÉES EN PARALLÈLE, LA TENSION AUXILIAIRE DE CES CONNEXIONS DE COMMANDE DOIT ÊTRE FOURNIE PAR UNE SOURCE UNIQUE, QUI PEUT ÊTRE SOIT L'UNE DES UNITÉS, SOIT UNE ALIMENTATION EXTERNE.

⚠ MISE EN GARDE

L'ENTRAÎNEMENT DÉMARRE AUTOMATIQUEMENT APRÈS UNE INTERRUPTION DE LA TENSION D'ENTRÉE SI LA COMMANDE DE DÉMARRAGE EXTERNE EST ACTIVE.

⚠ MISE EN GARDE

NE PAS COMMANDER LE MOTEUR AVEC LE DISPOSITIF DE DÉCONNEXION ; À LA PLACE, UTILISER LES TOUCHES DE MARCHE ET D'ARRÊT DU TABLEAU DE CONTRÔLE OU LES COMMANDES DU TABLEAU DES E/S DE L'ENTRAÎNEMENT. LE NOMBRE DE CYCLES DE CHARGE MAXIMUM PERMIS DES CONDENSATEURS CC (C'EST-À-DIRE LES MISES SOUS TENSION PAR APPLICATION DE PUISSANCE) EST DE CINQ EN DIX MINUTES.

⚠ MISE EN GARDE

FONCTIONNEMENT INCORRECT DE L'ENTRAÎNEMENT :

- **SI L'ENTRAÎNEMENT N'EST PAS MIS EN MARCHE PENDANT UNE LONGUE PÉRIODE, LA PERFORMANCE DE SES CONDENSATEURS ÉLECTROLYTIQUES SERA RÉDUITE**
- **S'IL EST ARRÊTÉ POUR UNE PÉRIODE PROLONGÉE, LE METTRE EN MARCHE AU MOINS TOUS LES SIX MOIS PENDANT AU MOINS 5 HEURES POUR RESTAURER LA PERFORMANCE DES CONDENSATEURS, PUIS VÉRIFIER SON FONCTIONNEMENT. IL EST RECOMMANDÉ DE NE PAS BRANCHER L'ENTRAÎNEMENT DIRECTEMENT SUR LA TENSION SECTEUR. LA TENSION DOIT ÊTRE AUGMENTÉE PROGRESSIVEMENT EN UTILISANT UNE SOURCE CA RÉGLABLE**

LE NON-RESPECT DE CES INSTRUCTIONS PEUT ENTRAÎNER DES BLESSURES OU DES DÉGÂTS MATÉRIELS.

Pour plus d'informations techniques, contacter l'usine ou le représentant commercial local.

Chapter 1—PowerXL Series overview

This chapter describes the purpose and contents of this manual, the receiving inspection recommendations and the PowerXL Series Open Drive catalog numbering system.

How to use this manual

The purpose of this manual is to provide you with information necessary to install, set and customize parameters, start up, troubleshoot and maintain the PowerXL Series Variable Frequency Drive (VFD). To provide for safe installation and operation of the equipment, read the safety guidelines at the beginning of this manual and follow the procedures outlined in the following chapters before connecting power to the PowerXL Series VFD. Keep this operating manual handy and distribute to all users, technicians and maintenance personnel for reference.

Receiving and inspection

The PowerXL Series VFD has met a stringent series of factory quality requirements before shipment. It is possible that packaging or equipment damage may have occurred during shipment. After receiving your PowerXL Series VFD, please check for the following:

Check to make sure that the package includes the Instruction Leaflet, Quick Start Guide and accessory packet. The accessory packet includes:

- Rubber grommets
- Control cable grounding clamps
- Additional grounding screw

Inspect the unit to ensure it was not damaged during shipment.

Make sure that the part number indicated on the nameplate corresponds with the catalog number on your order.

If shipping damage has occurred, please contact and file a claim with the carrier involved immediately.

If the delivery does not correspond to your order, please contact your representative.

Note: Do not destroy the packing. The template printed on the protective cardboard can be used for marking the mounting points of the PowerXL VFD on the wall or in a cabinet.

Real time clock battery activation

To activate the real time clock (RTC) functionality in the PowerXL Series VFD, the RTC battery (already mounted in the drive) must be connected to the control board.

Simply remove the primary drive cover, locate the RTC battery directly below the keypad, and connect the white 2-wire connector to the receptacle on the control board. Battery should be replaced after connected 3 or 4 years to keep it working

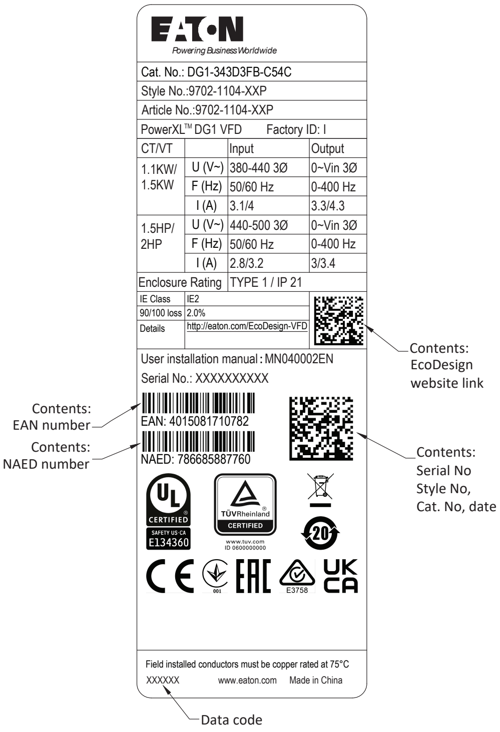
Figure 1. RTC battery connection

Table 1. Common abbreviations

Abbreviation	Definition
CT	Constant torque with high overload rating (150%)
VT	Variable torque with low overload rating (110%)
I_H	High overload current (150%)
I_L	Low overload current (110%)
VFD	Variable Frequency Drive
RTC	Real Time Clock

Rating label

Figure 2. Rating label—DG1



EATON
Powering Business Worldwide

Cat. No.: DG1-343D3FB-C54C
Style No.:9702-1104-XXP
Article No.:9702-1104-XXP
PowerXL™ DG1 VFD Factory ID: I

CT/VT		Input	Output
1.1KW/ 1.5KW	U (V~)	380-440 3Ø	0~Vin 3Ø
	F (Hz)	50/60 Hz	0-400 Hz
	I (A)	3.1/4	3.3/4.3
1.5HP/ 2HP	U (V~)	440-500 3Ø	0~Vin 3Ø
	F (Hz)	50/60 Hz	0-400 Hz
	I (A)	2.8/3.2	3/3.4
Enclosure Rating	TYPE 1 / IP 21		

IE Class	IE2
90/100 loss	2.0%
Details	http://eaton.com/EcoDesign-VFD

User installation manual: MN040002EN
Serial No.: XXXXXXXXXX
EAN: 4015081710782
NAED: 786685887760

Field installed conductors must be copper rated at 75°C
XXXXXX www.eaton.com Made in China

Contents: EcoDesign website link

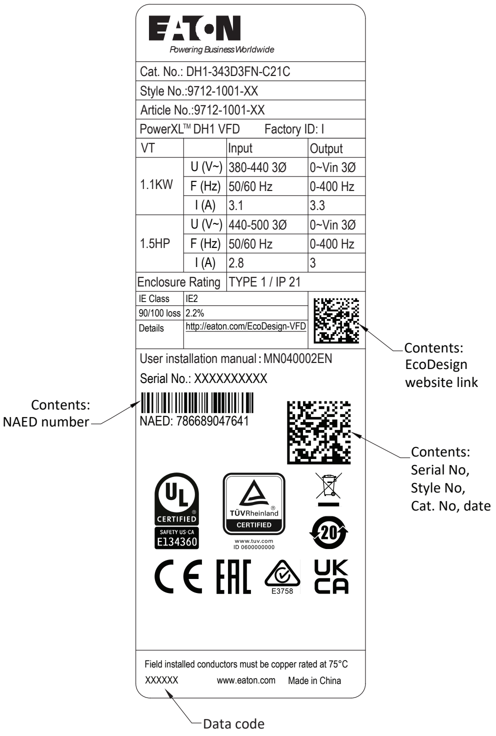
Contents: EAN number

Contents: NAED number

Contents: Serial No Style No, Cat. No, date

Data code

Figure 3. Rating label—DH1



EATON
Powering Business Worldwide

Cat. No.: DH1-343D3FN-C21C
Style No.:9712-1001-XX
Article No.:9712-1001-XX
PowerXL™ DH1 VFD Factory ID: I

VT		Input	Output
1.1KW	U (V~)	380-440 3Ø	0~Vin 3Ø
	F (Hz)	50/60 Hz	0-400 Hz
	I (A)	3.1	3.3
1.5HP	U (V~)	440-500 3Ø	0~Vin 3Ø
	F (Hz)	50/60 Hz	0-400 Hz
	I (A)	2.8	3
Enclosure Rating	TYPE 1 / IP 21		

IE Class	IE2
90/100 loss	2.2%
Details	http://eaton.com/EcoDesign-VFD

User installation manual: MN040002EN
Serial No.: XXXXXXXXXX
NAED: 786689047641

Field installed conductors must be copper rated at 75°C
XXXXXX www.eaton.com Made in China

Contents: EcoDesign website link

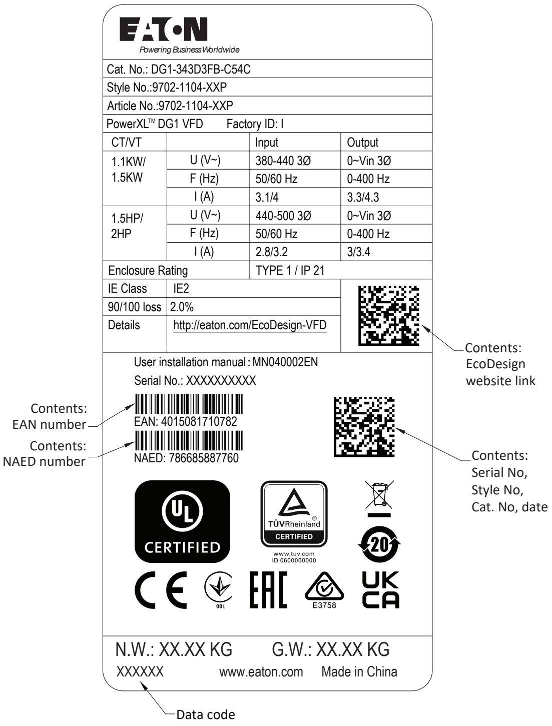
Contents: NAED number

Contents: Serial No, Style No, Cat. No, date

Data code

Carton labels (U.S. and Europe)

Figure 4. Carton label—DG1



EATON
Powering Business Worldwide

Cat. No.: DG1-343D3FB-C54C
Style No.:9702-1104-XXP
Article No.:9702-1104-XXP
PowerXL™ DG1 VFD Factory ID: I

CT/VT		Input	Output
1.1KW/ 1.5KW	U (V~)	380-440 3Ø	0~Vin 3Ø
	F (Hz)	50/60 Hz	0-400 Hz
	I (A)	3.1/4	3.3/4.3
1.5HP/ 2HP	U (V~)	440-500 3Ø	0~Vin 3Ø
	F (Hz)	50/60 Hz	0-400 Hz
	I (A)	2.8/3.2	3/3.4
Enclosure Rating		TYPE 1 / IP 21	

IE Class	IE2
90/100 loss	2.0%
Details	http://eaton.com/EcoDesign-VFD

User installation manual: MN040002EN
Serial No.: XXXXXXXXXX
EAN: 4015081710782
NAED: 786685887760

N.W.: XX.XX KG G.W.: XX.XX KG
XXXXXX www.eaton.com Made in China

Contents: EcoDesign website link

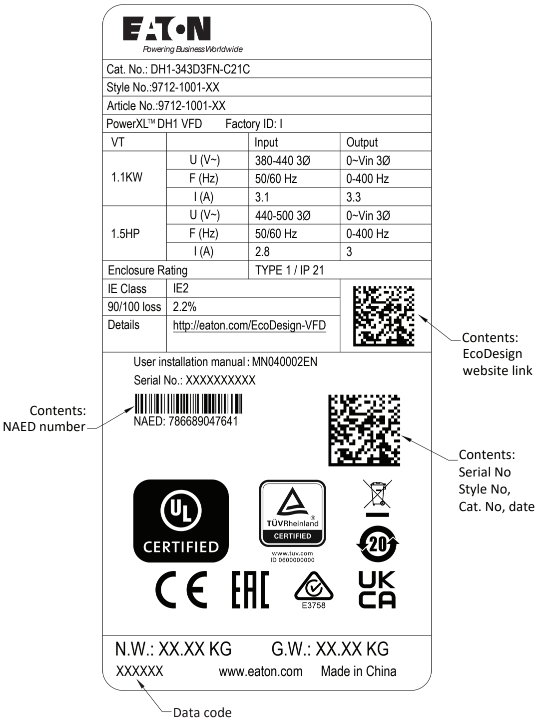
Contents: EAN number

Contents: NAED number

Contents: Serial No, Style No, Cat. No, date

Data code

Figure 5. Carton label—DH1



EATON
Powering Business Worldwide

Cat. No.: DH1-343D3FN-C21C
Style No.:9712-1001-XX
Article No.:9712-1001-XX
PowerXL™ DH1 VFD Factory ID: I

VT		Input	Output
1.1KW	U (V~)	380-440 3Ø	0~Vin 3Ø
	F (Hz)	50/60 Hz	0-400 Hz
	I (A)	3.1	3.3
1.5HP	U (V~)	440-500 3Ø	0~Vin 3Ø
	F (Hz)	50/60 Hz	0-400 Hz
	I (A)	2.8	3
Enclosure Rating		TYPE 1 / IP 21	

IE Class	IE2
90/100 loss	2.2%
Details	http://eaton.com/EcoDesign-VFD

User installation manual: MN040002EN
Serial No.: XXXXXXXXXX
NAED: 786689047641

N.W.: XX.XX KG G.W.: XX.XX KG
XXXXXX www.eaton.com Made in China

Contents: EcoDesign website link

Contents: NAED number

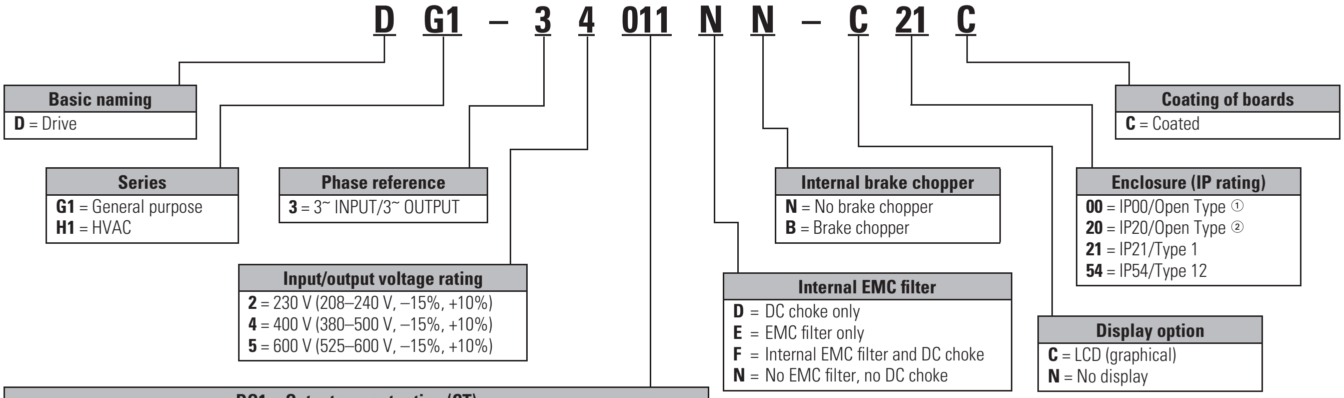
Contents: Serial No Style No, Cat. No, date

Data code

Catalog number system

Catalog number system is for illustrative purposes only and not to be used to create new catalog numbers.

Figure 6. Catalog numbering system



D G1 – 3 4 011 N N – C 21 C

Basic naming
D = Drive

Series
G1 = General purpose
H1 = HVAC

Phase reference
3 = 3~ INPUT/3~ OUTPUT

Input/output voltage rating
2 = 230 V (208–240 V, –15%, +10%)
4 = 400 V (380–500 V, –15%, +10%)
5 = 600 V (525–600 V, –15%, +10%)

Internal EMC filter
D = DC choke only
E = EMC filter only
F = Internal EMC filter and DC choke
N = No EMC filter, no DC choke

Internal brake chopper
N = No brake chopper
B = Brake chopper

Display option
C = LCD (graphical)
N = No display

Enclosure (IP rating)
00 = IP00/Open Type ①
20 = IP20/Open Type ②
21 = IP21/Type 1
54 = IP54/Type 12

Coating of boards
C = Coated

DG1—Output current rating (CT)

208–240 V	380–500 V	525–600 V
3D7 = 3.7 A, 0.55 kW, 0.75 hp	**2D2** = 2.2 A, 0.75 kW, 1 hp	**3D3** = 3.3 A, 1.5 kW, 2 hp
4D8 = 4.8 A, 0.75 kW, 1 hp	**3D3** = 3.3 A, 1.1 kW, 1.5 hp	**4D5** = 4.5 A, 2.2 kW, 3 hp
6D6 = 6.6 A, 1.1 kW, 1.5 hp	**4D3** = 4.3 A, 1.5 kW, 2 hp	**7D5** = 7.5 A, 3.7 kW, 5 hp
7D8 = 7.8 A, 1.5 kW, 2 hp	**5D6** = 5.6 A, 2.2 kW, 3 hp	**010** = 10 A, 5.5 kW, 7.5 hp
011 = 11 A, 2.2 kW, 3 hp	**7D6** = 7.6 A, 3 kW, 5 hp	**013** = 13.5 A, 7.5 kW, 10 hp
012 = 12.5 A, 3 kW, 5 hp (VT)	**9D0** = 9 A, 4 kW, 7.5 hp (VT)	**018** = 18 A, 11 kW, 15 hp
017 = 17.5 A, 3.7 kW, 5 hp	**012** = 12 A, 5.5 kW, 7.5 hp	**022** = 22 A, 15 kW, 20 hp
025 = 25 A, 5.5 kW, 7.5 hp	**016** = 16 A, 7.5 kW, 10 hp	**027** = 27 A, 18.5 kW, 25 hp
031 = 31 A, 7.5 kW, 10 hp	**023** = 23 A, 11 kW, 15 hp	**034** = 34 A, 22 kW, 30 hp
048 = 48 A, 11 kW, 15 hp	**031** = 31 A, 15 kW, 20 hp	**041** = 41 A, 30 kW, 40 hp
061 = 61 A, 15 kW, 20 hp	**038** = 38 A, 18.5 kW, 25 hp	**052** = 52 A, 37 kW, 50 hp
075 = 75 A, 18.5 kW, 25 hp	**046** = 46 A, 22 kW, 30 hp	**062** = 62 A, 45 kW, 60 hp
088 = 88 A, 22 kW, 30 hp	**061** = 61 A, 30 kW, 40 hp	**080** = 80 A, 55 kW, 75 hp
114 = 114 A, 30 kW, 40 hp	**072** = 72 A, 37 kW, 50 hp	**100** = 100 A, 75 kW, 100 hp
143 = 143 A, 37 kW, 50 hp	**087** = 87 A, 45 kW, 60 hp	**125** = 125 A, 90 kW, 125 hp
170 = 170 A, 45 kW, 60 hp	**105** = 105 A, 55 kW, 75 hp	**144** = 144 A, 110 kW, 150 hp
211 = 211 A, 55 kW, 75 hp	**140** = 140 A, 75 kW, 100 hp	**208** = 208 A, 132 kW, 200 hp
248 = 248 A, 75 kW, 100 hp	**170** = 170 A, 90 kW, 125 hp	
	205 = 205 A, 110 kW, 150 hp	
	245 = 245 A, 132 kW, 200 hp	

DH1—Output current rating (VT)

208–240 V	380–500 V	525–600 V
4D8 = 4.8 A, 1.0 hp, 0.75 kW	**3D3** = 3.3 A, 1.5 hp, 1.1 kW	**4D5** = 4.5 A, 3 hp, 2.2 kW
6D6 = 6.6 A, 1.5 hp, 1.1 kW	**4D3** = 4.3 A, 2.0 hp, 1.5 kW	**7D5** = 7.5 A, 5.0 hp, 3.7 kW
7D8 = 7.8 A, 2.0 hp, 1.5 kW	**5D6** = 5.6, 3.0 hp, 2.2 kW	**010** = 10 A, 7.5 hp, 5.5 kW
011 = 11 A, 3.0 hp, 2.2 kW	**7D6** = 7.6 A, 5.0 hp, 3 kW	**013** = 13.5 A, 10 hp, 7.5 kW
012 = 12.5 A, – hp, 3.0 kW	**9D0** = 9 A, 7.5 hp, 4 kW	**018** = 18 A, 15 hp, 11 kW
017 = 17.5 A, 5.0 hp, 3.7 kW	**012** = 12 A, 7.5 hp, 5.5 kW	**022** = 22 A, 20 hp, 15 kW
025 = 25 A, 7.5 hp, 5.5 kW	**016** = 16 A, 10 hp, 7.5 kW	**027** = 27 A, 25 hp, 18.5 kW
031 = 31 A, 10 hp, 7.5 kW	**023** = 23 A, 15 hp, 11 kW	**034** = 34 A, 30 hp, 22 kW
048 = 48 A, 15 hp, 11 kW	**031** = 31 A, 20 hp, 15 kW	**041** = 41 A, 40 hp, 30 kW
061 = 61 A, 20 hp, 15 kW	**038** = 38 A, 25 hp, 18.5 kW	**052** = 52 A, 50 hp, 37 kW
075 = 75 A, 25 hp, 18.5 kW	**046** = 46 A, 30 hp, 22 kW	**062** = 62 A, 60 hp, 45 kW
088 = 88 A, 30 hp, 22 kW	**061** = 61 A, 40 hp, 30 kW	**080** = 80 A, 75 hp, 55 kW
114 = 114 A, 40 hp, 30 kW	**072** = 72 A, 50 hp, 37 kW	**100** = 100 A, 100 hp, 75 kW
143 = 143 A, 50 hp, 37 kW	**087** = 87 A, 60 hp, 45 kW	**125** = 125 A, 125 hp, 90 kW
170 = 170 A, 60 hp, 45 kW	**105** = 105 A, 75 hp, 55 kW	**144** = 144 A, 150 hp, 110 kW
211 = 211 A, 75 hp, 55 kW	**140** = 140 A, 100 hp, 75 kW	**208** = 208 A, 200 hp, 132 kW
261 = 261 A, 100 hp, 75 kW	**170** = 170 A, 125 hp, 90 kW	**250** = 250 A, 250 hp, 160 kW
312 = 312 A, 125 hp, 90 kW	**205** = 205 A, 150 hp, 110 kW	
	261 = 261 A, 200 hp, 132 kW	
	310 = 310 A, 250 hp, 160 kW	

① IP00 FR7 and FR8 is not available for 230 V input product or with the PowerXL DH1 product.

Power ratings and product selection

PowerXL Series drives—FR0, 208–240 Volt

Table 2. Open Type IP20

	Constant torque (CT)/high overload (I_H)			Variable torque (VT)/low overload (I_L)				
Frame size	230 V, 50 Hz kW rating	230 V, 60 Hz hp	Current A	230 V, 50 Hz kW rating	230 V, 60 Hz hp	Current A	DG1 Catalog number	DH1 Catalog number
FR0	0.55	0.75	3.7	0.75	1	4.8	**DG1-323D7EB-C20C**	**DH1-324D8EB-C20C**
	0.75	1	4.8	1.1	1.5	6.6	**DG1-324D8EB-C20C**	**DH1-326D6EB-C20C**
	1.1	1.5	6.6	1.5	2	7.8	**DG1-326D6EB-C20C**	**DH1-327D8EB-C20C**

PowerXL Series drives—FR1–FR6, 208–240 Volt

Table 3. Type 1/IP21

	Constant torque (CT)/high overload (I_H)			Variable torque (VT)/low overload (I_L)				
Frame size	230 V, 50 Hz kW rating	230 V, 60 Hz hp	Current A	230 V, 50 Hz kW rating	230 V, 60 Hz hp	Current A	DG1 Catalog number	DH1 Catalog number
FR1	0.55	0.75	3.7	0.75	1	4.8	**DG1-323D7FB-C21C**	**DH1-324D8DN-C21C**
	0.75	1	4.8	1.1	1.5	6.6	**DG1-324D8FB-C21C**	**DH1-326D6DN-C21C**
	1.1	1.5	6.6	1.5	2	7.8	**DG1-326D6FB-C21C**	**DH1-327D8DN-C21C**
	1.5	2	7.8	2.2	3	11	**DG1-327D8FB-C21C**	**DH1-32011DN-C21C**
	2.2	3	11	3	–	12.5	**DG1-32011FB-C21C**	**DH1-32012DN-C21C**
FR2	3	–	12.5	3.7	5	17.5	**DG1-32012FB-C21C**	**DH1-32017DN-C21C**
	3.7	5	17.5	5.5	7.5	25	**DG1-32017FB-C21C**	**DH1-32025DN-C21C**
	5.5	7.5	25	7.5	10	31	**DG1-32025FB-C21C**	**DH1-32031DN-C21C**
FR3	7.5	10	31	11	15	48	**DG1-32031FB-C21C**	**DH1-32048DN-C21C**
	11	15	48	15	20	61	**DG1-32048FB-C21C**	**DH1-32061DN-C21C**
FR4	15	20	61	18.5	25	75	**DG1-32061FN-C21C**	**DH1-32075DN-C21C**
	18.5	25	75	22	30	88	**DG1-32075FN-C21C**	**DH1-32088DN-C21C**
	22	30	88	30	40	114	**DG1-32088FN-C21C**	**DH1-32114DN-C21C**
FR5	30	40	114	37	50	143	**DG1-32114FN-C21C**	**DH1-32143DN-C21C**
	37	50	143	45	60	170	**DG1-32143FN-C21C**	**DH1-32170DN-C21C**
	45	60	170	55	75	211	**DG1-32170FN-C21C**	**DH1-32211DN-C21C**
FR6	55	75	211	75	100	261	**DG1-32211FN-C21C**	**DH1-32261DN-C21C**
	75	100	248	90	125	312	**DG1-32248FN-C21C**	**DH1-32312DN-C21C**

Table 4. Type 12/IP54

	Constant torque (CT)/high overload (I_H)			Variable torque (VT)/low overload (I_L)				
Frame size	**230 V, 50 Hz kW rating**	**230 V, 60 Hz hp**	**Current A**	**230 V, 50 Hz kW rating**	**230 V, 60 Hz hp**	**Current A**	**DG1 Catalog number**	**DH1 Catalog number**
FR1	0.55	0.75	3.7	0.75	1	4.8	**DG1-323D7FB-C54C**	**DH1-324D8DN-C54C**
	0.75	1	4.8	1.1	1.5	6.6	**DG1-324D8FB-C54C**	**DH1-326D6DN-C54C**
	1.1	1.5	6.6	1.5	2	7.8	**DG1-326D6FB-C54C**	**DH1-327D8DN-C54C**
	1.5	2	7.8	2.2	3	11	**DG1-327D8FB-C54C**	**DH1-32011DN-C54C**
	2.2	3	11	3	–	12.5	**DG1-32011FB-C54C**	**DH1-32012DN-C54C**
FR2	3	–	12.5	3.7	5	17.5	**DG1-32012FB-C54C**	**DH1-32017DN-C54C**
	3.7	5	17.5	5.5	7.5	25	**DG1-32017FB-C54C**	**DH1-32025DN-C54C**
	5.5	7.5	25	7.5	10	31	**DG1-32025FB-C54C**	**DH1-32031DN-C54C**
FR3	7.5	10	31	11	15	48	**DG1-32031FB-C54C**	**DH1-32048DN-C54C**
	11	15	48	15	20	61	**DG1-32048FB-C54C**	**DH1-32061DN-C54C**
FR4	15	20	61	18.5	25	75	**DG1-32061FN-C54C**	**DH1-32075DN-C54C**
	18.5	25	75	22	30	88	**DG1-32075FN-C54C**	**DH1-32088DN-C54C**
	22	30	88	30	40	114	**DG1-32088FN-C54C**	**DH1-32114DN-C54C**
FR5	30	40	114	37	50	143	**DG1-32114FN-C54C**	**DH1-32143DN-C54C**
	37	50	143	45	60	170	**DG1-32143FN-C54C**	**DH1-32170DN-C54C**
	45	60	170	55	75	211	**DG1-32170FN-C54C**	**DH1-32211DN-C54C**
FR6	55	75	211	75	100	261	**DG1-32211FN-C54C**	**DH1-32261DN-C54C**
	75	100	248	90	125	312	**DG1-32248FN-C54C**	**DH1-32312DN-C54C**

PowerXL Series drives—FR0, 380–500 Volt

Table 5. Open Type IP20

	380-440 Volts 50Hz kW rating				440–500 Volt 60Hz HP rating					
Frame size	**CT kW**	**VT kW**	**CT output current**	**VT output current**	**CT HP**	**VT HP**	**CT output current**	**VT output current**	**Catalog**	**Catalog**
FR0	0.75	1.1	2.2	3.3	1	1.5	2.1	3	**DG1-342D2EB-C20C**	**DH1-343D3EB-C20C**
	1.1	1.5	3.3	4.3	1.5	2	3	3.4	**DG1-343D3EB-C20C**	**DH1-344D3EB-C20C**
	1.5	2.2	4.3	5.6	2	3	3.4	4.8	**DG1-344D3EB-C20C**	**DH1-345D6EB-C20C**
	2.2	3	5.6	7.6	3	5	4.8	7.6	**DG1-345D6EB-C20C**	**DH1-347D6EB-C20C**

PowerXL Series drives—FR1–FR6, 380–500 Volt

Table 6. Type 1/IP21

	380-440 Volts 50Hz kW rating				440–500 Volt 60Hz HP rating					
Frame size	**CT kW**	**VT kW**	**CT output current**	**VT output current**	**CT HP**	**VT HP**	**CT output current**	**VT output current**	**Catalog**	**Catalog**
FR1	0.75	1.1	2.2	3.3	1	1.5	2.1	3	**DG1-342D2FB--C21C**	**DH1-343D3DN--C21C**
	1.1	1.5	3.3	4.3	1.5	2	3	3.4	**DG1-343D3FB--C21C**	**DH1-344D3DN-C21C**
	1.5	2.2	4.3	5.6	2	3	3.4	4.8	**DG1-344D3FB-C21C**	**DH1-345D6DN-C21C**
	2.2	3	5.6	7.6	3	5	4.8	7.6	**DG1-345D6FB-C21C**	**DH1-347D6DN-C21C**
	3	4	7.6	9	5	-	7.6	-	**DG1-347D6FB-C21C**	**DH1-349D0DN-C21C**
	4	5.5	9	12	-	7.5	-	11	**DG1-349D0FB-C21C**	**DH1-34012DN-C21C**
FR2	5.5	7.5	12	16	7.5	10	11	14	**DG1-34012FB-C21C**	**DH1-34016DN-C21C**
	7.5	11	16	23	10	15	14	21	**DG1-34016FB-C21C**	**DH1-34023DN-C21C**
	11	15	23	31	15	20	21	27	**DG1-34023FB-C21C**	**DH1-34031DN-C21C**
FR3	15	18.5	31	38	20	25	27	34	**DG1-34031FB-C21C**	**DH1-34038DN-C21C**
	18.5	22	38	46	25	30	34	40	**DG1-34038FB-C21C**	**DH1-34046DN-C21C**
	22	30	46	61	30	40	40	52	**DG1-34046FB-C21C**	**DH1-34061DN-C21C**
FR4	30	37	61	72	40	50	52	65	**DG1-34061FB-C21C**	**DH1-34072DN-C21C**
	37	45	72	87	50	60	65	77	**DG1-34072FB-C21C**	**DH1-34087DN-C21C**
	45	55	87	105	60	75	77	96	**DG1-34087FB-C21C**	**DH1-34105DN-C21C**
FR5	55	75	105	140	75	100	96	124	**DG1-34105FB-C21C**	**DH1-34140DN-C21C**
	75	90	140	170	100	125	124	156	**DG1-34140FB-C21C**	**DH1-34170DN-C21C**
	90	110	170	205	125	150	156	180	**DG1-34170FB-C21C**	**DH1-34205DN-C21C**
FR6	110	132	205	261	150	200	180	240	**DG1-34205FB-C21C**	**DH1-34261FN-C21C**
	132	160	245	310	200	250	240	302	**DG1-34245FB-C21C**	**DH1-34310FN-C21C**

Table 7. Type 12/IP54

	380-440 Volts 50Hz kW rating				440–500 Volt 60Hz HP rating					
Frame size	**CT kW**	**VT kW**	**CT output current**	**VT output current**	**CT HP**	**VT HP**	**CT output current**	**VT output current**	**Catalog**	**Catalog**
FR1	0.75	1.1	2.2	3.3	1	1.5	2.1	3	**DG1-342D2FB-C54C**	**DH1-343D3DN--C54C**
	1.1	1.5	3.3	4.3	1.5	2	3	3.4	**DG1-343D3FB-C54C**	**DH1-344D3DN-C54C**
	1.5	2.2	4.3	5.6	2	3	3.4	4.8	**DG1-344D3FB-C54C**	**DH1-345D6DN-C54C**
	2.2	3	5.6	7.6	3	5	4.8	7.6	**DG1-345D6FB-C54C**	**DH1-347D6DN-C54C**
	3	4	7.6	9	5	-	7.6	-	**DG1-347D6FB-C54C**	**DH1-349D0DN-C54C**
	4	5.5	9	12	-	7.5	-	11	**DG1-349D0FB-C54C**	**DH1-34012DN-C54C**
FR2	5.5	7.5	12	16	7.5	10	11	14	**DG1-34012FB-C54C**	**DH1-34016DN-C54C**
	7.5	11	16	23	10	15	14	21	**DG1-34016FB-C54C**	**DH1-34023DN-C54C**
	11	15	23	31	15	20	21	27	**DG1-34023FB-C54C**	**DH1-34031DN-C54C**
FR3	15	18.5	31	38	20	25	27	34	**DG1-34031FB-C54C**	**DH1-34038DN-C54C**
	18.5	22	38	46	25	30	34	40	**DG1-34038FB-C54C**	**DH1-34046DN-C54C**
	22	30	46	61	30	40	40	52	**DG1-34046FB-C54C**	**DH1-34061DN-C54C**
FR4	30	37	61	72	40	50	52	65	**DG1-34061FB-C54C**	**DH1-34072DN-C54C**
	37	45	72	87	50	60	65	77	**DG1-34072FB-C54C**	**DH1-34087DN-C54C**
	45	55	87	105	60	75	77	96	**DG1-34087FB-C54C**	**DH1-34105DN-C54C**
FR5	55	75	105	140	75	100	96	124	**DG1-34105FB-C54C**	**DH1-34140DN-C54C**
	75	90	140	170	100	125	124	156	**DG1-34140FB-C54C**	**DH1-34170DN-C54C**
	90	110	170	205	125	150	156	180	**DG1-34170FB-C54C**	**DH1-34205DN-C54C**
FR6	110	132	205	261	150	200	180	240	**DG1-34205FB-C54C**	**DH1-34261FN-C54C**
	132	160	245	310	200	250	240	302	**DG1-34245FB-C54C**	**DH1-34310FN-C54C**

PowerXL Series drives—FR1–FR6, 600 Volt

Table 8. Type 1/IP21

	Constant torque (CT)/high overload (I_H)			Variable torque (VT)/low overload (I_L)				
Frame size	**600 V, 50 Hz kW rating**	**600 V, 60 Hz hp**	**Current A**	**600 V, 50 Hz kW rating**	**600 V, 60 Hz hp**	**Current A**	**DG1 Catalog number**	**DH1 Catalog number**
FR1	1.5	2	3.3	2.2	3	4.5	**DG1-353D3FB-C21C**	**DH1-354D5DN-C21C**
	2.2	3	4.5	3.7	5	7.5	**DG1-354D5FB-C21C**	**DH1-357D5DN-C21C**
	3.7	5	7.5	5.5	7.5	10	**DG1-357D5FB-C21C**	**DH1-35010DN-C21C**
FR2	5.5	7.5	10	7.5	10	13.5	**DG1-35010FB-C21C**	**DH1-35013DN-C21C**
	7.5	10	13.5	11	15	18	**DG1-35013FB-C21C**	**DH1-35018DN-C21C**
	11	15	18	15	20	22	**DG1-35018FB-C21C**	**DH1-35022DN-C21C**
FR3	15	20	22	18.5	25	27	**DG1-35022FB-C21C**	**DH1-35027DN-C21C**
	18.5	25	27	22	30	34	**DG1-35027FB-C21C**	**DH1-35034DN-C21C**
	22	30	34	30	40	41	**DG1-35034FB-C21C**	**DH1-35041DN-C21C**
FR4	30	40	41	37	50	52	**DG1-35041FN-C21C**	**DH1-35052DN-C21C**
	37	50	52	45	60	62	**DG1-35052FN-C21C**	**DH1-35062DN-C21C**
	45	60	62	55	75	80	**DG1-35062FN-C21C**	**DH1-35080DN-C21C**
FR5	55	75	80	75	100	100	**DG1-35080FN-C21C**	**DH1-35100DN-C21C**
	75	100	100	90	125	125	**DG1-35100FN-C21C**	**DH1-35125DN-C21C**
	90	125	125	110	150	144	**DG1-35125FN-C21C**	**DH1-35144DN-C21C**
FR6	110	150	144	132	200	208	**DG1-35144FN-C21C**	**DH1-35208DN-C21C**
	132	200	208	160	250	250	**DG1-35208FN-C21C**	**DH1-35250DN-C21C**

Table 9. Type 12/IP54

	Constant torque (CT)/high overload (I_H)			Variable torque (VT)/low overload (I_L)				
Frame size	**600 V, 50 Hz kW rating**	**600 V, 60 Hz hp**	**Current A**	**600 V, 50 Hz kW rating**	**600 V, 60 Hz hp**	**Current A**	**DG1 Catalog number**	**DH1 Catalog number**
FR1	1.5	2	3.3	2.2	3	4.5	**DG1-353D3FB-C54C**	**DH1-354D5DN-C54C**
	2.2	3	4.5	3.7	5	7.5	**DG1-354D5FB-C54C**	**DH1-357D5DN-C54C**
	3.7	5	7.5	5.5	7.5	10	**DG1-357D5FB-C54C**	**DH1-35010DN-C54C**
FR2	5.5	7.5	10	7.5	10	13.5	**DG1-35010FB-C54C**	**DH1-35013DN-C54C**
	7.5	10	13.5	11	15	18	**DG1-35013FB-C54C**	**DH1-35018DN-C54C**
	11	15	18	15	20	22	**DG1-35018FB-C54C**	**DH1-35022DN-C54C**
FR3	15	20	22	18.5	25	27	**DG1-35022FB-C54C**	**DH1-35027DN-C54C**
	18.5	25	27	22	30	34	**DG1-35027FB-C54C**	**DH1-35034DN-C54C**
	22	30	34	30	40	41	**DG1-35034FB-C54C**	**DH1-35041DN-C54C**
FR4	30	40	41	37	50	52	**DG1-35041FN-C54C**	**DH1-35052DN-C54C**
	37	50	52	45	60	62	**DG1-35052FN-C54C**	**DH1-35062DN-C54C**
	45	60	62	55	75	80	**DG1-35062FN-C54C**	**DH1-35080DN-C54C**
FR5	55	75	80	75	100	100	**DG1-35080FN-C54C**	**DH1-35100DN-C54C**
	75	100	100	90	125	125	**DG1-35100FN-C54C**	**DH1-35125DN-C54C**
	90	125	125	110	150	144	**DG1-35125FN-C54C**	**DH1-35144DN-C54C**
FR6	110	150	144	132	200	208	**DG1-35144FN-C54C**	**DH1-35208DN-C54C**
	132	200	208	160	250	250	**DG1-35208FN-C54C**	**DH1-35250DN-C54C**

DG1 replacement parts

Table 10. Frame 0

Description	中文描述:	Catalog number 230 V	Catalog number 480 V	Catalog number 600 V
Standard keypad	DG1 标准键盘	**DXG-KEY-LCD**	**DXG-KEY-LCD**	—
Control module kit with keypad	DG1 控制模块及键盘套件	**DXG-SPR-CTRLKIT**	**DXG-SPR-CTRLKIT**	—
Control module kit without keypad	DG1 控制模块	**DXG-SPR-CTRLBOARD**	**DXG-SPR-CTRLBOARD**	—
Software kit (software, cable, manual)	DG1 软件套件（软件，线缆，说明书）	**DXG-ACC-SOFTWARE**	**DXG-ACC-SOFTWARE**	—
Main power board	FR0 主功率板	**DXG-SPR-2FR0MPB-xxx** ②	**DXG-SPR-4FR0MPB-xxx** ②	—
Fan kit	FR0 风扇	**DXG-SPR-FR0FAN**	**DXG-SPR-FR0FAN**	—
IGBT module	IGBT 模块	**DXG-SPR-2FR0IGBT**	**DXG-SPR-4FR0IGBT**	—
EMC kit	EMC 套件	**DXG-SPR-FR0EMCKIT**	**DXG-SPR-FR0EMCKIT**	—

Table 11. Frame 1

Description	中文描述:	Catalog number 230 V	Catalog number 480 V	Catalog number 600 V
Standard keypad	DG1 标准键盘	**DXG-KEY-LCD**	**DXG-KEY-LCD**	**DXG-KEY-LCD**
Control module kit with keypad	DG1 控制模块及键盘套件	**DXG-SPR-CTRLKIT**	**DXG-SPR-CTRLKIT**	**DXG-SPR-CTRLKIT**
Control module kit without keypad	DG1 控制模块	**DXG-SPR-CTRLBOARD**	**DXG-SPR-CTRLBOARD**	**DXG-SPR-CTRLBOARD**
Software kit (software, cable, manual)	DG1 软件套件（软件，线缆，说明书）	**DXG-ACC-SOFTWARE**	**DXG-ACC-SOFTWARE**	**DXG-ACC-SOFTWARE**
Type 1/IP21 standard cover	Type1/IP21 前面板	**DXG-SPR-FR1CVR**	**DXG-SPR-FR1CVR**	**DXG-SPR-FR1CVR**
EMI board	EMI 板	**DXG-SPR-2FR1EB**	**DXG-SPR-4FR1EB**	**DXG-SPR-5FR1EB**
Type 12/IP54 kit	Type12/IP54 套件	**DXG-ACC-2FR1N12KIT**	**DXG-ACC-4FR1N12KIT**	**DXG-ACC-4FR1N12KIT**
Main power board	FR1 主功率板	**DXG-SPR-2FR1MPB-XXX** ②	**DXG-SPR-4FR1MPB-XXX** ②	**DXG-SPR-5FR1MPB-XXX** ②
Control board cover		**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**
Main fan kit ①		**DXG-SPR-FR1FAN**	**DXG-SPR-FR1FAN**	**DXG-SPR-FR1FAN**
Control fan		**DXG-SPR-2FR1CF**	**DXG-SPR-4FR1CF**	**DXG-SPR-4FR1CF**
Middle chassis cover		**DXG-SPR-FR1MCC**	**DXG-SPR-FR1MCC**	**DXG-SPR-FR1MCC**
Outer housing		**DXG-SPR-FR1OH**	**DXG-SPR-FR1OH**	**DXG-SPR-5FR1OH**
UL conduit plate		**DXG-SPR-FR1CPUL**	**DXG-SPR-FR1CPUL**	**DXG-SPR-FR1CPUL**
IEC conduit plate		**DXG-SPR-FR1CPIEC**	**DXG-SPR-FR1CPIEC**	**DXG-SPR-FR1CPIEC**
Type 12 grommet		**DXG-SPR-FR1GRN12**	**DXG-SPR-FR1GRN12**	**DXG-SPR-FR1GRN12**
Terminal block		**DXG-SPR-2FR1TB**	**DXG-SPR-FR1TB**	**DXG-SPR-FR1TB**

Table 12. Frame 2

Description	中文描述:	Catalog number 230 V	Catalog number 480 V	Catalog number 600 V
Standard Keypad	DG1 标准键盘	**DXG-KEY-LCD**	**DXG-KEY-LCD**	**DXG-KEY-LCD**
Control module kit with keypad	DG1 控制模块及键盘套件	**DXG-SPR-CTRLKIT**	**DXG-SPR-CTRLKIT**	**DXG-SPR-CTRLKIT**
Control module kit without keypad	DG1 控制模块	**DXG-SPR-CTRLBOARD**	**DXG-SPR-CTRLBOARD**	**DXG-SPR-CTRLBOARD**
Software kit (software, cable, manual)	DG1 软件套件（软件，线缆，说明书）	**DXG-ACC-SOFTWARE**	**DXG-ACC-SOFTWARE**	**DXG-ACC-SOFTWARE**
Type 1/IP21 standard cover	Type1/IP21 前面板	**DXG-SPR-FR2CVR**	**DXG-SPR-FR2CVR**	**DXG-SPR-FR2CVR**
EMI board	EMI 板	**DXG-SPR-2FR2EB**	**DXG-SPR-4FR2EB**	**DXG-SPR-5FR2EB**
Type 12/IP54 kit	Type1/IP54 套件	**DXG-ACC-FR2N12KIT**	**DXG-ACC-FR2N12KIT**	**DXG-ACC-FR2N12KIT**
Main power board	FR2 主功率板	**DXG-SPR-2FR2MPB-XXX** ②	**DXG-SPR-4FR2MPB-XXX** ②	**DXG-SPR-5FR2MPB-XXX** ②
Control board cover		**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**

① Factory recommended spare parts.

② Output current rating code.

Table 12. Frame 2, continued

Description	中文描述：	Catalog number 230 V	Catalog number 480 V	Catalog number 600 V
Main fan kit ①		**DXG-SPR-FR2FAN**	**DXG-SPR-FR2FAN**	**DXG-SPR-FR2FAN**
Control fan		**DXG-SPR-FR2CF**	**DXG-SPR-FR2CF**	**DXG-SPR-FR2CF**
Bus capacitor		**DXG-SPR-2FR2BC**	**DXG-SPR-4FR24BC**	**DXG-SPR-5FR24BC**
IGBT module		**DXG-SPR-FR2IGBT**	**DXG-SPR-FR2IGBT**	**DXG-SPR-5FR2IGBT**
Middle chassis cover		**DXG-SPR-FR2MCC**	**DXG-SPR-FR2MCC**	**DXG-SPR-FR2MCC**
Outer housing		**DXG-SPR-FR2OH**	**DXG-SPR-FR2OH**	**DXG-SPR-5FR2OH**
UL conduit plate		**DXG-SPR-FR2CPUL**	**DXG-SPR-FR2CPUL**	**DXG-SPR-FR2CPUL**
IEC conduit plate		**DXG-SPR-FR2CPIEC**	**DXG-SPR-FR2CPIEC**	**DXG-SPR-FR2CPIEC**
Type 12 grommet		**DXG-SPR-FR2GRN12**	**DXG-SPR-FR2GRN12**	**DXG-SPR-FR2GRN12**
Terminal block		**DXG-SPR-FR2TB**	**DXG-SPR-FR2TB**	**DXG-SPR-FR2TB**

Table 13. Frame 3

Description	中文描述：	Catalog number 230 V	Catalog number 480 V	Catalog number 600 V
Standard keypad	DG1 标准键盘	**DXG-KEY-LCD**	**DXG-KEY-LCD**	**DXG-KEY-LCD**
Control module kit with keypad	DG1 控制模块及键盘套件	**DXG-SPR-CTRLKIT**	**DXG-SPR-CTRLKIT**	**DXG-SPR-CTRLKIT**
Control module kit without keypad	DG1 控制模块	**DXG-SPR-CTRLBOARD**	**DXG-SPR-CTRLBOARD**	**DXG-SPR-CTRLBOARD**
Software kit (software, cable, manual)	DG1 软件套件（软件，线缆，说明书）	**DXG-ACC-SOFTWARE**	**DXG-ACC-SOFTWARE**	**DXG-ACC-SOFTWARE**
Type 1/IP21 standard cover	Type1/IP21 前面板	**DXG-SPR-FR3CVR**	**DXG-SPR-FR3CVR**	**DXG-SPR-FR3CVR**
EMI board	EMI 板	**DXG-SPR-2FR3EB**	**DXG-SPR-4FR3EB**	**DXG-SPR-5FR3EB**
Drive board	驱动板	**DXG-SPR-2FR3DB-XXX** ②	**DXG-SPR-4FR3DB-XXX** ②	**DXG-SPR-5FR3DB-XXX** ②
Main power board	FR3 主功率板	**DXG-SPR-2FR3MPB**	**DXG-SPR-4FR3MPB**	**DXG-SPR-5FR3MPB**
Control board cover		**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**
Main fan kit ①		**DXG-SPR-FR3FANKIT**	**DXG-SPR-FR3FANKIT**	**DXG-SPR-FR3FANKIT**
Main fan		**DXG-SPR-FR3FAN**	**DXG-SPR-FR3FAN**	**DXG-SPR-FR3FAN**
Control fan		**DXG-SPR-FR34CF**	**DXG-SPR-FR34CF**	**DXG-SPR-FR34CF**
Bus capacitor		**DXG-SPR-FR3BC**	**DXG-SPR-FR3BC**	**DXG-SPR-5FR3BC**
Output board		**DXG-SPR-FR3OB**	**DXG-SPR-FR3OB**	**DXG-SPR-5FR3OB**
Middle chassis cover		**DXG-SPR-FR3MCC**	**DXG-SPR-FR3MCC**	**DXG-SPR-FR3MCC**
Outer housing		**DXG-SPR-FR3OH**	**DXG-SPR-FR3OH**	**DXG-SPR-FR3OH**
UL conduit plate		**DXG-SPR-FR3CPUL**	**DXG-SPR-FR3CPUL**	**DXG-SPR-FR3CPUL**
IEC conduit plate		**DXG-SPR-FR3CPIEC**	**DXG-SPR-FR3CPIEC**	**DXG-SPR-FR3CPIEC**
Type 12 grommet		**DXG-SPR-FR3GRN12**	**DXG-SPR-FR3GRN12**	**DXG-SPR-FR3GRN12**
Terminal block		**DXG-SPR-FR3TB**	**DXG-SPR-FR3TB**	**DXG-SPR-FR3TB**

Table 14. Frame 4

Description	中文描述：	Catalog number 230 V	Catalog number 480 V	Catalog number 600 V
Standard keypad	DG1 标准键盘	**DXG-KEY-LCD**	**DXG-KEY-LCD**	**DXG-KEY-LCD**
Control module kit with keypad	DG1 控制模块及键盘套件	**DXG-SPR-CTRLKIT**	**DXG-SPR-CTRLKIT**	**DXG-SPR-CTRLKIT**
Control module kit without keypad	DG1 控制模块	**DXG-SPR-CTRLBOARD**	**DXG-SPR-CTRLBOARD**	**DXG-SPR-CTRLBOARD**
Software kit (software, cable, manual)	DG1 软件套件（软件，线缆，说明书）	**DXG-ACC-SOFTWARE**	**DXG-ACC-SOFTWARE**	**DXG-ACC-SOFTWARE**
Type 1/IP21 standard cover	Type1/IP21 前面板	**DXG-SPR-FR4CVR**	**DXG-SPR-FR4CVR**	**DXG-SPR-FR4CVR**
EMI board	EMI 板	**DXG-SPR-4FR4EB**	**DXG-SPR-4FR4EB**	**DXG-SPR-5FR4EB**

① Factory recommended spare parts.

② Output current rating code.

Table 14. Frame 4, continued

Description	中文描述：	Catalog number 230 V	Catalog number 480 V	Catalog number 600 V
Softstart board	软启动电路板	**DXG-SPR-2FR4SB**	**DXG-SPR-4FR4SB**	**DXG-SPR-5FR4SB**
Main power board	FR4 主功率板	**DXG-SPR-2FR4MPB-XXX** ②	**DXG-SPR-4FR4MPB-XXX** ②	**DXG-SPR-5FR4MPB-XXX** ②
Control board cover		**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**
Main fan kit ①		**DXG-SPR-FR4FANKIT**	**DXG-SPR-FR4FANKIT**	**DXG-SPR-FR4FANKIT**
Main fan		**DXG-SPR-FR4FAN**	**DXG-SPR-FR4FAN**	**DXG-SPR-FR4FAN**
Control fan		**DXG-SPR-FR34CF**	**DXG-SPR-FR34CF**	**DXG-SPR-FR34CF**
Bus capacitor		**DXG-SPR-2FR4BC**	**DXG-SPR-4FR24BC**	**DXG-SPR-5FR24BC**
IGBT module		**DXG-SPR-2FR4IGBT**	**DXG-SPR-4FR4IGBT**	**DXG-SPR-5FR4IGBT**
Rectifier module		**DXG-SPR-2FR4RM**	**DXG-SPR-4FR4RM**	**DXG-SPR-5FR4RM**
Brake chopper module		**DXG-SPR-2FR4BCM**	**DXG-SPR-4FR4BCM**	**DXG-SPR-5FR4BCM**
Middle chassis cover		**DXG-SPR-FR4MCC**	**DXG-SPR-FR4MCC**	**DXG-SPR-FR4MCC**
Outer housing		**DXG-SPR-FR4OH**	**DXG-SPR-FR4OH**	**DXG-SPR-5FR4OH**
UL conduit plate		**DXG-SPR-FR4CPUL**	**DXG-SPR-FR4CPUL**	**DXG-SPR-FR4CPUL**
IEC conduit plate		**DXG-SPR-FR4CPIEC**	**DXG-SPR-FR4CPIEC**	**DXG-SPR-FR4CPIEC**
Type 12 grommet		**DXG-SPR-FR4GRN12**	**DXG-SPR-FR4GRN12**	**DXG-SPR-FR4GRN12**
Terminal block		**DXG-SPR-FR4TB**	**DXG-SPR-FR4TB**	**DXG-SPR-FR4TB**

Table 15. Frame 5

Description	中文描述：	Catalog number 230 V	Catalog number 480 V	Catalog number 600 V
Standard keypad	DG1 标准键盘	**DXG-KEY-LCD**	**DXG-KEY-LCD**	**DXG-KEY-LCD**
Control module kit with keypad	DG1 控制模块及键盘套件	**DXG-SPR-CTRLKIT**	**DXG-SPR-CTRLKIT**	**DXG-SPR-CTRLKIT**
Control module kit without keypad	DG1 控制模块	**DXG-SPR-CTRLBOARD**	**DXG-SPR-CTRLBOARD**	**DXG-SPR-CTRLBOARD**
Software kit (software, cable, manual)	DG1 软件套件（软件，线缆，说明书）	**DXG-ACC-SOFTWARE**	**DXG-ACC-SOFTWARE**	**DXG-ACC-SOFTWARE**
Type 1/IP21 standard cover	Type1/IP21 前面板	**DXG-SPR-FR5CVR**	**DXG-SPR-FR5CVR**	**DXG-SPR-FR5CVR**
EMI-1 board	EMI-1 板	**DXG-SPR-2FR5E1B**	**DXG-SPR-4FR5E1B**	**DXG-SPR-5FR5E1B**
Main power board	FR5 主功率板	**DXG-SPR-2FR5MPB-XXX** ②	**DXG-SPR-4FR5MPB-XXX** ②	**DXG-SPR-5FR5MPB-XXX** ②
Control board cover		**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**
Main fan kit ①		**DXG-SPR-FR5FANKIT**	**DXG-SPR-FR5FANKIT**	**DXG-SPR-FR5FANKIT**
Main fan		**DXG-SPR-FR5FAN**	**DXG-SPR-FR5FAN**	**DXG-SPR-FR5FAN**
Control fan		**DXG-SPR-FR5CF**	**DXG-SPR-FR5CF**	**DXG-SPR-FR5CF**
Bus capacitor		**DXG-SPR-FR5BC**	**DXG-SPR-FR5BC**	**DXG-SPR-5FR5BC**
EMI-2 board		**DXG-SPR-2FR5E2B**	**DXG-SPR-4FR5E2B**	**DXG-SPR-5FR5E2B**
EMI-3 board		**DXG-SPR-FR5E3B**	**DXG-SPR-FR5E3B**	**N/A**
IGBT module		**DXG-SPR-FR5IGBT**	**DXG-SPR-FR5IGBT**	**DXG-SPR-5FR5IGBT**
Rectifier module		**DXG-SPR-2FR5RM**	**DXG-SPR-4FR5RM**	**DXG-SPR-5FR5RM**
Brake chopper module		**DXG-SPR-2FR5BCM**	**DXG-SPR-4FR5BCM**	**DXG-SPR-5FR5BCM**
Middle chassis cover		**DXG-SPR-FR5MCC**	**DXG-SPR-FR5MCC**	**DXG-SPR-FR5MCC**
Outer housing		**DXG-SPR-FR5OH**	**DXG-SPR-FR5OH**	**DXG-SPR-FR5OH**
UL conduit plate		**DXG-SPR-FR5CPUL**	**DXG-SPR-FR5CPUL**	**DXG-SPR-FR5CPUL**
IEC conduit plate		**DXG-SPR-FR5IECCP**	**DXG-SPR-FR5IECCP**	**DXG-SPR-FR5IECCP**
Type 12 grommet		**DXG-SPR-FR5GRN12**	**DXG-SPR-FR5GRN12**	**DXG-SPR-FR5GRN12**
Terminal block (1-pole)		**DXG-SPR-FR5TB1P**	**DXG-SPR-FR5TB1P**	**DXG-SPR-FR5TB1P**
Terminal block (3-pole)		**DXG-SPR-FR5TB3P**	**DXG-SPR-FR5TB3P**	**DXG-SPR-FR5TB3P**

① Factory recommended spare parts.

② Output current rating code.

Table 16. Frame 6

Description	中文描述：	Catalog number 230 V	Catalog number 480 V	Catalog number 600 V
Standard keypad	DG1 标准键盘	**DXG-KEY-LCD**	**DXG-KEY-LCD**	**DXG-KEY-LCD**
Control module kit with keypad	DG1 控制模块及键盘套件	**DXG-SPR-CTRLKIT**	**DXG-SPR-CTRLKIT**	**DXG-SPR-CTRLKIT**
Control module kit without keypad	DG1 控制模块	**DXG-SPR-CTRLBOARD**	**DXG-SPR-CTRLBOARD**	**DXG-SPR-CTRLBOARD**
Software kit (software, cable, manual)	DG1 软件套件（软件，线缆，说明书）	**DXG-ACC-SOFTWARE**	**DXG-ACC-SOFTWARE**	**DXG-ACC-SOFTWARE**
Main power board	FR6 主功率板	**DXG-SPR-2FR6MPB-XXX** ②	**DXG-SPR-4FR6MPB-XXX** ②	**DXG-SPR-5FR6MPB-XXX** ②
Control board cover		**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**
Type 1/IP21 standard cover		**DXG-SPR-FR6CVR**	**DXG-SPR-FR6CVR**	**DXG-SPR-FR6CVR**
Main fan kit ①		**DXG-SPR-FR6FANKIT**	**DXG-SPR-FR6FANKIT**	**DXG-SPR-FR6FANKIT**
Control fan		**DXG-SPR-FR6CF**	**DXG-SPR-FR6CF**	**DXG-SPR-FR6CF**
Bus capacitor		**DXG-SPR-FR6BC**	**DXG-SPR-FR6BC**	**DXG-SPR-5FR6BC**
EMI board		**DXG-SPR-FR6EB**	**DXG-SPR-FR6EB**	**DXG-SPR-FR6EB**
Softstart board		**DXG-SPR-2FR6SB**	**DXG-SPR-4FR6SB**	**DXG-SPR-5FR6SB**
Rectifier snubber board		**DXG-SPR-2FR6RSB**	**DXG-SPR-4FR6RSB**	**DXG-SPR-5FR6RSB**
IGBT module with drive board		**DXG-SPR-2FR6IGBT**	**DXG-SPR-4FR6IGBT**	**DXG-SPR-5FR6IGBT**
Rectifier module		**DXG-SPR-FR6RM**	**DXG-SPR-FR6RM**	**DXG-SPR-5FR6RM**
Middle chassis cover		**DXG-SPR-FR6MCC**	**DXG-SPR-FR6MCC**	**DXG-SPR-FR6MCC**
Outer housing		**DXG-SPR-FR6OH**	**DXG-SPR-FR6OH**	**DXG-SPR-FR6OH**
UL conduit plate		**DXG-SPR-FR6CPUL**	**DXG-SPR-FR6CPUL**	**DXG-SPR-FR6CPUL**
IEC conduit plate		**DXG-SPR-FR6CPIEC**	**DXG-SPR-FR6CPIEC**	**DXG-SPR-FR6CPIEC**
Type 12 grommet		**DXG-SPR-FR6GRN12**	**DXG-SPR-FR6GRN12**	**DXG-SPR-FR6GRN12**
Terminal block (1-pole)		**DXG-SPR-FR6TB1P**	**DXG-SPR-FR6TB1P**	**DXG-SPR-FR6TB1P**
Terminal block (3-pole)		**DXG-SPR-FR6TB3P**	**DXG-SPR-FR6TB3P**	**DXG-SPR-FR6TB3P**

DH1 replacement parts

Table 17. Frame 0

Description	Catalog number 230 V	Catalog number 480 V	Catalog number 575 V
Standard keypad	**DXH-KEY-LCD**	**DXH-KEY-LCD**	—
Main control board	**DXH-SPR-CTRLBOARD**	**DXH-SPR-CTRLBOARD**	—
Control module kit with keypad	**DXH-SPR-CTRLKIT**	**DXH-SPR-CTRLKIT**	—
Main fan kit ①	**DXG-SPR-FR0FAN**	**DXG-SPR-FR0FAN**	—
Main power board	**DXG-SPR-2FR0MPB-xxx** ②	**DXG-SPR-4FR0MPB-xxx** ②	—
EMI kit for C2	**DXG-SPR-FR0EMCKIT**	**DXG-SPR-FR0EMCKIT**	—

① Factory recommended spare parts.

② Output current rating code.

Table 18. Frame 1

Description	Catalog number 230 V	Catalog number 480 V	Catalog number 575 V
Standard keypad	**DXH-KEY-LCD**	**DXH-KEY-LCD**	**DXH-KEY-LCD**
Control module kit with keypad	**DXH-SPR-CTRLKIT**	**DXH-SPR-CTRLKIT**	**DXH-SPR-CTRLKIT**
Main control board	**DXH-SPR-CTRLBOARD**	**DXH-SPR-CTRLBOARD**	**DXH-SPR-CTRLBOARD**
Standard cover	**DXH-SPR-FR1CVR**	**DXH-SPR-FR1CVR**	**DXH-SPR-FR1CVR**
EMI board	**DXG-SPR-2FR1EB**	**DXG-SPR-4FR1EB**	**DXG-SPR-5FR1EB**
Type 12/IP54 kit	**DXH-ACC-2FR1N12KIT**	**DXH-ACC-4FR1N12KIT**	**DXH-ACC-5FR1N12KIT**
Main power board	**DXH-SPR-2FR1MPB**	**DXH-SPR-4FR1MPB**	**DXG-SPR-5FR1MPB**
Control board cover	**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**
Main fan kit	**DXG-SPR-FR1FAN**	**DXG-SPR-FR1FAN**	**DXG-SPR-FR1FAN**
Control fan		**DXG-SPR-4FR1CF**	**DXG-SPR-4FR1CF**
Middle chassis cover	**DXG-SPR-FR1MCC**	**DXG-SPR-FR1MCC**	**DXG-SPR-FR1MCC**
Outer housing	**DXG-SPR-FR1OH**	**DXG-SPR-FR1OH**	**DXG-SPR-5FR1OH**
UL conduit plate	**DXG-SPR-FR1CPUL**	**DXG-SPR-FR1CPUL**	**DXG-SPR-FR1CPUL**
IEC conduit plate	**DXG-SPR-FR1CPIEC**	**DXG-SPR-FR1CPIEC**	**DXG-SPR-FR1CPIEC**

Table 19. Frame 2

Description	Catalog number 230 V	Catalog number 480 V	Catalog number 575 V
Standard keypad	**DXH-KEY-LCD**	**DXH-KEY-LCD**	**DXH-KEY-LCD**
Control module kit with keypad	**DXH-SPR-CTRLKIT**	**DXH-SPR-CTRLKIT**	**DXH-SPR-CTRLKIT**
Main control board	**DXH-SPR-CTRLBOARD**	**DXH-SPR-CTRLBOARD**	**DXH-SPR-CTRLBOARD**
Standard cover	**DXH-SPR-FR2CVR**	**DXH-SPR-FR2CVR**	**DXH-SPR-FR2CVR**
EMI board	**DXG-SPR-2FR2EB**	**DXG-SPR-4FR2EB**	**DXG-SPR-5FR2EB**
Type 12/IP54 kit	**DXH-ACC-FR2N12KIT**	**DXH-ACC-FR2N12KIT**	**DXH-ACC-FR2N12KIT**
Main power board	**DXH-SPR-2FR2MPB**	**DXH-SPR-4FR2MPB**	**DXG-SPR-5FR2MPB**
Control board cover	**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**
Main fan kit	**DXG-SPR-FR2FAN**	**DXG-SPR-FR2FAN**	**DXG-SPR-FR2FAN**
Control fan	**DXG-SPR-FR2CF**	**DXG-SPR-FR2CF**	**DXG-SPR-FR2CF**
Bus capacitor	**DXG-SPR-4FR24BC**	**DXG-SPR-4FR24BC**	**DXG-SPR-5FR24BC**
Middle chassis cover	**DXG-SPR-FR2MCC**	**DXG-SPR-FR2MCC**	**DXG-SPR-FR2MCC**
Outer housing	**DXG-SPR-FR2OH**	**DXG-SPR-FR2OH**	**DXG-SPR-5FR2OH**
UL conduit plate	**DXG-SPR-FR2CPUL**	**DXG-SPR-FR2CPUL**	**DXG-SPR-FR2CPUL**
IEC conduit plate	**DXG-SPR-FR2CPIEC**	**DXG-SPR-FR2CPIEC**	**DXG-SPR-FR2CPIEC**

Table 20. Frame 3

Description	Catalog number 230 V	Catalog number 480 V	Catalog number 575 V
Standard keypad	**DXH-KEY-LCD**	**DXH-KEY-LCD**	**DXH-KEY-LCD**
Control module kit with keypad	**DXH-SPR-CTRLKIT**	**DXH-SPR-CTRLKIT**	**DXH-SPR-CTRLKIT**
Main control board	**DXH-SPR-CTRLBOARD**	**DXH-SPR-CTRLBOARD**	**DXH-SPR-CTRLBOARD**
Standard cover	**DXH-SPR-FR3CVR**	**DXH-SPR-FR3CVR**	**DXH-SPR-FR3CVR**
EMI board	**DXG-SPR-2FR3EB**	**DXG-SPR-4FR3EB**	**DXG-SPR-5FR3EB**
Control board cover	**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**
Main fan kit	**DXG-SPR-FR3FANKIT**	**DXG-SPR-FR3FANKIT**	**DXG-SPR-FR3FANKIT**

Table 20. Frame 3, continued

Description	Catalog number 230 V	Catalog number 480 V	Catalog number 575 V
Main fan	**DXG-SPR-FR3FAN**	**DXG-SPR-FR3FAN**	**DXG-SPR-FR3FAN**
Control fan	**DXG-SPR-FR34CF**	**DXG-SPR-FR34CF**	**DXG-SPR-FR34CF**
Bus capacitor	**DXG-SPR-FR3BC**	**DXG-SPR-FR3BC**	**DXG-SPR-5FR3BC**
Middle chassis cover	**DXG-SPR-FR3MCC**	**DXG-SPR-FR3MCC**	**DXG-SPR-FR3MCC**
Outer housing	**DXG-SPR-FR3OH**	**DXG-SPR-FR3OH**	**DXG-SPR-FR3OH**
UL conduit plate	**DXG-SPR-FR3CPUL**	**DXG-SPR-FR3CPUL**	**DXG-SPR-FR3CPUL**
IEC conduit plate	**DXG-SPR-FR3CPIEC**	**DXG-SPR-FR3CPIEC**	**DXG-SPR-FR3CPIEC**
Drive board	**DXH-SPR-2FR3DB**	**DXH-SPR-4FR3DB**	**DXG-SPR-5FR3DB**
Output board	**DXG-SPR-FR3OB**	**DXG-SPR-FR3OB**	**DXG-SPR-5FR3OB**

Table 21. Frame 4

Description	Catalog number 230 V	Catalog number 480 V	Catalog number 575 V
Standard keypad	**DXH-KEY-LCD**	**DXH-KEY-LCD**	**DXH-KEY-LCD**
Control module kit with keypad	**DXH-SPR-CTRLKIT**	**DXH-SPR-CTRLKIT**	**DXH-SPR-CTRLKIT**
Main control board	**DXH-SPR-CTRLBOARD**	**DXH-SPR-CTRLBOARD**	**DXH-SPR-CTRLBOARD**
Standard cover	**DXH-SPR-FR4CVR**	**DXH-SPR-FR4CVR**	**DXH-SPR-FR4CVR**
EMI board	**DXG-SPR-2FR4EB**	**DXG-SPR-4FR4EB**	**DXG-SPR-5FR4EB**
Main power board	**DXH-SPR-2FR4MPB**	**DXH-SPR-4FR4MPB**	**DXG-SPR-5FR4MPB**
Control board cover	**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**
Main fan kit	**DXG-SPR-FR4FANKIT**	**DXG-SPR-FR4FANKIT**	**DXG-SPR-FR4FANKIT**
Main fan	**DXG-SPR-FR4FAN**	**DXG-SPR-FR4FAN**	**DXG-SPR-FR4FAN**
Control fan	**DXG-SPR-FR34CF**	**DXG-SPR-FR34CF**	**DXG-SPR-FR34CF**
Bus capacitor	**DXG-SPR-4FR24BC**	**DXG-SPR-4FR24BC**	**DXG-SPR-5FR24BC**
Middle chassis cover	**DXG-SPR-FR4MCC**	**DXG-SPR-FR4MCC**	**DXG-SPR-FR4MCC**
Outer housing	**DXG-SPR-FR4OH**	**DXG-SPR-FR4OH**	**DXG-SPR-5FR4OH**
UL conduit plate	**DXG-SPR-FR4CPUL**	**DXG-SPR-FR4CPUL**	**DXG-SPR-FR4CPUL**
IEC conduit plate	**DXG-SPR-FR4CPIEC**	**DXG-SPR-FR4CPIEC**	**DXG-SPR-FR4CPIEC**
Softstart board	**DXH-SPR-2FR4SB**	**DXH-SPR-4FR4SB**	**DXG-SPR-5FR4SB**
IGBT Module	**DXG-SPR-2FR4IGBT**	**DXG-SPR-4FR4IGBT**	**DXG-SPR-5FR4IGBT**
Rectifier module	**DXG-SPR-2FR4RM**	**DXG-SPR-4FR4RM**	**DXG-SPR-5FR4RM**
Brake chopper module	**DXG-SPR-2FR4BCM**	**DXG-SPR-4FR4BCM**	**DXG-SPR-5FR4BCM**

Table 22. Frame 5

Description	Catalog number 230 V	Catalog number 480 V	Catalog number 575 V
Standard keypad	**DXH-KEY-LCD**	**DXH-KEY-LCD**	**DXH-KEY-LCD**
Control module kit with keypad	**DXH-SPR-CTRLKIT**	**DXH-SPR-CTRLKIT**	**DXH-SPR-CTRLKIT**
Main control board	**DXH-SPR-CTRLBOARD**	**DXH-SPR-CTRLBOARD**	**DXH-SPR-CTRLBOARD**
Standard cover	**DXH-SPR-FR5CVR**	**DXH-SPR-FR5CVR**	**DXH-SPR-FR5CVR**
EMI-1 board	**DXG-SPR-2FR5E1B**	**DXG-SPR-4FR5E1B**	**DXG-SPR-5FR5E1B**
EMI-2 board	**DXG-SPR-2FR5E2B**	**DXG-SPR-4FR5E2B**	**DXG-SPR-5FR5E2B**
EMI-3 board	**DXG-SPR-FR5E3B**	**DXG-SPR-FR5E3B**	
Main power board	**DXH-SPR-2FR5MPB**	**DXH-SPR-4FR5MPB**	**DXG-SPR-5FR5MPB**
Control board cover	**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**

Table 22. Frame 5, continued

Description	Catalog number 230 V	Catalog number 480 V	Catalog number 575 V
Main fan kit	**DXG-SPR-FR5FANKIT**	**DXG-SPR-FR5FANKIT**	**DXG-SPR-FR5FANKIT**
Main fan	**DXG-SPR-FR5FAN**	**DXG-SPR-FR5FAN**	**DXG-SPR-FR5FAN**
Control fan	**DXG-SPR-FR5CF**	**DXG-SPR-FR5CF**	**DXG-SPR-FR5CF**
Bus capacitor	**DXG-SPR-FR5BC**	**DXG-SPR-FR5BC**	**DXG-SPR-5FR5BC**
Middle chassis cover	**DXG-SPR-FR5MCC**	**DXG-SPR-FR5MCC**	**DXG-SPR-FR5MCC**
Outer housing	**DXG-SPR-FR5OH**	**DXG-SPR-FR5OH**	**DXG-SPR-FR5OH**
UL conduit plate	**DXG-SPR-FR5CPUL**	**DXG-SPR-FR5CPUL**	**DXG-SPR-FR5CPUL**
IEC conduit plate	**DXG-SPR-FR5IECCP**	**DXG-SPR-FR5IECCP**	**DXG-SPR-FR5IECCP**
IGBT Module	**DXG-SPR-2FR5IGBT**	**DXG-SPR-4FR5IGBT**	**DXG-SPR-5FR5IGBT**
Rectifier module	**DXG-SPR-FR5RM**	**DXG-SPR-FR5RM**	**DXG-SPR-5FR5RM**
Brake chopper module	**DXG-SPR-2FR5BCM**	**DXG-SPR-4FR5BCM**	**DXG-SPR-5FR5BCM**
DC terminal kit	**DXG-SPR-FR5DCKIT**	**DXG-SPR-FR5DCKIT**	**DXG-SPR-FR5DCKIT**

Table 23. Frame 6

Description	Catalog number 230 V	Catalog number 480 V	Catalog number 575 V
Standard keypad	**DXH-KEY-LCD**	**DXH-KEY-LCD**	**DXH-KEY-LCD**
Control module kit with keypad	**DXH-SPR-CTRLKIT**	**DXH-SPR-CTRLKIT**	**DXH-SPR-CTRLKIT**
Main control board	**DXH-SPR-CTRLBOARD**	**DXH-SPR-CTRLBOARD**	**DXH-SPR-CTRLBOARD**
Standard cover	**DXH-SPR-FR6CVR**	**DXH-SPR-FR6CVR**	**DXH-SPR-FR6CVR**
EMI board	**DXG-SPR-FR6EB**	**DXG-SPR-FR6EB**	**DXG-SPR-FR6EB**
Main power board	**DXG-SPR-2FR6MPB**	**DXG-SPR-4FR6MPB**	**DXG-SPR-5FR6MPB**
Control board cover	**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**	**DXG-SPR-BCOVER**
Main fan kit	**DXG-SPR-FR6FANKIT**	**DXG-SPR-FR6FANKIT**	**DXG-SPR-FR6FANKIT**
Main fan	**DXG-SPR-FR6FAN**	**DXG-SPR-FR6FAN**	**DXG-SPR-FR6FAN**
Control fan	**DXG-SPR-FR6CF**	**DXG-SPR-FR6CF**	**DXG-SPR-FR6CF**
Bus capacitor	**DXG-SPR-FR6BC**	**DXG-SPR-FR6BC**	**DXG-SPR-5FR6BC**
Middle chassis cover	**DXG-SPR-FR6MCC**	**DXG-SPR-FR6MCC**	**DXG-SPR-FR6MCC**
Outer housing	**DXG-SPR-FR6OH**	**DXG-SPR-FR6OH**	**DXG-SPR-FR6OH**
UL conduit plate	**DXG-SPR-FR6CPUL**	**DXG-SPR-FR6CPUL**	**DXG-SPR-FR6CPUL**
IEC conduit plate	**DXG-SPR-FR6CPIEC**	**DXG-SPR-FR6CPIEC**	**DXG-SPR-FR6CPIEC**
IGBT Module	**DXG-SPR-2FR6IGBT**	**DXG-SPR-4FR6IGBT**	**DXG-SPR-5FR6IGBT**
Brake chopper module	**DXG-SPR-2FR6BCM**	**DXG-SPR-4FR6BCM**	**DXG-SPR-5FR6BCM**
Rectifier module	**DXG-SPR-FR6RM**	**DXG-SPR-FR6RM**	**DXG-SPR-5FR6RM**
Type 12 grommet kit	**DXG-SPR-FR6GRN12**	**DXG-SPR-FR6GRN12**	**DXG-SPR-FR6GRN12**
Softstart board	**DXG-SPR-2FR6SB**	**DXG-SPR-4FR6SB**	**DXG-SPR-5FR6SB**
Rectifier snubber board	**DXG-SPR-2FR6RSB**	**DXG-SPR-4FR6RSB**	**DXG-SPR-5FR6RSB**
Terminal block kit (1-pole)	**DXG-SPR-FR6TB1P**	**DXG-SPR-FR6TB1P**	**DXG-SPR-FR6TB1P**
Terminal block kit (3-pole)	**DXG-SPR-FR6TB3P**	**DXG-SPR-FR6TB3P**	**DXG-SPR-FR6TB3P**

Chapter 2—Engineering considerations

Introduction

This chapter describes the most important features in the energy circuit of a drive system that you should take into consideration in your project planning.

Figure 7. Drive system (PDS = power drive system)

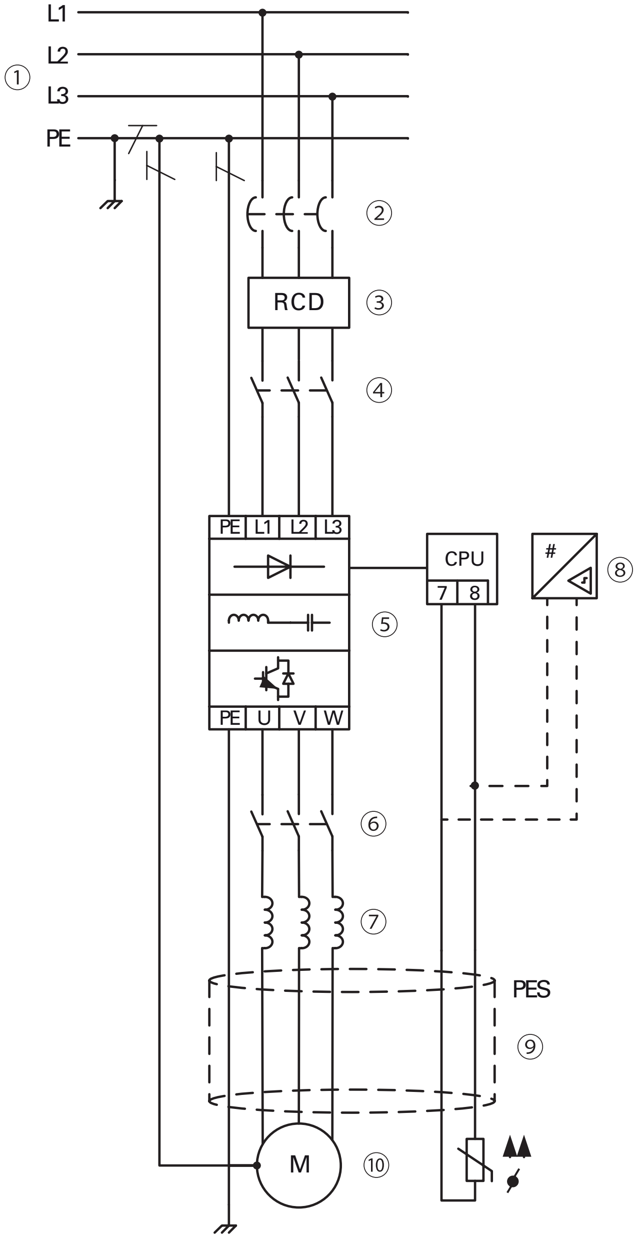


Table 24. Drive system components

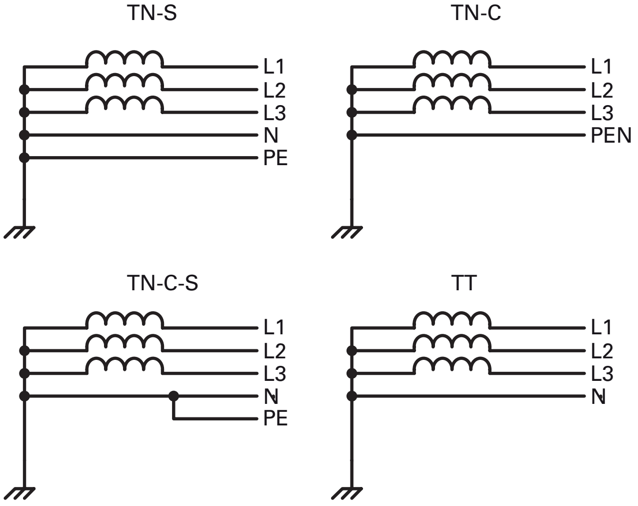
Item no.	Description
1	Power grid configuration, input voltage, input frequency, interactions with PF correction systems
2	Breakers, fuses, cable cross-sections
3	Protection of persons and animals with residual-current protective devices
4	Input contactor, disconnector
5	Frequency inverter: mounting, installation; power connection; EMC measures; circuit examples
6	Output contactor, disconnector
7	Output reactor, dV/dT filter, sine-wave filter
8	Motor protection; thermistor (can be connected to drive directly)
9	Cable lengths, motor cables, shielding (EMC)
10	Motor and application, parallel operation of multiple motors on a VFD, bypass circuit, DC braking

Electrical power network

Input connection and configuration

The PowerXL Series frequency inverters can be connected and operated with all control-point grounded AC power networks (see IEC 60364 for more information).

Figure 8. AC power networks with grounded neutral point (TN-/TT networks)



The frequency inverter can be applied to all types of power networks above. If multiple frequency inverters with single-phase supplies are to be connected, a symmetrical distribution to the three external conductors shall be taken into account. In addition, the total current of all single-phase consumers is not to cause an overload of the neutral conductor (N-conductor).

The connection and operation of frequency inverters to asymmetrically grounded TN networks (phase-grounded delta network "Grounded Delta", USA) or neutral point ungrounded or high-resistance grounded (>30 ohms) IT networks is only conditionally permissible. In these networks above-mentioned, the internal interference suppression filter of frequency inverter must be disconnected (unscrew the screw marked 'EMC', see "Installation in IT System" on **Page 53**). Then the required filtering for EMC (electromagnetic compatibility) is no longer present (degrade to Class T).

Measures for EMC are mandatory in a drive system in order to meet the legal requirements for EMC and low voltage regulations.

Good grounding measures are a prerequisite for the effective insert of further measures such as shielding of filters. Without respective grounding measures, further steps are superfluous.

Input voltage and frequency

The standardized input voltages (IEC 60038, VDE017-1) for energy suppliers (EVU) guarantee the following conditions at the transition points:

- Deviation from the rated value of voltage: Max. ±10%
- Deviation in voltage phase balance: Max. ±3%
- Deviation from rated value of the frequency: Max. ±4%

The board tolerance band of the PowerXL Series frequency inverter considers the rated value for
European as (EU: U_{LN} = 230 V/400 V, 50 Hz),
American as (USA: U_{LN} = 240 V/480 V, 60 Hz) and
Canada as (CAN: U_{LN} = 600 V, 60 Hz) standard voltages:

- 230 V, 50 Hz (EU) and 240 V, 60 Hz (USA) at DG1/DH1-32_
- 400 V, 50 Hz (EU) and 480 V, 60 Hz (USA) at DG1/DH1-34_
- 600 V, 60 Hz (CAN) at DG1/DH1-35_

For the bottom voltage value, the permitted voltage drop of 4% in the consumer circuits is also taken into account, therefore a total of U_{LN} –14%.

- 230 V device class (DG1/DH1-32_): 208 V –15% to 240 V +10% (177 V –0% to 264 V +0%)
- 400 V device class (DG1/DH1-34_): 380 V –15% to 500 V +10% (323 V –0% to 550 V +0%)
- 600 V device class (DG1/DH1-35_): 525 V –15% to 600 V +10% (446 V –0% to 660 V +0%)

The permitted frequency range is 50/60 Hz (45 Hz –0% to 66 Hz +0%).

Input voltage balance

Due to the uneven loading on the conductor, and with the direct connection of greater power ratings, deviations from the ideal voltage form and asymmetrical voltages can be caused in three-phase AC power networks. These asymmetric divergences in the input voltage can lead to different loading of the diodes in input rectifiers with three-phase supplied frequency inverters, and as a result, an advance failure of this diode.

In the project planning for the connection of three-phase supplied frequency inverters, consider only AC power networks that handle permitted asymmetric divergences in the input voltage ≤ +3%.

If this condition is not fulfilled, or symmetry at the connection location is uncertain, the use of an assigned AC choke is recommended.

Total harmonic distortion (THD)

Non-linear consumers (loads) in an AC supply system produce harmonic voltages that again result in harmonic currents. These harmonic currents at the inductive and capacitive reactances of a mains supply system produce additional voltage drops with different values that are then overlaid on the sinusoidal mains voltage and result in distortions. In supply systems, this form of "noise" can give rise to problems in an installation if the sum of the harmonics exceeds certain limit values.

Non-linear consumers (harmonics producers) include for example:

- Induction and arc furnaces, welding devices
- Current converters, rectifiers and inverters, soft starters, variable frequency drives
- Switched-mode power supply units (computers, monitors, lighting), uninterrupted power supply (UPS)

The THD value (THD = Total Harmonic Distortion) is defined in standard IEC/EN 61800-3 as the ratio of the rms value of all harmonic components to the rms value of the fundamental frequency. It is given in percent of the total value.

$$\text{THD} \quad \frac{\sqrt{U_2^2 + U_3^2 + U_4^2 + \cdots U_n^2}}{U_1} \times 100\%$$

U_1 — *fundamental component*

U_n — n^{th} *order harmonic component*

The THD value of the harmonic distortion is stated in relation to the rms value of the total signal as a percentage. On a variable frequency drive, the total harmonic distortion is around 28–36%.

To assist in the calculation of system harmonics, a Harmonic Estimation Calculator Tool is available at Eaton.com/drives.

Reactive power compensation devices

Special compensation measures on the power supply side is not required for PowerXL Series drives, which take on very little reactive power of the fundamental harmonics from the AC power supply network (cosØ ~0.98).

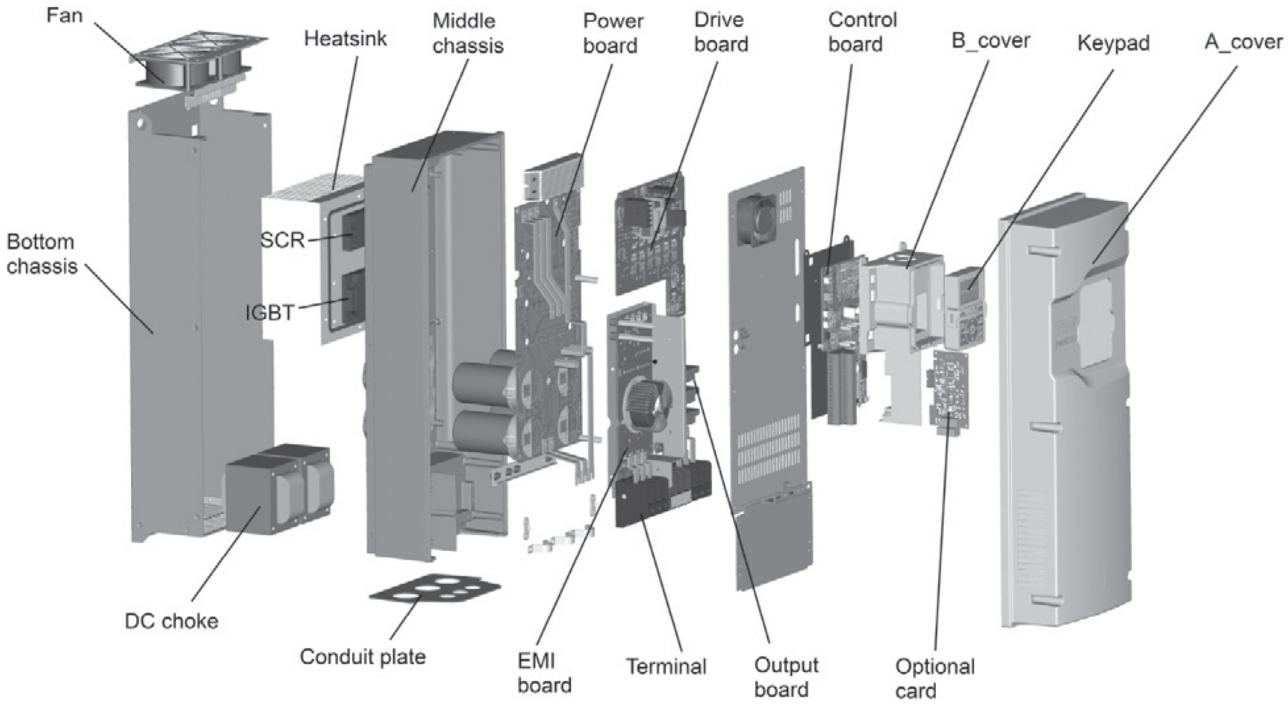
In the AC power networks with non-choked reactive current compensation devices, current deviations can enable parallel resonance and undefinable circumstances.

In the project planning for the connection of frequency inverters to AC power networks with undefined circumstances, please consider using AC chokes.

Chapter 3—Product overview

Component identification

Figure 9. Description of the PowerXL Series



Features

The PowerXL frequency inverter converts the voltage and frequency of an existing AC network into a DC voltage. This DC voltage is used to generate a three-phase AC voltage with adjustable frequency and assigned amplitude values for the variable speed control of three-phase asynchronous motors.

Figure 10. Block diagram, elements of PowerXL frequency inverters

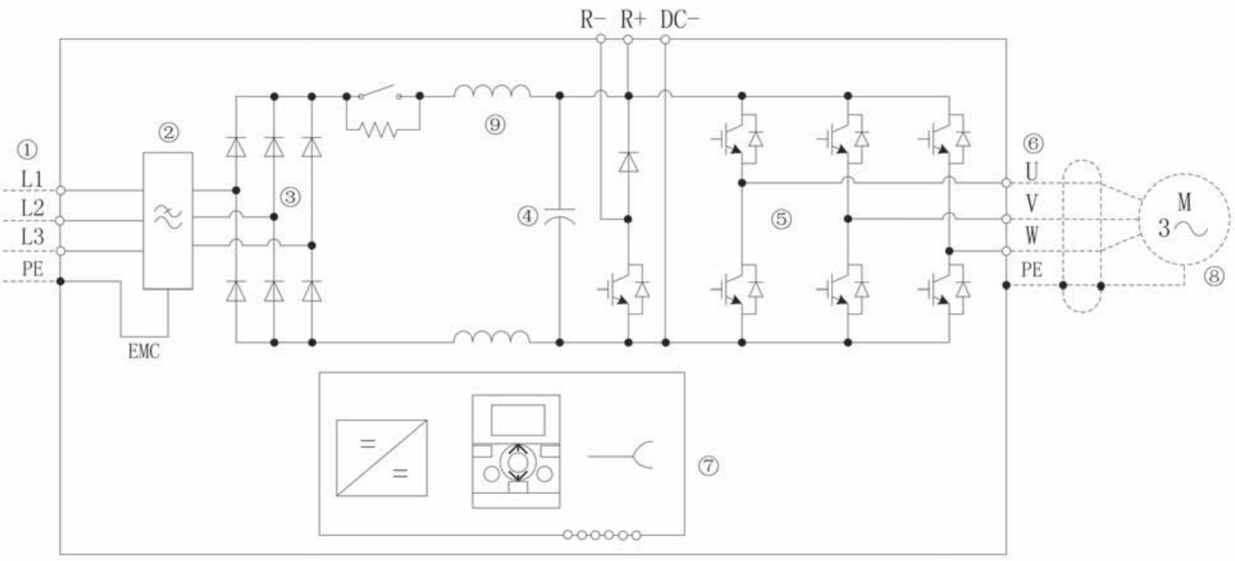


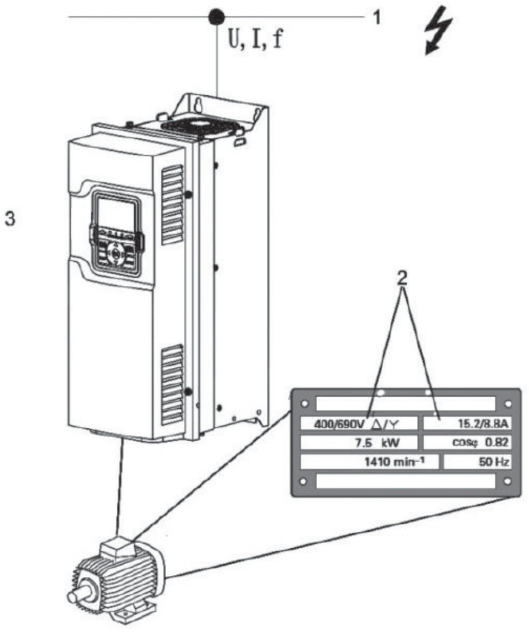
Table 25. Elements of PowerXL frequency inverters

Item no.	Description
1	Supply L1, L2 L3, PE, input supply voltage U_{LN} = Ue at 50/60 Hz: D_1-32: 230 V class, three-phase input connection (3 AC 230 V/240 V) D_1-34: 400 V class, three-phase input connection (3 AC 400 V/480 V) D_1-35: 600 V class, three-phase input connection (3 AC 600 V)
2	Internal interference suppression filter, category C2 to IEC/EN 61800-3 EMC-connection of internal interference suppression filter to PE
3	Rectifier bridge, converts the AC voltage of the electrical network into DC voltage
4	DC link with charging resistor, capacitor and switching mode power supply unit (SMPS = Switching Mode Power Supply): DC link voltage UDC with three-phase input connection (3 AC): U_{DC} = 1.41 x U_{LN}
5	Inverter. The IGBT based inverter converts the DC voltage of the DC link (UDC) into a three-phase AC voltage (U2) with variable amplitude and frequency (f2). Sinusoidal pulse width modulation (PWM) with V/f control can be switched to speed control with slip compensation
6	Motor connection U/T1, V/T2, W/T3 with output voltage U2 (0–100% Ue) and output frequency f2 (0–400 Hz) output current (I2): D_1-32: 3.7 A to 248 A D_1-34: 2.2 A to 245 A D_1-35: 3.3 A to 208 A 100% at an ambient temperature of 122 °F (50 °C) with an overload capacity of 150% for 60 s every 600 s and a starting current of 200% for 2 s every 20 s
7	Keypad with control buttons, graphic display, control voltage, control signal terminals, micro-switches, and interface for the PC interface module (option)
8	Three-phase asynchronous motor, variable speed control of three-phase asynchronous motor for assigned motor shaft power values (P2): D_1-32: 0.55 kW to 75 kW (230 V, 50 Hz) or 0.75 hp to 100 hp (240 V, 60 Hz) D_1-34: 0.75 kW to 132 kW (400 V, 50 Hz) or 1 hp to 200 hp (460 V, 60 Hz) D_1-35: 1.5 kW to 132 kW (600 V, 50 Hz) or 2 hp to 200 hp (600 V, 60 Hz)
9	DC link—chokes, to minimize current harmonics

Selection criteria

The frequency inverter **[3]** is selected according to the supply voltage U_{LN} of the input supply **[1]** and the rated current of the assigned motor **[2]**. The circuit type (Δ/Y) of the motor must be selected according to the supply voltage **[1]**. The rated output current I_e of the frequency inverter must be greater than/equal to the rated motor current.

Figure 11. Selection criteria



When selecting the drive, the following criteria must be known:

- Type of motor (three-phase asynchronous motor)
- Input voltage = rated operating voltage of the motor (for example, 3 AC ~400 V)
- Rated motor current (guide value, dependent on the circuit type and the supply voltage)
- Load torque (quadratic, constant)
- Starting torque
- Ambient temperature (rated value 122 °F [50 °C])

When connecting multiple motors in parallel to the output of a frequency inverter, the motor currents are added geometrically—separated by effective and idle current components. When you select a frequency inverter, make sure that it can supply the total resulting current. If necessary, for dampening and compensating the deviating current values, motor reactors or sinusoidal filters must be connected between the frequency inverter and the motor.

The parallel connection of multiple motors in the output of the frequency inverter is only permitted with V/Hz characteristic curve control.

If you connect a motor to an operational frequency inverter, the motor draws a multiple of its rated operational current. When you select a frequency inverter, make sure that the starting current plus the sum of the currents of the running motors will not exceed the rated output current of the frequency inverter.

Switching in the output of the frequency inverter is only permitted with V/Hz characteristic curve control.

Proper use

The PowerXL frequency inverters are electrical apparatus for controlling variable speed drives with three-phase motors. They are designed for installation in machines or for use in combination with other components within a machine or system.

After installation in a machine, the frequency inverters must not be taken into operation until the associated machine has been confirmed to comply with the safety requirements of Machinery Directive (MD) 2006/42/EC (meets the requirements of EN 60204-1). The user of the equipment is responsible for ensuring that the machine use complies with the relevant EU Directives.

The CE markings on the PowerXL frequency inverters confirm that, when used in a typical drive configuration, the apparatus complies with the relevant EU Directives listed in Appendix F.

The UKCA markings on the PowerXL frequency inverters confirm that, when used in a typical drive configuration, the apparatus complies with the relevant UK Regulations listed in Appendix F.

In the described system configurations, PowerXL frequency inverters are suitable for use in public and non-public networks.

A connection to IT networks (networks without reference to earth potential) is permissible only to a limited extent, because the device's built-in filter capacitors connect the network with the earth potential (enclosure). On earth free networks, this can lead to dangerous situations or damage to the device (isolation monitoring required).

To the output of the frequency inverter (terminals U, V, W) you must not:

- Connect a voltage or capacitive loads (for example, phase compensation capacitors)
- Connect multiple frequency inverters in parallel
- Make a direct connection to the input (bypass)

Observe the technical data and connection requirements. For additional information, refer to the equipment nameplate or label at the frequency inverter, and the documentation.

Any other usage constitutes improper use.

Maintenance and inspection

PowerXL frequency inverters are maintenance free. However, external influences may affect the function and the lifespan of the PowerXL frequency inverter. We therefore recommend that the devices are checked regularly and the following maintenance measures are carried out at the specified intervals.

If the PowerXL frequency inverter is damaged by external influences, contact Technical Service.

Table 26. Maintenance measures and intervals

Maintenance measure	Maintenance interval
Clean cooling vents (cooling slits)	If required
Check the fan function	6–24 months (depending on the environment)
Filter in the switching cabinet doors (see manufacturer specifications)	6–24 months (depending on the environment)
Check the tightening torques of the terminals (control signal terminals, power terminals)	Regularly
Check connection terminals and all metallic surfaces for corrosion	6–24 months (depending on the environment)

Storage

If the frequency inverter is stored before use, suitable ambient conditions must be ensured at the site of storage:

- Storage temperature: –40 °F to 158 °F (–40 °C to 70 °C)
- Relative average air humidity: <95%, noncondensing (EN 50178)
- To prevent damage to the DC link capacitors, storage times longer than 12 months are not recommended

Charging the internal DC link capacitors

After extended storage times or extended downtimes during which no power is supplied (>12 months), the capacitors in the internal DC link must be recharged in a controlled manner in order to prevent damage. To do this, the PowerXL variable frequency drive must be supplied with power, with a controlled DC power supply unit, via two mains DC bus connection terminals. Please consult the factory for detailed instructions.

Service and warranty

In the unlikely event that you have a problem with your PowerXL frequency inverter, please contact your local sales office.

When you call, have the following information ready:

- The exact frequency inverter part no. (see nameplate)
- The date of purchase
- A detailed description of the problem that has occurred with the frequency inverter

If some of the information printed on the nameplate is not legible, please state only the information that is clearly legible. This information can also be found on the cover of the control terminals.

Information concerning the guarantee can be found in the General Terms and Conditions of Sale.

Chapter 4—Safety and switching

Note: All following information is strongly recommended but is not necessary if sufficient system design and validation has been completed.

Fuses and cable cross-sections

The fuses and wire cross-sections allocated for power-side connections depend on the rated input current and output current of the frequency inverter (without AC choke).

⚠ CAUTION

WHEN SELECTING THE CABLE CROSS-SECTION, TAKE THE VOLTAGE DROP UNDER LOAD CONDITIONS INTO ACCOUNT.

THE CONSIDERATION OF OTHER STANDARDS (FOR EXAMPLE, VDE 0113 OR VDE 0289) IS THE RESPONSIBILITY OF THE USER.

THE NATIONAL AND REGIONAL STANDARDS (FOR EXAMPLE VDE 0113, EN 60204) MUST BE OBSERVED AND THE NECESSARY APPROVALS (FOR EXAMPLE UL) AT THE SITE OF INSTALLATION MUST BE FULFILLED.

WHEN THE DEVICE IS OPERATED IN A UL-APPROVED SYSTEM, USE ONLY UL-APPROVED FUSES, FUSE BASES, AND CABLES.

SEE APPENDIX D–SAFETY INSTRUCTIONS FOR UL AND CUL FOR DETAILS.

⚠ CAUTION

THE SPECIFIED MINIMUM PE CONDUCTOR CROSS-SECTIONS IN THIS MANUAL MUST BE MAINTAINED. THE MINIMUM SIZE OF THE PROTECTIVE EARTHING CONDUCTOR MUST COMPLY WITH THE REQUIREMENTS OF EN 61800-5-1 AND/OR THE LOCAL SAFETY REGULATIONS.

TOUCH CURRENTS IN THIS FREQUENCY INVERTER ARE GREATER THAN 3.5 MA (AC). ACCORDING TO PRODUCT STANDARD IEC/EN 61800-5-1, AN ADDITIONAL EQUIPMENT GROUNDING CONDUCTOR OF THE SAME CROSS-SECTIONAL AREA AS THE ORIGINAL PROTECTIVE EARTHING CONDUCTOR MUST BE CONNECTED, OR THE CROSS-SECTION OF THE EQUIPMENT GROUNDING CONDUCTOR MUST BE AT LEAST 10 MM^2 CU.

CHOOSE THE CROSS-SECTION OF THE PE CONDUCTOR IN THE MOTOR LINES AT LEAST AS LARGE AS THE CROSS-SECTION OF THE PHASE LINES (U, V, W).

Cables and fuses

The cross-sections of the cables and line protection fuses used must correspond with local standards.

For an installation in accordance with UL guidelines:

- Use UL listed Class RK5, J, T or equivalent fuses for the branch circuit protection
- Use 75 °C or higher copper wire only
- Use UL listed conduit fittings with the same type rating (Type 1/Type 12) as the enclosure

See **Appendix D**–Safety Instructions for UL and cUL for details.

Use power cables with insulation according to the specified input voltages for the permanent installation. A shielded cable is not required on the input side.

A completely (360°) shielded low impedance cable is required on the motor side. The length of the motor cable depends on the RFI class and must not exceed approximately 300 ft (100 m) without additional filtering.

Residual-current device (RCD)

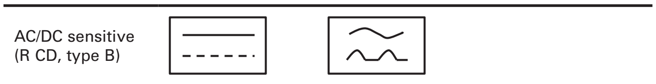
RCD (Residual Current Device): Residual current device, residual current circuit breaker (FI circuit breaker).

Residual current circuit breakers protect persons and animals from the existence (not the origination) of impermissibly high contact voltages. They prevent dangerous, and in some cases deadly injuries caused by electrical accidents, and also serve as fire prevention.

⚠ CAUTION

THIS DRIVE CAN CAUSE A DC CURRENT IN THE PROTECTIVE EARTHING CONDUCTOR. WHERE A RESIDUAL CURRENT-OPERATED PROTECTIVE (RCD) OR MONITORING (RCM) DEVICE IS USED FOR PROTECTION IN CASE OF DIRECT OR INDIRECT CONTACT, ONLY AN RCD OR RCM OF TYPE B IS ALLOWED ON THE SUPPLY SIDE OF THIS PRODUCT.

Figure 12. Identification on the FI circuit breakers



Frequency inverters work internally with rectified AC currents. If an error occurs, the DC currents can block a type A RCD circuit breaker from triggering and therefore disable the protective functionality.

⚠ CAUTION

DEBOUNCED INPUTS MAY NOT BE USED IN THE SAFETY CIRCUIT DIAGRAM.

RESIDUAL CURRENT CIRCUIT BREAKERS (RCD) ARE ONLY TO BE INSTALLED BETWEEN THE AC POWER SUPPLY NETWORK AND THE FREQUENCY INVERTER.

SAFETY-RELEVANT LEAKAGE CURRENTS CAN OCCUR WHILE HANDLING AND WHEN OPERATING THE FREQUENCY INVERTER, IF THE FREQUENCY INVERTER IS NOT GROUNDED (BECAUSE OF A FAULT).

LEAKAGE CURRENTS TO GROUND ARE MAINLY CAUSED BY FOREIGN CAPACITIES WITH FREQUENCY INVERTERS, BETWEEN THE MOTOR PHASES AND THE SHIELDING OF THE MOTOR CABLE AND VIA THE Y-CAPACITORS OF THE RFI FILTER. THE SIZE OF THE LEAKAGE CURRENT IS MAINLY DEPENDENT UPON THE:

- LENGTH OF THE MOTOR CABLE
- SHIELDING OF THE MOTOR CABLE
- HEIGHT OF THE SWITCHING FREQUENCY OF THE INVERTER
- DESIGN OF THE RFI FILTER
- GROUNDING MEASURES AT THE SITE OF THE MOTOR

THE LEAKAGE CURRENT TO GROUND IS GREATER THAN 3.5 MA WITH A FREQUENCY INVERTER. ACCORDING TO PRODUCT STANDARD IEC/EN 61800-5-1, AN ADDITIONAL EQUIPMENT GROUNDING (PE) CONDUCTOR OF THE SAME CROSS-SECTIONAL AREA AS THE ORIGINAL PROTECTIVE EARTHING CONDUCTOR SHOULD BE CONNECTED, OR THE CROSS-SECTION OF THE EQUIPMENT GROUNDING CONDUCTOR SHOULD BE AT LEAST 10 MM^2 CU.

RESIDUAL CURRENT CIRCUIT BREAKERS MUST BE SUITABLE FOR:

- THE PROTECTION OF INSTALLATIONS WITH DC CURRENT COMPONENT IN CASE OF FAULT SCENARIO (RCD TYPE B)
- HIGH LEAKAGE CURRENTS
- BRIEF DISCHARGES OF PULSE CURRENT SPIKES

Leakage current

⚠ CAUTION

AS SHOWN IN TABLE 16, THE FOLLOWING LEAKAGE CURRENTS WERE DETECTED. THESE VALUES WERE OBTAINED UNDER NORMAL OPERATING CONDITIONS WITH NO OUTSIDE INFLUENCES. ACTUAL VALUES WILL DIFFER DEPENDING ON THE CONDITIONS PREVIOUSLY EXPLAINED.

Input contactor

The input contactor enables an operational switching on and off of the supply voltage for the frequency inverter, and switching off in case of a fault.

The input contactor is designed based on the input current (ILN) of the frequency inverter and the utilization category AC-1 (IEC 60947). Input contactors and the assignment to PowerXL frequency inverters are explained in **Appendix A**.

While planning the project, make sure that inching operation is not done via the input contactor of the frequency inverter on frequency-controlled drives, but through a controller input of the frequency inverter.

The maximum permitted operating frequency of the input voltage with the PowerXL frequency inverter is one time per minute (normal operation).

EMC measures

Electrical components in a system (machine) have an interaction effect on each other. Each device not only emits interference but is also affected by it. The interference can be produced by galvanic, capacitive, and/or inductive sources, or by electromagnetic radiation. In practice, the limit between line-conducted interference and radiated emitted interference is around 30 MHz. Above 30 MHz, cables and conductors act like antennas that radiate electromagnetic waves.

Electromagnetic compatibility (EMC) for frequency controlled drives (variable frequency drives) is implemented in accordance with product standard IEC/EN 61800-3. This includes the complete power drive system (PDS), from the input supply to the motor, including all components, as well as cables. This type of drive system can consist of several individual drives.

The generic standards of the individual components in a PDS compliant with IEC/EN 61800-3 do not apply. These component manufacturers, however, must offer solutions that ensure standards-compliant use.

In Europe, maintaining the EMC guidelines is mandatory.

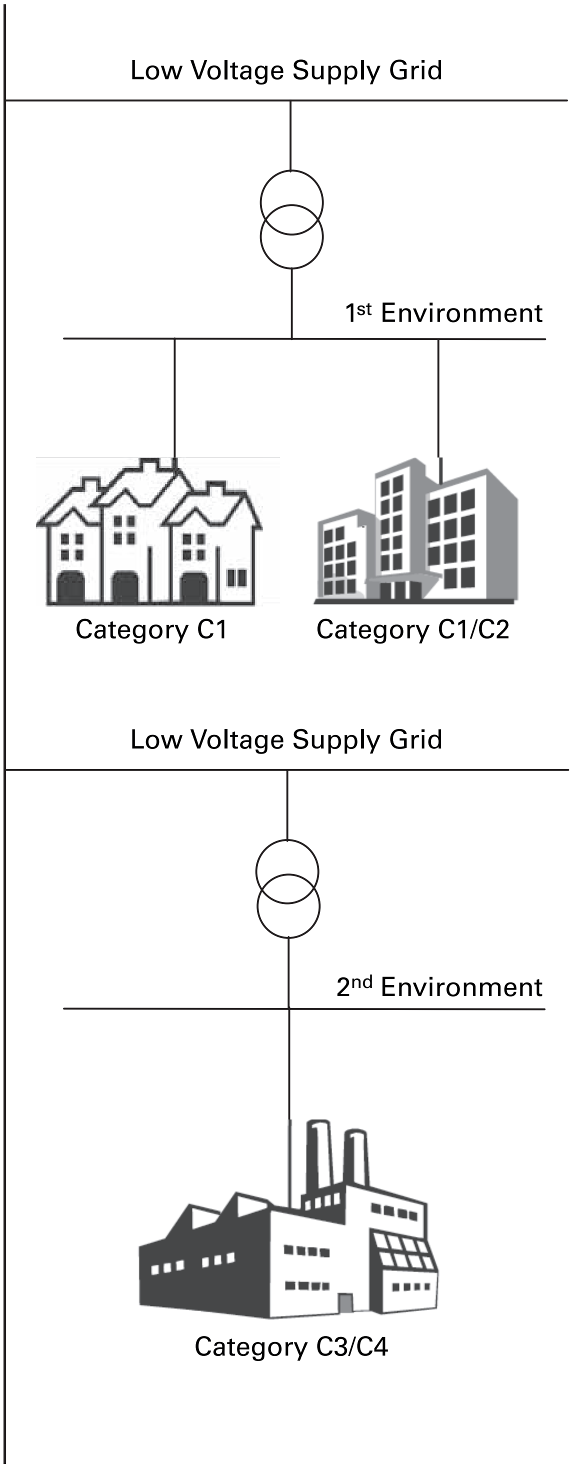
A declaration of conformity (CE) always refers to a "typical" power drive system (PDS). The responsibility to comply with the legally stipulated limit values and thus the provision of electromagnetic compatibility is ultimately the responsibility of the end user or system operator. This operator must also take measures to minimize or remove emission in the environment concerned (see **Figure 13**). He must also use means to increase the interference immunity of the devices of the system.

With their high interference immunity up to category C2, PowerXL frequency inverters are ideal for use in commercial networks (1st environment).

Table 27. Motor power cable EMC guidelines

Item	Directive
Product	IEC 61800-2
Safety	UL 508C, IEC/EN 61800-5-1
EMC (at default settings)	Immunity (EMS): IEC/EN 61800-3, 2nd environment
	Radiated and Conducted emissions (EMI): IEC/EN 61800-3
	230/480 V Series: Category C1: is possible with external filter connected to drive. Please consult factory Category C2: with internal filter maximum of 10 m motor cable length FR0: This is obtained with 2 turns on a ferrite core and using metal ground plate Category C3: with internal filter maximum of 50 m motor cable length FR0: This is obtained with no ferrite core and metal plate
	575 V Series: Category C3: with internal filter maximum of 10 m motor cable length

Figure 13. EMC measures



Chapter 5—Motor and application

Note: All following information is strongly recommended but is not necessary if sufficient system design and validation has been completed.

Motor selection

General recommendations for motor selection:

- Use three-phase powered asynchronous motors with short-circuit rotors and surface cooling, also called inverter motors or standard motors for the frequency-controlled drive system (PDS). Other specifications such as external rotor motors, slip-ring motors, reluctance motors, synchronous or servo motors can also be run with a frequency inverter, but normally require additional planning and discussion with the motor manufacturer
- Use only motors with at least heat class F (311 °F [155 °C] maximum steady state temperature)
- Four-pole motors are preferred (synchronous speed: 1500 min^{-1} at 50 Hz or 1800 min^{-1} at 60 Hz)
- Take the operating conditions into account for S1 operation (IEC 60034-1)
- When operating multiple motors in parallel on one frequency inverter, the motor output should not be more than three power classes apart
- Ensure that the motor is not over-dimensioned. If a motor in speed control mode is under-dimensioned, the motor rating must only be one rating level lower

Connecting motors in parallel

The PowerXL frequency inverters allow parallel operation of several motors using multi-pump application control mode:

- *Multi-pump application: several motors with the same or different rated operational data.* The sum of all motor currents must be less than the frequency inverter’s rated operational current
- *Multi-pump application: parallel control of several motors.* The sum of the motor currents plus the motors’ inrush currents must be less than the frequency inverter’s rated operational current

Parallel operation at different motor speeds can be implemented only by changing the number of pole pairs and/or changing the motor’s transmission ratio.

⚠ CAUTION

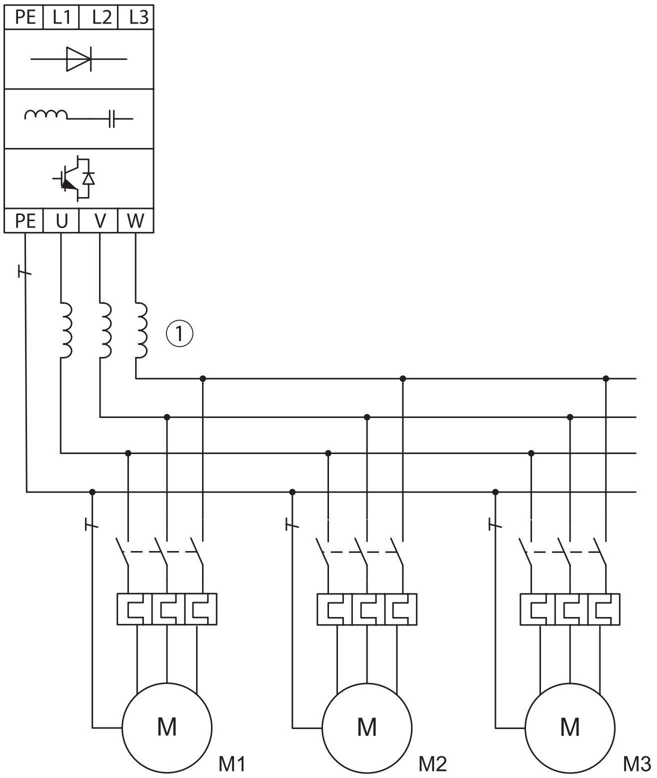
DEBOUNCED INPUTS MAY NOT BE USED IN THE SAFETY CIRCUIT DIAGRAM.

IF YOU ARE CONNECTING MULTIPLE MOTORS ON ONE FREQUENCY INVERTER, YOU MUST DESIGN THE CONTACTORS FOR THE INDIVIDUAL MOTORS ACCORDING TO UTILIZATION CATEGORY AC-3.

SELECTING THE MOTOR CONTACTOR IS DONE ACCORDING TO THE RATED OPERATIONAL CURRENT OF THE MOTOR TO BE CONNECTED.

Parallel connection of several motors to one frequency inverter

Figure 14. Parallel connection



Connecting motors in parallel reduces the load resistance at the frequency inverter output. The total stator inductance is lower and the leakage capacity of the lines greater. As a result, the current distortion is greater than in a single-motor circuit. To reduce the current distortion, you should use motor reactors (see a in **Figure 14**) in the output of the frequency inverter.

The current consumption of all motors connected in parallel must not exceed the frequency inverter's rated output current I_{2N}.

Electronic motor protection cannot be used when operating the frequency inverter with several parallel connected motors. You must, however, protect each motor with thermistors and/or overload relays.

The use of a motor protective circuit breaker at the frequency inverter's output can lead to nuisance tripping.

Motor and circuit type

The motor's stator winding can be connected in a star or delta configuration, in accordance with the rated operational data on the nameplate.

Figure 15. Example of a motor ratings plate

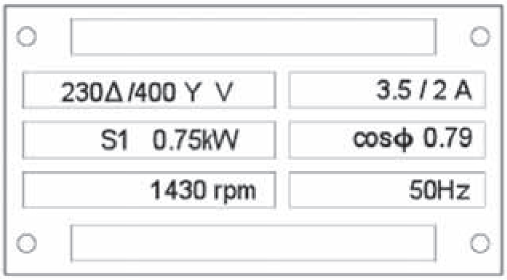
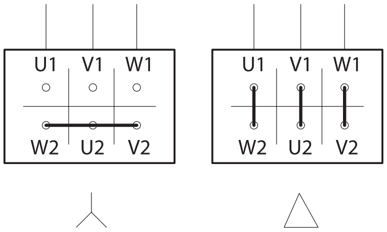


Figure 16. Star and delta circuit types



The three-phase motor with the rating plate based on **Figure 15**, can be run in a star or delta connection. The operational characteristic curve is determined by the ratio of motor voltage and motor frequency, in this case.

87 Hz characteristic curve

In the delta circuit with 400 V and 87 Hz, the motor shown in **Figure 15** was released with three times-fold output (~1.3 kW).

Because of the higher thermal loading, using only the next higher motor output according to the list (1.1 kW) is recommended. The motor (in this example) therefore still has 1.47-fold higher output compared with the listed output (0.75 kW).

With the 87 Hz characteristic curve, the motor also works in the range from 50 Hz to 87 Hz with an un-attenuated field. The pull-out torque remains at the same level as in input operation with 50 Hz.

The heat class of the motor must be at least F in 87 Hz operation.

V/Hz characteristic curve

Figure 17. V/Hz characteristic curve

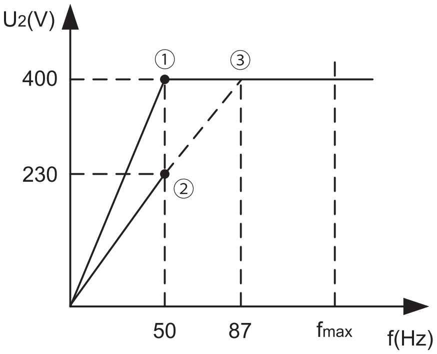


Table 28 shows the allocation of possible frequency inverters depending on the input voltage and the type of circuit.

Table 28. Assignment of frequency inverters to example motor circuit (see Figure 17)

Frequency inverters	D_1-323D7FB	D_1-343D3FB	D_1-344D3FB
Rated operational current	3.7 A	3.3 A	4.3 A
Input voltage	3 AC, 230 V	3 AC, 400 V	3 AC, 400 V
Motor circuit	Delta	Star	Delta
V/Hz characteristic curve	②	①	③
Motor current	3.5 A	2.0 A	3.5 A
Motor voltage (ratings plate)	230 V	400 V	230 V
Motor speed	1430 min-1	1430 min-1	2474 min-1 ④
Motor frequency	50 Hz	50 Hz	87 Hz c

Notes: ① Star connection: 400 V, 50 Hz.
② Delta connection: 230 V, 50 Hz.
③ Delta connection: 400 V, 87 Hz.
④ Note the permitted limit values of the motor.

Bypass operation

If you want to have the option of operating the motor with the frequency inverter or directly from the input supply, the input branches must be interlocked mechanically.

⚠ CAUTION

DEBOUNCED INPUTS MAY NOT BE USED IN THE SAFETY CIRCUIT DIAGRAM.

A CHANGEOVER BETWEEN THE FREQUENCY INVERTER AND THE INPUT SUPPLY MUST TAKE PLACE IN A VOLTAGE-FREE STATE.

⚠ WARNING

THE FREQUENCY INVERTER OUTPUTS (U, V, W) MUST NOT BE CONNECTED TO THE INPUT VOLTAGE (DESTRUCTION OF THE DEVICE, RISK OF FIRE).

Figure 18. Bypass motor control (example)

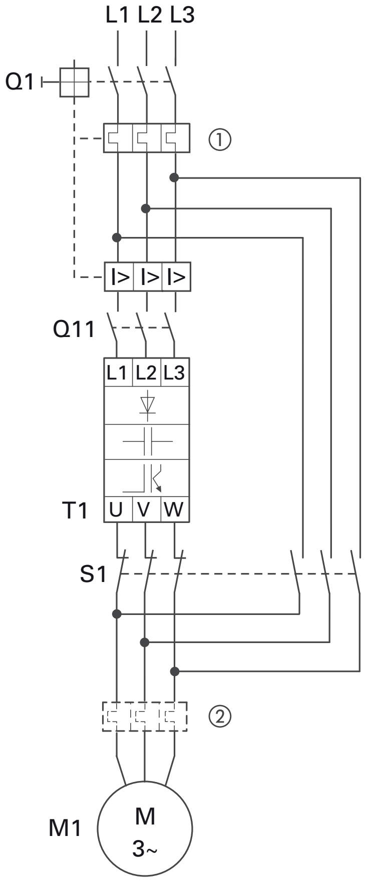


Table 29. Bypass motor control

Item No.	Description
1	Input/bypass contactor
2	Output contactor

⚠ CAUTION

DEBOUNCED INPUTS MAY NOT BE USED IN THE SAFETY CIRCUIT DIAGRAM.

SWITCH S1 MUST SWITCH ONLY WHEN FREQUENCY INVERTER T1 IS AT ZERO CURRENT.

CONTACTORS AND SWITCHES (S1) IN THE FREQUENCY INVERTER OUTPUT AND FOR THE DIRECT START MUST BE DESIGNED BASED ON UTILIZATION CATEGORY AC-3 FOR THE RATED OPERATIONAL CURRENT OF THE MOTOR.

Connecting EX motors

Note the following when connecting explosion-protected motors:

- The frequency inverter must be installed outside the EX area
- Note the branch- and country-specific standards for explosion-protected areas (ATEX 100 A)
- Note the standards and information of the motor manufacturer regarding operation on frequency inverters— for example, if motor reactors or sine-wave filters are specified
- Temperature monitors in the motor windings (thermistor, thermo-Click) are not to be connected directly to frequency inverters but must be connected via an approved trigger apparatus for EX areas

Chapter 6—Installation requirements

Note: All following information is strongly recommended but is not necessary if sufficient system design and validation has been completed.

This chapter contains all of the information required to properly install and prepare the PowerXL Series VFD for operation. The contents are listed to serve as a list of tasks needed to complete the installation. Included in this section are:

- Line (mains) and motor power wiring
- I/O control wiring

Electrical installation warnings and cautions

⚠ WARNING

CARRY OUT WIRING WORK ONLY AFTER THE FREQUENCY INVERTER HAS BEEN CORRECTLY MOUNTED AND SECURED.

⚠ WARNING

ELECTRIC SHOCK HAZARD—RISK OF INJURIES!

CARRY OUT WIRING WORK ONLY IF THE UNIT IS DE-ENERGIZED.

⚠ CAUTION

DEBOUNCED INPUTS MAY NOT BE USED IN THE SAFETY CIRCUIT DIAGRAM.

FIRE HAZARD!

ONLY USE CABLES, PROTECTIVE SWITCHES, AND CONTACTORS THAT FEATURE THE INDICATED PERMISSIBLE NOMINAL CURRENT VALUE.

⚠ CAUTION

DEBOUNCED INPUTS MAY NOT BE USED IN THE SAFETY CIRCUIT DIAGRAM.

ACCORDING TO PRODUCT STANDARD IEC/EN 61800-5-1, AN ADDITIONAL EQUIPMENT GROUNDING (PE) CONDUCTOR OF THE SAME CROSS-SECTIONAL AREA AS THE ORIGINAL PROTECTIVE EARTHING CONDUCTOR MUST BE CONNECTED, OR THE CROSS-SECTION OF THE EQUIPMENT GROUNDING CONDUCTOR MUST BE AT LEAST 10 MM^2 CU.

⚠ WARNING

THE COMPONENTS IN THE DRIVE'S POWER SECTION REMAIN ENERGIZED AFTER THE SUPPLY VOLTAGE HAS BEEN SWITCHED OFF. AFTER DISCONNECTING THE SUPPLY, WAIT AT LEAST FIVE MINUTES BEFORE REMOVING THE COVER TO ALLOW THE INTERMEDIATE CIRCUIT CAPACITORS TO DISCHARGE.

PAY ATTENTION TO HAZARD WARNINGS!

Standard mounting instructions

- Select the mounting location based on requirements listed in this chapter
- Mounting surface must be a vertical, flat, non-flammable surface
- PowerXL Series open drives may be mounted side-by-side or stacked vertically, as outlined in this chapter
- Surface must be strong enough to support the drive and not subject to excessive motion or vibration
- Mark the location of the mounting holes on the mounting surface (using the template provided on the cover of the cardboard shipping package)
- Using fasteners appropriate to your VFD and mounting surface, securely attach the VFD to the mounting surface using all four mounting hole locations

When mounting one unit above the other, the lower unit air outlet must be directed away from the inlet air used by the upper one. The clearance between the upper and lower unit should equal C + D. See **Figure 19** on next page.

1. Measure the mounting space to ensure that it allows the minimum space surrounding the VFD Series drive. Drive dimensions are on **Appendix C**
2. Make sure the mounting surface is flat and strong enough to support the drive, is not flammable, and is not subject to excessive motion or vibration
3. Ensure that the minimum airflow requirements for your drive are met at the mounting location
4. Mark the location of the mounting holes on the mounting surface, using the template provided on the cover of the cardboard shipping package
5. Using fasteners appropriate to your drive and mounting surface, securely attached the drive to the mounting surface using all four screws or bolts

Mounting dimensions

Refer to **Appendix C** for drive dimensions.

Figure 19. Mounting space

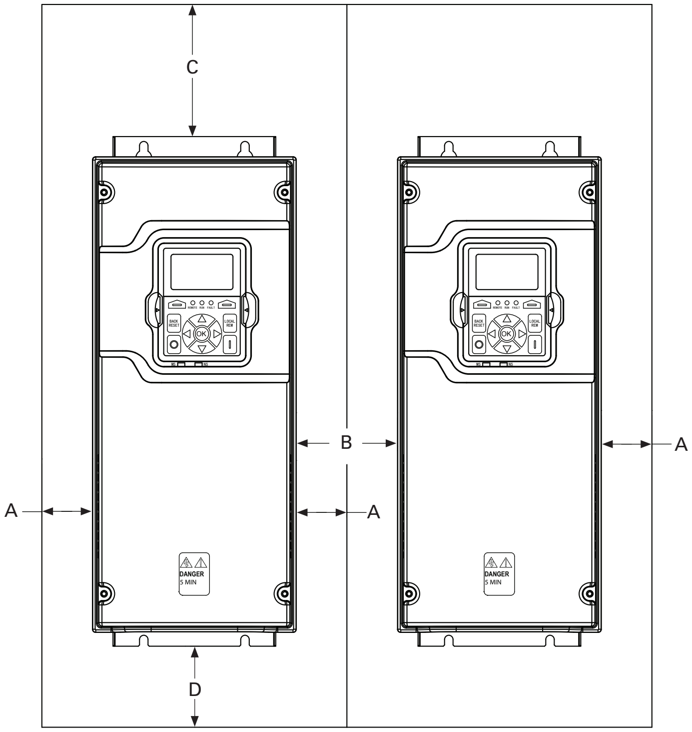


Table 30. Space requirements for mounting the PowerXL Series VFD and airflow

Frame size	A ① In (mm)	B ① In (mm)	C In (mm)	D In (mm)	Cooling air required CFM (m^3/h) ②
FR0	0	0	3.94 (100)	1.97 (50)	16.5 (28)
FR1 (IP21)	0.79 (20)	1.58 (40)	3.94 (100)	1.97 (50)	14 (24)
FR1 (IP54)	0	0	3.94 (100)	1.97 (50)	14 (24)
FR2 (IP21)	1.18 (30)	2.36 (60)	6.30 (160)	2.36 (60)	55 (94)
FR2 (IP54)	0	0	6.30 (160)	2.36 (60)	55 (94)
FR3	0	0	7.87 (200)	3.15 (80)	85 (144)
FR4	0	0	11.81 (300)	3.94 (100)	153 (260)
FR5	3.15 (80)	6.30 (160)	11.81 (300)	7.87 (200)	232 (395)
FR6	0	0	15.75 (400)	12.99 (330)	230 V: 435 (739) 480 and 575 V: 400 (679)

Notes: ① The above guidelines apply unless testing has been completed to validate a design outside of these recommendations.

② Minimum clearances A and B for drives with Type 12 (IP54) enclosure is 0 mm (in).

Dimensions

Approximate dimensions in mm

Figure 20. Open Drives FR0–FR6

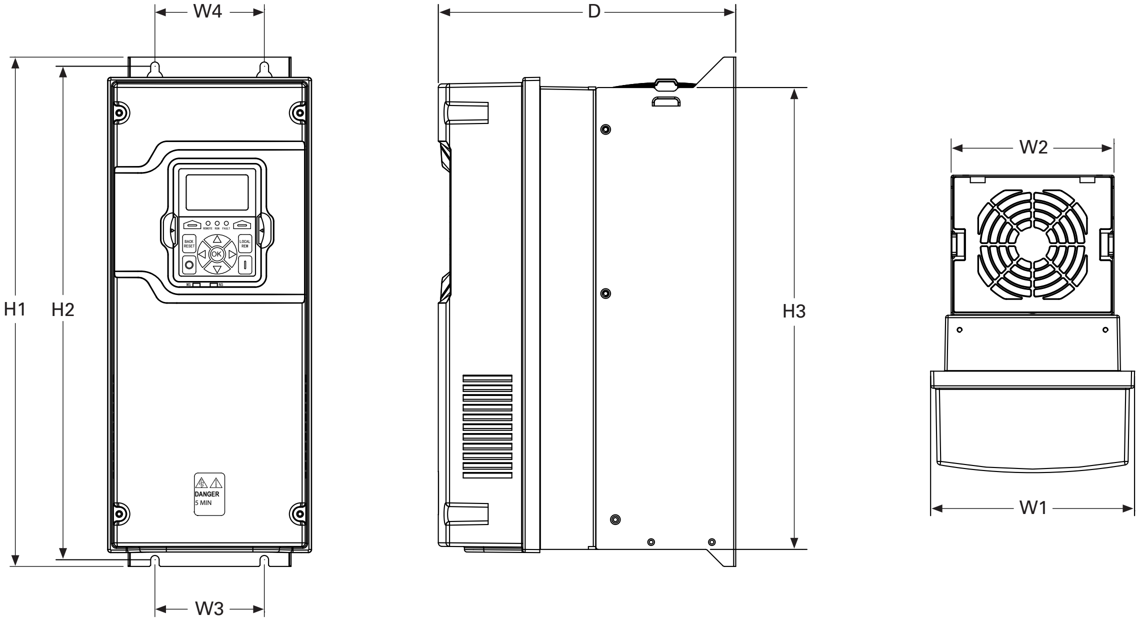


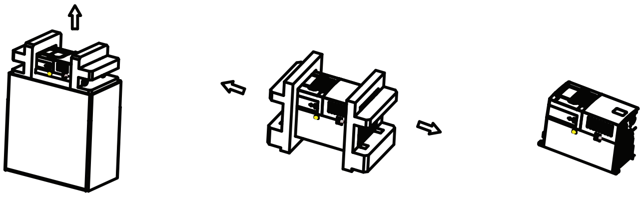
Table 31. Mounting drive dimensions

Frame size	Approximate dimensions in inches (mm) D	H1	H2	H3	W1	W2	W3	W4	Ø	Weight Lb (kg)
FR0	6.83 (173.5)	10.58 (268.7)	10.16 (258.0)	9.54 (242.3)	5.00 (127.0)	4.97 (126.3)	4.26 (108.3)	4.26 (108.3)	0.28 (7.0)	4.41 (2.0)
FR1	7.91 (200.9)	12.87 (327.0)	12.28 (312.0)	11.50 (292.0)	6.02 (153.0)	4.80 (122.0)	3.94 (100.0)	3.94 (100.0)	0.28 (7.0)	14.33 (6.5)
FR2	9.63 (244.7)	16.50 (419.0)	15.98 (406.0)	14.96 (380.0)	6.61 (167.8)	5.28 (134.0)	3.54 (90.0)	3.54 (90.0)	0.28 (7.0)	23.37 (10.6)
FR3	10.44 (265.1)	21.97 (558.0)	21.46 (545.0)	20.41 (518.5)	8.06 (204.6)	7.24 (184.0)	4.92 (125.0)	4.92 (125.0)	0.35 (9.0)	49.82 (22.6)
FR4	11.57 (294.0)	24.80 (630.0)	24.31 (617.5)	23.26 (590.7)	9.36 (237.7)	9.13 (232.0)	8.07 (205.0)	8.07 (205.0)	0.35 (9.0)	77.60 (35.2)
FR5	13.41 (340.7)	34.98 (888.5)	29.65 (753.0)	27.83 (707.0)	11.34 (288.0)	11.10 (282.0)	8.66 (220.0)	8.66 (220.0)	0.35 (9.0)	154.32 (70.0)
FR6	14.61 (371)	40.75 (1035)	33.27 (845)	31.38 (797)	19.13 (486)	18.90 (480)	15.75 (400)	15.75 (400)	0.35 (9)	246.91 (112)

Standard drive mounting

FR0 mounting instructions

Step 1: Lift the drive out from the carton, remove the packaging.



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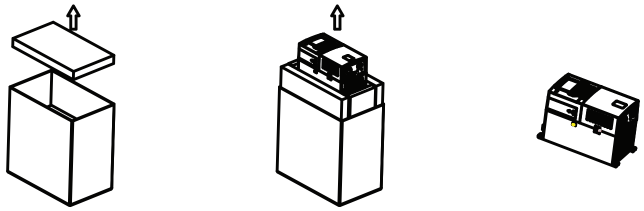
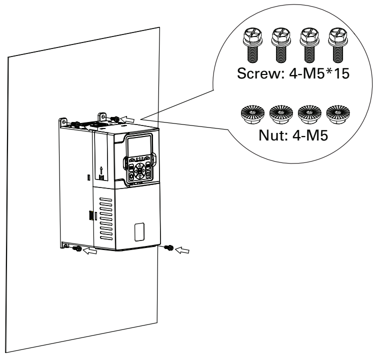
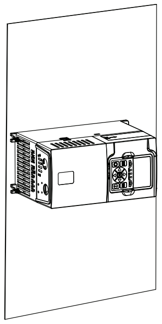


Step 2: Attach the drive to the mounting plate with four M5x15 screws and four M5 nuts. The opening dimension on the mounting plate should follow required dimension (refer to the drive mounting template printed on the outside carton. The drive can be mounted vertically or horizontally according to customer's needs.



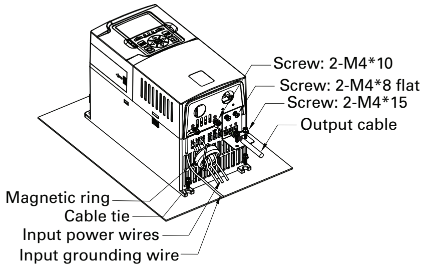
Vertical Mounting



Horizontal Mounting

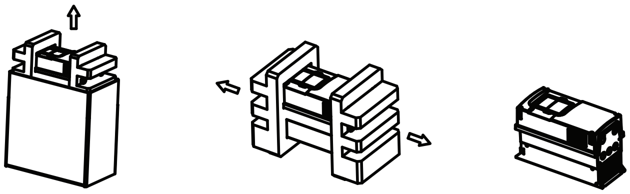
Step 3:

1. EN version FR0 or U.S. version FR0 with EMC kit.
   - a. Input wiring: Run the L1, L2, L3 wires through a magnetic ring and wind one lap, fix the L1, L2, L3 wires and magnetic ring with a cable tie, then connect the L1, L2, L3 wires to input terminals. Connect the input grounding wire to the bottom metal plate with an M4x10 screw.
   - b. Output wiring: Attach an L-shape EMC grounding plate to the bottom of drive with two M4x8 flat screws. Connect the output U, V, W wires to output terminals. Connect the output grounding wire to the bottom metal plate with an M4x10 screw. Clamp the output cable shield to the L-shape EMC grounding plate with a small rectangular EMC grounding plate and two M4x15 screws.
2. U.S. version FR0 without EMC kit, there are no magnetic ring and EMC grounding plates, but it is necessary to connect the output cable shield to the bottom metal surface with an M4x10 screw.



FR1 mounting instructions

Step 1: Lift the drive out from the carton. Remove the packaging.



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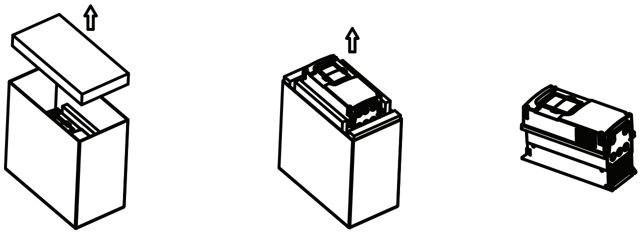
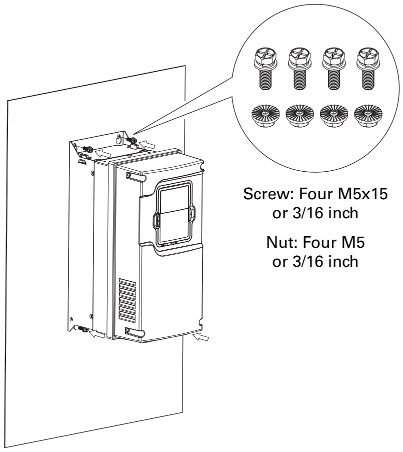
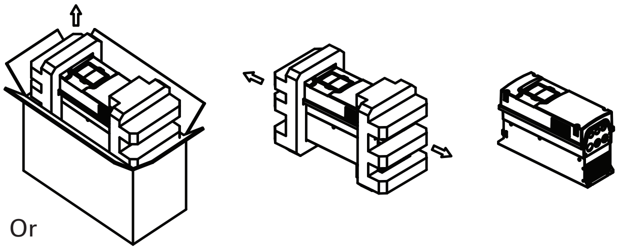


Step 2: Attach the drive to the mounting plate with four M5x15 or 3/16 inch screws and four M5 or 3/16 inch nuts. The opening dimensions on the mounting plate should follow required dimensions (refer to the drive mounting template printed on the outside carton).



FR2 mounting instructions

Step 1: Lift the drive out from the carton. Remove the packaging.



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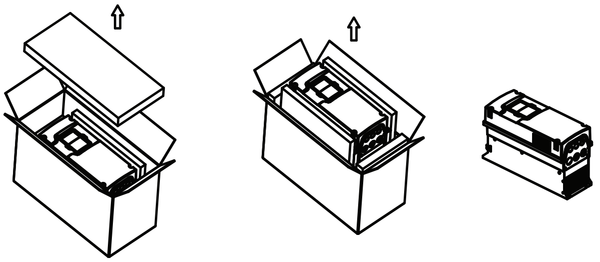
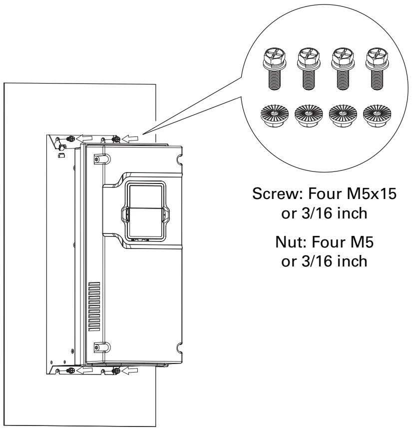
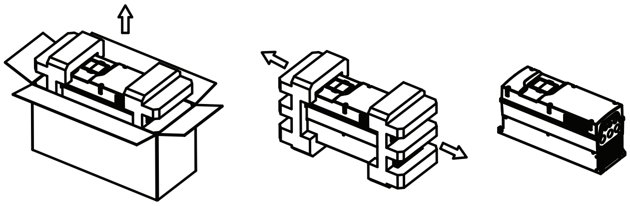


Step 2: Attach the drive to the mounting plate with four M5x15 or 3/16 inch screws and four M5 or 3/16 inch nuts. The opening dimensions on the mounting plate should follow required dimensions (refer to the drive mounting template printed on the outside carton).



FR3 mounting instructions

Step 1: Lift the drive out of the carton. Remove the packaging.



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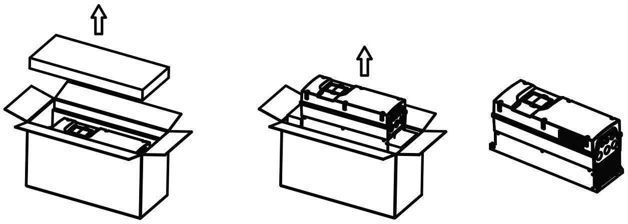
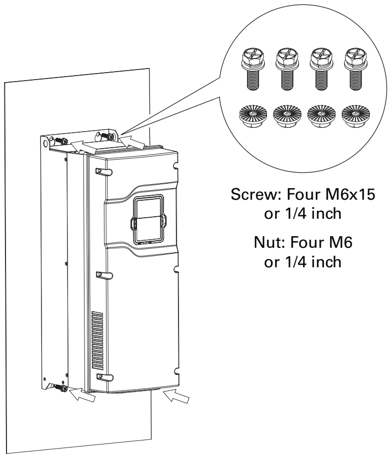
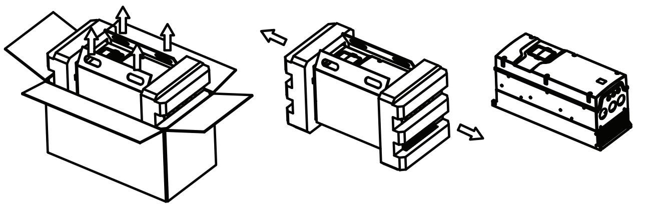


Step 2: Attach the drive to the mounting plate with four M6x15 or 1/4 inch screws and four M6 or 1/4 inch nuts. The opening dimensions on the mounting plate should follow required dimensions (refer to the drive mounting template printed on the outside carton).



FR4 mounting instructions

Step 1: Lift the drive out of the carton with the cardboard. Remove the packaging.



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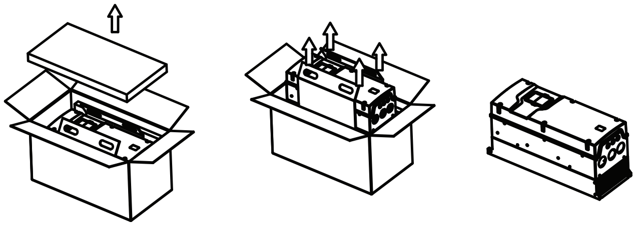
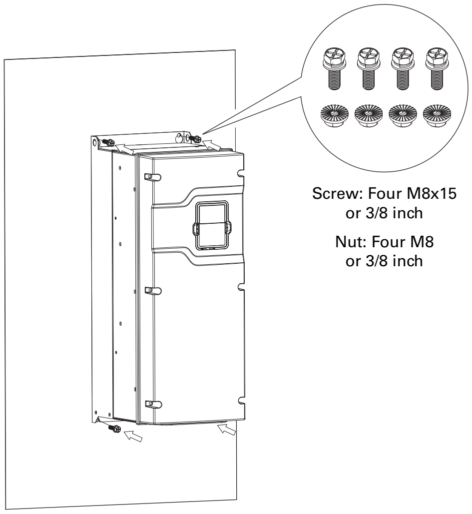
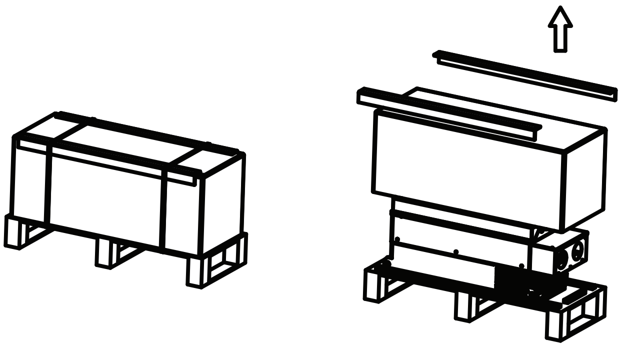


Step 2: Attach the drive to the mounting plate with four M8x15 or 3/8 inch screws and four M8 or 3/8 inch nuts. The opening dimensions on the mounting plate should follow required dimensions (refer to the drive mounting template printed on the outside carton).

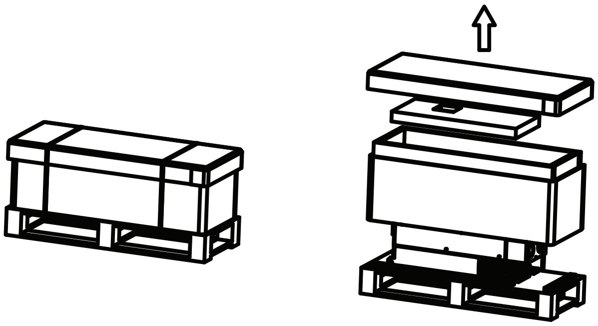


FR5 mounting instructions

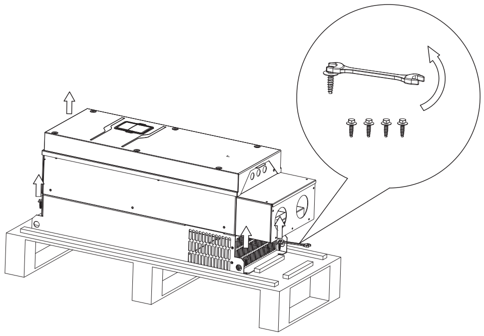
Step 1: Remove the carton from the drive.



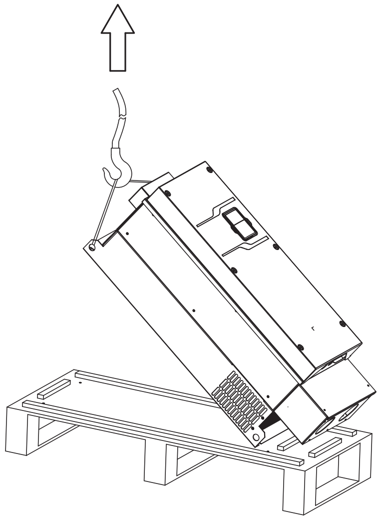
Or



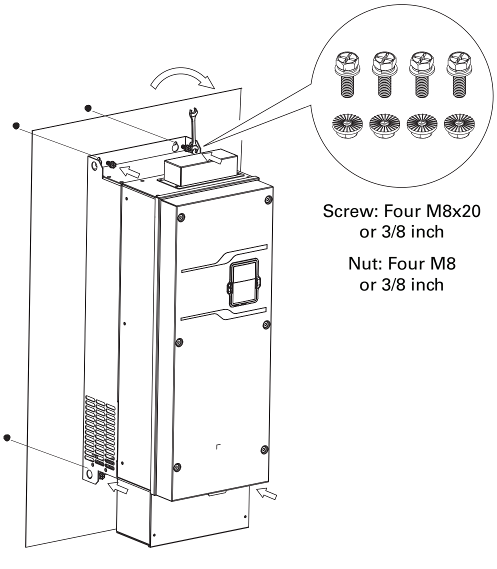
Step 2: Remove the four screws (used to fix the drive to the pallet) with an M8 or 3/8 inch wrench.



Step 3: Use a hook to lift the drive.

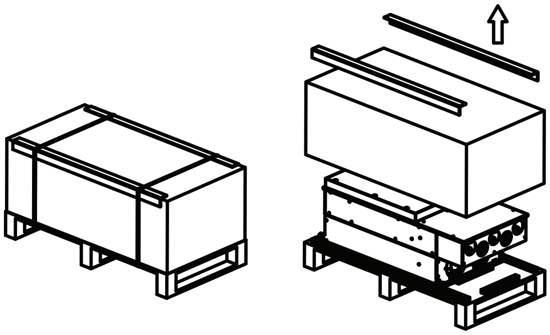


Step 4: Attach the drive to the mounting plate with four M8x20 or 3/8 inch screws and four M8 or 3/8 inch nuts with an M8 or 3/8 inch wrench. The opening dimensions on the mounting plate should follow required dimensions (refer to the drive mounting template printed on the outside carton).

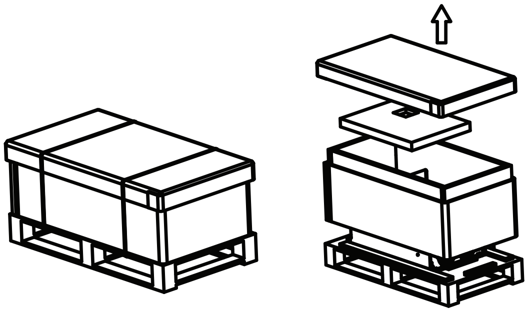


FR6 mounting instructions

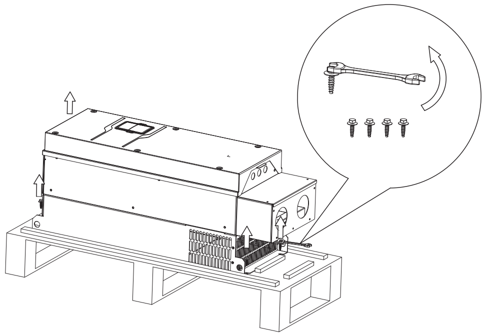
Step 1: Remove the carton from the drive.



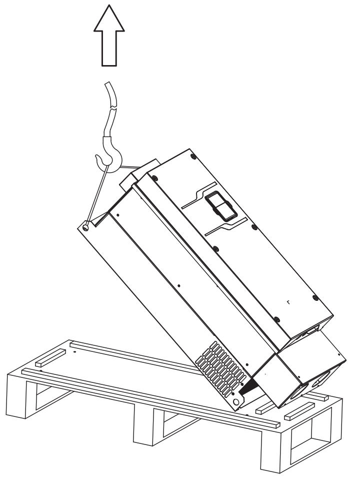
Or



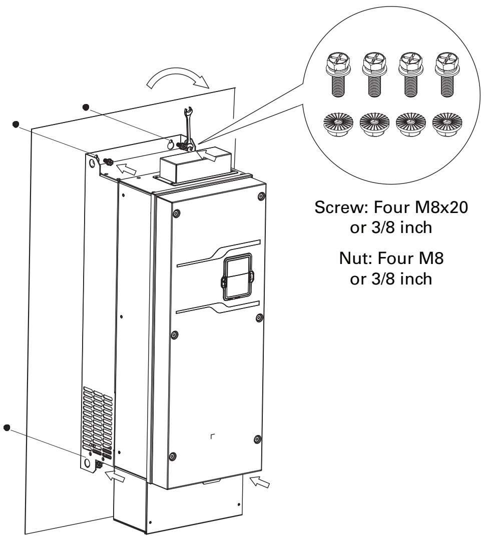
Step 2: Remove the four screws (used to fix the drive to the pallet) with an M8 or 3/8 inch wrench.



Step 3: Use a hook to lift the drive.



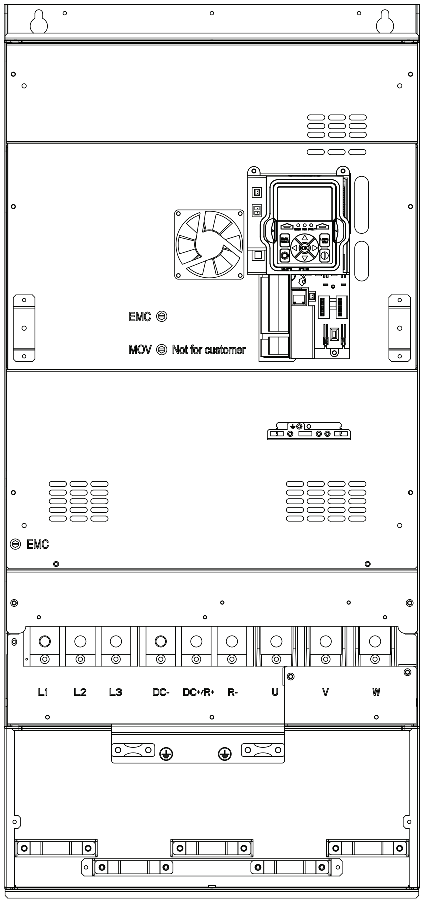
Step 4: Attach the drive to the mounting plate with four M8x20 or 3/8 inch screws and four M8 or 3/8 inch nuts with an M8 or 3/8 inch wrench. The opening dimensions on the mounting plate should follow required dimensions (refer to the drive mounting template printed on the outside carton).



Note: The TLK series lug from KST for connecting is recommended, but other types can be used. The rated lug hole should be 1/2 inch or 13 mm to support the FR6 stud.

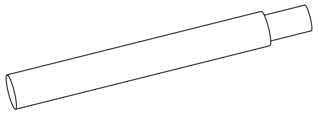
FR6 wiring

Figure 21. FR6 wiring layout

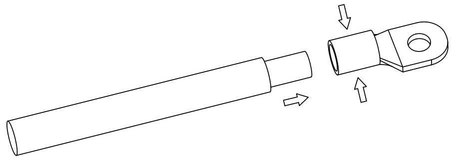


FR6 wiring process

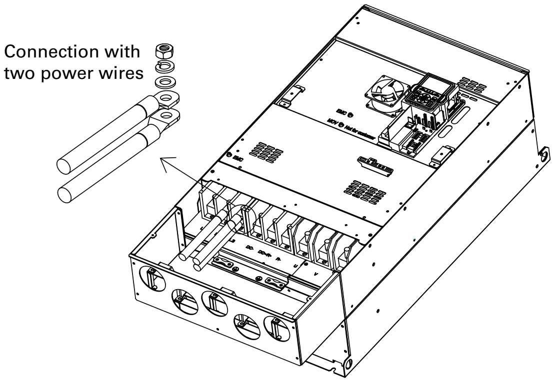
Step 1: Strip power wire jacket (Stripping length according to **Table 36**).



Step 2: Connect the power wire to a lug. Use a tool to press the wire and lug together tightly.



Step 3: Connect the power wire to the FR6 terminal block, lock the wire by a nut. Depending on the current level, one or two power wires can be connected to each pole of the terminal block.



Power wiring selection

Motor cable connections are made to terminals U, V, and W.

Cable selection: Power and motor leads

- Use UL approved heat-resistant copper cables only
- 75 °C or higher for all units rated
- Line voltage/mains should be Class 1 wire only outside North America
- Refer to the following tables for cable sizing guidelines
  - North America 208 V to 240 V: **Appendix B**
  - North America 380 V to 500 V: **Appendix B**
  - All other International 380 V to 600 V: **Appendix B**

Line (Mains) and motor cable installation

The input line and motor cables must be sized in accordance with the rated PowerXL VFD input and output current.

If motor temperature sensing is used for overload protection, the output cable size may be selected based on the motor specifications.

Maximum symmetrical supply current is 100,000 A RMS for all size PowerXL VFDs.

Input protection

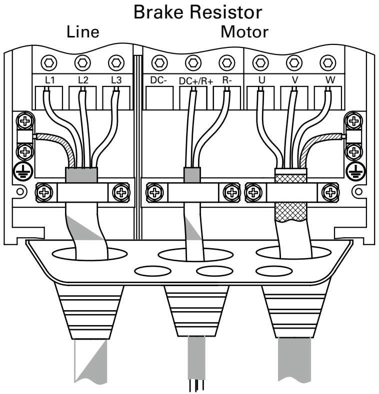
Input protection devices are rated based on PowerXL rated input and output current. For UL and cUL/CSA, refer to **Appendix D** for proper sizing. For gG/gL (IEC 60269-1), refer to **Appendix B** for proper sizing.

Consult with service representative for further information about input protection requirements.

Brake chopper connection

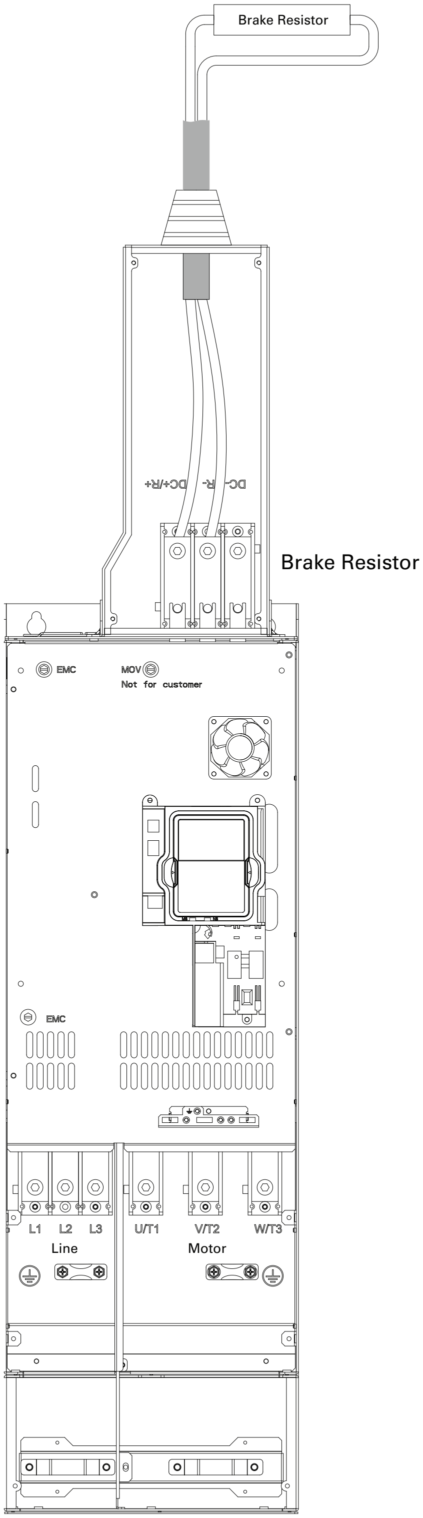
Dynamic braking resistor connections are made to the R+ and R- terminal on the drive. Wire size should be followed according to the wattage being transfered. Below are images of the locations for wiring.

Figure 22. Brake resistor wiring



Note: This is a representation, depending on frame size, the image could change.

FR5 design



Connection tightening torque

Table 32. Tightening torque ①②

Frame Size	Power wire In-Lb (Nm)	Ground wire In-Lb (Nm)	Control wire ③ In-Lb (Nm)
FR0	5.3 (0.6)	14 (1.6)	4.5 (0.5)
FR1	5.3 (0.6)	10 (1.1)	4.5 (0.5)
FR2	15.6 (1.8)	10 (1.1)	4.5 (0.5)
FR3	33/(3.7)	10 (1.1)	4.5 (0.5)
FR4	95 (10.7)	14 (1.6)	4.5 (0.5)
FR5	354 (40)	35 (4.0)	4.5 (0.5)
FR6	480 (54.2)	35 (4.0)	4.5 (0.5)

Notes: ① Strip the motor and power cables as shown in **Figure 23**.
② Both UL and IEC tools may be used.
③ Applies to strained wire, solid wire, or ferrule installations.

Table 33. Spacing between parallel motor cables

Cable length	Distance between cables
Less than 164 ft (50 m)	1 ft (0.3 m)
Less than 657 ft (200 m)	3 ft (1.0 m)

Table 34. Maximum motor power cable length 230/480 V ①

Frame size	Maximum cable length
FR0	100 m (328 ft)
FR1	100 m (328 ft)
FR2	150 m (492 ft)
FR3	150 m (492 ft)
FR4	200 m (656 ft)
FR5	200 m (656 ft)
FR6	200 m (656 ft)

Note: ① Lengths above are without EMC considerations.

Table 35. Maximum motor power cable lengths 575 V

Frame size	Maximum cable length
FR1	
FR2	
FR3	
FR4	
FR5	
FR6	12.2 m (40 ft)

Note: To achieve the maximum cable length, VFD shielded cable is required on motor side with proper grounding and cable layout.

Figure 23. Input power and motor cable stripping lengths

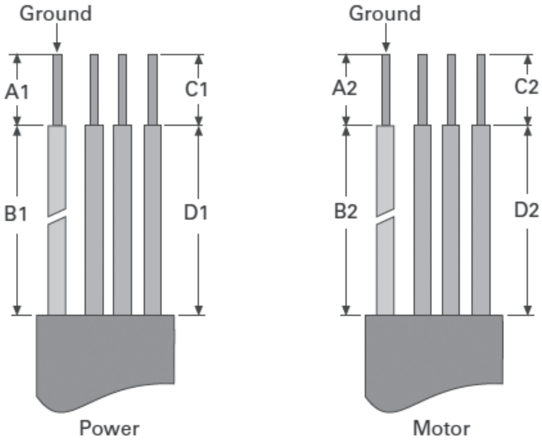


Table 36. Input power and motor cable stripping and wire lengths

Frame Size	Power wiring in inches (mm)				Motor wiring in inches (mm)			
	A1	B1	C1	D1	A2	B2	C2	D2
FR0	0.39 (10)	5.12 (130)	0.39 (10)	5.12 (130)	0.39 (10)	3.15 (80)	0.39 (10)	1.97 (50)
FR1	0.39 (10)	1.77 (45)	0.39 (10)	1.38 (35)	0.39 (10)	1.77 (45)	0.39 (10)	1.38 (35)
FR2	0.59 (15)	1.77 (45)	0.59 (15)	1.77 (45)	0.59 (15)	1.57 (40)	0.59 (15)	1.57 (40)
FR3	0.59 (15)	1.57 (40)	0.59 (15)	1.97 (50)	0.59 (15)	1.57 (40)	0.59 (15)	1.97 (50)
FR4	0.98 (25)	2.56 (65)	0.98 (25)	4.72 (120)	0.98 (25)	2.56 (65)	0.98 (25)	4.72 (120)
FR5	1.10 (28)	6.10 (155)	1.10 (28)	9.45 (240)	1.10 (28)	6.10 (155)	1.10 (28)	9.45 (240)
FR6	0.98 (25)	4.72 (120)	0.98 (25)	7.87 (200)	0.98 (25)	4.72 (120)	0.98 (25)	7.87 (200)

Cable routing

If conduit is being used for wiring, use separate conduits for line voltage (mains), motor cables, and all interface/control wiring.

To meet the UL requirements, if conduit is being used for wiring, the enclosure openings provided for conduit connections in the field shall be closed by UL listed conduit fittings with the same type rating (Type 1 / Type 12) as the enclosure.

Avoid running motor cables alongside or parallel to any other wiring. If it is necessary to run motor cables with other wiring, then maintain spacing between motor cables and other wiring in accordance with **Table 33**.

Wiring the VFD

Refer to **Table 34** and **Table 35** for maximum cable lengths by frame size.

If three or more motor cables are used, each conductor must have its own overcurrent protection.

Power wiring notice

Do not discard the plastic bag containing the wiring hardware.

1. Remove the A-cover by removing (4) screws, then lifting the A-cover away from the base

Wiring hardware contents (included with drive)

- European rubber grommet and flat rubber grommet (for IP54 integrity)
- Modification label
- Detachable cable clamp
- Attachable grounding strap
- Ground strap mounting screws

Power wiring/grounding

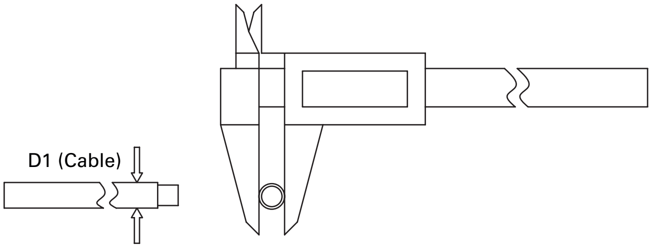
2. Remove power wiring protection plate. Use power/motor cable tables on **Appendix B**
3. Add attachable grounding clamps (qty 2), one on each side of drive
4. Pass motor, input power wires/cables through base wiring plate
5. If shielded cable is used, connect the shields of input power and motor cables shields to ground

6. Wire power terminals (L1, L2, L3), motor terminal (U, V, W), and grounding terminals per **Figure 24**. It is recommended for power and motor leads to be in separate conduit

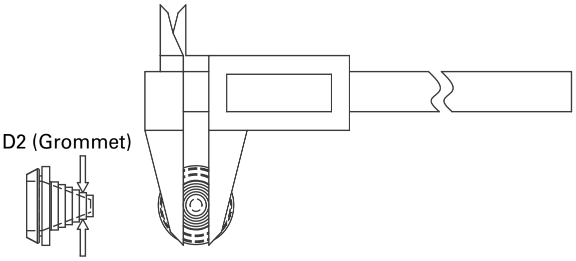
   To meet the UL requirements, if conduit is being used for wiring, the enclosure openings provided for conduit connections in the field shall be closed by UL listed conduit fittings with the same type rating (Type 1/Type 12) as the enclosure.

Rubber grommet installation instructions

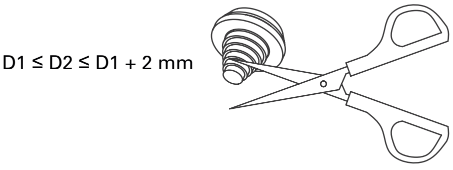
Step 1: Measure the outside diameter of the cable (D1) used to connect to the drive.



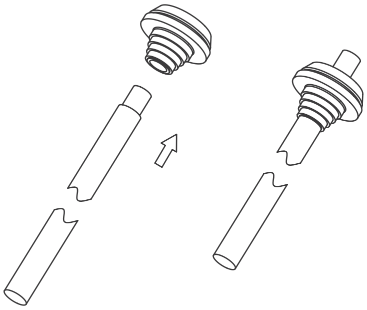
Step 2: Measure the outside diameter of the rubber grommet (D2) and select a suitable D2 (D1 ≤ D2 ≤ D1 + 2 mm).



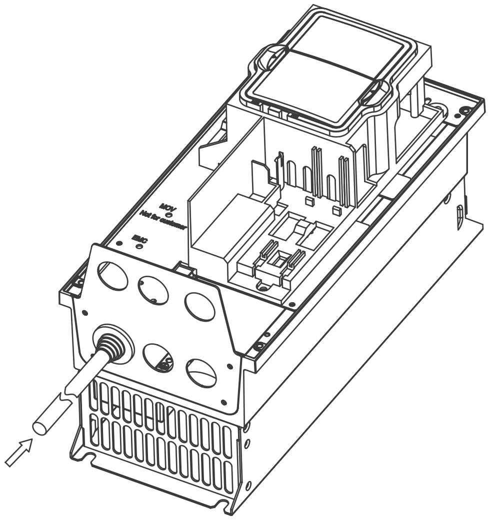
Step 3: Cut the rubber grommet at the selected diameter.



Step 4: Run the cable through the rubber grommet.



Step 5: Insert the rubber grommet into the conduit plate together with the cable.



Step 6: Fasten the rubber grommet and cable with a self-locking cable tie.

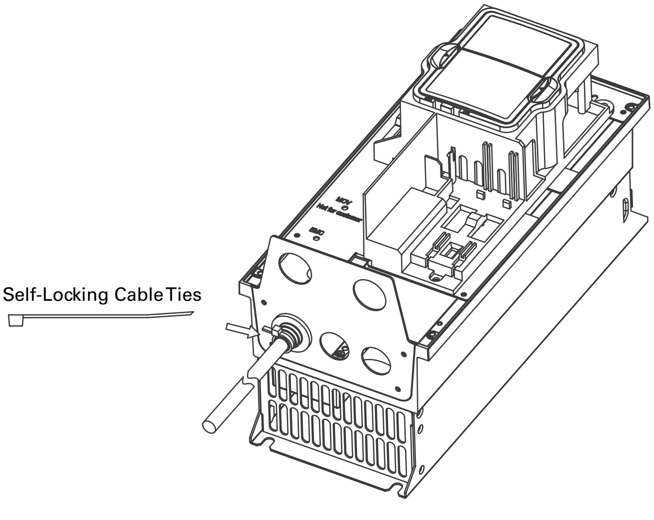
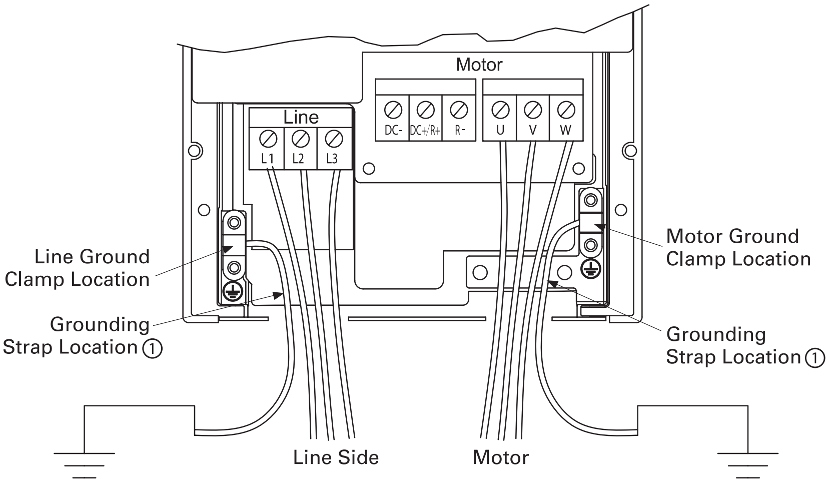


Figure 24. Ground wiring

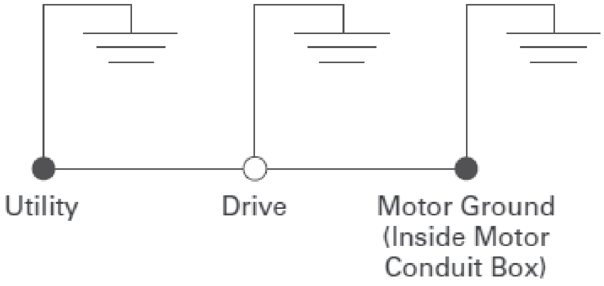


Note: Do not wire motor leads to R+, R–. This will cause damage to the drive.

Note: ① Actual layout may vary slightly by frame.

Ground wiring

- Run motor cables in separate conduit
- DO NOT RUN CONTROL WIRES in same conduit
- Cables sized per **Appendix B**
- Provide **dedicated** wire for low impedance ground between drive and motor. DO NOT USE conduit as ground

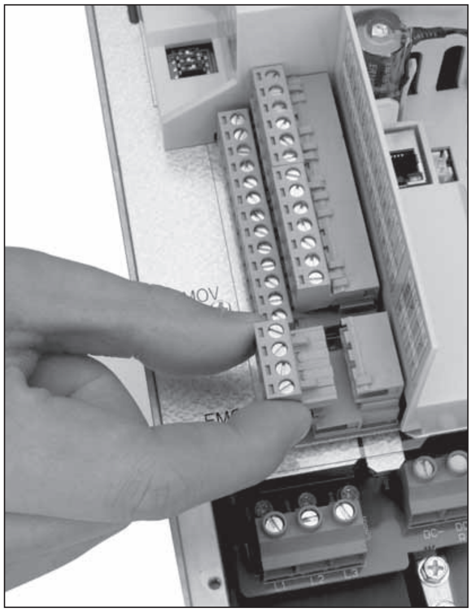


⚠ CAUTION

IMPROPER GROUNDING COULD RESULT IN DAMAGE TO THE MOTOR AND/OR DRIVE AND COULD VOID WARRANTY.

Control wiring

7. Wire the control terminals following the details for the specific option boards shown on the following pages



Note: For ease of access, the board terminals blocks can be unplugged for wiring.

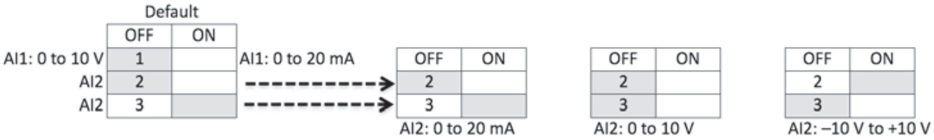
8. Wire control to the control board

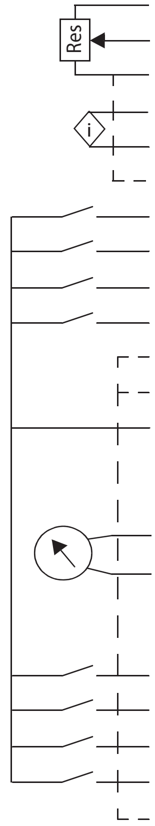
Note: Drive default is programmed for external interlock.

I/O connection

- Run 240 Vac and 24 Vdc control wiring in separate conduit
- Communication wire to be shielded

Table 37. DG1 I/O connection

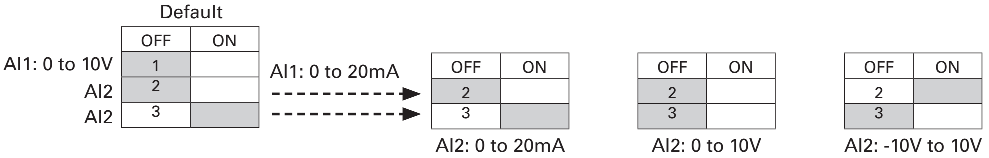


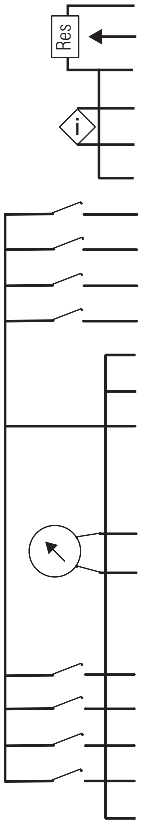
External Wiring [a]	Pin	Signal name	Signal	Default setting	Description
	1	+10 V	Ref. Output voltage	—	10 Vdc supply source
	2	AI1+ [b]	Analog input 1	0–10 V	Voltage speed reference (programmable to 4 mA to 20 mA)
	3	AI1–	Analog input 1 ground	—	Analog input 1 common (ground)
	4	AI2+ [b]	Analog input 2	4 Ma to 20 ma	Current speed reference (programmable to 0–10 v)
	5	AI2–	Analog input 2 ground	—	Analog input 2 common (ground)
	6	GND	I/O signal ground	—	I/O ground for reference and control
	7	DIN5	Digital input 5	Preset speed b0	Sets frequency output to preset speed 1
	8	DIN6	Digital input 6	Preset speed b1	Sets frequency output to preset speed 2
	9	DIN7	Digital input 7	Emergency stop (ti–)	Input forces VFD output to shut off
	10	DIN8	Digital input 8	Force remote (ti+)	Input takes VFD from local to remote
	11	CMB	Di5 to di8 common	Grounded	Allows source input
	12	GND	I/O signal ground	—	I/O ground for reference and control
	13	24 V	+24 Vdc output	—	Control voltage output (100 mA max.)
	14	DO1	Digital output 1	Ready	Shows the drive is ready to run
	15	24 Vo	+24 Vdc output	—	Control voltage output (100 mA max.)
	16	GND	I/O signal ground	—	I/O ground for reference and control
	17	AO1+	Analog output 1	Output frequency	Shows output frequency to motor 0–60 hz (4 mA to 20 mA)
	18	AO2+	Analog output 2	Motor current	Shows motor current of motor 0–fla (4 mA to 20 mA)
	19	24 Vi	+24 Vdc input	—	External control voltage input
	20	DIN1	Digital input 1	Run forward	Input starts drive in forward direction (start enable)
	21	DIN2	Digital input 2	Run reverse	Input starts drive in reverse direction (start enable)
	22	DIN3	Digital input 3	External fault	Input causes drive to fault
	23	DIN4	Digital input 4	Fault reset	Input resets active faults
	24	CMA	Di1 to di4 common	Grounded	Allows source input
	25	A	Rs-485 signal a	—	Fieldbus communication (modbus, bacnet)
	26	B	Rs-485 signal b	—	Fieldbus communication (modbus, bacnet)
	27	R3NO	Relay 3 normally open	At speed	Relay output 3 shows VFD is at ref. Frequency
	28	R1NC	Relay 1 normally closed	Run	Relay output 1 shows VFD is in a run state
	29	R1CM	Relay 1 common		
	30	R1NO	Relay 1 normally open		
	31	R3CM	Relay 3 common	At speed	Relay output 3 shows VFD is at ref. Frequency
	32	R2NC	Relay 2 normally closed	Fault	Relay output 2 shows VFD is in a fault state
	33	R2CM	Relay 2 common		
	34	R2NO	Relay 2 normally open		

Notes: ① The above wiring demonstrates a SINK configuration. It is important that CMA and CMB are wired to ground (as shown by dashed line). If a SOURCE configuration is desired, wire 24 V to CMA and CMB and close the inputs to ground. When using the +10 V for AI1, it is important to wire AI1—to ground (as shown by dashed line). If using +10 V for AI1 or AI2, terminals 3, 5, and 6 need to be jumpered together.

② AI1+ and AI2+ use a 10k pot for 0–10 V.

Table 38. DH1 I/O connection



External Wiring	Pin	Signal Name	Signal	Default Setting	Description
	1	+10V	Ref. Output Voltage	-	10VDC Supply Source
	2	AI1+ [a]	Analog Input 1	0-10V	Voltage Speed Reference (Programmable to 4-20mA)
	3	AI1-	Analog Input 1 Ground	-	Analog Input 1 Common (Ground)
	4	AI2+[a]	Analog Input 2	4-20mA	Current Speed Reference (Programmable to 0-10V)
	5	AI2-	Analog Input 2 Ground	-	Analog Input 2 Common (Ground)
	6	GND	I/O Signal Ground	-	I/O Ground for Reference and Control
	7	DIN5	Digital Input 5	Preset Speed B0	Sets frequency output to Preset Speed 1
	8	DIN6	Digital Input 6	Fire Mode	Enables drive into Fire Mode
	9	DIN7	Digital Input 7\TI+	Bypass Start	Enables drive into Bypass mode waiting for drive start
	10	DIN8	Digital Input 8\TI-	Force Auto	Input forces drive into Auto Control place
	11	CMB	DI5 to DI8 Common	Grounded	Allows source input
	12	GND	I/O Signal Ground	-	I/O Ground for Reference and Control
	13	24Vo	+24VDC Output	-	Control voltage output (100mA Max)
	14	DO1	Digital Output 1	Ready	Shows the drive is ready to run
	15	24Vo	+24VDC Output	-	Control voltage output (100mA Max)
	16	GND	I/O Signal Ground	-	I/O Ground for Reference and Control
	17	AO1+	Analog Output 1	Output Frequency	Shows Output frequency to motor 0 - 60Hz (4-20mA)
	18	AO2+	Analog Output 2	Motor Current	Shows Motor current of motor 0-FLA (4-20mA)
	19	24Vi	+24VDC Input	-	External control voltage input
	20	DIN1	Digital Input 1	Run Forward	Input starts drive in forward direction (start enable)
	21	DIN2	Digital Input 2	Run Reverse	Input starts drive in reverse direction(start enable)
	22	DIN3	Digital Input 3	External Fault	Input causes drive to fault
	23	DIN4	Digital Input 4	Fault Reset	Input resets active faults
	24	CMA	DI1 to DI4 Common	Grounded	Allows source input
	25	A	RS-485 Signal A/+	-	Fieldbus Communication (Modbus, BACnet)
	26	B	RS-485 Signal B/-	-	Fieldbus Communication (Modbus, BACnet)
	27	R3NO	Relay 3 Normally Open	Fault	Relay output 3 shows VFD is Faulted
	28	R1NC	Relay 1 Normally Closed	Bypass Run	Relay output 1 shows VFD is in a bypass run state
	29	R1CM	Relay 1 Common		
	30	R1NO	Relay 1 Normally Open		
	31	R3CM	Relay 3 Common	Fault	Relay output 3 shows VFD is Faulted
	32	R2NC	Relay 2 Normally Closed	Run	Relay output 2 shows VFD is in a drive run state
	33	R2CM	Relay 2 Common		
	34	R2NO	Relay 2 Normally Open		

Notes: ① The above wiring demonstrates a SINK configuration. It is important that CMA and CMB are wired to ground (as shown by dashed line). If a SOURCE configuration is desired, wire 24 V to CMA and CMB and close the inputs to ground. When using the +10 V for AI1, it is important to wire AI1—to ground (as shown by dashed line). If using +10 V for AI1 or AI2, terminals 3, 5, and 6 need to be jumpered together.

② AI1+ and AI2+ use a 10k pot for 0–10 V.

Figure 25. Terminal block layout

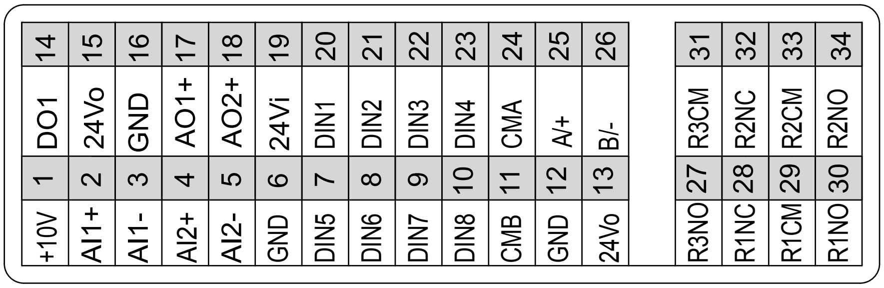
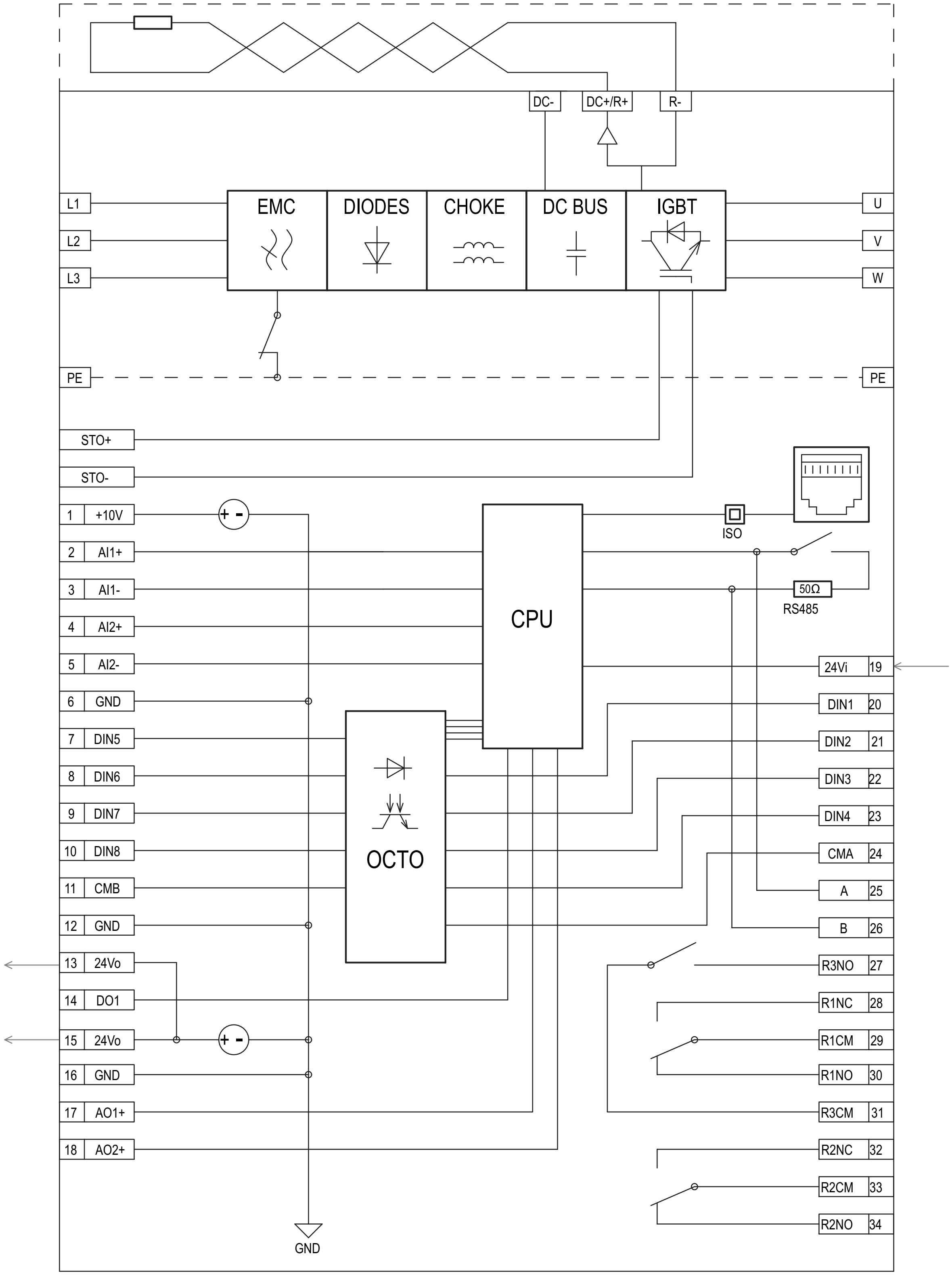


Table 39. I/O specifications

Item	Specification
Analog input 1	Selectable for either voltage or current reference signal
	0 to 10 V, 0 (4) to 20 mA; R_i – 250 ohm differential
Analog input 2	Selectable for either voltage or current reference signal
	0 to 10 V, –10 to 10 V, 0 (4) to 20 mA; R_i – 250 ohm differential
Digital inputs (8)	Positive or negative logic; 18 to 30 Vdc, one input can be used as thermistor input
+24 V output	Auxiliary voltage, +24 V ±15%, total max. 250 mA on board (include optional cards)
+10 VREF	Output reference voltage, +10 V +3%, max. load 10 mA
Analog outputs	0 (4) to 20 mA; R_L max. 500 ohm
	0 to 10 V, 10 mA
Digital output	Open collector output, 50 mA/48 V for CE, 50 mA/36 V for UL
Relay outputs (3)	Programmable relay outputs: 2 x form c (relay 1 and relay 2) and 1 x form a (relay 3), relay 3 can be used as thermistor output
	Switching capacity: 24 Vdc/6 A, 48 Vdc/2 A, 240 Vac/6 A, 125 Vdc/0.4 A

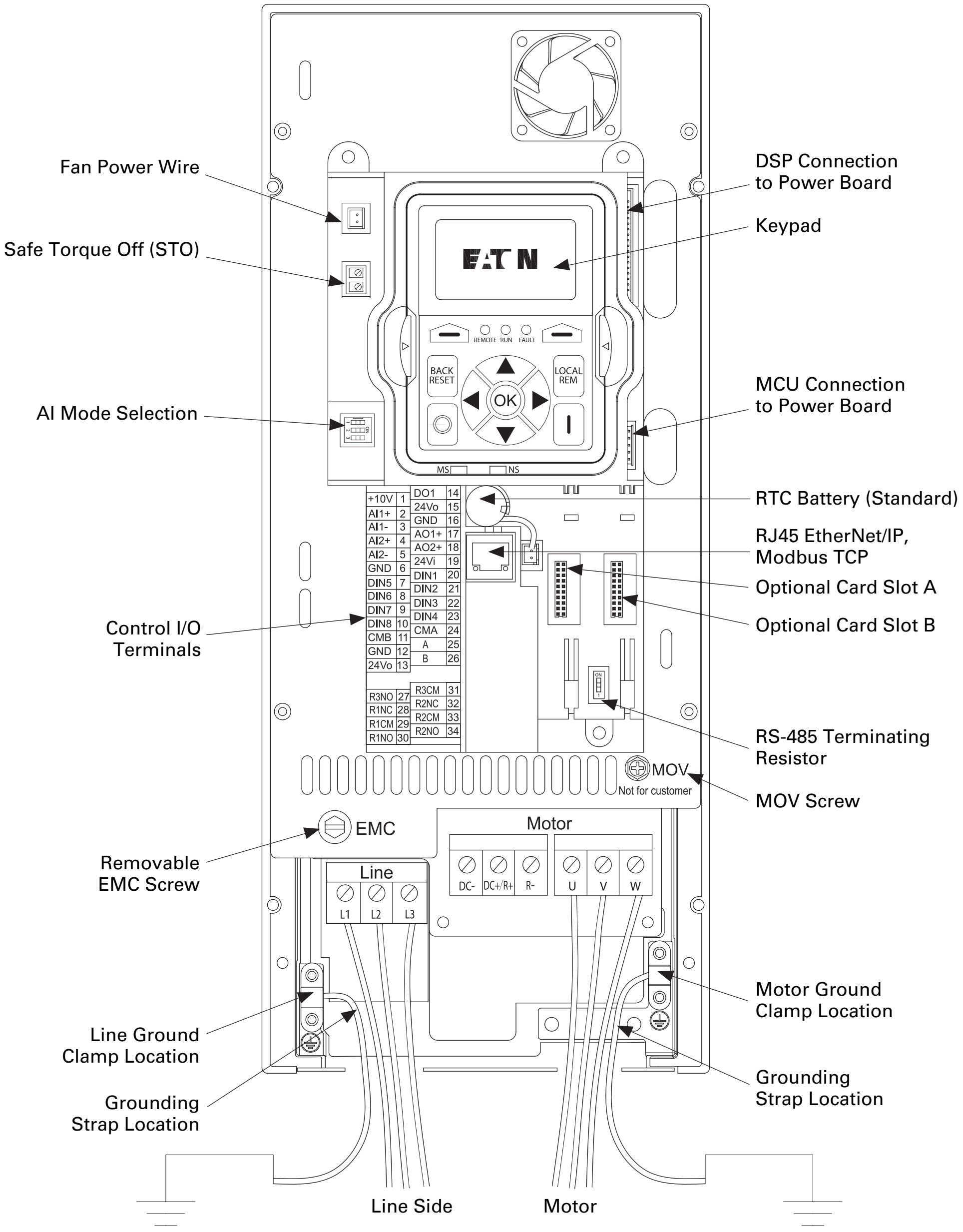
Figure 26. Basic internal control wiring diagram



Control board

The main PowerXL Series VFD consists of a main control board, control I/O connections block and two slots for extra option boards.

Figure 27. PowerXL variable frequency drive



Note: This is a representation showing location of items. Location may be slightly different depending on frame size.

Control wiring

- All control I/O wiring is recommended to be segregated from line (mains) and motor cabling
- Control wiring shall be shielded twisted pairs to meet EMC levels required by IEC/EN 61800-3 (2004) + A1 (2012)
- Run 240 Vac and +24 Vdc control I/O in separate conduit
- Control I/O terminals must be tightened to 4.5 in-lb (0.5 Nm)
- Wiring or ferrule size: 28~12 (Sol) AWG, 30~12 (Str) AWG, or 0.2~2.5 mm^2

Safe torque off (STO)

Refer to Appendix E for details of STO.

The PowerXL Series includes Safe Torque Off (STO) functionality as standard and provides:

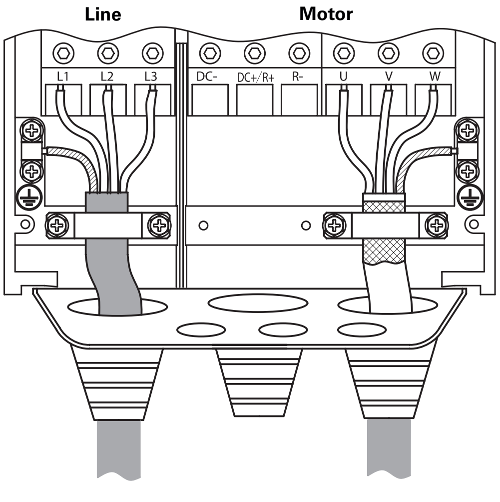
- Isolation from the control board will stop IGBT from firing
- Functional safety SIL1 certification: IEC/EN 61800-5-2 and DIN EN ISO 13849-1, Performance Level C

Connection to power section

Figure 28 shows the general connections for the frequency inverter in the power section.

Three-phase input connection

Figure 28. Connection to power section



Terminal designations in the power section

- L1, L2, L3: Connection terminals for the supply voltage (input, input voltage)
- U, V, W: Connection terminals for the three-phase line to the AC motor (output, frequency inverter)
- PE: Connection for protective ground (reference potential). PES with mounted cable routing plate for shielded cables

Ground connection

The ground connection is connected directly with the cable clamp plates.

The shielded cables between the frequency inverter and the motor should be as short as possible. Connect the shielding on both ends and over a large surface area with protective ground PES (Protective Earth Shielding). You can connect the shielding of the motor cable directly to the cable clamp plate (360 degrees coverage) with the protective ground.

The frequency inverter must always be connected to the ground potential via a grounding cable (PE).

Figure 29. Grounding

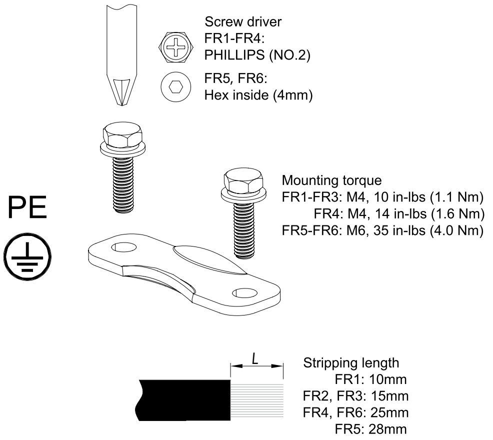
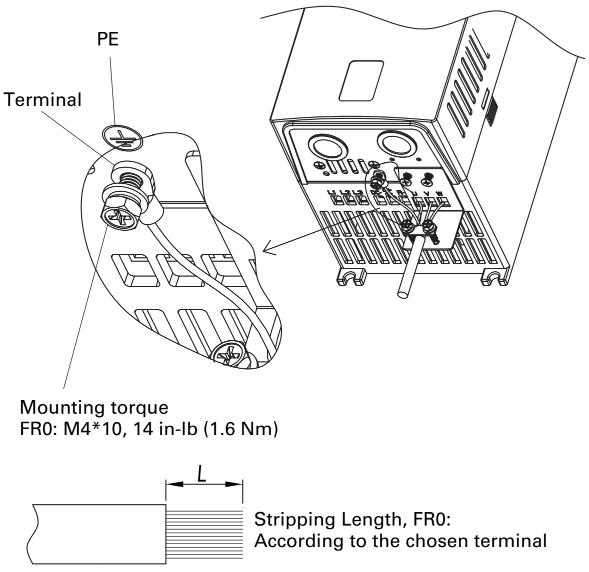


Figure 30. FR0 grounding



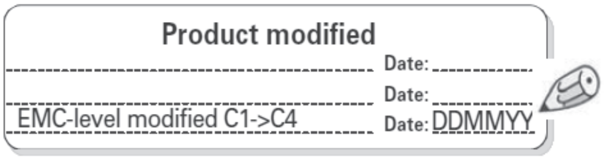
⚠ CAUTION

BEFORE CONNECTING THE AC DRIVE TO MAINS MAKE SURE THAT THE EMC PROTECTION CLASS SETTINGS OF THE DRIVE ARE APPROPRIATELY MADE

Note: After having performed the change write “EMC level modified” on the sticker included in the PowerXL Series delivery (see **Figure 31**) and note the date. Unless already done, attach the sticker close to the name plate of the AC drive.

Product modified sticker

Figure 31. Product modified sticker



Product modified

Date:

Date:

EMC-level modified C1->C4 Date: DDMMYY

Checking the cable and motor insulation

1. Check the motor cable insulation as follows:
    - Disconnect the motor cable from terminals U, V and W of the PowerXL Series drive and from the motor
    - Measure the insulation resistance of the motor cable between each phase conductor as well as between each phase conductor and the protective ground conductor
    - The insulation resistance must be >1M ohm
2. Check the input power cable insulation as follows:
    - Disconnect the input power cable from terminals L1/N, L2/N and L3 of the PowerXL Series drive and from the utility line feeder
    - Measure the insulation resistance of the input power cable between each phase conductor as well as between each phase conductor and the protective ground conductor
    - The insulation resistance must be >1M ohm
3. Check the motor insulation as follows:
    - Disconnect the motor cable from the motor and open any bridging connections in the motor connection box
    - Measure the insulation resistance of each motor winding. The measurement voltage must equal at least the motor nominal voltage but not exceed 1000 V
    - The insulation resistance must be >1M ohm

Chapter 7—EMC installation

Note: All following information is strongly recommended but is not necessary if sufficient system design and validation has been completed.

The responsibility to meet the local system EMC limit values and electromagnetic compatibility requirements is the responsibility of the end user or the system operator. This operator must also take measures to minimize or remove emissions in the environment concerned (see figure on **Page 49**). He must also use means to increase the interference immunity of the system devices.

In a drive system (PDS) with frequency inverters, you should take measures for electromagnetic compatibility (EMC) while doing your planning, because changes or improvements to the installation site, which are required in the installation or while mounting, are normally associated with additional higher costs.

The technology and system of a frequency inverter cause the flow of high frequency leakage current during operation. All grounding measures must therefore be implemented with low impedance connections over a large surface area.

With leakage currents greater than 3.5 mA, in accordance with VDE 0160 or EN 61800-5-1, either

- the protective conductor must have a cross-section of at least 10 mm^2
- the protective conductor must be open-circuit monitored, and the supply must be automatically disconnected in case of discontinuity of the protective earthing conductor, or
- the second protective conductor must be fitted

For an EMC-compliant installation, we recommend the following measures:

- Installation of the frequency inverter in a metallic, electrically conducting enclosure with a good connection to earth
- Shielded motor cables (short cable lengths)
- Ground all conductive components and housings in a drive system using as short a line as possible with the greatest possible cross-section (Cu-braid)

EMC measures in the control panel

For EMC-compatible installation, connect all metallic parts of the device and the switching cabinet together over broad surfaces and so that high-frequencies will be conducted. Mounting plates and cabinet doors should make good contact and be connected with short HF-braided cables. It is recommended to avoid using painted surfaces (anodized, chromized). An overview of all EMC measures is provided in the figure on **Page 49**.

Install the frequency inverter as directly as possible (without spacers) on a metal plate (mounting plate).

Route input and motor cables in the switch cabinet as close to the ground potential as possible. This is because free moving cables act as antennas.

When laying HF cables (for example, shielded motor cables) or suppressed cables (for example, input supply cables, control circuit and signal cables) in parallel, a minimum clearance of 11.81 in (300 mm) is recommended in order to prevent the radiation of electromagnetic energy. Separate cable routing is also recommended when large voltage potential differences are involved. Any necessary crossed cabling between the control signal and power cables should be implemented at right angles (90 degrees).

It is recommended to never lay control or signal cables in the same duct as power cables. Analog signal cables (measured, reference and correction values) should be shielded.

Earthing

The ground connection (PE) in the cabinet should be connected from the input supply to a central earth point (mounting plate). All protective conductors should be routed in star formation from this earth point and all conductive components of the PDS (frequency inverter, motor reactor, motor filter, main choke) are to be connected.

Avoid ground loops when installing multiple frequency inverters in one cabinet. Make sure that all metallic devices that are to be grounded have a broad area connection with the mounting plate.

Screen earth kit

Cables that are not shielded work like antennas (sending, receiving). Make sure that any cables that may carry disruptive signals (for example, motor cables) and sensitive cables (analog signal and measurement values) are shielded apart from one another with EMC-compatible connections.

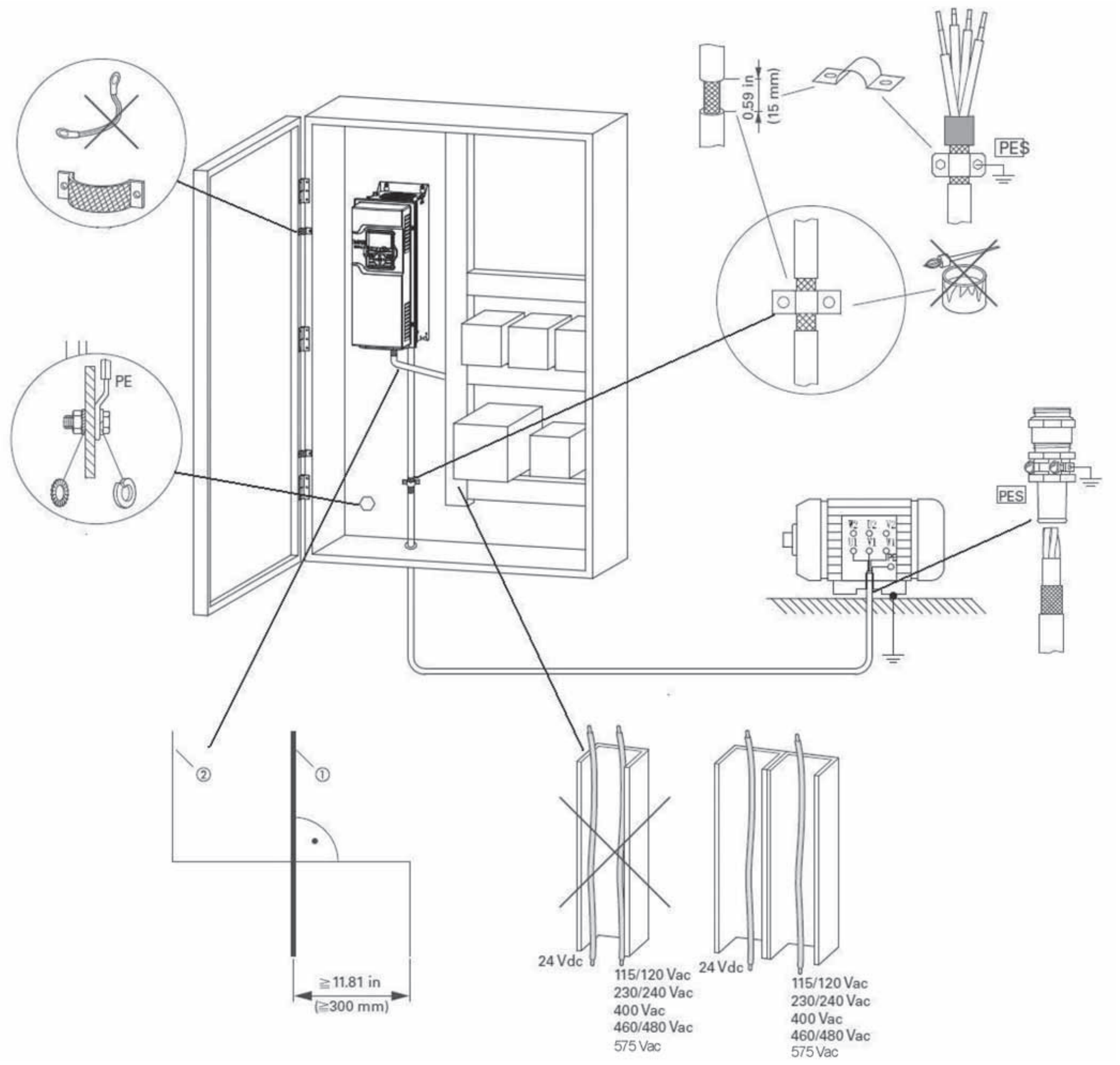
The effectiveness of the cable shield depends on a good shield connection and a low shield impedance.

It is recommended to use only shields with tinned or nickel-plated copper braiding. Braided steel shields are unsuitable.

Control and signal lines (analog, digital) should be grounded on one end, in the immediate vicinity of the supply voltage source (PES).

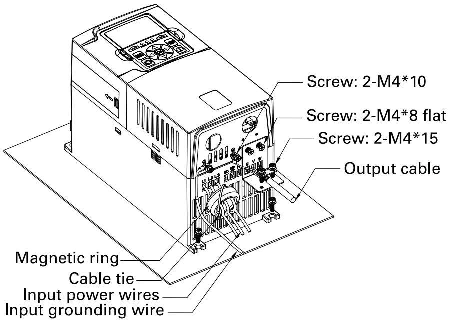
Installation requirements

Figure 34. EMC-Compliant Setup—230 Vac, 460/480 Vac, 600 Vac



Notes: ① Power cable: L1, L2, L3 and U, V, W.

② Control and signal lines: 1 to 36, fieldbus connection Large-area connection of all metallic control panel components. Mounting surfaces of frequency inverter and cable shielding must be free from paint. Connect the cable shielding in the output of the frequency inverter with a large surface area contact to the ground potential (PES). Large-area cable shield contacts with motor. Large-area earth connection of all metallic parts.



International EMC protection cable requirements

The screened cables between the variable frequency drive and the motor should be as short as possible.

- Connect the screening, on both sides and across a large area (360° overlap), to the protective earth (PE). The power screening protective earth (PES) connection should be in the immediate proximity of the variable frequency drive and directly on the motor terminal box
- Prevent the screening from becoming unbraided, e.g., by pushing the opened plastic sheath over the end of the screening or with a rubber grommet on the end of the screening. As an alternative, in addition to a broad area cable clip, you can also twist the shielding braid at the end and connect to protective ground with a cable clip. To prevent EMC disturbance, this twisted shielding connection should be made as short as possible
- Screened three- or four-wire cable is recommended for the motor cables. The green/yellow line of a four-wire cable connects the protective ground connections from the motor and the variable frequency drive and therefore minimizes the equalizing current loads on the shielding braid
- If there are additional subassemblies in a motor feeder (such as motor contactors, overload relays, motor reactor, sinusoidal filters or terminals), the shielding of the motor cable can be interrupted close to these subassemblies and connected to the mounting plate (PES) with a large area connection

Free or non-screened connection cables should not be any longer than about 300 mm.

Table 40. 1st Environment 2nd environment EMC levels according to EN 61800-3 (2004) ①

Cable Type	Category C2	Category C3	Category C4 ②
Line voltage/mains	1	1	1
Motor cable	3 ③	2	2
Control cable	4	4	4

Notes: ① For EMC Class 2 requirements on FR0 PowerXL Series drive, use provided ferrite core with input wires going through it twice, so there is a loop on the core.

② For installations in IT systems, it is necessary to modify the EMC protection to EMC level C4. See the following page for the procedure.

③ 360° earthing of the shield with cable glands in motor end needed for EMC Level C2. See the following page for the procedure.

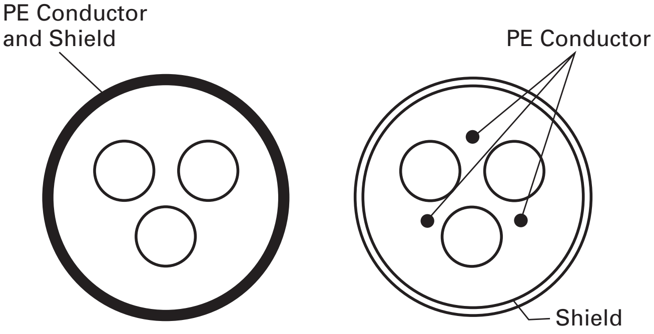
Table 41. Motor power cable EMC guidelines

Item	Directive
Product	IEC 61800-2
Safety	UL 508C, IEC/EN 61800-5-1
EMC (at default settings)	Immunity (EMS): IEC/EN 61800-3, 2nd environment
	Radiated and Conducted emissions (EMI): IEC/EN 61800-3
	230/480V Series
	Category C1: is possible with external filter connected to drive. Please consult factory
	Category C2: with internal filter maximum of 10 m motor cable length (FR0: This is obtained with 2 turns on a ferrite core and using metal ground plate)
	Category C3: with internal filter maximum of 50 m motor cable length (FR0: This is obtained with no ferrite core and metal plate)
	575V Series
	Category C3: with internal filter maximum of 10 m motor cable length

Table 42. Cable categories

Cable category	Description (All cables are rated for the specific operating voltage)
1	Intended for fixed installation
2	Symmetrical power cable equipped with a concentric protection wire.
3	Symmetrical power cable with compact low-impedance shield. Recommended cable transfer impedance of 1–30 MHz max. See figure below.
4	Screened cable equipped with compact low-impedance shield

Figure 35. Cable description



Installation in corner-grounded network and IT system

Corner grounding and IT system are allowed for all the drive types.

In these circumstances the EMC protection class must be changed to level C4. This is done by removing the built-in EMC Screw with a simple procedure described below.

In addition on FR2 and FR4 the MOV screw is required to be removed, see **Figure 38**.

⚠ WARNING

DO NOT PERFORM ANY MODIFICATIONS ON THE AC DRIVE WHEN IT IS CONNECTED TO MAINS.

⚠ WARNING

ELECTRIC SHOCK HAZARD—RISK OF INJURIES! CARRY OUT WIRING WORK ONLY IF THE UNIT IS DE-ENERGIZED.

AFTER DISCONNECTING THE SUPPLY, WAIT AT LEAST FIVE MINUTES BEFORE REMOVING THE COVER TO ALLOW THE INTERMEDIATE CIRCUIT CAPACITORS TO DISCHARGE.

⚠ WARNING

FAILURE TO FOLLOW THESE INSTRUCTIONS WILL RESULT IN DEATH OR SERIOUS INJURY.

Remove the main cover of the AC drive and remove the EMC/MOV screws depending on frame size (see **Figure 36–Figure 39**). Once the screw is removed, it can be reconnected to re-engage the EMC protection.

Figure 36. Location of the EMC screw in Frame 0

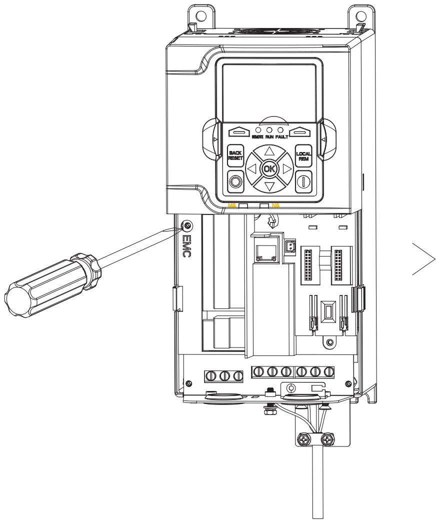


Figure 37. Locations of the EMC screw in Frame 1 and Frame 3

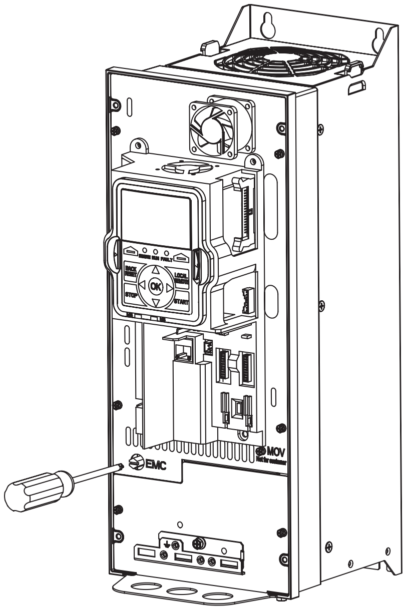


Figure 38. Locations of EMC and MOV screws for Frame 2 and Frame 4

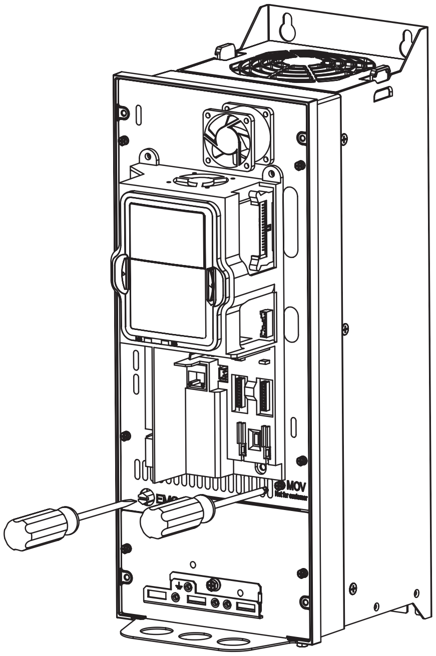
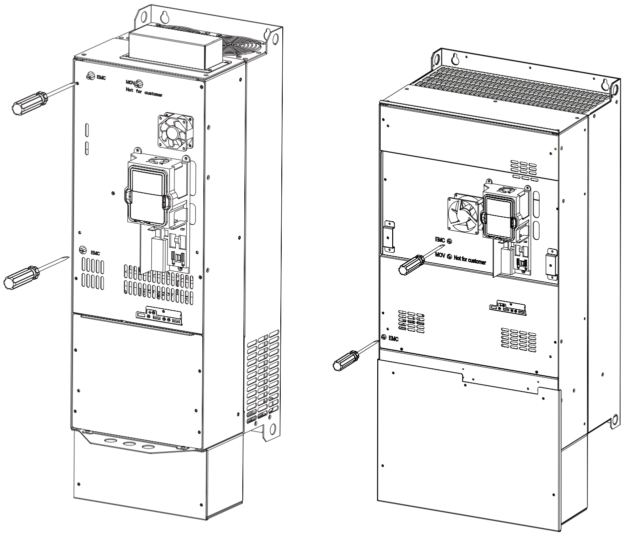


Figure 39. Locations of the EMC screws in Frame 5 and Frame 6



Appendix A—Technical data and specifications

Technical data

Table 43. PowerXL Series

Attribute	Description	Specification
Input ratings	Input voltage Uin	208 V to 240 V, 380 V to 500 V, 525 V to 600 V, –15 to 10%
	Input frequency	50 Hz to 60 Hz (variation up to 45 Hz to 66 Hz)
	Connection to power	Once per minute or less
	Starting delay	3 s (FR0 to FR2), 4 s (FR3), 5 s (FR4), 6 s (FR5 and FR6)
	Short-circuit withstand rating	100 kAIC (fuses and circuit breakers)
Output ratings	Output voltage	0 to Uin
	Continuous output current	I_L: ambient temperature maximum 40 °C, up to 60 °C with derating, overload 1.1 x I_L (1 min./10 min.) I_H: ambient temperature maximum 50 °C, up to 60 °C with derating, overload 1.5 x I_H (1 min./10 min.)
	Overload current	150% respectively 110% (1 min./10 min.)
	Initial output current	200% (2 s / 20 s) based of the drives rated nameplate I_H current rating.
	Output frequency	0–400 Hz (standard)
	Frequency resolution	0.01 Hz
Control characteristics	Control methods	Frequency control Speed control Open-loop speed control Open-loop torque control
	Switching frequency	230 V / 480 V Range: FR0–3: 1 kHz to 12 kHz FR4–6: 1 kHz to 10 kHz 230 V / 480 V defaults: FR0–3: 4 kHz FR4–5: 3.6 kHz FR6: 2 kHz 600 V range: FR1–6: 1 kHz to 6 kHz 600 V defaults: FR1–6: 1.5 kHz Automatic switching frequency derating in case of overload.
	Frequency reference	Analog input: resolution 0.1% (10-bit), accuracy +1% Analog output: resolution 0.1% (10-bit), accuracy +1% Panel reference: resolution 0.01 Hz
	Field weakening point	20 Hz to 400 Hz
	Acceleration time	0.1 s to 3000 s
	Deceleration time	0.1 s to 3000 s
	Braking torque	DC brake: 30% x Motor Rated Torque (Tn) (without brake chopper) Dynamic braking (with optional brake chopper using an external brake resistor): 100% continuous maximum rating
Ambient conditions	Ambient operating temperature	–10 °C (no frost) to +50 °C, up to +60 °C with derating (CT) –10 °C (no frost) to +40 °C, up to +60 °C with derating (VT)
	Storage temperature	–40 °C to +70 °C
	Relative humidity	0–95% RH, noncondensing, non-corrosive
	Air quality: • Chemical vapors • Mechanical particles	Tested according to IEC 60068-2-60 Test Key: Flowing mixed gas corrosion test, Method 1 (H2S [hydrogen sulfide] and SO2 [sulfur dioxide]) Designed according to: IEC 60721-3-3, unit in operation, class 3C2 IEC 60721-3-3, unit in operation, class 3S2

Table 43. PowerXL Series, continued

Attribute	Description	Specification
Ambient conditions, continued	Altitude	100% load capacity (no derating) up to 3280 ft (1000 m); 1% derating for each 328 ft (100 m) above 3280 ft (1000 m); max. 9842 ft (3000 m) (2000 m for corner grounded earth main systems) For 600 V product, maximum altitude is 2000 m regardless of main system
	Vibration: • EN 61800-5-1 • EN 60068-2-6	5–150 Hz Displacement amplitude: 1 mm (peak) at 5 Hz to 15.8 Hz (FR0–FR6) Maximum acceleration amplitude: 1g at 15.8 Hz to 150 Hz (FR0–FR6)
	Shock: • ISTA 1 A • EN 60068-2-27	Storage and shipping: maximum 15 g, 11 ms (in package)
	Overvoltage	Overvoltage Category III
	Pollution degree	Pollution Degree 2
	Enclosure class	FR0: Open Type /IP20 FR1–FR6: IP21/Type 1 standard in entire kW/hp range IP54/Type 12 option Note: Keypad or keypad hole plug required to be mounted in drive for IP54/Type 12 rating
	Immunity	Fulfills IEC/EN 61800-3
	MTBF	FR0: 150,000 hours FR1: 165,457 hours FR2: 134,833 hours FR3: 102,515 hours FR4: 121,567 hours FR5: 108,189 hours FR6: 100,000 hours
	Noise	FR0: 51.7 dB FR1: 51.2 dB FR2: 58.6 dB FR3: 61.0 dB FR4: 68.0 dB FR5: 69.1 dB FR6: 73.2dB
Standards	Safety	UL 508C, CSA C22.2 No. 274-13 or CSA C22.2 No. 274-17, IEC/EN 61800-5-1
	EMC	IEC/EN 61800-3, 2nd environment 230/480 V Series: Category 2 575 V Series: Category 3
	STO	Cat. 1 / PL c acc. to EN ISO 13849-1 SIL 1 / SIL CL 1 acc. to IEC/EN 61800-5-2, IEC/EN 62061, IEC/EN 61508
	MD	IEC/EN 60204-1
	RoHS	EN IEC 63000
	Eco-Design	IE2 acc. to IEC/EN 61800-9-2, (90;100) losses are marked on rating labels Other details can be found at: Eaton.com/EcoDesign-VFD
	Electrostatic discharge	Second environment, IEC/EN 61000-4-2, 4 kV CD or 8 kV AD, Criterion B
	Fast transient burst	Second environment, IEC/EN 61000-4-4, 2 kV / 5 kHz, Criterion B
	Approvals	UL, cUL, CE, UKCA, EAC, RCM (C-Tick), UkrSEPRO, RoHS, TUV (STO)
Fieldbus connections		Onboard DG1: EtherNet/IP, Modbus® TCP, Modbus RTU, BACnet Onboard DH1: Modbus TCP, BACnet/IP, Modbus RTU, BACnet

Table 43. PowerXL Series, continued

Attribute	Description	Specification
Safety/protections	Overvoltage protection	Yes
	Overvoltage trip limit	230 V drives: 456 V 480 V drives: 911 V 600 V drives: 1100 V
	Undervoltage protection	Yes
	Undervoltage trip limit	230 V drives: 211 V 480 V drives: 370 V 600 V drives: 550 V
	Earth fault protection	Yes, Default: 15% Motor FLA Min: 0% Motor FLA Max: 30% Motor FLA
	Input phase supervision	Yes
	Motor phase supervision	Yes
	Overcurrent protection	Yes
	Unit overtemperature protection	Yes
	Motor overload protection	Yes
	Motor stall protection	Yes
	Motor underload protection	Yes
	DC bus overvoltage control	Yes
	Short-circuit protection of 24 V reference voltages	Yes
	Surge protection	Yes (differential mode 2 kV; common mode 4 kV 230 V drives: 275 Vac, 10,000 A 480 V drives: 320 Vac, 8000 A 600 V drives: 385 Vac, 10,000 A
	Common coated boards	Yes (prevents corrosion)
	RTC Battery	3.6V Lithium Battery (Able ER14250) ROHS compliant Follow local Recycling program to dispose. 10,000 hour life *Only active when Power Removed
Efficiency	Drive efficiency ratings	230 V: FR0 = DG1-323D7EB-C20C: 96.37% DG1-324D8EB-C20C: 96.38% DG1-326D6EB-C20C: 96.31% FR1 = 96.7% FR2 = 97.4% FR3 = 97.2% FR4 = 97.4% FR5 = 97.7% FR6 = 97.5% 480 V: FR0 = DG1-342D2EB-C20C: 97.23% DG1-343D3EB-C20C: 97.33% DG1-344D3EB-C20C: 97.27% DG1-345D6EB-C20C: 97.15% FR1 = 97.7% FR2 = 97.9% FR3 = 97.7% FR4 = 98.0% FR5 = 98.2% FR6 = 97.9% 600 V: FR1 = 98.1% FR2 = 98.2% FR3 = 97.7% FR4 = 98.3% FR5 = 98.6% FR6 = 98.5%

Appendix B—Installation guidelines

Cable and fuse sizing

See **Page 40** for cable stripping guidelines.

Table 44. North America cable and fuse sizes—208 Vac to 240 Vac ratings

Frame size	CT Amp Suffix	VT Amp Suffix	208 V input current (CT/IH)	208 V input current (VT/IL)	NEC motor Amp rating at 230 V	NEC motor Amp rating at 208 V	Current (CT/IH) at 50 °C	Current (VT/IL) at 40 °C	Recommended fuse rating	NEC wire size (AWG)		Terminal connection size (AWG)	
										Line and motor	Ground	Line and motor	Ground
FR0	3D7	4D8	4.3	5.6	4.2	4.6	3.7	4.8	10	14	14	26–10	18–10
	4D8	6D6	5.6	7.6	6	6.6	4.8	6.6	10	14	14	26–10	18–10
	6D6	7D8	7.6	9	6.8	7.5	6.6	7.8	15	14	14	26–10	18–10
FR1	3D7	4D8	3.2	4.4	4.2	4.6	3.7	4.8	10	14	14	24–10	18–10
	4D8	6D6	4.4	6.1	6.0	6.6	4.8	6.6	10	14	14	24–10	18–10
	6D6	7D8	6.1	7.2	6.8	7.5	6.6	7.8	10	14	14	24–10	18–10
	7D8	011	7.2	10.2	9.6	10.6	7.8	11	15	14	14	24–10	18–10
	011	012	10.2	11.6	—	—	11	12.5	15	12	12	24–10	18–10
FR2	012	017	10.2	16.3	15.2	16.7	12.5	17.5	20	10	10	20–6	12–6
	017	025	16.2	23.2	22	24.2	17.5	25	30	8	10	20–6	12–6
	025	031	23.1	29	28	30.8	25	31	35	8	10	20–6	12–6
FR3	031	048	28.7	44.2	42	46.2	31	48	60	6	6	20-2	14–4
	048	061	44.4	56	54	59.4	48	61	80	4	6	20-2	14–4
FR4	061	075	56.4	64.6	68	74.8	61	75	100	3	4	6–1/0	10–1/0
	075	088	69.4	78	80	88	75	88	110	2	4	6–1/0	10–1/0
	088	114	81.4	94.3	104	114	88	114	125	1/0	3	6–1/0	10–1/0
FR5	114	143	105.5	129	130	143	114	143	175	3/0	3	1/0–350 kcmil	8–250 kcmil
	143	170	132.3	157	154	169	143	170	200	4/0	3	1/0–350 kcmil	8–250 kcmil
	170	211	157.3	189	192	211	170	211	250	300	3	1/0–350 kcmil	8–250 kcmil
FR6	211	261	196.3	242.8	248	273	211	261	400	2*2/0	3	2*(1/0–300 kcmil)	3–300 kcmil
	248	312	230.7	290.3	312	343	248	312	400	2*4/0	3	2*(1/0–300 kcmil)	3–300 kcmil

Notes: ① Line and motor cable size is selected according to UL 508C for copper conductor rated 75 °C.
Use only with copper wire rated 75 °C here.
Size requirements for other different wire types are defined in the National Electrical Code, ANSI/NFPA 70

② Earthing conductor size is determined by the maximum overcurrent device rating used ahead of the drive according to UL 508C.

③ If power cubes or bypass are used, a UL listed Class RK5, J, T, or equivalent fuse is recommended.

Table 45. International cable and fuse sizes—208 Vac to 240 Vac ratings

Frame size	CT Amp Suffix	VT Amp Suffix	208 V input current (CT/IH)	208 V input current (VT/IL)	Current (CT/IH) at 50 °C	Current (VT/IL) at 40 °C	Fuse rating (gG/gL)	Mains and motor cable Cu (mm²)	Terminal cable size	
									Main terminal Cu (mm²)	Earth terminal Cu (mm²)
FR0	3D7	4D8	4.3	5.6	3.7	4.8	10	3*1.5+1.5	0.2–6 solid or 0.2–4 stranded	0.75–6
	4D8	6D6	5.6	7.6	4.8	6.6	10	3*1.5+1.5	0.2–6 solid or 0.2–4 stranded	0.75–6
	6D6	7D8	7.6	9	6.6	7.8	16	3*1.5+1.5	0.2–6 solid or 0.2–4 stranded	0.75–6
FR1	3D7	4D8	3.2	4.4	3.7	4.8	6	3*1.5+1.5	0.2–6 solid or 0.2–4 stranded	0.75–6
	4D8	6D6	4.4	6.1	4.8	6.6	10	3*1.5+1.5	0.2–6 solid or 0.2–4 stranded	0.75–6
	6D6	7D8	6.1	7.2	6.6	7.8	16	3*1.5+1.5	0.2–6 solid or 0.2–4 stranded	0.75–6
	7D8	011	7.2	10.2	7.8	11	16	3*1.5+1.5	0.2–6 solid or 0.2–4 stranded	0.75–6
	011	012	10.2	11.6	11	12.5	16	3*1.5+1.5	0.2–6 solid or 0.2–4 stranded	0.75–6
FR2	012	017	10.2	16.3	12.5	17.5	20	3*4+4	0.5–16	4–16
	017	025	16.2	23.2	17.5	25	32	3*4+4	0.5–16	4–16
	025	031	23.1	29	25	31	32	3*6+6	0.5–16	4–16
FR3	031	048	28.7	44.2	31	48	50	3*16+16	0.5-35	2.5–25
	048	061	44.4	56	48	61	63	3*16+16	0.5-35	2.5–25
FR4	061	075	56.4	64.6	61	75	80	3*25+16	16–50	6–50
	075	088	69.4	78	75	88	100	3*35+16	16–50	6–50
	088	114	81.4	94.3	88	114	125	3*50+25	16–50	6–50
FR5	114	143	105.5	129	114	143	160	3*70+35	50–185	10–120
	143	170	132.3	157	143	170	200	3*95+50	50–185	10–120
	170	211	157.3	189	170	211	250	3*150+95	50–185	10–120
FR6	211	261	196.3	242.8	211	261	400	2*(3*70+35)	2*(50–150)	25-150
	248	312	230.7	290.3	248	312	400	2*(3*95+50)	2*(50–150)	25-150

Notes: ① Line and motor cable size is selected according to IEC 60364–5–52 for copper conductor with PVC insulation with a wiring condition of ambient temperature 30 °C in air and an installation method of "B2" (cables in conduit and cable trunking systems). For other wiring conditions, please refer to the standard of IEC 60364–5–52 for suitable cable sizes.

② Earthing conductor size is determined by the cross–sectional area of phase conductors according to IEC/EN 61800–5–1. So if phase conductor size is changed, earthing conductor size should also be changed accordingly.

③ If power cubes or bypass are used, a Class gG/gL fuse is recommended.

Table 46. North America cable and fuse sizes—440 Vac to 500 Vac ratings

Frame size	CT Amp Suffix	VT Amp Suffix	460 V input current (CT/IH)	460 V input current (VT/IL)	NEC motor Amp rating at 460 V	Current (CT/IH) at 50 °C	Current (VT/IL) at 40 °C	Recommended fuse rating	NEC wire size (AWG)		Terminal connection size (AWG)	
									Line and motor	Ground	Line and motor	Ground
FR0	2D2	3D3	2.6	3.8	3	2.1	3	10	14	14	26–10	18–10
	3D3	4D3	3.8	4.3	3.4	3	3.4	10	14	14	26–10	18–10
	4D3	5D6	4.3	6	4.8	3.4	4.8	10	14	14	26–10	18–10
	5D6	7D6	6	9.6	7.6	4.8	7.6	15	14	14	26–10	18–10
FR1	2D2	3D3	2	2.8	3.0	2.1	3.0	10	14	14	26–10	18–10
	3D3	4D3	2.8	3.2	3.4	3.0	3.4	10	14	14	26–10	18–10
	4D3	5D6	3.2	4.5	4.8	3.4	4.8	10	14	14	26–10	18–10
	5D6	7D6	4.5	7.1	7.6	4.8	7.6	10	14	14	26–10	18–10
	7D6	9D0	7.1	8.4	—	7.6	7.6	15	14	14	26–10	18–10
	9D0	012	8.4	10.2	11	7.6	11	15	14	14	26-10	18–10
FR2	012	016	10.2	13	14	11	14	20	12	12	20–6	12–6
	016	023	13	19.6	21	14	21	30	10	10	20–6	12–6
	023	031	19.5	25.2	27	21	27	35	8	8	20–6	12–6
FR3	031	038	25.1	31.7	34	27	34	50	6	8	20-2	14–4
	038	046	31.6	37	40	34	40	60	6	8	20-2	14–4
	046	061	37.2	48.1	52	40	52	80	4	6	20-2	14–4
FR4	061	072	48.3	59.3	65	52	65	100	4	4	6–1/0	10–1/0
	072	087	60.4	70.3	77	65	77	110	3	4	6–1/0	10–1/0
	087	105	71.6	87.6	96	77	96	125	1	3	6–1/0	10–1/0
FR5	105	140	89.2	114.4	124	96	124	175	2/0	3	1/0–350 kcmil	8–250 kcmil
	140	170	115.3	144	156	124	156	200	3/0	3	1/0–350 kcmil	8–250 kcmil
	170	205	145	166.1	180	156	180	250	250 kcmil	3	1/0–350 kcmil	8–250 kcmil
FR6	205	261	169.8	226.4	240	180	240	400	2*2/0	3	2*(1/0–300 kcmil)	3–300 kcmil
	245	310	226.4	284.9	302	240	302	400	2*4/0	3	2*(1/0–300 kcmil)	3–300 kcmil

Notes: ① Line and motor cable size is selected according to UL 508C for copper conductor rated 75 °C. Use only with copper wire rated 75 °C here. Size requirements for other different wire types are defined in the National Electrical Code, ANSI/NFPA 70.

② Earthing conductor size is determined by the maximum overcurrent device rating used ahead of the drive according to UL 508C.

③ If power cubes or bypass are used, a UL listed Class RK5, J, T, or equivalent fuse is recommended.

Table 47. International cable and fuse sizes—380 Vac to 440 Vac ratings

									Terminal cable size	
Frame size	**CT Amp Suffix**	**VT Amp Suffix**	**400 V input current (CT/IH)**	**400 V input current (VT/IL)**	**Current (CT/IH) at 50 °C**	**Current (VT/IL) at 40 °C**	**Fuse rating (gG/gL)**	**Mains and motor cable Cu (mm^2)**	**Main terminal Cu (mm^2)**	**Earth terminal Cu (mm^2)**
FR0	2D2	3D3	2.7	4.3	2.2	3.3	6	3*1.5+1.5	0.2–6 solid or 0.2–4 stranded	0.75–6
	3D3	4D3	4.3	5.5	3.3	4.3	10	3*1.5+1.5	0.2–6 solid or 0.2–4 stranded	0.75–6
	4D3	5D6	5.5	7.1	4.3	5.6	10	3*1.5+1.5	0.2–6 solid or 0.2–4 stranded	0.75–6
	5D6	7D6	7.1	9.6	5.6	7.6	16	3*1.5+1.5	0.2–6 solid or 0.2–4 stranded	0.75–6
FR1	2D2	3D3	2.0	3.1	2.2	3.3	6	3*1.5+1.5	0.2–6 solid or 0.2–4 stranded	0.75–6
	3D3	4D3	3.1	4	3.3	4.3	6	3*1.5+1.5		0.75–6
	4D3	5D6	4	5.2	4.3	5.6	10	3*1.5+1.5		0.75–6
	5D6	7D6	5.2	7.1	5.6	7.6	16	3*1.5+1.5		0.75–6
	7D6	9D0	7.1	8.4	7.6	9	16	3*1.5+1.5		0.75–6
	9D0	012	8.4	11.2	9	12	16	3*1.5+1.5		0.75–6
FR2	012	016	11.2	15	12	16	20	3*4+4	0.5–16	4–16
	016	023	14.9	21.5	16	23	25	3*4+4	0.5–16	4–16
	023	031	21.4	29	23	31	32	3*6+6	0.5–16	4–16
FR3	031	038	28.8	35.2	31	38	40	3*16+16	0.5-35	2.5–25
	038	046	35.3	42.6	38	46	50	3*16+16	0.5-35	2.5–25
	046	061	42.8	55.7	46	61	63	3*16+16	0.5-35	2.5–25
FR4	061	072	56.7	65.7	61	72	80	3*25+16	16–50	6–50
	072	087	66.9	79.4	72	87	100	3*35+16	16–50	6–50
	087	105	80.9	97	87	105	125	3*50+25	16–50	6–50
FR5	105	140	97.6	129	105	140	160	3*70+35	50–185	10–120
	140	170	130.1	157	140	170	200	3*95+50	50–185	10–120
	170	205	158.0	189	170	205	250	3*120+70	50–185	10–120
FR6	205	261	193.4	246.2	205	261	400	2*(3*70+35)	2*(50–150)	25-150
	245	310	231.1	292.4	245	310	400	2*(3*95+50)	2*(50–150)	25-150

Notes: ① Line and motor cable size is selected according to IEC 60364–5–52 for copper conductor with PVC insulation with a wiring condition of ambient temperature 30 °C in air and an installation method of "B2" (cables in conduit and cable trunking systems). For other wiring conditions, please refer to the standard of IEC 60364–5–52 for suitable cable sizes.

② Earthing conductor size is determined by the cross–sectional area of phase conductors according to IEC/EN 61800–5–1. So if phase conductor size is changed, earthing conductor size should also be changed accordingly.

③ If power cubes or bypass are used, a Class gG/gL fuse is recommended.

Table 48. North America cable and fuse sizes—525 Vac to 600 Vac ratings

Frame size	CT Amp Suffix	VT Amp Suffix	575 V Input current (CT/IH)	575 V Input current (VT/IL)	NEC motor amp rating at 575 V	Current (CT/IH) at 50 °C	Current (VT/IL) at 40 °C	Recommended fuse rating C	Nec wire size (AWG) Line and motor	Nec wire size (AWG) Ground	Terminal connection size (AWG) Line and motor	Terminal connection size (AWG) Ground
FR1	3D3	4D5	3.1	4.2	3.9	3.3	4.5	10	14	14	26–10	18–10
	4D5	7D5	4.2	7	6.1	4.5	7.5	10	14	12	26–10	18–10
	7D5	010	7	9.3	9	7.5	10	15	14	10	26–10	18–10
FR2	010	013	9.3	12.5	11	10	13.5	20	12	10	20–6	12–6
	013	018	12.5	16.7	17	13.5	18	30	10	10	20–6	12–6
	018	022	16.7	20.4	22	18	22	35	10	8	20–6	12–6
FR3	022	027	20.4	25.2	27	22	27	40	6	8	20-2	14–4
	027	034	25.1	31.7	32	27	34	45	6	8	20-2	14–4
	034	041	31.6	38.2	41	34	41	50	6	6	20-2	14–4
FR4	041	052	38.1	48.1	52	41	52	70	4	6	6–1/0	10–1/0
	052	062	48.3	57.4	62	52	62	80	4	6	6–1/0	10–1/0
	062	080	57.6	73	77	62	80	100	2	4	6–1/0	10–1/0
FR5	080	100	74.4	91.3	99	80	100	125	1/0	4	1/0–350 kcmil	8–250 kcmil
	100	125	93	114.1	125	100	125	150	2/0	4	1/0–350 kcmil	8–250 kcmil
	125	144	116.2	132.9	144	125	144	175	3/0	4	1/0–350 kcmil	8–250 kcmil
FR6	144	208	140.4	202.8	192	144	208	250	2*1/0	3	2*(1/0–300 kcmil)	3–300 kcmil
	208	250	202.8	243.8	242	208	250	300	2*2/0	3	2*(1/0–300 kcmil)	3–300 kcmil

Notes: ① Line and motor cable size is selected according to UL 508C for copper conductor rated 75 °C. Use only with copper wire rated 75 °C here. Size requirements for other different wire types are defined in the National Electrical Code, ANSI/NFPA 70.

② Earthing conductor size is determined by the maximum overcurrent device rating used ahead of the drive according to UL 508C.

③ If power cubes or bypass are used, a UL listed class RK5, J, T or equivalent fuse is recommended.

Table 48a. International cable and fuse sizes—525 Vac to 600 Vac ratings

Frame size	CT Amp Suffix	VT Amp Suffix	575V Input current (CT/IH)	575V Input current (VT/IL)	Current (CT/IH) at 50 °C	Current (VT/IL) at 40 °C	Recommended fuse rating (gG/gL)	Mains and motor cable Cu (mm²)	Terminal cable size Main terminal Cu (mm²)	Terminal cable size Earth terminal Cu (mm²)
FR1	3D3	4D5	3.1	4.2	3.3	4.5	10	3*1.5+1.5	0.2-6 Sol 0.2-4 Str	0.75-6
	4D5	7D5	4.2	7	4.5	7.5	10	3*1.5+1.5		0.75-6
	7D5	010	7	9.3	7.5	10	16	3*1.5+1.5		0.75-6
FR2	010	013	9.3	12.5	10	13.5	16	3*2.5+4	0.5-16	4-16
	013	018	12.5	16.7	13.5	18	25	3*2.5+4	0.5-16	4-16
	018	022	16.7	20.4	18	22	32	3*4+4	0.5-16	4-16
FR3	022	027	20.4	25.2	22	27	32	3*6+6	0.5-35	2.5-25
	027	034	25.1	31.7	27	34	40	3*10+10	0.5-35	2.5-25
	034	041	31.6	38.2	34	41	50	3*10+10	0.5-35	2.5-25
FR4	041	052	38.1	48.1	41	52	63	3*16+16	16-50	6-50
	052	062	48.3	57.4	52	62	80	3*16+16	16-50	6-50
	062	080	57.6	73	62	80	100	3*25+16	16-50	6-50
FR5	080	100	74.4	91.3	80	100	125	3*50+25	50-185	10-120
	100	125	93	114.1	100	125	160	3*70+35	50-185	10-120
	125	144	116.2	132.9	125	144	200	3*70+35	50-185	10-120
FR6	144	208	140.4	202.8	144	208	250	2*(3*50+25)	2*(50-150)	25-150
	208	250	202.8	243.8	208	250	315	2*(3*70+35)	2*(50-150)	25-150

Notes: ① Line and motor cable size is selected according to IEC 60364–5–52 for copper conductor with PVC insulation with a wiring condition of ambient temperature 30 °C in air and an installation method of "B2" (cables in conduit and cable trunking systems). For other wiring conditions, please refer to the standard of IEC 60364–5–52 for suitable cable sizes.

② Earthing conductor size is determined by the cross–sectional area of phase conductors according to IEC/EN 61800–5–1. So if phase conductor size is changed, earthing conductor size should also be changed accordingly.

③ If power cubes or bypass are used, a Class gG/gL fuse is recommended.

Temperature deratings

When using the PowerXL drives at elevated temperatures, derating is required to size the drive and maintain proper cooling. The following procedures and tables describe the process of derating and choosing the correct drive.

Procedure

Certain operating parameters and conditions are required for correct derating. These are: voltage, torque application (variable or constant), operating temperature, enclosure rating, switching frequency, required amperage.

Follow the below steps to correctly derate the PowerXL drives.

1. Find the derating table (**Table 49**–**Table 54**) for the voltage and torque application.

   ex.) 480 V, Variable Torque = **Table 8**
2. Within the table, find the sections of rows for the application temperature and column for the switching frequency.

   ex.) 50 °C section, 4 kHz column
3. Look at all the frame sizes and find the frame size for your required amperage.

   ex.) FR1 = 9 A
   FR2 = 25 A
   FR3 = 51.8 A ← this is the frame size needed for the 37 A application
   FR4 = 89.9 A
   FR5 = 66.1 A
4. Take the derating % for that frame size and go to the catalog tables (**Table 2**–**Table 7**). Derate each option within that frame size to find the correct drive.

   ex.) the derating percentage is 84.9%
   DG1-34031FB-C21C: normal 38 A, derated to 84.9% = 32.3 A
   DG1-34038FB-C21C: normal 46 A. derated to 84.9% = 39.1 A ← this is the drive to select
   DG1-34046FB-C21C: normal 61 A, derated to 84.9% = 51.8 A

Table 49. 230 V temperature deratings (VT)

Shading indicates default switching frequency for each frame size.

Variable torque (VT)/ low overload (I_L)		Maximum rated current (A), percentage of rated current											
		Switching frequency											
Temperature	Frame size	1 kHz	2 kHz	3 kHz	3.6 kHz	4 kHz	5 kHz	6 kHz	7 kHz	8 kHz	9 kHz	10 kHz	12 kHz
40 °C	FR0	7.8 A (100%)	7.8 A (100%)	7.8 A (100%)	7.8 A (100%)	7.8 A (100%)	7.8 A (100%)	7.8 A (100%)	7.8 A (100%)	7.8 A (100%)	7.8 A (100%)	7.8 A (100%)	7.8 A (100%)
	FR1	12.5 A (100%)	12.5 A (100%)	12.5 A (100%)	12.5 A (100%)	12.5 A (100%)	12.5 A (100%)	12.5 A (100%)	12.1 A (96.8%)	11.7 A (93.6%)	11.3 A (90.4%)	10.9 A (87.2%)	10.1 A (80.8%)
	FR2	31 A (100%)	31 A (100%)	31 A (100%)	31 A (100%)	31 A (100%)	31 A (100%)	31 A (100%)	30.1 A (97.3%)	29.3 A (94.6%)	28.5 A (91.9%)	27.6 A (89.2%)	26 A (83.8%)
	FR3	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)
	FR4	114 A (100%)	114 A (100%)	114 A (100%)	114 A (100%)	112.8 A (98.9%)	109.8 A (96.3%)	106.9 A (93.8%)	104 A (91.2%)	99.6 A (87.4%)	95.3 A (83.6%)	91 A (79.8%)	—
	FR5	211 A (100%)	211 A (100%)	211 A (100%)	211 A (100%)	206.5 A (97.8%)	195.3 A (92.5%)	184.1 A (87.2%)	173 A (81.9%)	165.3 A (78.3%)	157.6 A (74.7%)	150 A (71%)	—
	FR6	312 A (100%)	312 A (100%)	312 A (100%)	—	300 A (96.2%)	288 A (92.3%)	276 A (88.5%)	264 A (84.6%)	252 A (80.8%)	240 A (76.9%)	228 A (73.1%)	—
50 °C	FR0	7.8 A (100%)	7.8 A (100%)	7.8 A (100%)	7.8 A (100%)	7.8 A (100%)	7.8 A (100%)	7.8 A (100%)	7.7 A (98.7%)	7.6 A (97.4%)	7.5 A (96.2%)	7.4 A (94.9%)	7.2 A (92.3%)
	FR1	10.5 A (84%)	10.5 A (84%)	10.5 A (84%)	10.5 A (84%)	10.5 A (84%)	10.5 A (84%)	10.5 A (84%)	10.1 A (80.8%)	9.7 A (77.6%)	9.3 A (74.4%)	8.9 A (71.2%)	8.1 A (64.8%)
	FR2	27 A (87%)	27 A (87%)	27 A (87%)	27 A (87%)	27 A (87%)	27 A (87%)	27 A (87%)	26.1 A (84.4%)	25.3 A (81.7%)	24.5 A (79%)	23.6 A (76.3%)	22 A (70.9%)
	FR3	57 A (93.4%)	57 A (93.4%)	57 A (93.4%)	57 A (93.4%)	57 A (93.4%)	57 A (93.4%)	57 A (93.4%)	57 A (93.4%)	57 A (93.4%)	57 A (93.4%)	55.6 A (91.2%)	53 A (86.8%)
	FR4	100 A (87.7%)	100 A (87.7%)	100 A (87.7%)	100 A (87.7%)	98.8 A (86.6%)	95.8 A (84.1%)	92.9 A (81.5%)	90 A (78.9%)	86.6 A (76%)	83.3 A (73%)	80 A (70.1%)	—
	FR5	170 A (80.5%)	170 A (80.5%)	170 A (80.5%)	170 A (80.5%)	166.1 A (78.7%)	156.4 A (74.1%)	146.7 A (69.5%)	137 A (64.9%)	126.6 A (60%)	116.3 A (55.1%)	106 A (50.2%)	—
	FR6	260 A (83.3%)	250 A (80.1%)	240 A (76.9%)	—	230 (73.7%)	220 (70.5%)	210 (67.3%)	200 (64.1%)	190 (60.9%)	180 (57.7%)	170 A (54.5%)	—
60 °C	FR0	7.8 A (100%)	7.8 A (100%)	7.8 A (100%)	7.8 A (100%)	7.8 A (100%)	7.8 A (100%)	7.8 A (100%)	7.5 A (96.2%)	7.2 A (92.3%)	6.9 A (88.5%)	6.6 A (84.6%)	6 A (76.9%)
	FR1	8.5 A (68%)	8.5 A (68%)	8.5 A (68%)	8.5 A (68%)	8.5 A (68%)	8.5 A (68%)	8.5 A (68%)	8.2 A (65.8%)	7.9 A (63.7%)	7.7 A (61.6%)	7.4 A (59.4%)	6.9 A (55.2%)
	FR2	23 A (74.1%)	23 A (74.1%)	23 A (74.1%)	23 A (74.1%)	23 A (74.1%)	23 A (74.1%)	23 A (74.1%)	22 A (70.9%)	21 A (67.7%)	20 A (64.5%)	19 A (61.2%)	17 A (54.8%)
	FR3	50 A (81.9%)	50 A (81.9%)	50 A (81.9%)	50 A (81.9%)	50 A (81.9%)	50 A (81.9%)	50 A (81.9%)	49 A (80.3%)	48 A (78.6%)	47 A (77%)	45.6 A (74.8%)	43 A (70.4%)
	FR4	85 A (74.5%)	85 A (74.5%)	85 A (74.5%)	85 A (74.5%)	83.7 A (73.4%)	80.4 A (70.5%)	77.2 A (67.7%)	74 A (64.9%)	71 A (62.2%)	68 A (59.6%)	65 A (57%)	—
	FR5	135 A (63.9%)	135 A (63.9%)	135 A (63.9%)	135 A (63.9%)	131.9 A (62.5%)	124.2 A (58.9%)	116.6 A (55.2%)	109 A (51.6%)	101.1 A (47.9%)	93.3 A (44.2%)	85.5 A (40.5%)	—
	FR6	248 A (79.5%)	233 A (74.7%)	218 (69.9%)	—	203 A (65.1%)	188 A (60.3%)	173 A (55.4%)	158 A (50.6%)	143 A (45.8%)	128 A (41%)	113 A (36.2%)	—

Notes: ① Operation above 100Hz might require specific derating.
② For higher output frequencies, please contact your local Eaton office.

Table 50. 230 V temperature deratings (CT)

Shading indicates default switching frequency for each frame size.

Constant torque (CT) /high overload (I_H)		**Maximum rated current (A), percentage of rated current**											
		Switching frequency											
Temperature	**Frame size**	**1 kHz**	**2 kHz**	**3 kHz**	**3.6 kHz**	**4 kHz**	**5 kHz**	**6 kHz**	**7 kHz**	**8 kHz**	**9 kHz**	**10 kHz**	**12 kHz**
40 °C	FR0	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)
	FR1	11 A (100%)	11 A (100%)	11 A (100%)	11 A (100%)	11 A (100%)	11 A (100%)	11 A (100%)	11 A (100%)	11 A (100%)	11 A (100%)	10.7 A (97.2%)	10.1 A (91.8%)
	FR2	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)
	FR3	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)
	FR4	87 A (100%)	87 A (100%)	87 A (100%)	87 A (100%)	87 A (100%)	87 A (100%)	87 A (100%)	87 A (100%)	83.6 A (96.1%)	80.3 A (92.3%)	77 A (88.5%)	—
	FR5	170 A (100%)	170 A (100%)	170 A (100%)	170 A (100%)	170 A (100%)	170 A (100%)	170 A (100%)	170 A (100%)	163.3 A (96%)	156.6 A (92.1%)	150 A (88.2%)	—
	FR6	248 A (100%)	248 A (100%)	248 A (100%)	—	248 A (100%)	248 A (100%)	248 A (100%)	238 A (95.9%)	228 A (91.9%)	218 A (87.9%)	208 A (83.8%)	—
50 °C	FR0	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)
	FR1	11 A (100%)	11 A (100%)	11 A (100%)	11 A (100%)	11 A (100%)	10.7 A (97.7%)	10.5 A (95.4%)	10.1 A (91.8%)	9.7 A (88.1%)	9.3 A (84.5%)	8.9 A (80.9%)	8.1 A (73.6%)
	FR2	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	25 A (100%)	24.5 A (98%)	24 A (96%)	23.5 A (94%)	23 A (92%)	22 A (88%)
	FR3	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)	48 A (100%)
	FR4	87 A (100%)	87 A (100%)	87 A (100%)	87 A (100%)	85.8 A (98.6%)	82.8 A (95.2%)	79.9 A (91.8%)	77 A (88.5%)	73.6 A (84.6%)	70.3 A (80.8%)	67 A (77%)	—
	FR5	170 A (100%)	170 A (100%)	170 A (100%)	170 A (100%)	166.1 A (97.7%)	156.4 A (92%)	146.7 A (86.2%)	137 A (80.5%)	126.6 A (74.5%)	116.3 A (68.4%)	106 A (62.3%)	—
	FR6	248 A (100%)	248 A (100%)	248 A (100%)	—	236 A (95.2%)	224 A (95.2%)	212 A (85.5%)	200 A (80.6%)	188 A (75.8%)	176 A (71%)	164 A (66.1%)	—
60 °C	FR0	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)	6.6 A (100%)
	FR1	9.2 A (83.6%)	9.2 A (83.6%)	9.2 A (83.6%)	9.2 A (83.6%)	9.2 A (83.6%)	8.9 A (80.9%)	8.6 A (78.1%)	8.3 A (75.4%)	8 A (72.7%)	7.7 A (70%)	7.4 A (67.2%)	6.8 A (61.8%)
	FR2	23 A (92%)	23 A (92%)	23 A (92%)	23 A (92%)	23 A (92%)	23 A (92%)	23 A (92%)	22 A (88%)	21 A (84%)	20 A (80%)	19 A (76%)	17 A (68%)
	FR3	44 A (91.6%)	44 A (91.6%)	44 A (91.6%)	44 A (91.6%)	44 A (91.6%)	43.3 A (90.2%)	42.8 A (89.3%)	42.4 A (88.4%)	42 A (87.5%)	41.3 A (86.1%)	40.8 A (85.1%)	40 A (83.3%)
	FR4	73 A (83.9%)	73 A (83.9%)	73 A (83.9%)	73 A (83.9%)	71.7 A (82.4%)	68.4 A (78.7%)	65.2 A (74.9%)	62 A (71.2%)	58.6 A (67.4%)	55.3 A (63.6%)	52 A (59.7%)	—
	FR5	135 A (79.4%)	135 A (79.4%)	135 A (79.4%)	135 A (79.4%)	131.9 A (77.6%)	124.2 A (73.1%)	116.6 A (68.6%)	109 A (64.1%)	101.1 A (59.5%)	93.3 A (54.9%)	85.5 A (50.2%)	—
	FR6	248 A (100%)	233 A (94%)	218 A (87.9%)	—	203 A (81.9%)	188 A (75.8%)	173 A (69.8%)	158 A (63.7%)	143 A (57.7%)	128 A (51.6%)	113 A (45.6%)	—

Notes: ① Operation above 100Hz might require specific derating.
② For higher output frequencies, please contact your local Eaton office.

Table 51. 480 V temperature deratings (VT)

Shading indicates default switching frequency for each frame size.

Variable torque (VT)/ low overload (I_L)		Maximum rated current (A), percentage of rated current											
		Switching frequency											
Temperature	**Frame size**	**1 kHz**	**2 kHz**	**3 kHz**	**3.6 kHz**	**4 kHz**	**5 kHz**	**6 kHz**	**7 kHz**	**8 kHz**	**9 kHz**	**10 kHz**	**12 kHz**
40 °C	FR0	7.6 A (100%)	7.6 A (100%)	7.6 A (100%)	7.6 A (100%)	7.6 A (100%)	7.6 A (100%)	7.6 A (100%)	7.4 A (97.2%)	7.2 A (94.3%)	7 A (91.5%)	6.7 A (88.6%)	6.3 A (82.9%)
	FR1	12 A (100%)	12 A (100%)	12 A (100%)	12 A (100%)	12 A (100%)	12 A (100%)	12 A (100%)	11.2 A (93.7%)	10.5 A (87.5%)	9.7 A (81.2%)	9 A (75%)	7.5 A (62.5%)
	FR2	31 A (100%)	31 A (100%)	31 A (100%)	31 A (100%)	31 A (100%)	31 A (100%)	31 A (100%)	29.5 A (95.1%)	28 A (90.3%)	26.5 A (85.4%)	25 A (80.6%)	22 A (70.9%)
	FR3	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	61 A (100%)	58.2 A (95.4%)	55.5 A (90.9%)	52.7 A (86.4%)	50 A (81.9%)	44.5 A (72.9%)
	FR4	105 A (100%)	105 A (100%)	105 A (100%)	105 A (100%)	102.7 A (97.8%)	97.1 A (92.5%)	91.5 A (87.1%)	85.8 A (81.7%)	80.2 A (76.4%)	74.6 A (71%)	69 A (65.7%)	—
	FR5	205 A (100%)	205 A (100%)	205 A (100%)	205 A (100%)	199.6 A (97.3%)	186.3 A (90.8%)	173 A (84.3%)	159.5 A (77.8%)	146 A (71.2%)	132.5 A (64.6%)	119 A (58%)	—
	FR6	310 A (100%)	310 A (100%)	310 A (100%)	—	290 A (93.5%)	270 (87.1%)	250 A (80.6%)	230 A (74.2%)	210 A (67.7%)	190 A (61.3%)	170 A (54.8%)	—
50 °C	FR0	7.6 A (100%)	7.6 A (100%)	7.6 A (100%)	7.6 A (100%)	7.6 A (100%)	7.6 A (100%)	7.6 A (100%)	7.2 A (94.3%)	6.7 A (88.6%)	6.3 A (82.9%)	5.9 A (77.2%)	5 A (65.8%)
	FR1	9 A (75%)	9 A (75%)	9 A (75%)	9 A (75%)	9 A (75%)	9 A (75%)	9 A (75%)	8.5 A (70.8%)	8 A (66.6%)	7.5 A (62.5%)	7 A (58.3%)	6 A (50%)
	FR2	25 A (80.6%)	25 A (80.6%)	25 A (80.6%)	25 A (80.6%)	25 A (80.6%)	25 A (80.6%)	25 A (80.6%)	24 A (77.4%)	23 A (74.1%)	22 A (70.9%)	21 A (67.7%)	19 A (61.2%)
	FR3	51.8 A (84.9%)	51.8 A (84.9%)	51.8 A (84.9%)	51.8 A (84.9%)	51.8 A (84.9%)	51.8 A (84.9%)	51.8 A (84.9%)	49.4 A (81%)	47.1 A (77.2%)	44.7 A (73.3%)	42.4 A (69.5%)	37.7 A (61.8%)
	FR4	92 A (87.6%)	92 A (87.6%)	92 A (87.6%)	92 A (87.6%)	89.9 A (85.6%)	84.7 A (80.7%)	79.6 A (75.8%)	74.4 A (70.9%)	69.3 A (66%)	64.1 A (61.1%)	59 A (56.1%)	—
	FR5	170 A (82.9%)	170 A (82.9%)	170 A (82.9%)	170 A (82.9%)	165 A (80.4%)	152.5 A (74.3%)	140 A (68.2%)	127.5 A (62.1%)	115 A (56%)	102.5 A (50%)	90 A (43.9%)	—
	FR6	295 A (95.2%)	275 A (88.7%)	255 A (82.2%)	—	235 A (75.8%)	215 A (69.3%)	195 A (62.9%)	175 A (56.4%)	155 A (50%)	135 A (43.5%)	115 A (37%)	—
60 °C	FR0	7.6 A (100%)	7.6 A (100%)	7.6 A (100%)	7.6 A (100%)	7.6 A (100%)	7.6 A (100%)	7.6 A (100%)	7.1 A (93.4%)	6.6 A (86.8%)	6.1 A (80.3%)	5.6 A (73.7%)	4.6 A (60.5%)
	FR1	7 A (58.3%)	7 A (58.3%)	7 A (58.3%)	7 A (58.3%)	7 A (58.3%)	7 A (58.3%)	7 A (58.3%)	6.5 A (54.1%)	6 A (50%)	5.5 A (45.8%)	5 A (41.6%)	4 A (33.3%)
	FR2	21 A (67.7%)	21 A (67.7%)	21 A (67.7%)	21 A (67.7%)	21 A (67.7%)	21 A (67.7%)	21 A (67.7%)	20 A (64.5%)	19 A (61.2%)	18 A (58%)	17 A (54.8%)	15 A (48.3%)
	FR3	43.5 A (71.3%)	43.5 A (71.3%)	43.5 A (71.3%)	43.5 A (71.3%)	43.5 A (71.3%)	43.5 A (71.3%)	43.5 A (71.3%)	41.6 A (68.2%)	39.8 A (65.2%)	37 A (60.7%)	34.3 A (56.2%)	29.7 A (48.6%)
	FR4	76 A (72.3%)	76 A (72.3%)	76 A (72.3%)	76 A (72.3%)	74.1 A (70.5%)	69.4 A (66.1%)	64.7 A (61.6%)	60 A (57.2%)	55.3 A (52.7%)	50.6 A (48.2%)	46 A (43.8%)	—
	FR5	140 A (68.2%)	140 A (68.2%)	140 A (68.2%)	140 A (68.2%)	135.6 A (66.1%)	124.6 A (60.8%)	113.7 A (55.4%)	102.8 A (50.1%)	91.8 A (44.8%)	80.9 A (39.4%)	70 A (34.1%)	—
	FR6	250 A (80.6%)	230 A (74.2%)	210 A (67.7%)	—	190 A (61.3%)	170 A (54.8%)	150 A (48.4%)	130 A (41.9%)	110 A (35.5%)	90 A (29%)	70 A (22.6%)	—

Notes: ① Operation above 100Hz might require specific derating.
② For higher output frequencies, please contact your local Eaton office.

Table 52. 480 V temperature deratings (CT)

Shading indicates default switching frequency for each frame size.

Constant torque (CT)/ high overload (I_H)		**Maximum rated current (A), percentage of rated current**											
		Switching frequency											
Temperature	**Frame size**	**1 kHz**	**2 kHz**	**3 kHz**	**3.6 kHz**	**4 kHz**	**5 kHz**	**6 kHz**	**7 kHz**	**8 kHz**	**9 kHz**	**10 kHz**	**12 kHz**
40 °C	FR0	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)
	FR1	7.6 A (100%)	7.6 A (100%)	7.6 A (100%)	7.6 A (100%)	7.6 A (100%)	7.6 A (100%)	7.6 A (100%)	7.3 A (96%)	7 A (92.1%)	6.7 A (88.1%)	6.4 A (84.2%)	5.8 A (76.3%)
	FR2	23 A (100%)	23 A (100%)	23 A (100%)	23 A (100%)	23 A (100%)	23 A (100%)	23 A (100%)	23 A (100%)	23 A (100%)	23 A (100%)	22 A (95.6%)	20 A (86.9%)
	FR3	46 A (100%)	46 A (100%)	46 A (100%)	46 A (100%)	46 A (100%)	46 A (100%)	46 A (100%)	46 A (100%)	46 A (100%)	44 A (95.6%)	42 A (91.3%)	38 A (82.6%)
	FR4	87 A (100%)	87 A (100%)	87 A (100%)	87 A (100%)	87 A (100%)	87 A (100%)	87 A (100%)	82.5 A (94.8%)	78 A (89.6%)	73.5 A (84.4%)	69 A (79.3%)	—
	FR5	170 A (100%)	170 A (100%)	170 A (100%)	170 A (100%)	170 A (100%)	170 A (100%)	170 A (100%)	157.5 A (92.6%)	145 A (85.2%)	132.5 A (77.9%)	120 A (70.5%)	—
	FR6	245 A (100%)	245 A (100%)	245 A (100%)	—	245 A (100%)	245 A (100%)	230 A (93.8%)	215 A (87.7%)	200 A (81.6%)	185 A (75.5%)	170 A (69.4%)	—
50 °C	FR0	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5 A (89.3%)
	FR1	7.6 A (100%)	7.6 A (100%)	7.6 A (100%)	7.6 A (100%)	7.6 A (100%)	7.2 A (95.7%)	6.9 A (91.4%)	6.6 A (87.1%)	6.2 A (82.8%)	5.9 A (78.5%)	5.6 A (74.2%)	5 A (65.7%)
	FR2	23 A (100%)	23 A (100%)	23 A (100%)	23 A (100%)	23 A (100%)	22 A (95.6%)	21 A (91.3%)	20 A (86.9%)	19 A (82.6%)	18 A (78.2%)	17 A (73.9%)	15 A (65.2%)
	FR3	46 A (100%)	46 A (100%)	46 A (100%)	46 A (100%)	46 A (100%)	43.5 A (94.5%)	41 A (89.1%)	38.5 A (83.6%)	36 A (78.2%)	33.5 A (72.8%)	31 A (67.3%)	26 A (56.5%)
	FR4	87 A (100%)	87 A (100%)	87 A (100%)	87 A (100%)	85.2 A (97.9%)	80.8 A (92.9%)	76.5 A (87.9%)	72.1 A (82.9%)	67.7 A (77.8%)	63.3 A (72.8%)	59 A (67.8%)	—
	FR5	170 A (100%)	170 A (100%)	170 A (100%)	170 A (100%)	165 A (97%)	152.5 A (89.7%)	140 A (82.3%)	127.5 A (75%)	115 A (67.6%)	102.5 A (60.2%)	90 A (52.9%)	—
	FR6	245 A (100%)	245 A (100%)	245 A (100%)	—	227 A (92.6%)	209 A (85.3%)	191 A (77.9%)	173 A (70.6%)	155 A (63.2%)	137 A (55.9%)	119 A (48.6%)	—
60 °C	FR0	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	5.6 A (100%)	4.6 A (82.1%)
	FR1	7 A (92.1%)	7 A (92.1%)	7 A (92.1%)	7 A (92.1%)	7 A (92.1%)	6.6 A (87.1%)	6.2 A (82.2%)	5.8 A (77.2%)	5.4 A (72.3%)	5.1 A (67.3%)	4.7 A (62.4%)	4 A (52.6%)
	FR2	18 A (78.2%)	18 A (78.2%)	18 A (78.2%)	18 A (78.2%)	18 A (78.2%)	17 A (73.9%)	16 A (69.5%)	15 A (65.2%)	14 A (60.8%)	13 A (56.5%)	12 A (52.1%)	10 A (43.4%)
	FR3	37 A (80.4%)	37 A (80.4%)	37 A (80.4%)	37 A (80.4%)	37 A (80.4%)	35 A (76%)	33 A (71.7%)	31 A (67.3%)	29 A (63%)	27 A (58.6%)	25 A (54.3%)	21 A (45.6%)
	FR4	76 A (87.3%)	76 A (87.3%)	76 A (87.3%)	76 A (87.3%)	74.1 A (85.2%)	69.4 A (79.8%)	64.7 A (74.4%)	60 A (69%)	55.3 A (63.6%)	50.6 A (58.2%)	46 A (52.8%)	—
	FR5	140 A (82.3%)	140 A (82.3%)	140 A (82.3%)	140 A (82.3%)	135.6 A (79.7%)	124.6 A (73.3%)	113.7 A (66.9%)	102.8 A (60.4%)	91.8 A (54%)	80.9 A (47.6%)	70 A (41.1%)	—
	FR6	240 A (97.9%)	222 A (90.6%)	204 A (83.3%)	—	186 A (75.9%)	168 A (68.6%)	150 A (61.2%)	132 A (53.9%)	114 A (46.5%)	96 A (39.2%)	78 A (31.8%)	—

Notes: ① Operation above 100Hz might require specific derating.
② For higher output frequencies, please contact your local Eaton office.

Table 53. 600 V temperature deratings (VT)

Shading indicates default switching frequency for each frame size.

Variable torque (VT)/ low overload (I_L)		Maximum rated current (A), percentage of rated current						
		Switching frequency						
Temperature	**Frame size**	**1 kHz**	**1.5 kHz**	**2 kHz**	**3 kHz**	**4 kHz**	**5 kHz**	**6 kHz**
40 °C	FR1	10 A (100%)	10 A (100%)	10 A (100%)	10 A (100%)	8 A (80%)	6 A (60%)	4 A (40%)
	FR2	22 A (100%)	22 A (100%)	22 A (100%)	22 A (100%)	19.5 A (88.6%)	16.9 A (77.2%)	14.5 A (65.9%)
	FR3	41 A (100%)	41 A (100%)	41 A (100%)	41 A (100%)	37.9 A (92.6%)	35 A (85.3%)	32 A (78%)
	FR4	80 A (100%)	80 A (100%)	80 A (100%)	80 A (100%)	70 A (87.5%)	60 A (75%)	50 A (62.5%)
	FR5	144 A (100%)	144 A (100%)	144 A (100%)	123.9 A (86.1%)	103.9 A (72.2%)	83.9 A (58.3%)	63.9 A (44.4%)
	FR6	250 (100%)	250 (100%)	234 A (93.6%)	202 A (80.8%)	170 A (68%)	138 A (55.2%)	106 (42.4%)
50 °C	FR1	8 A (80%)	8 A (80%)	8 A (80%)	8 A (80%)	6.5 A (65%)	5 A (50%)	3.5 A (35%)
	FR2	18 A (81.8%)	18 A (81.8%)	18 A (81.8%)	18 A (81.8%)	16 A (72.7%)	14 A (63.6%)	12 A (54.5%)
	FR3	34 A (82.9%)	34 A (82.9%)	34 A (82.9%)	34 A (82.9%)	31 A (75.6%)	27.9 A (68.2%)	25 A (60.9%)
	FR4	70 A (87.5%)	70 A (87.5%)	70 A (87.5%)	70 A (87.5%)	59.6 A (74.5%)	49.2 A (61.5%)	38.8 A (48.5%)
	FR5	125 A (86.8%)	125 A (86.8%)	125 A (86.8%)	108 A (75%)	90.9 A (63.1%)	74 A (51.3%)	56.9 A (39.5%)
	FR6	208 (83.2%)	208 (83.2%)	192 A (76.8%)	160 A (64%)	128 A (51.2%)	96 A (38.4%)	64 (25.6%)
60 °C	FR1	5.3 A (53%)	5.3 A (53%)	5.3 A (53%)	5.3 A (53%)	4.4 A (44%)	3.5 A (35%)	2.6 A (26%)
	FR2	13 A (59.1%)	13 A (59.1%)	13 A (59.1%)	13 A (59.1%)	11 A (50%)	9 A (40.9%)	7 A (31.8%)
	FR3	27 A (65.9%)	27 A (65.9%)	27 A (65.9%)	27 A (65.9%)	23 A (56.1%)	18.9 A (46.3%)	15 A (36.5%)
	FR4	58 A (72.5%)	58 A (72.5%)	58 A (72.5%)	58 A (72.5%)	49.6 A (62%)	41.2 A (51.5%)	32.8 A (41%)
	FR5	105 A (72.9%)	105 A (72.9%)	105 A (72.9%)	90 A (62.5%)	75 A (52%)	60 A (41.6%)	45 A (31.2%)
	FR6	203 (81.2%)	188 (75.2%)	173 A (69.2%)	143 A (57.2%)	113 A (45.2%)	83 A (33.2%)	53 (21.2%)

Notes: ① Operation above 100Hz might require specific derating.
② For higher output frequencies, please contact your local Eaton office.

Table 54. 600 V temperature deratings (CT)

Shading indicates default switching frequency for each frame size.

Constant torque (CT)/ high overload (I_H)		**Maximum rated current (A), percentage of rated current**						
		Switching frequency						
Temperature	**Frame Size**	**1 kHz**	**1.5 kHz**	**2.5 kHz**	**3.5 kHz**	**4.5 kHz**	**5.5 kHz**	**6 kHz**
40 °C	FR1	7.5 A (100%)	7.5 A (100%)	7.5 A (100%)	7.5 A (100%)	7.5 A (100%)	6 A (80%)	4.5 A (60%)
	FR2	18 A (100%)	18 A (100%)	18 A (100%)	18 A (100%)	18 A (100%)	16.2 A (90%)	14.5 A (80.5%)
	FR3	34 A (100%)	34 A (100%)	34 A (100%)	34 A (100%)	34 A (100%)	34 A (100%)	32 A (94.1%)
	FR4	62 A (100%)	62 A (100%)	62 A (100%)	62 A (100%)	62 A (100%)	62 A (100%)	50 A (80.6%)
	FR5	125 A (100%)	125 A (100%)	125 A (100%)	124 A (99.2%)	104 A (83.2%)	84 A (67.2%)	64 A (51.2%)
	FR6	208 (100%)	208 (100%)	208 (100%)	181 (87%)	154 (74%)	127 (61.1%)	113.5 (54.6%)
50 °C	FR1	7.5 A (100%)	7.5 A (100%)	7.5 A (100%)	7.5 A (100%)	6 A (80%)	4.5 A (60%)	3 A (40%)
	FR2	18 A (100%)	18 A (100%)	18 A (100%)	18 A (100%)	16 A (88.8%)	14 A (77.7%)	12 A (66.6%)
	FR3	34 A (100%)	34 A (100%)	34 A (100%)	34 A (100%)	31 A (91.1%)	28 A (82.3%)	25 A (73.5%)
	FR4	62 A (100%)	62 A (100%)	62 A (100%)	62 A (100%)	52.7 A (85%)	43.4 A (70%)	34.1 A (55%)
	FR5	125 A (100%)	125 A (100%)	125 A (100%)	108 A (86.4%)	91 A (72.8%)	74 A (59.2%)	57 A (45.6%)
	FR6	208 (100%)	208 (100%)	176 (84.6%)	144 (69.2%)	112 (53.8%)	80 (38.5%)	64 (30.8%)
60 °C	FR1	5.3 A (70.6%)	5.3 A (70.6%)	5.3 A (70.6%)	5.3 A (70.6%)	4.4 A (58.6%)	3.5 A (46.6%)	2.6 A (34.6%)
	FR2	13 A (72.2%)	13 A (72.2%)	13 A (72.2%)	13 A (72.2%)	11 A (61.1%)	9 A (50%)	7 A (38.8%)
	FR3	27 A (79.4%)	27 A (79.4%)	27 A (79.4%)	27 A (79.4%)	23 A (67.6%)	19 A (55.8%)	15 A (44.1%)
	FR4	50.8 A (82%)	50.8 A (82%)	50.8 A (82%)	50.8 A (82%)	44 A (71%)	37.2 A (60%)	30.3 A (49%)
	FR5	105 A (84%)	105 A (84%)	105 A (84%)	90 A (72%)	75 A (60%)	60 A (48%)	45 A (36%)
	FR6	203 (97.6%)	188 (90.4%)	158 (76%)	128 (61.5%)	98 (47.1%)	68 (32.7%)	53 (25.5%)

Notes: ① Operation above 100Hz might require specific derating.
② For higher output frequencies, please contact your local Eaton office.

Heat loss data

Table 55. 230 V heat loss data

Frame size	CT Amp Suffix	VT Amp Suffix	230 V, 60 Hz VT/I_L (110%) Pv (W)	230 V, 60 Hz CT/I_H (150%) Pv (W)
0	3D7	4D8	53	43
	4D8	6D6	73	50
	6D6	7D8	88	70
1	3D7	4D8	63	46
	4D8	6D6	78	60
	6D6	7D8	89	77
	7D8	011	108	86
	011	012	129	103
2	012	017	163	111
	017	025	229	165
	025	031	315	214
3	031	048	445	239
	048	061	602	425
4	061	075	689	524
	075	088	830	689
	088	114	1167	830
5	114	143	1077	810
	143	170	1336	1077
	170	211	1724	1336
6	211	261	2191	1698
	248	312	2736	2053

Table 56. 400 V heat loss data

			400 V, 50 Hz		460 V, 60 Hz	
Frame size	CT Amp Suffix	VT Amp Suffix	VT/I_L (110%) Pv (W)	CT/I_H (150%) Pv (W)	VT/I_L (110%) Pv (W)	CT/I_H (150%) Pv (W)
0	2D2	3D3	49	33	58	37
	3D3	4D3	61	46	73	53
	4D3	5D6	82	58	99	66
	5D6	7D6	115	77	139	90
1	2D2	3D3	59	49	56	48
	3D3	4D3	73	60	71	59
	4D3	5D6	86	75	83	71
	5D6	7D6	105	83	109	82
	7D6	9D0	130	103	112	99
	9D0	012	167	129	156	104
2	012	016	191	121	189	113
	016	023	293	168	242	169
	023	031	421	268	365	228
3	031	038	471	361	433	349
	038	046	575	433	499	394
	046	061	818	541	671	451
4	061	072	758	631	706	539
	072	087	914	758	851	706
	087	105	1217	914	1187	852
5	105	140	1289	918	1112	901
	140	170	1594	1289	1399	1112
	170	205	2024	1594	1759	1399
6	205	261	2620	1960	2340	1750
	245	310	3280	2420	3120	2330

Table 57. 600 V heat loss data

Frame size	CT Amp suffix	VT Amp suffix	600 V, 60 Hz VT/I_L (110%) Pv (W)	CT/I_H (150%) Pv (W)
FR1	3D3	4D5	94	70
	4D5	7D5	118	92
	7D5	010	177	147
FR2	010	013	221	153
	013	018	303	221
	018	022	391	303
FR3	022	027	451	350
	027	034	512	363
	034	041	633	548
FR4	041	052	738	586
	052	062	884	743
	062	080	1187	894
FR5	080	100	1149	842
	100	125	1390	1055
	125	144	1627	1304
FR6	144	208	2502	1688
	208	250	3165	2506

Table 58. 230 V idle heat loss FR0~FR6

	Heat loss (W)					
	IP54 version		IP21 version		IP20 version	
Frame size	Fans start	Fans stop	Fans start	Fans stop	Fans start	Fans stop
FR0	—	—	—	—	11	8.45
FR1	17.56	15.33	17.56	15.33	—	—
FR2	30.46	18.97	28.23	16.62	—	—
FR3	46.16	18.15	46.16	18.15	—	—
FR4	74.28	17.1	74.28	17.1	—	—
FR5	87.17	19.32	87.17	19.32	—	—
FR6	299.29	59.17	299.29	59.17	—	—

Table 59. 480 V idle heat loss FR0~FR6

	Heat loss (W)					
	IP54 version		IP21 version		IP20 version	
Frame size	Fans start	Fans stop	Fans start	Fans stop	Fans start	Fans stop
FR0	—	—	—	—	13.9	11.4
FR1	20.49	17.33	17.56	15.1	—	—
FR2	29.76	19.5	24.89	15.75	—	—
FR3	46.63	24.12	46.63	24.12	—	—
FR4	79.67	24.42	79.67	24.42	—	—
FR5	102.83	30.74	102.83	30.74	—	—
FR6	305.9	62.45	305.9	62.45	—	—

Table 60. 575 V idle heat loss FR1~FR6

	Heat loss (W)			
	IP54 version		IP21 version	
Frame size	Fans start	Fans stop	Fans start	Fans stop
FR1	22.2	18.96	20.97	18.08
FR2	33.56	23.19	32.09	20.96
FR3	52.96	26.41	52.96	26.41
FR4	84.42	24.65	84.42	24.65
FR5	97.37	27.23	97.37	27.23
FR6	317.63	84.3	317.63	84.3

Brake resistor sizing

Table 61. Brake resistor sizing data

	230 V		460 V		600 V	
Frame size	Brake chopper nominal current at 80 °C (A)	Minimum resistance (Ohm)	Brake chopper nominal current at 80 °C (A)	Minimum resistance (Ohm)	Brake chopper nominal current at 80 °C (A)	Minimum resistance (Ohm)
FR0	20	30	18	63	—	—
FR1	30.0	30.0	25.0	63.0	26.0	100.0
FR2	78.0	20.0	78.0	42.0	41.0	30.0
FR3	100.0	10.0	100.0	14.0	100.0	18.0
FR4	200.0	3.3	200.0	6.5	200.0	9.0
FR5	400.0	1.4	450.0	3.3	400.0	7.0
FR6	600	1.4	600	3.3	450	2.5

Efficiency ratings

Table 62. 230 V FR0-Xhp efficiency rating

230 V FR0-Xhp

	25%Torque						50%Torque						100%Torque					
	Pin (kW)	**Pout (kW)**	**Ploss (kW)**	**Ploss (%)**	**Power factor output**	**Efficiency (%)**	**Pin (kW)**	**Pout (kW)**	**Ploss (kW)**	**Ploss (%)**	**Power factor output**	**Efficiency (%)**	**Pin (kW)**	**Pout (kW)**	**Ploss (kW)**	**Ploss (%)**	**Power factor output**	**Efficiency (%)**
10%Speed	0.15007	0.10759	0.04248	28.31%	0.40878	71.69%	0.20843	0.17042	0.03801	18.24%	0.5486	81.76%	0.34187	0.2867	0.05517	16.14%	0.6629	83.86%
50%Speed	0.39832	0.35507	0.04325	10.86%	0.298	89.14%	0.6099	0.56306	0.04684	7.68%	0.451	92.32%	1.07267	1.00629	0.06638	6.19%	0.6678	93.81%
90%Speed	0.61219	0.56622	0.04597	7.51%	0.259	92.49%	0.96485	0.91007	0.05478	5.68%	0.397	94.32%	1.70079	1.63519	0.0656	3.86%	0.60754	96.14%
100%Speed	0.6592	0.6094	0.0498	7.55%	0.25	92.45%	1.0525	0.99872	0.05378	5.11%	0.391	94.89%	1.8725	1.80729	0.06521	3.48%	0.602	96.52%

Table 63. 230 V FR1-4hp efficiency rating

230 V FR1-4hp

	25%Torque						50%Torque						100%Torque					
	Pin (kW)	**Pout (kW)**	**Ploss (kW)**	**Ploss (%)**	**Power factor output**	**Efficiency (%)**	**Pin (kW)**	**Pout (kW)**	**Ploss (kW)**	**Ploss (%)**	**Power factor output**	**Efficiency (%)**	**Pin (kW)**	**Pout (kW)**	**Ploss (kW)**	**Ploss (%)**	**Power factor output**	**Efficiency (%)**
10%Speed	0.189	0.136	0.053	28.04%	0.469	71.89%	0.277	0.216	0.061	22.02%	0.603	77.89%	0.514	0.43	0.084	16.34%	0.74	83.65%
50%Speed	0.677	0.616	0.061	9.01%	0.39	90.98%	1.078	1.001	0.077	7.14%	0.568	92.01%	2.029	1.93	0.099	4.88%	0.773	95.18%
90%Speed	1.169	1.105	0.064	5.47%	0.386	94.54%	1.994	1.913	0.081	4.06%	0.581	95.95%	3.53	3.412	0.118	3.34%	0.762	96.61%
100%Speed	1.269	1.201	0.068	5.36%	0.379	94.68%	2.119	2.034	0.085	4.01%	0.564	96.02%	3.91	3.786	0.124	3.17%	0.761	96.72%

Note: All 10% speed is taken at 5Hz.

Table 64. 230 V FR2-10hp efficiency rating

230 V FR2-10hp

	25%Torque						50%Torque						100%Torque					
	Pin (kW)	**Pout (kW)**	**Ploss (kW)**	**Ploss (%)**	**Power factor output**	**Efficiency (%)**	**Pin (kW)**	**Pout (kW)**	**Ploss (kW)**	**Ploss (%)**	**Power factor output**	**Efficiency (%)**	**Pin (kW)**	**Pout (kW)**	**Ploss (kW)**	**Ploss (%)**	**Power factor output**	**Efficiency (%)**
10%Speed	0.387	0.304	0.083	21.45%	0.607	78.42%	0.703	0.588	0.115	16.36%	0.74	83.68%	1.699	1.465	0.234	13.77%	0.82	86.26%
50%Speed	1.488	1.376	0.112	7.53%	0.561	92.46%	2.77	2.659	0.111	4.01%	0.769	96.00%	5.637	5.391	0.246	4.36%	0.866	95.64%
90%Speed	2.635	2.535	0.1	3.80%	0.553	96.21%	4.776	4.642	0.134	2.81%	0.76	97.19%	9.346	9.061	0.285	3.05%	0.87	96.96%
100%Speed	2.847	2.746	0.101	3.55%	0.638	96.45%	5.222	5.073	0.149	2.85%	0.817	97.15%	10.556	10.225	0.331	3.14%	0.871	96.86%

Note: All 10% speed is taken at 5Hz.

Table 65. 230 V FR3-20hp efficiency rating

230 V FR3-20hp

	25%Torque						50%Torque						100%Torque					
	Pin (kW)	**Pout (kW)**	**Ploss (kW)**	**Ploss (%)**	**Power factor output**	**Efficiency (%)**	**Pin (kW)**	**Pout (kW)**	**Ploss (kW)**	**Ploss (%)**	**Power factor output**	**Efficiency (%)**	**Pin (kW)**	**Pout (kW)**	**Ploss (kW)**	**Ploss (%)**	**Power factor output**	**Efficiency (%)**
10%Speed	0.732	0.589	0.143	19.54%	0.605	80.33%	1.448	1.241	0.207	14.30%	0.777	85.74%	2.085	1.798	0.287	13.76%	0.761	86.22%
50%Speed	2.62	2.46	0.16	6.11%	0.527	93.57%	5.16	4.92	0.24	4.65%	0.766	95.32%	10.54	10.06	0.48	4.55%	0.877	95.45%
90%Speed	4.656	4.464	0.192	4.12%	0.521	95.88%	8.836	8.56	0.276	3.12%	0.745	96.87%	17.55	17.001	0.549	3.13%	0.869	96.86%
100%Speed	5.224	5.031	0.193	3.69%	0.525	96.30%	9.885	9.606	0.279	2.82%	0.767	97.16%	19.544	18.936	0.608	3.11%	0.882	96.88%

Note: All 10% speed is taken at 5Hz.

Table 66. 230 V FR4-40hp efficiency rating

	230 V FR4-40hp																	
	25%Torque						50%Torque						100%Torque					
	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
10%Speed	1.113	0.87	0.243	21.83%	0.559	78.23%	1.996	1.67	0.326	16.33%	0.719	83.69%	3.892	3.354	0.538	13.82%	0.798	86.18%
50%Speed	4.628	4.34	0.288	6.22%	0.572	93.78%	9.195	8.772	0.423	4.60%	0.7896	95.39%	17.93	17.12	0.81	4.52%	0.867	95.48%
90%Speed	8.046	7.735	0.311	3.87%	0.565	96.13%	16.095	15.622	0.473	2.94%	0.784	97.06%	32.156	31.208	0.948	2.95%	0.872	97.05%
100%Speed	8.929	8.608	0.321	3.60%	0.562	96.41%	17.67	17.19	0.48	2.72%	0.781	97.29%	35.17	34.214	0.956	2.72%	0.877	97.28%

Note: All 10% speed is taken at 5Hz.

Table 67. 230 V FR5-75hp efficiency rating

	230 V FR5-75hp																	
	25%Torque						50%Torque						100%Torque					
	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
10%Speed	1.955	1.604	0.351	17.95%	0.566	82.05%	3.922	3.413	0.723	18.43%	87.027	86.23%	8.176	7.279	0.897	10.97%	0.792	89.03%
50%Speed	8.33	7.926	0.404	4.85%	0.619	95.12%	16.407	15.783	0.624	3.80%	0.817	96.20%	33.429	32.124	1.305	3.90%	0.884	96.10%
90%Speed	14.539	14.086	0.453	3.12%	0.611	96.89%	28.707	27.989	0.718	2.50%	0.814	97.50%	57.974	56.471	1.503	2.59%	0.887	97.41%
100%Speed	16.195	15.747	0.448	2.77%	0.641	97.23%	31.865	31.131	0.734	2.30%	0.835	97.71%	64.892	63.21	1.682	2.59%	0.892	97.41%

Note: All 10% speed is taken at 5Hz.

Table 68. 400 V FR0-Xhp efficiency rating

	400 V FR0-Xhp																	
	25%Torque						50%Torque						100%Torque					
	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
10%Speed	0.2597	0.2043	0.0554	21.33%	0.4867	78.67%	0.3677	0.3133	0.0544	14.79%	0.5958	85.21%	0.6045	0.5176	0.0869	14.38%	0.692	85.62%
50%Speed	0.7224	0.665	0.0574	7.95%	0.383	92.05%	1.1296	1.0713	0.0583	5.16%	0.5566	94.84%	1.9884	1.906	0.0824	4.14%	0.747	95.86%
90%Speed	1.2338	1.1782	0.0556	4.51%	0.37	95.49%	1.888	1.8193	0.0687	3.64%	0.518	96.36%	3.35	3.26	0.09	2.69%	0.715	97.31%
100%Speed	1.3748	1.3103	0.0645	4.69%	0.367	95.31%	2.1335	2.0663	0.0672	3.15%	0.526	96.85%	3.7081	3.6179	0.0902	2.43%	0.717	97.57%

Note: All 10% speed is taken at 5Hz.

Table 69. 400 V FR1-7.5hp efficiency rating

	400 V FR1-7.5hp																	
	25%Torque						50%Torque						100%Torque					
	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
10%Speed	0.31	0.254	0.056	18.06%	0.53	81.95%	0.588	0.515	0.073	12.41%	0.696	87.58%	1.016	0.912	0.104	10.24%	0.786	89.70%
50%Speed	1.02	0.957	0.063	6.18%	0.486	93.86%	1.803	1.716	0.087	4.83%	0.695	95.28%	3.494	3.37	0.124	3.55%	0.846	96.44%
90%Speed	1.738	1.665	0.073	4.20%	0.464	95.88%	3.097	3	0.097	3.13%	0.67	96.94%	6.011	5.85	0.161	2.68%	0.829	97.39%
100%Speed	1.934	1.861	0.073	3.77%	0.481	96.25%	3.448	3.356	0.092	2.67%	0.69	97.33%	6.366	6.213	0.153	2.40%	0.83	97.60%

Note: All 10% speed is taken at 5Hz.

Table 70. 400 V FR2-20hp efficiency rating

400 V FR2-20hp

	25%Torque						50%Torque						100%Torque					
	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
10%Speed	0.7	0.572	0.128	18.29%	0.531	81.66%	1.392	1.216	0.176	12.64%	0.708	87.33%	2.414	2.156	0.258	10.69%	0.797	89.31%
50%Speed	2.363	2.227	0.136	5.76%	0.485	94.23%	4.559	4.374	0.185	4.06%	0.727	95.93%	9.182	8.833	0.349	3.80%	0.865	96.20%
90%Speed	3.971	3.819	0.152	3.83%	0.461	96.16%	7.85	7.64	0.21	2.68%	0.708	97.41%	15.482	15.096	0.386	2.49%	0.855	97.51%
100%Speed	4.535	4.386	0.149	3.29%	0.499	96.72%	8.734	8.536	0.198	2.27%	0.74	97.73%	17.303	16.904	0.399	2.31%	0.868	97.69%

Note: All 10% speed is taken at 5Hz.

Table 71. 400 V FR3-40hp efficiency rating

400 V FR3-40hp

	25%Torque						50%Torque						100%Torque					
	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
10%Speed	1.043	0.858	0.185	17.74%	0.557	82.28%	1.886	1.65	0.236	12.51%	0.73	87.46%	3.629	3.239	0.39	10.75%	0.822	89.26%
50%Speed	4.666	4.451	0.215	4.61%	0.581	95.38%	9.156	8.834	0.322	3.52%	0.793	96.48%	18.174	17.534	0.64	3.52%	0.872	96.49%
90%Speed	8.142	7.9	0.242	2.97%	0.573	97.07%	16.09	15.716	0.374	2.32%	0.785	97.65%	31.707	30.968	0.739	2.33%	0.872	97.67%
100%Speed	8.982	8.742	0.24	2.67%	0.59	97.32%	17.734	17.359	0.375	2.11%	0.794	97.87%	34.785	34.04	0.745	2.14%	0.877	97.86%

Note: All 10% speed is taken at 5Hz.

Table 72. 400 V FR4-75hp efficiency rating

400 V FR4-75hp

	25%Torque						50%Torque						100%Torque					
	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
10%Speed	1.735	1.426	0.309	17.81%	0.588	82.17%	3.5	3.05	0.45	12.86%	0.779	87.38%	7.026	6.227	0.799	11.37%	0.837	88.63%
50%Speed	7.711	7.34	0.371	4.81%	0.598	95.19%	15.006	14.477	0.529	3.53%	0.808	96.48%	30.273	29.232	1.041	3.44%	0.885	96.56%
90%Speed	13.543	13.153	0.39	2.88%	0.593	97.12%	26.318	25.758	0.56	2.13%	0.799	97.87%	52.871	51.724	1.147	2.17%	0.886	97.83%
100%Speed	15.019	14.632	0.387	2.58%	0.624	97.43%	29.464	28.886	0.578	1.96%	0.819	98.04%	58.669	57.491	1.178	2.01%	0.89	97.99%

Note: All 10% speed is taken at 5Hz.

Table 73. 400 V FR5-150hp efficiency rating

400 V FR5-150hp

	25%Torque						50%Torque						100%Torque					
	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
10%Speed	2.833	2.382	0.451	15.92%	0.689	84.00%	5.823	5.13	0.693	11.90%	0.817	88.10%	12.051	10.758	1.293	10.73%	0.852	89.27%
50%Speed	14.992	14.456	0.536	3.58%	0.745	96.43%	32.798	31.858	0.94	2.87%	0.899	97.13%	64.38	62.431	1.949	3.03%	0.919	96.97%
90%Speed	28.276	27.675	0.601	2.13%	0.759	97.87%	59.715	58.641	1.074	1.80%	0.902	98.20%	111.45	109.307	2.143	1.92%	0.925	98.08%
100%Speed	30.607	30.022	0.585	1.91%	0.763	98.09%	63.925	62.905	1.02	1.60%	0.904	98.41%	120.93	118.876	2.054	1.70%	0.926	98.30%

Note: All 10% speed is taken at 5Hz.

Table 74. 575 V FR1-7.5hp efficiency rating

	575 V FR1-7.5hp																	
	25%Torque						50%Torque						100%Torque					
	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
10%Speed	0.29	0.222	0.068	23.45%	0.45	76.28%	0.486	0.425	0.061	12.55%	0.622	87.46%	0.91	0.817	0.093	10.22%	0.737	89.80%
50%Speed	1.175	1.111	0.064	5.45%	0.44	94.56%	2.099	2.024	0.075	3.57%	0.644	96.43%	4.008	3.898	0.11	2.74%	0.803	97.42%
90%Speed	2.036	1.95	0.086	4.22%	0.424	96.36%	3.619	3.542	0.077	2.13%	0.626	97.87%	6.872	6.75	0.122	1.78%	0.787	98.24%
100%Speed	2.23	2.161	0.069	3.09%	0.457	96.83%	4.415	4.058	0.357	8.09%	0.672	97.88%	8.01	7.871	0.139	1.74%	0.816	98.25%

Note: All 10% speed is taken at 5Hz.

Table 75. 575 V FR2-20hp efficiency rating

	575 V FR2-20hp																	
	25%Torque						50%Torque						100%Torque					
	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
10%Speed	0.523	0.424	0.099	18.93%	0.586	81.06%	1.07	0.949	0.121	11.31%	0.633	88.48%	2.123	1.942	0.181	8.53%	0.754	91.47%
50%Speed	2.906	2.791	0.115	3.96%	0.509	96.05%	4.895	4.751	0.144	2.94%	0.693	97.05%	9.638	9.401	0.237	2.46%	0.845	97.40%
90%Speed	5.12	4.995	0.125	2.44%	0.506	97.33%	8.659	8.497	0.162	1.87%	0.686	98.13%	16.767	16.482	0.285	1.70%	0.832	98.30%
100%Speed	5.601	5.477	0.124	2.21%	0.533	97.74%	9.51	9.35	0.16	1.68%	0.715	98.32%	18.33	18.04	0.29	1.58%	0.842	98.41%

Note: All 10% speed is taken at 5Hz.

Table 76. 575 V FR3-40hp efficiency rating

	575 V FR3-40hp																	
	25%Torque						50%Torque						100%Torque					
	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
10%Speed	1.869	1.582	0.287	15.36%	0.569	84.63%	3.331	2.964	0.367	11.02%	0.732	88.97%	6.443	5.835	0.608	9.44%	0.826	90.56%
50%Speed	9.647	9.309	0.338	3.50%	0.566	96.50%	18.148	17.68	0.468	2.58%	0.777	97.42%	33.857	33.074	0.783	2.31%	0.87	97.69%
90%Speed	16.319	15.945	0.374	2.29%	0.551	97.71%	30.83	30.33	0.5	1.62%	0.759	98.40%	60.187	59.266	0.921	1.53%	0.866	98.47%
100%Speed	17.841	17.467	0.374	2.10%	0.584	97.91%	33.966	33.441	0.525	1.55%	0.79	98.46%	65.644	64.709	0.935	1.42%	0.876	98.58%

Note: All 10% speed is taken at 5Hz.

Table 77. 575 V FR4-75hp efficiency rating

575 V FR4-75hp	25%Torque						50%Torque						100%Torque					
	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
10%Speed	0.959	0.768	0.191	19.92%	0.347	80.03%	1.648	1.43	0.218	13.23%	0.516	86.61%	3.23	2.93	0.3	9.29%	0.686	90.72%
50%Speed	4.49	4.27	0.22	4.90%	0.318	95.01%	7.994	7.728	0.266	3.33%	0.514	96.80%	15.82	15.45	0.37	2.34%	0.745	97.66%
90%Speed	7.634	7.424	0.21	2.75%	0.406	97.24%	13.928	13.665	0.263	1.89%	0.626	98.11%	28.16	27.682	0.478	1.70%	0.821	98.42%
100%Speed	8.35	8.13	0.22	2.63%	0.485	97.31%	15.371	15.1	0.271	1.76%	0.703	98.23%	31.148	30.664	0.484	1.55%	0.846	98.45%

Note: All 10% speed is taken at 5Hz.

Table 78. 575 V FR5-150hp efficiency rating

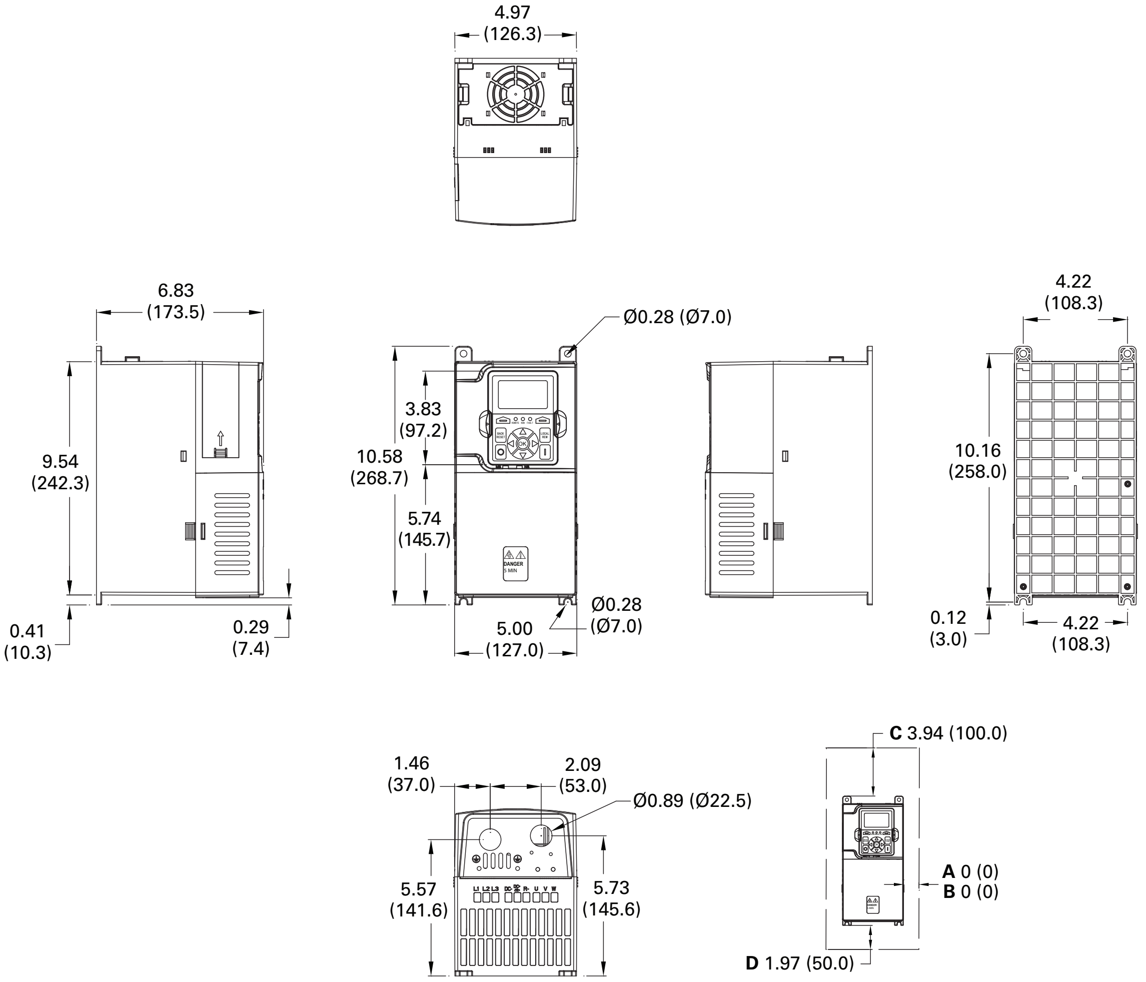
575 V FR5-150hp	25%Torque						50%Torque						100%Torque					
	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)	Pin (kW)	Pout (kW)	Ploss (kW)	Ploss (%)	Power factor output	Efficiency (%)
10%Speed	3.157	2.692	0.465	14.73%	0.594	85.30%	5.838	5.19	0.648	11.10%	0.753	88.91%	11.696	10.562	1.134	9.70%	0.826	90.30%
50%Speed	16.472	15.93	0.542	3.29%	0.582	96.71%	31.784	30.996	0.788	2.48%	0.785	97.52%	61.081	59.617	1.464	2.40%	0.872	97.60%
90%Speed	28.182	27.596	0.586	2.08%	0.569	97.92%	54.26	53.42	0.84	1.55%	0.773	98.45%	105.47	103.875	1.595	1.51%	0.866	98.49%
100%Speed	30.804	30.25	0.554	1.80%	0.614	98.22%	59.65	58.775	0.875	1.47%	0.802	98.53%	116.102	114.431	1.671	1.44%	0.873	98.56%

Note: All 10% speed is taken at 5Hz.

Appendix C—Dimension drawings

Approximate dimensions in inches (mm)

Figure 40. FR0 Dimension drawing

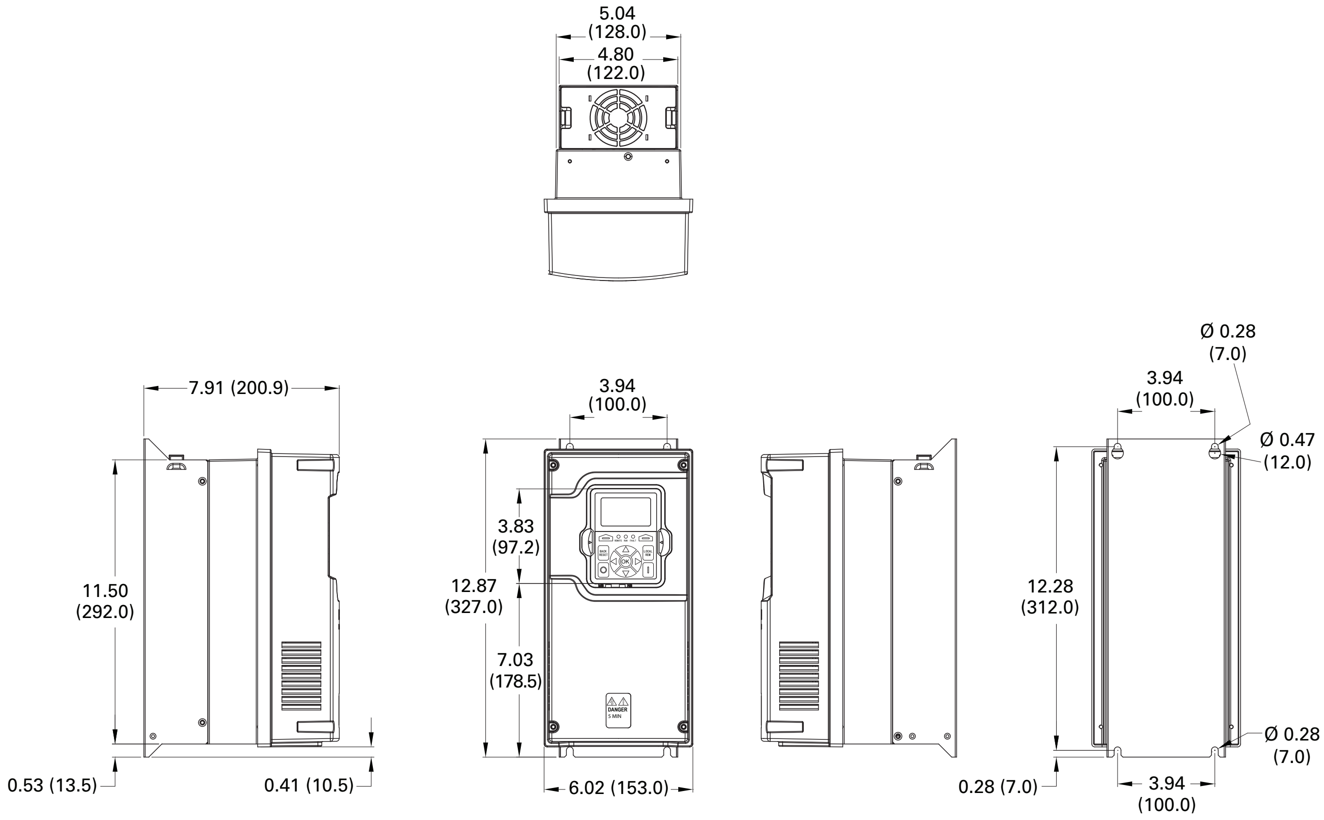


Minimum Dimensions

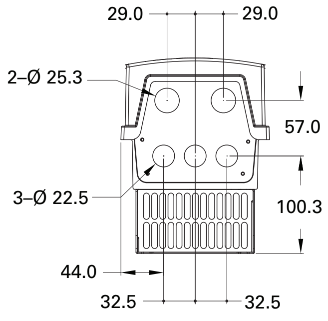
A = Air gap around drive
(between drive and cabinet)
B = Space between two drives
C = Free space above drive
D = Free space below drive

Approximate dimensions in inches (mm)

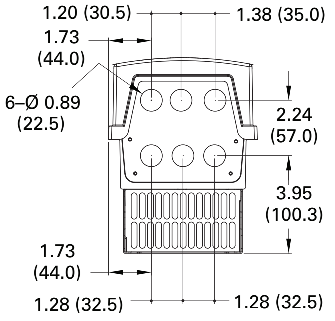
Figure 41. FR1 dimension drawing

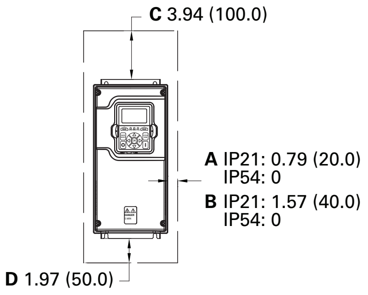


IP21/IP54 Metric



Type 1/12 UL



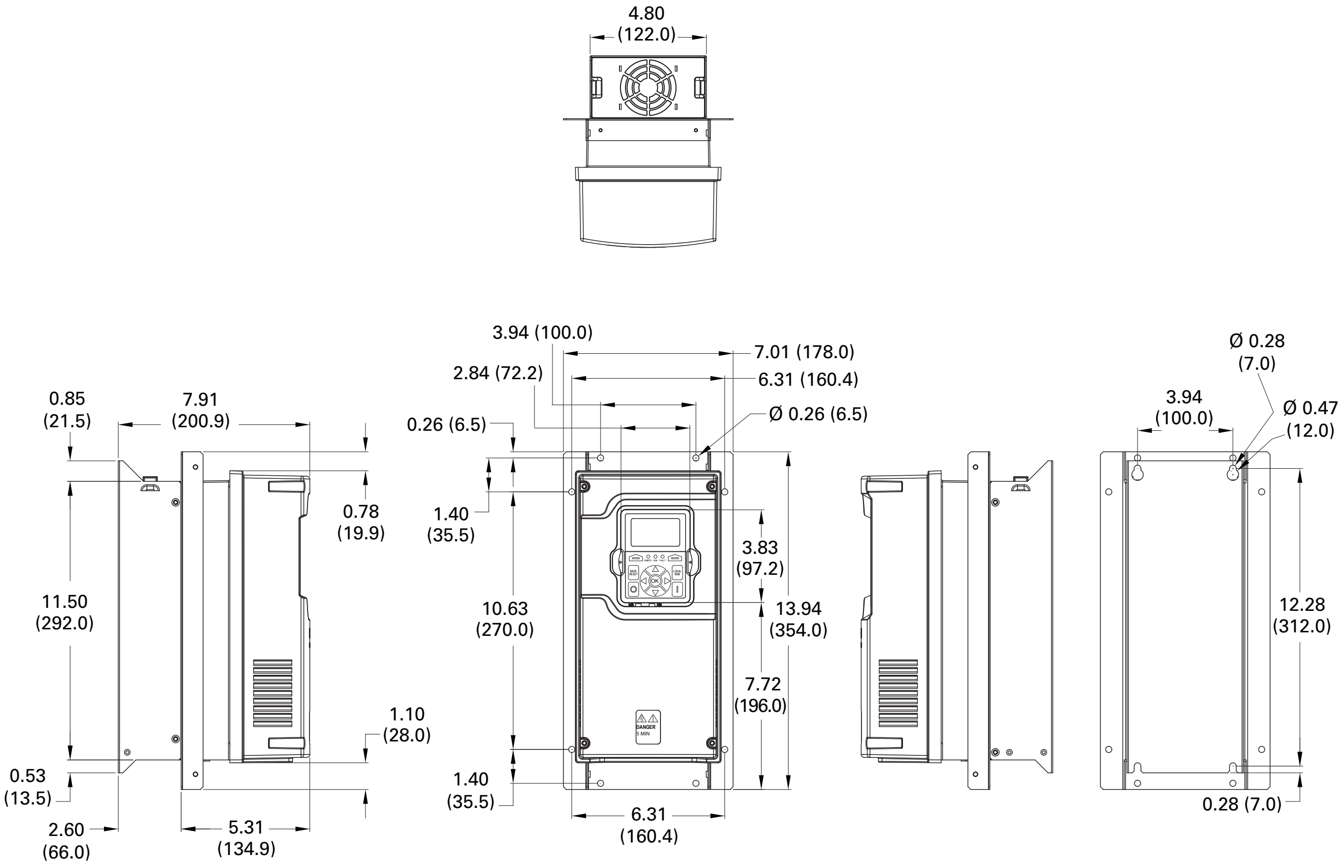


Minimum Dimensions

A = Air gap around drive (between drive and cabinet)
B = Space between two drives
C = Free space above drive
D = Free space below drive

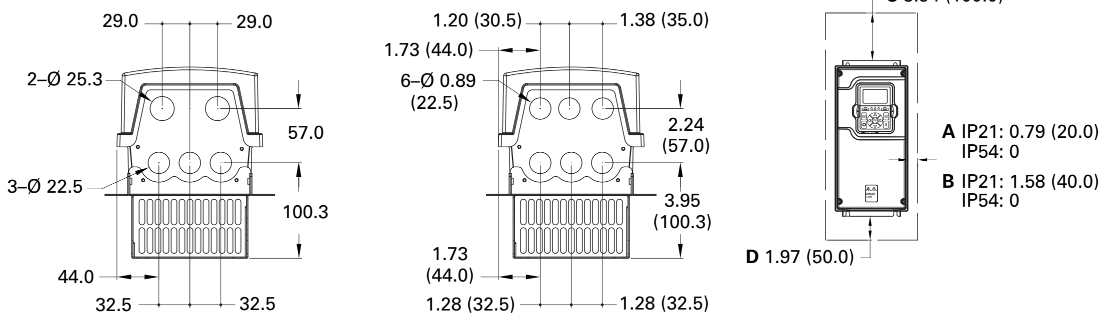
Approximate dimensions in inches (mm)

Figure 42. FR1 dimension drawing flange mount



IP21/IP54 Metric

Type 1/12 UL

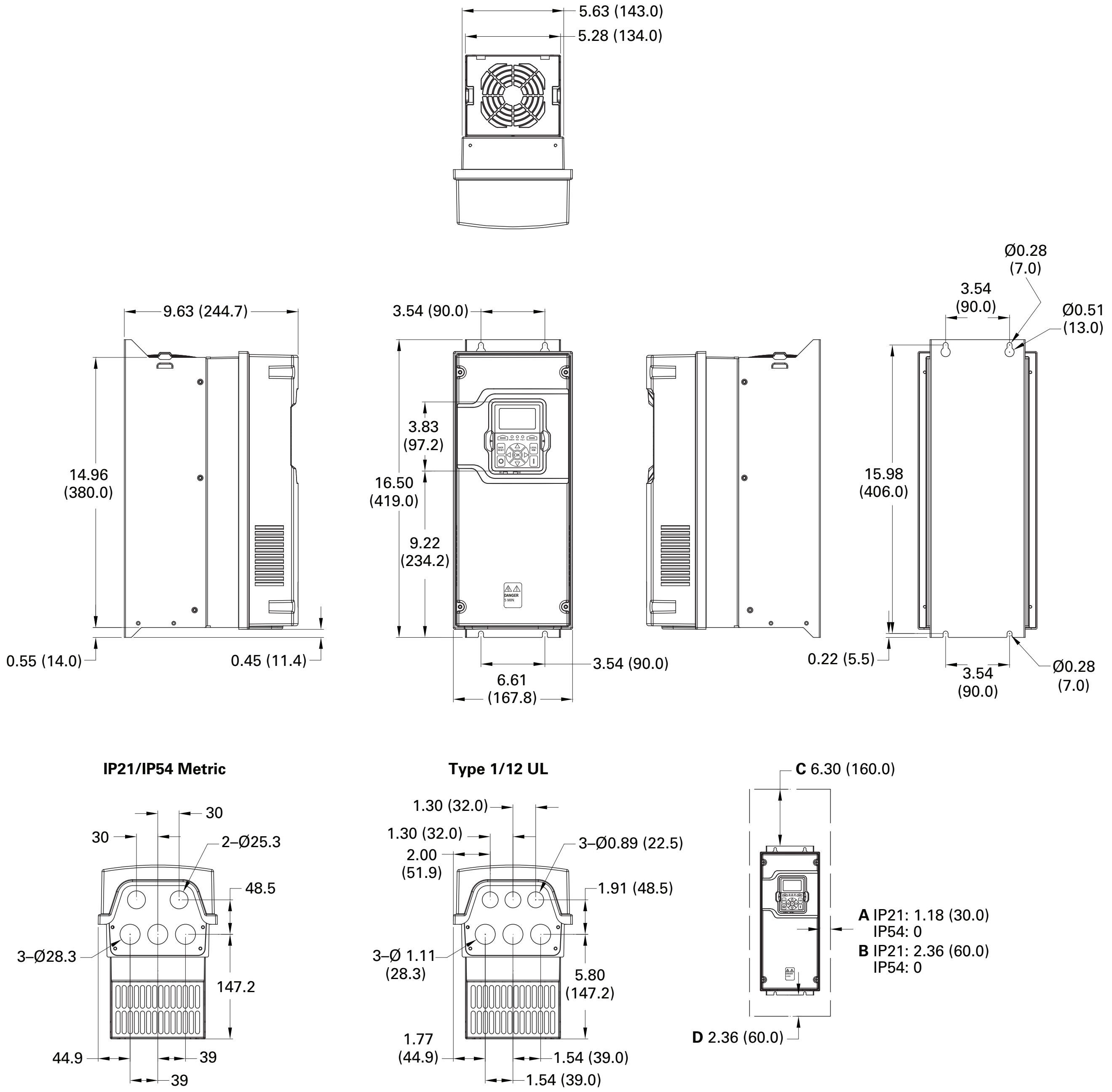


Minimum Dimensions

A = Air gap around drive
(between drive and cabinet)
B = Space between two drives
C = Free space above drive
D = Free space below drive

Approximate dimensions in inches (mm)

Figure 43. FR2 dimension drawing

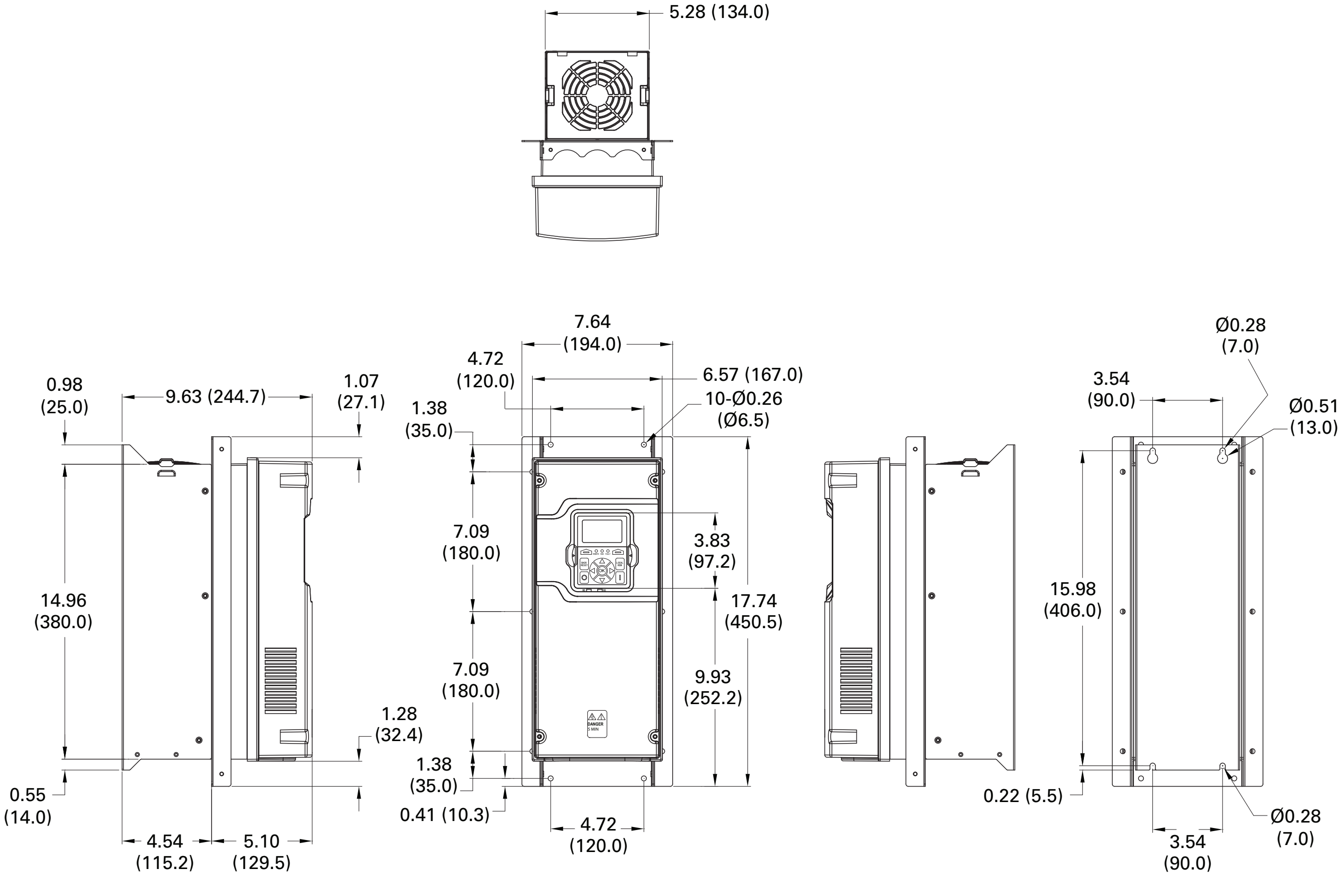


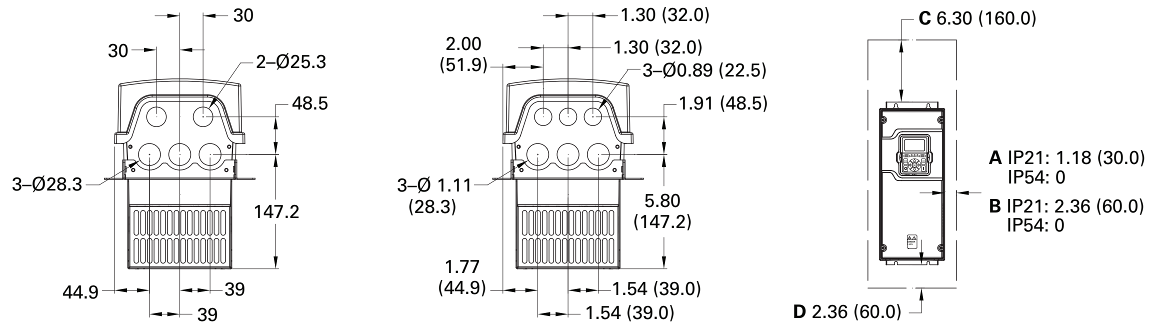
Minimum Dimensions

A = Air gap around drive (between drive and cabinet)
B = Space between two drives
C = Free space above drive
D = Free space below drive

Approximate dimensions in inches (mm)

Figure 44. FR2 dimension drawing flange mount



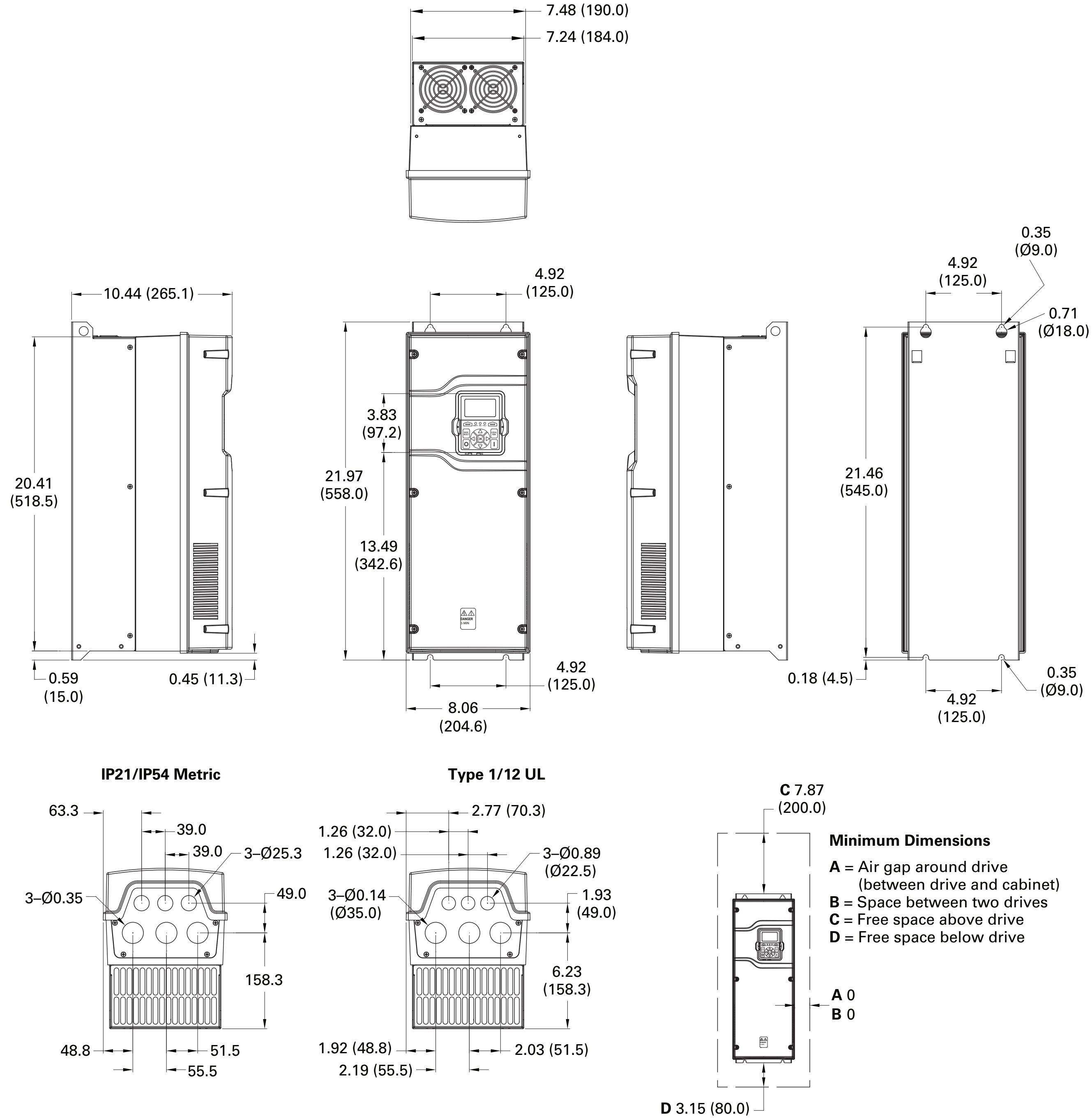


Minimum Dimensions

A = Air gap around drive (between drive and cabinet)
B = Space between two drives
C = Free space above drive
D = Free space below drive

Approximate dimensions in inches (mm)

Figure 45. FR3 dimension drawing

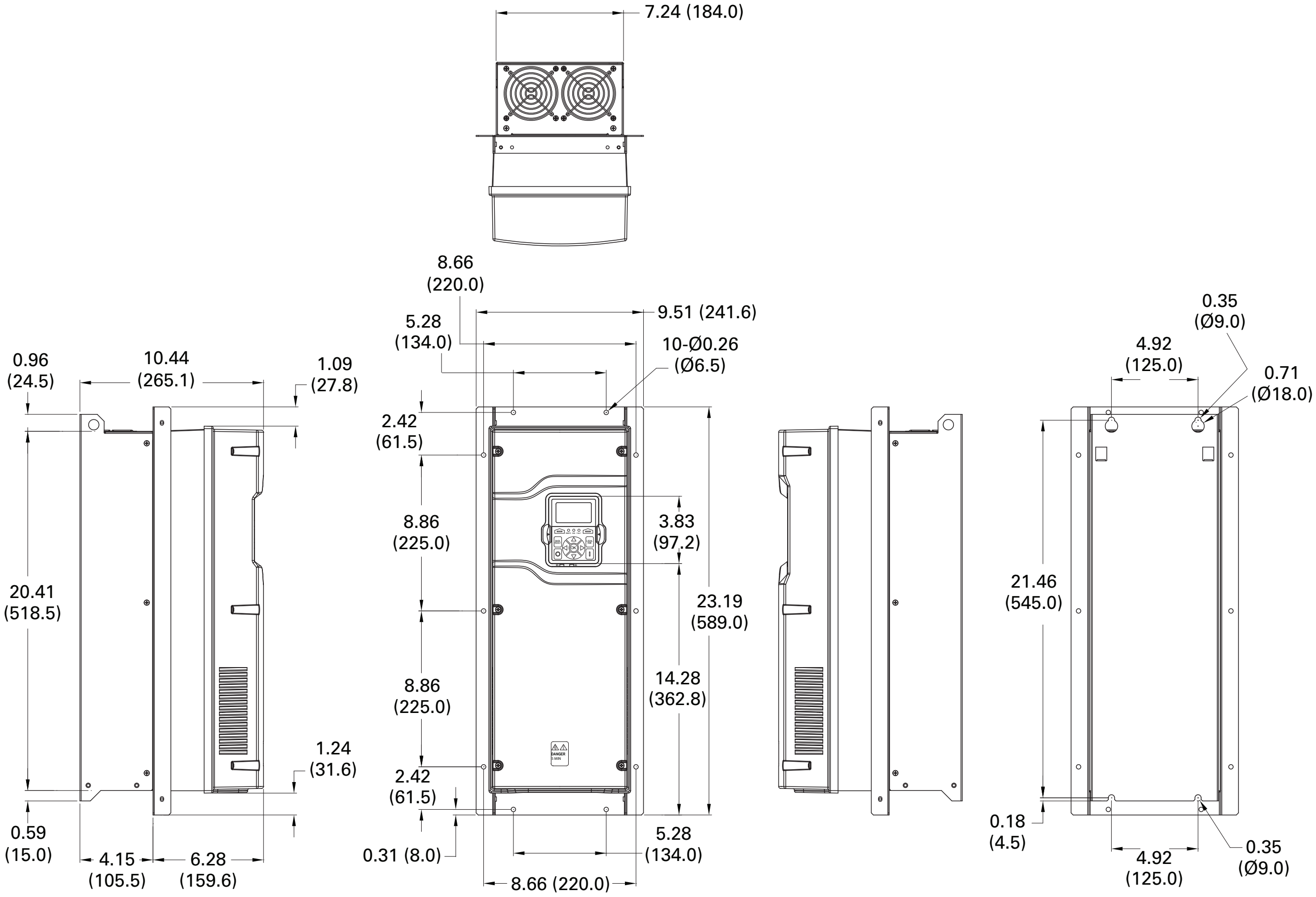


Minimum Dimensions

A = Air gap around drive (between drive and cabinet)
B = Space between two drives
C = Free space above drive
D = Free space below drive

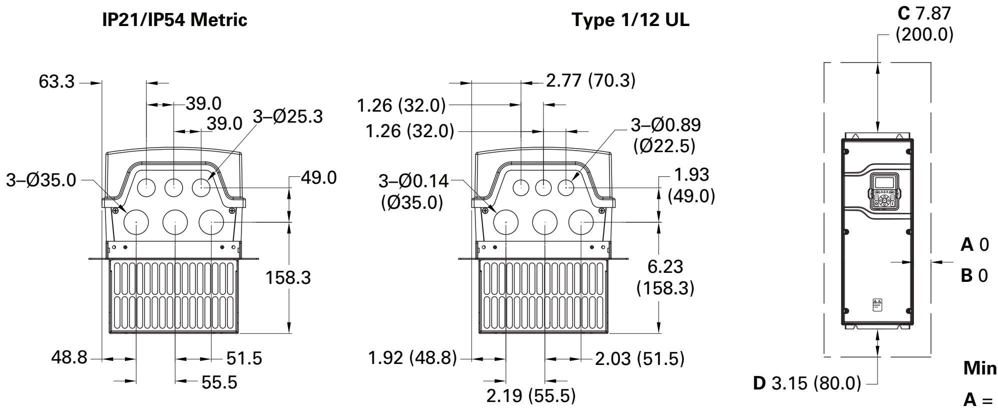
Approximate dimensions in inches (mm)

Figure 46. FR3 dimension drawing flange mount



IP21/IP54 Metric

Type 1/12 UL

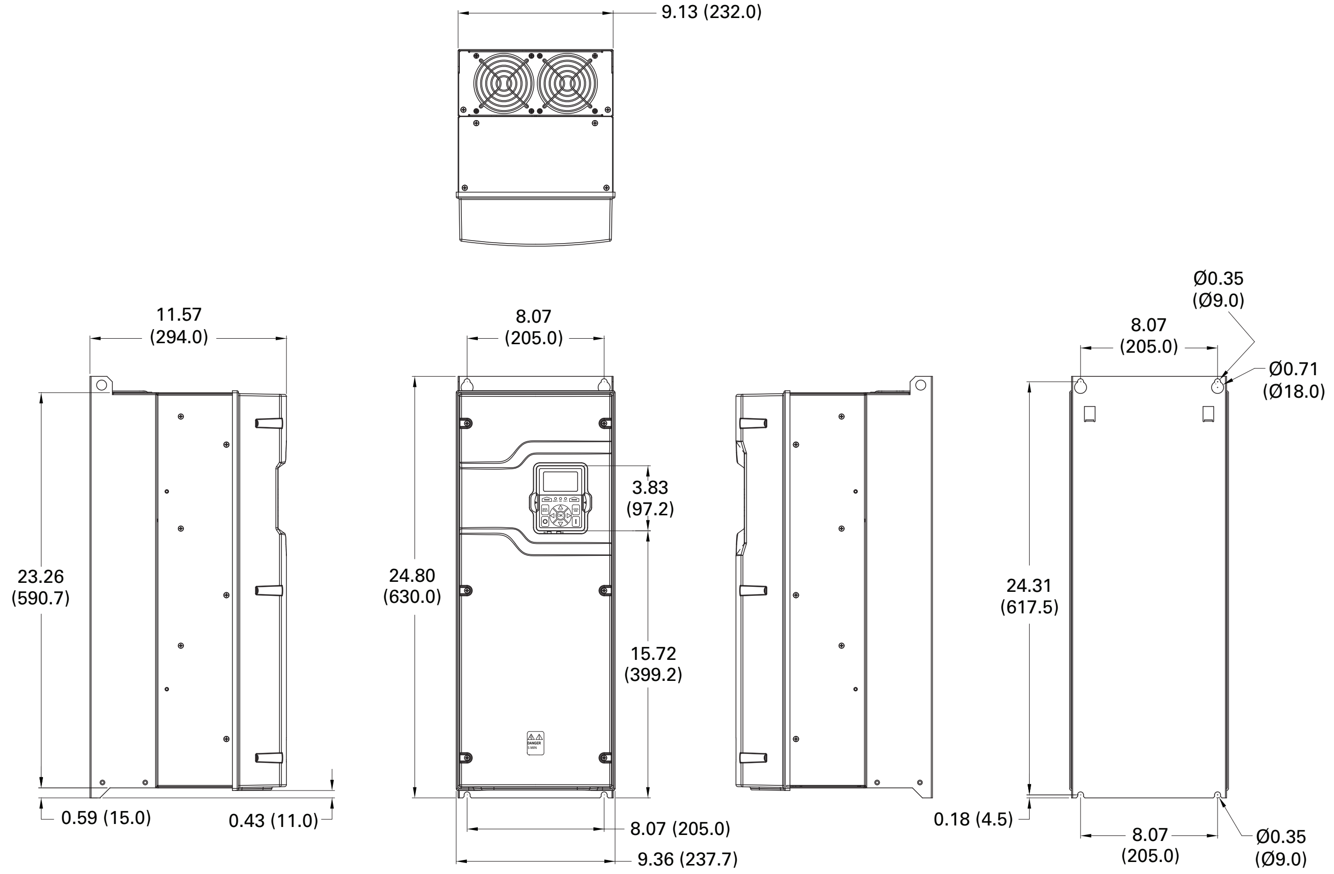


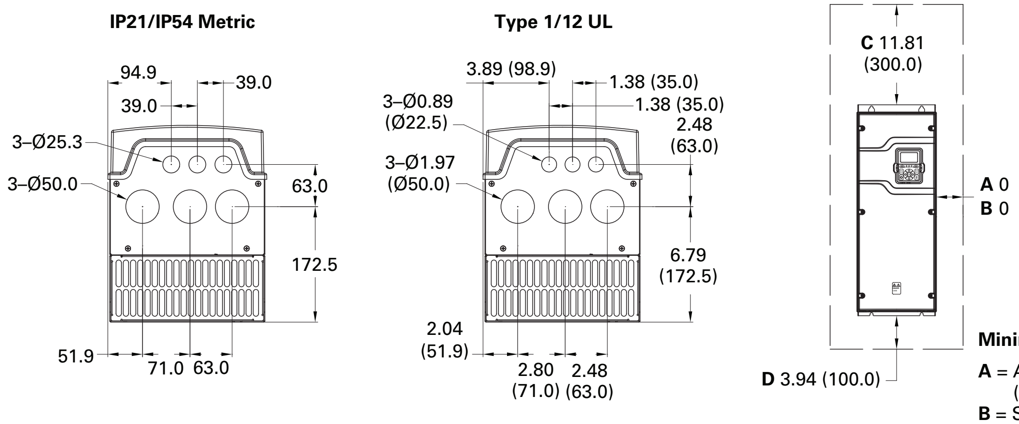
Minimum Dimensions

A = Air gap around drive
(between drive and cabinet)
B = Space between two drives
C = Free space above drive
D = Free space below drive

Approximate dimensions in inches (mm)

Figure 47. FR4 dimension drawing




IP21/IP54 Metric

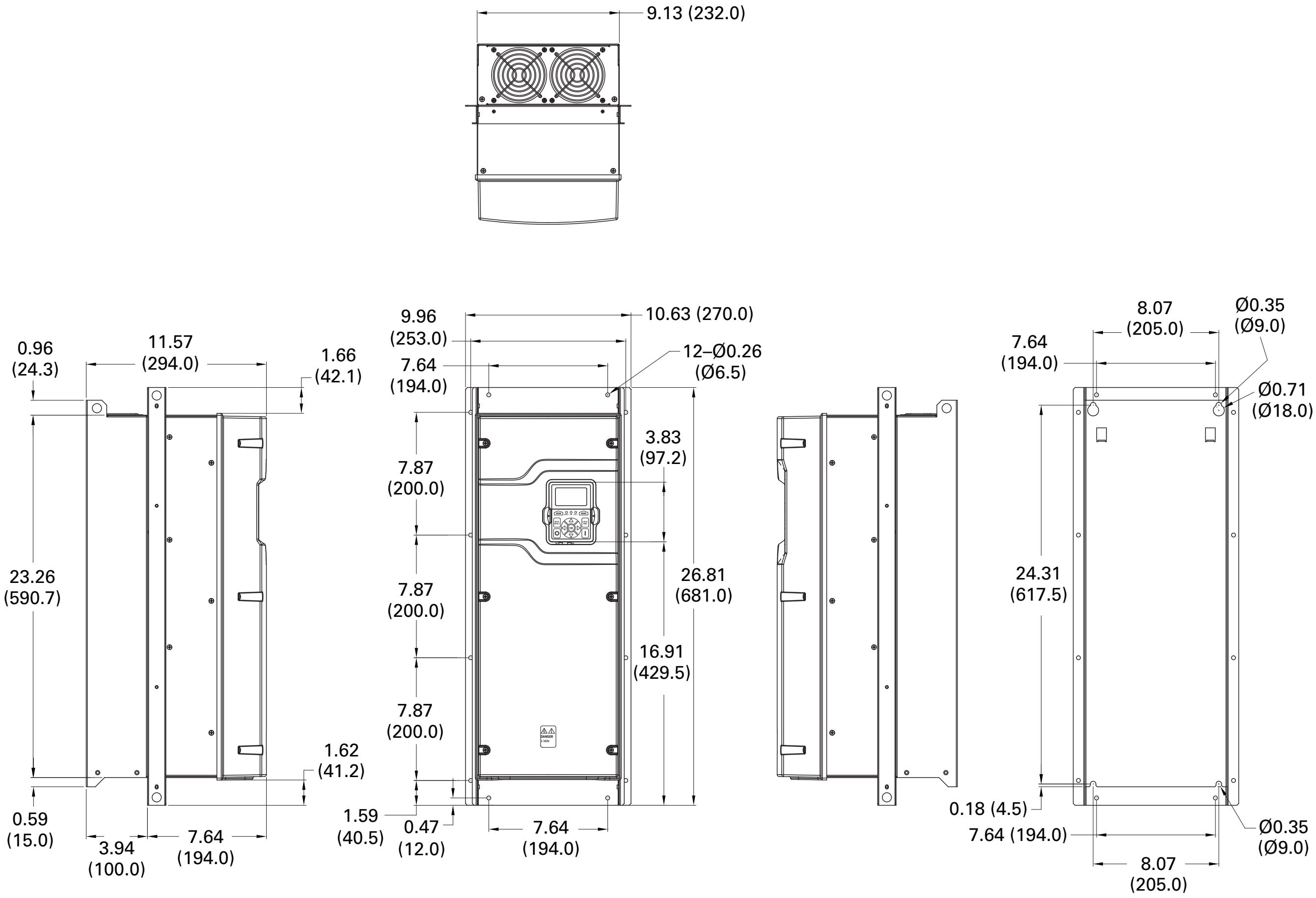
Type 1/12 UL

Minimum Dimensions

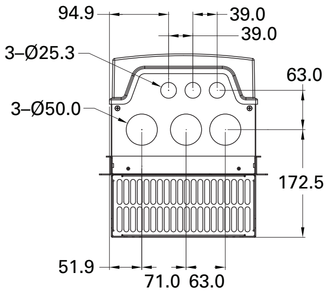
A = Air gap around drive (between drive and cabinet)
B = Space between two drives
C = Free space above drive
D = Free space below drive

Approximate dimensions in inches (mm)

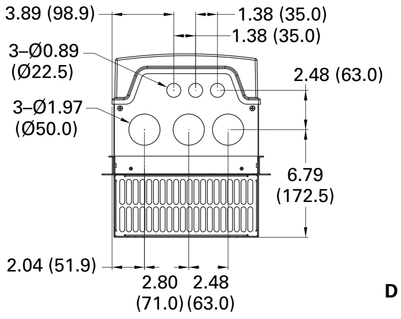
Figure 48. FR4 dimension drawing flange mount

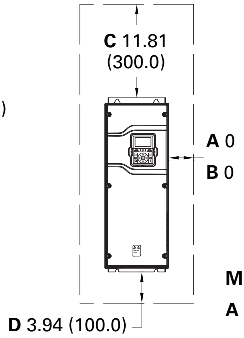


IP21/IP54 Metric



Type 1/12 UL



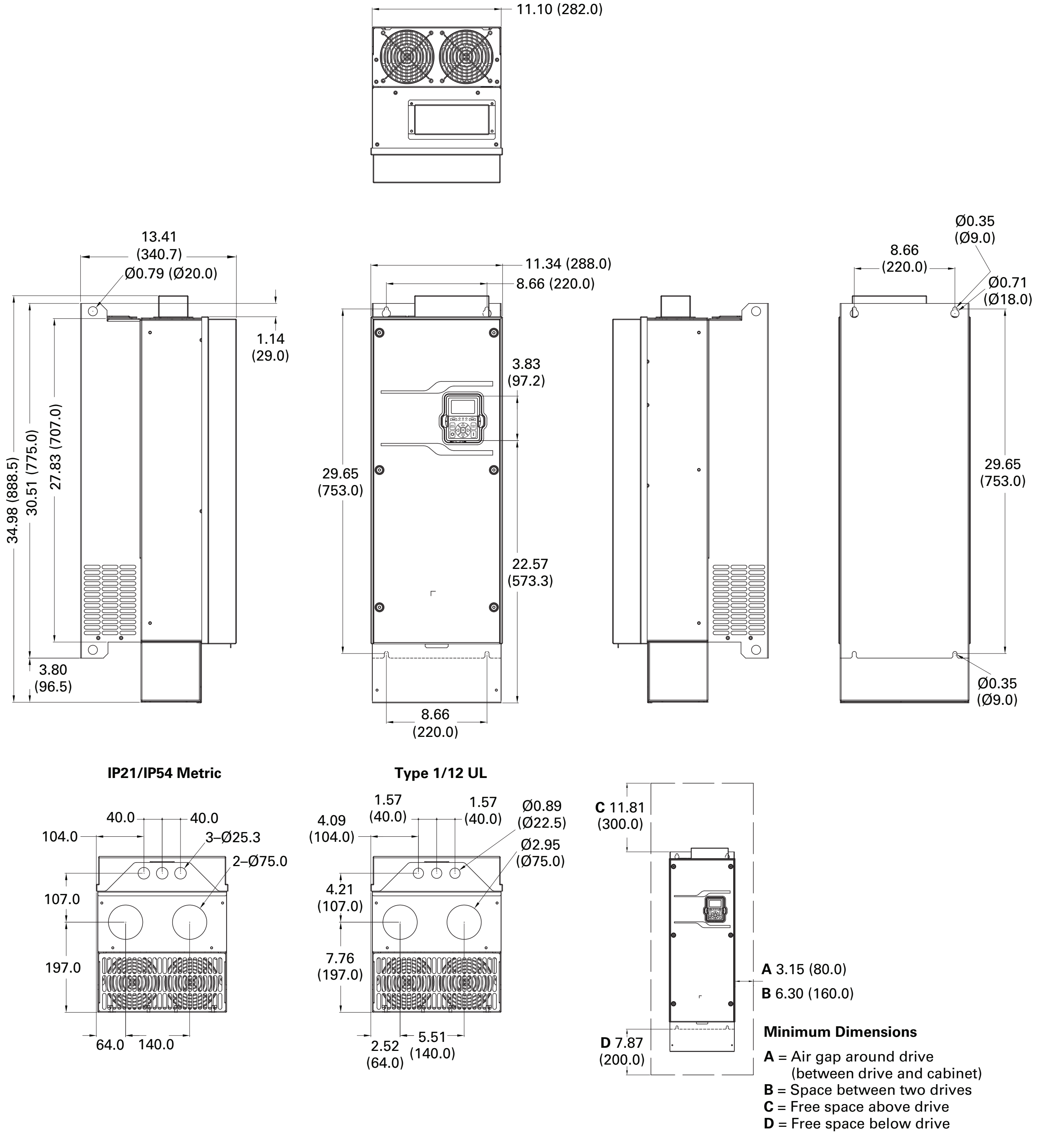


Minimum Dimensions

A = Air gap around drive
(between drive and cabinet)
B = Space between two drives
C = Free space above drive
D = Free space below drive

Approximate dimensions in inches (mm)

Figure 49. FR5 dimension drawing

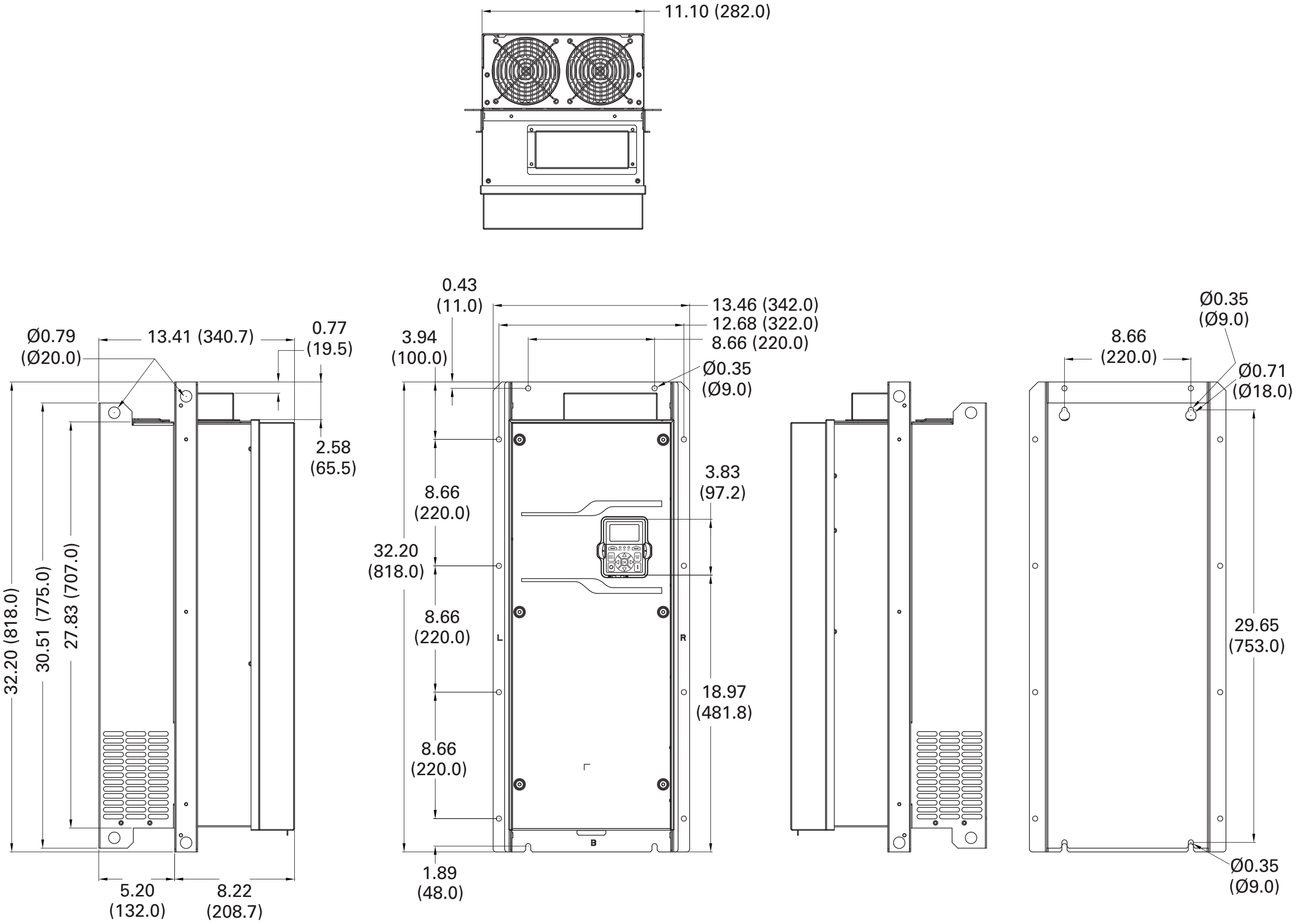


Minimum Dimensions

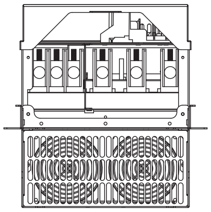
A = Air gap around drive
(between drive and cabinet)
B = Space between two drives
C = Free space above drive
D = Free space below drive

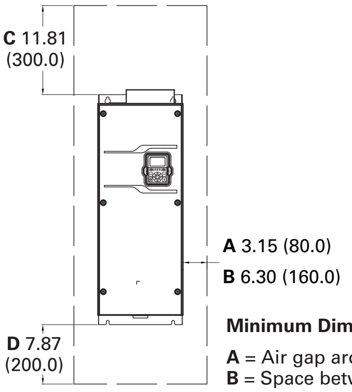
Approximate dimensions in inches (mm)

Figure 50. FR5 dimension drawing flange mount



IP21/IP54 Metric and Type 1/12 UL



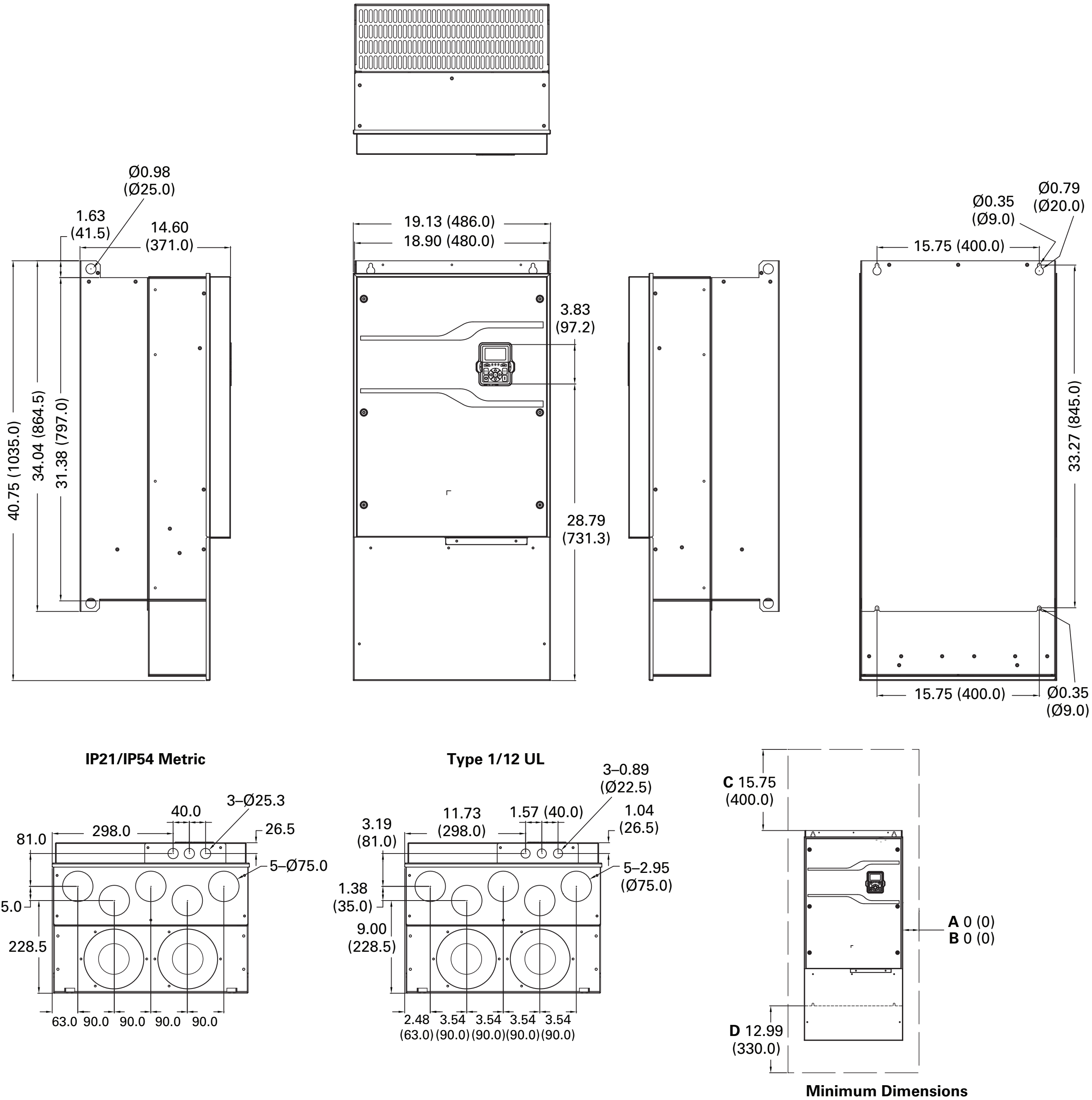


Minimum Dimensions

A = Air gap around drive
B = Space between two drives or drive and cabinet
C = Free space above drive
D = Free space below drive

Approximate dimensions in inches (mm)

Figure 51. FR6 dimensional drawing

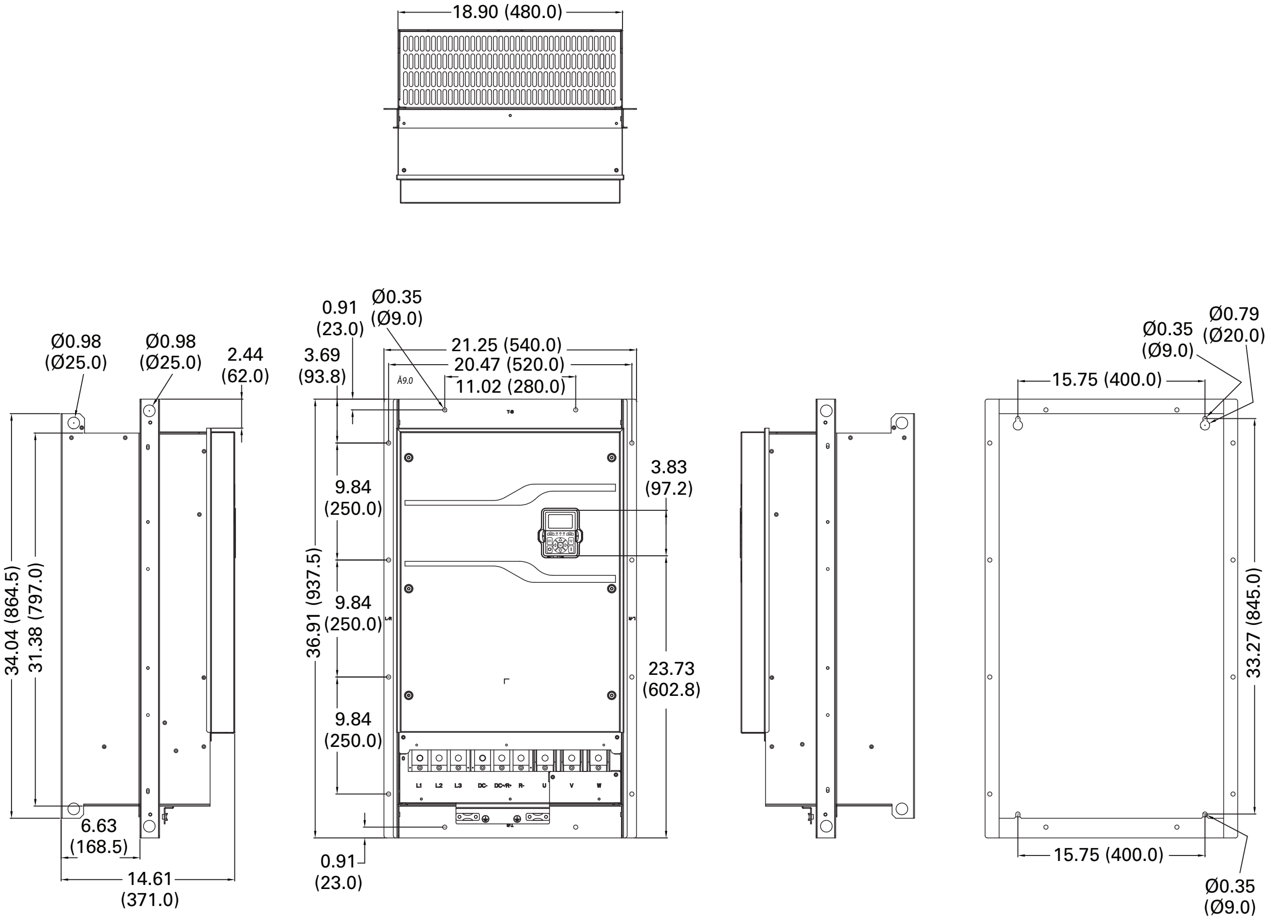


Minimum Dimensions

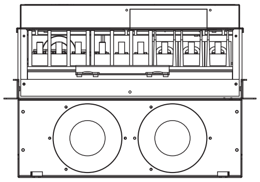
A = Air gap around drive (between drive and cabinet)
B = Space between two drives
C = Free space above drive
D = Free space below drive

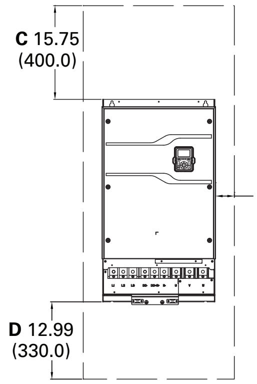
Approximate dimensions in inches (mm)

Figure 52. FR6 dimensional drawing flange mount



IP21/IP54 Metric and Type 1/12 UL





Minimum Dimensions

A = Air gap around drive (between drive and cabinet)
B = Space between two drives
C = Free space above drive
D = Free space below drive

Appendix D—Safety instructions for UL and cUL

⚠ CAUTION

THE UL AND CUL COMPLIANCE CAN BE MAINTAINED ONLY IF THIS DRIVE IS INSTALLED ACCORDING TO THE REQUIREMENTS OF APPENDIX D —SAFETY INSTRUCTIONS FOR UL AND CUL. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN UL AND CUL NON-COMPLIANCE.

UL standards compliance

This drive is tested in accordance with UL 508C and CSA C22.2 No. 274-13 and CSA C22.2 No. 274-17 and is found to comply with these requirements. To ensure continued compliance when using this drive or when using it in combination with other equipment, meet the following conditions.

General

This drive shall be applied in accordance with the specifications detailed in **Table 24**.

Overvoltage category

To comply with standard CSA C22.2 No. 274-13 and CSA C22.2 No. 274-17 requirement, the following applies to cUL applications:

- This drive should be installed in environment of Overvoltage Category III
- **For 480 V Series**: It is recommended that transient surge suppression be installed on the line side of this equipment and be rated 500 V (phase to ground), suitable for Overvoltage Category III, and shall provide protection for a rated impulse withstand voltage peak of 6 kV
- **For 230 V Series**: It is recommended that transient surge suppression be installed on the line side of this equipment and be rated 240 V (phase to ground), suitable for Overvoltage Category III, and provide protection for a rated impulse withstand voltage peak of 4 kV
- **For 575 V Series:** It is recommended that transient surge suppression be installed on the line side of this equipment and be rated 600 V (phase to ground), suitable for Overvoltage Category III, and shall provide protection for a rated impulse withstand voltage peak of 6 kV

Motor overload and over-temperature protection

This drive provides solid-state motor overload protection. The solid-state motor overload protection limit is adjustable, see the drives application manual for more details.

This drive can accept and act upon a signal from a thermal sensor or switch embedded in the motor or from an external protective relay to achieve the motor over temperature protection. Therefore, in order to achieve the motor over temperature protection, a sensor from the motor will be needed.

Branch circuit short circuit protection

Integral solid-state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local codes.

480 V Drive Series are suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 500 volts maximum, when protected by UL and cUL/CSA Listed devices mentioned below with an A.I.C. rating of 100 kA minimum.

- Class RK5, Class J, Class T or equivalent fuses
- Thermal-magnetic circuit breakers
- Magnetic only circuit breakers (Eaton Type HMCP)

Refer to the following information for recommended ratings. See **Table 79**.

Table 79. Protection ratings—480 V drive series

					Magnetic only circuit breakers	
Frame size	**DG1 catalog number**	**DH1 catalog number**	**Maximum fuse rating ①**	**Maximum thermal-magnetic breaker rating ①**	**Maximum magnetic breaker rating ①**	**Maximum rated Eaton type HMCP ①**
0	**DG1-342D2EB-C20C**	**DH1-343D3EB-C20C**	600 V, 10 A	480 V, 15 A	480 V, 7 A	**HMCP007C0C**
	DG1-343D3EB-C20C	**DH1-344D3EB-C20C**	600 V, 10 A	480 V, 15 A	480 V, 15 A	**HMCP015E0C**
	DG1-344D3EB-C20C	**DH1-345D6EB-C20C**	600 V, 15 A	480 V, 15 A	480 V, 15 A	**HMCP015E0C**
	DG1-345D6EB-C20C	**DH1-347D6EB-C20C**	600 V, 15 A	480 V, 15 A	480 V, 25A	**HMCP025D0C**
1	**DG1-342D2xx-xxxx**	**DH1-343D3XX-CXXC**	600 V, 10 A	480 V, 15 A	480 V, 7 A	**HMCP007C0C**
	DG1-343D3xx-xxxx	**DH1-344D3XX-CXXC**	600 V, 10 A	480 V, 15 A	480 V, 15 A	**HMCP015E0C**
	DG1-344D3xx-xxxx	**DH1-345D6XX-CXXC**	600 V, 15 A	480 V, 15 A	480 V, 15 A	**HMCP015E0C**
	DG1-345D6xx-xxxx	**DH1-347D6XX-CXXC**	600 V, 15 A	480 V, 15 A	480 V, 25 A	**HMCP025D0C**
	DG1-347D6xx-xxxx	**DH1-349D0XX-CXXC**	600 V, 15 A	480 V, 15 A	480 V, 25 A	**HMCP025D0C**
	DG1-349D0xx-xxxx	**DH1-34012XX-CXXC**	600 V, 15 A	480 V, 15 A	480 V, 25 A	**HMCP025D0C**
2	**DG1-34012xx-xxxx**	**DH1-34016XX-CXXC**	600 V, 35 A	480 V, 35 A	480 V, 50 A	**HMCP050K2C**
	DG1-34016xx-xxxx	**DH1-34023XX-CXXC**	600 V, 60 A	480 V, 60 A	480 V, 70 A	**HMCP070M2C**
	DG1-34023xx-xxxx	**DH1-34031XX-CXXC**	600 V, 80 A	480 V, 80 A	480 V, 100 A	**HMCP100R3C**
3	**DG1-34031xx-xxxx**	**DH1-34038XX-CXXC**	600 V, 90 A	480 V, 90 A	480 V, 100 A	**HMCP100R3C**
	DG1-34038xx-xxxx	**DH1-34046XX-CXXC**	600 V, 100 A	480 V, 100 A	480 V, 100 A	**HMCP100R3C**
	DG1-34046xx-xxxx	**DH1-34061XX-CXXC**	600 V, 150 A	480 V, 150 A	480 V, 100 A	**HMCP100R3C**
4	**DG1-34061xx-xxxx**	**DH1-34072XX-CXXC**	600 V, 175 A	480 V, 175 A	480 V, 250 A	**HMCP250W5C**
	DG1-34072xx-xxxx	**DH1-34087XX-CXXC**	600 V, 200 A	480 V, 200 A	480 V, 250 A	**HMCP250W5C**
	DG1-34087xx-xxxx	**DH1-34105XX-CXXC**	600 V, 300 A	480 V, 300 A	480 V, 400 A	**HMCP400W5C**
5	**DG1-34105xx-xxxx**	**DH1-34140XX-CXXC**	600 V, 350 A	480 V, 350 A	480 V, 400 A	**HMCP400N5C**
	DG1-34140xx-xxxx	**DH1-34170XX-CXXC**	600 V, 400 A	480 V, 400 A	480 V, 400 A	**HMCP400N5C**
	DG1-34170xx-xxxx	**DH1-34205XX-CXXC**	600 V, 400 A	480 V, 400 A	480 V, 400 A	**HMCP400N5C**
6	**DG1-34205xx-xxxx**	**DH1-34261XX-CXXC**	600 V, 400 A	480 V, 400 A	480 V, 400 A	**HMCP400N5C**
	DG1-34245xx-xxxx	**DH1-34310XX-CXXC**	600 V, 400 A	480 V, 400 A	480 V, 400 A	**HMCP400N5C**

Notes: ① These ratings are based on the largest wire size designed for the given Frame. Please verify your protection protects your wire sizing. See Appendix B for recommended fuse and wire size.

230 V Drive Series are suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 240 volts maximum when protected by UL and cUL/CSA Listed devices mentioned below with an A.I.C. rating of 100 kA minimum.

- Class RK5, Class J, Class T or equivalent fuses
- Thermal-magnetic circuit breakers
- Magnetic only circuit breakers (Eaton Type HMCP)

Refer to the following information for recommended ratings. See **Table 80**.

Table 80. Protection ratings—230 V drive series

Frame size	DG1 catalog number	DH1 catalog number	Maximum fuse rating ①	Maximum thermal-magnetic breaker rating ①	Magnetic only circuit breakers	
					Maximum magnetic breaker rating ①	Maximum rated Eaton type HMCP ①
0	**DG1-323D7EB-C20C**	**DH1-324D8EB-C20C**	600 V, 15 A	480 V, 15 A	480 V, 15 A	**HMCP015E0C**
	DG1-324D8EB-C20C	**DH1-326D6EB-C20C**	600 V, 20 A	480 V, 20 A	480 V, 25 A	**HMCP025D0C**
	DG1-326D6EB-C20C	**DH1-327D8EB-C20C**	600 V, 20 A	480 V, 20 A	480 V, 25 A	**HMCP025D0C**
1	**DG1-323D7xx-xxxx**	**DH1-324D8XX-CXXC**	600 V, 15 A	480 V, 15 A	480 V, 15 A	**HMCP015E0C**
	DG1-324D8xx-xxxx	**DH1-326D6XX-CXXC**	600 V, 20 A	480 V, 20 A	480 V, 25 A	**HMCP025D0C**
	DG1-326D6xx-xxxx	**DH1-327D8XX-CXXC**	600 V, 20 A	480 V, 20 A	480 V, 25 A	**HMCP025D0C**
	DG1-327D8xx-xxxx	**DH1-32011XX-CXXC**	600 V, 30 A	480 V, 30 A	480 V, 30 A	**HMCP030H1C**
	DG1-32011xx-xxxx	**DH1-32012XX-CXXC**	600 V, 30 A	480 V, 30 A	480 V, 30 A	**HMCP030H1C**
2	**DG1-32012xx-xxxx**	**DH1-32017XX-CXXC**	600 V, 40 A	480 V, 40 A	480 V, 50 A	**HMCP050K2C**
	DG1-32017xx-xxxx	**DH1-32025XX-CXXC**	600 V, 40 A	480 V, 40 A	480 V, 50 A	**HMCP050K2C**
	DG1-32025xx-xxxx	**DH1-32031XX-CXXC**	600 V, 40 A	480 V, 40 A	480 V, 50 A	**HMCP050K2C**
3	**DG1-32031xx-xxxx**	**DH1-32048XX-CXXC**	600 V, 125 A	480 V, 125 A	480 V, 150 A	**HMCP150U4C**
	DG1-32048xx-xxxx	**DH1-32061XX-CXXC**	600 V, 150 A	480 V, 150 A	480 V, 150 A	**HMCP150U4C**
4	**DG1-32061xx-xxxx**	**DH1-32075XX-CXXC**	600 V, 200 A	480 V, 200 A	480 V, 250 A	**HMCP250W5C**
	DG1-32075xx-xxxx	**DH1-32088XX-CXXC**	600 V, 225 A	480 V, 225 A	480 V, 250 A	**HMCP250W5C**
	DG1-32088xx-xxxx	**DH1-32114XX-CXXC**	600 V, 300 A	480 V, 300 A	480 V, 400 A	**HMCP400W5C**
5	**DG1-32114xx-xxxx**	**DH1-32143XX-CXXC**	600 V, 400 A	480 V, 400 A	480 V, 400 A	**HMCP400N5C**
	DG1-32143xx-xxxx	**DH1-32170XX-CXXC**	600 V, 400 A	480 V, 400 A	480 V, 400 A	**HMCP400N5C**
	DG1-32170xx-xxxx	**DH1-32211XX-CXXC**	600 V, 400 A	480 V, 400 A	480 V, 400 A	**HMCP400N5C**
6	**DG1-32211xx-xxxx**	**DH1-32261XX-CXXC**	600 V, 400 A	480 V, 400 A	480 V, 400 A	**HMCP400N5C**
	DG1-32248xx-xxxx	**DH1-32312XX-CXXC**	600 V, 400 A	480 V, 400 A	480 V, 400 A	**HMCP400N5C**

Notes: ① These ratings are based on the largest wire size designed for the given Frame. Please verify your protection protects your wire sizing. See Appendix B for recommended fuse and wire size.

575 V Drive Series are suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 600 volts maximum, when protected by UL and cUL/CSA Listed devices mentioned below with an A.I.C. rating of 100 kA minimum.

- Class RK5, Class J, Class T or equivalent fuses
- Thermal-magnetic circuit breakers (see Note below)
- Current limiting circuit breakers (for FR1-3 only)

Note: When protected by UL and cUL/CSA Listed Thermal-magnetic circuit breakers:

- FR0–3 are only suitable for use on a circuit capable of delivering not more than 35,000 rms symmetrical amperes, 600 volts maximum
- FR4–6 are only suitable for use on a circuit capable of delivering not more than 65,000 rms symmetrical amperes, 600 volts maximum

Refer to the following information for recommended ratings. See **Table 81**.

Table 81. Protection ratings—575 V drive series

Frame size	DG1 catalog number	DH1 catalog number	Maximum fuse rating ①	Maximum thermal-magnetic breaker rating ①	Maximum current limiting breaker ratings ①
1	**DG1-353D3xx-xxxx**	**DH1-354D5XX-CXXC**	600 V, 10 A	600 V, 15 A	600 V, 15 A
	DG1-354D5xx-xxxx	**DH1-357D5XX-CXXC**	600 V, 20 A	600 V, 20 A	600 V, 20 A
	DG1-357D5xx-xxxx	**DH1-35010XX-CXXC**	600 V, 30 A	600 V, 30 A	600 V, 30 A
2	**DG1-35010xx-xxxx**	**DH1-35013XX-CXXC**	600 V, 35 A	600 V, 35 A	600 V, 35 A
	DG1-35013xx-xxxx	**DH1-35018XX-CXXC**	600 V, 60 A	600 V, 60 A	600 V, 60 A
	DG1-35018xx-xxxx	**DH1-35022XX-CXXC**	600 V, 80 A	600 V, 80 A	600 V, 80 A
3	**DG1-35022xx-xxxx**	**DH1-35027XX-CXXC**	600 V, 80 A	600 V, 90 A	600 V, 90 A
	DG1-35027xx-xxxx	**DH1-35034XX-CXXC**	600 V, 80 A	600 V, 100 A	600 V, 100 A
	DG1-35034xx-xxxx	**DH1-35041XX-CXXC**	600 V, 80 A	600 V, 150 A	600 V, 150 A
4	**DG1-35041xx-xxxx**	**DH1-35052XX-CXXC**	600 V, 150 A	600 V, 175 A	N/A
	DG1-35052xx-xxxx	**DH1-35062XX-CXXC**	600 V, 150 A	600 V, 200 A	N/A
	DG1-35062xx-xxxx	**DH1-35080XX-CXXC**	600 V, 150 A	600 V, 300 A	N/A
5	**DG1-35080xx-xxxx**	**DH1-35100XX-CXXC**	600 V, 200 A	600 V, 225 A	N/A
	DG1-35100xx-xxxx	**DH1-35125XX-CXXC**	600 V, 200 A	600 V, 225 A	N/A
	DG1-35125xx-xxxx	**DH1-35144XX-CXXC**	600 V, 200 A	600 V, 300 A	N/A
6	**DG1-35144xx-xxxx**	**DH1-35208XX-CXXC**	600 V, 400 A	600 V, 400 A	N/A
	DG1-35208xx-xxxx	**DH1-35250XX-CXXC**	600 V, 400 A	600 V, 400 A	N/A

Notes: ① These ratings are based on the largest wire size designed for the given Frame. Please verify your protection protects your wire sizing. See Appendix B for recommended fuse and wire size.

Field wiring

- The field installed conductors for this drive should be 75 °C or higher copper wire
- The enclosure openings provided for conduit connections in the field shall be closed by UL Listed conduit fittings with same type rating as the enclosure (Type 1/Type 12)

Line and motor wiring

- For 480 V Drive Series, required line and motor wire torque, type and size range are listed in **Table 82**

Table 82. Required line and motor wire torque (480 V)

DG1 catalog number	DH1 catalog number	Terminal type	Required torque (in-lb)	Required wire range
FR0				
DG1-342D2EB-C20C	**DH1-343D3EB-C20C**	L1, L2, L3, DC+, DC-, R+, R-, U, V, W	5.3	14–10 AWG
DG1-343D3EB-C20C	**DH1-344D3EB-C20C**		5.3	14–10 AWG
DG1-344D3EB-C20C	**DH1-345D6EB-C20C**		5.3	14–10 AWG
DG1-345D6EB-C20C	**DH1-347D6EB-C20C**		5.3	14–10 AWG
FR1				
DG1-342D2xx-xxxx	**DH1-343D3XX-XXXX**	L1, L2, L3, DC+, DC–, R+, R–, U, V, W	5.3	14–10 AWG
DG1-343D3xx-xxxx	**DH1-344D3XX-XXXX**		5.3	14–10 AWG
DG1-344D3xx-xxxx	**DH1-345D6XX-XXXX**		5.3	14–10 AWG
DG1-345D6xx-xxxx	**DH1-347D6XX-XXXX**		5.3	14–10 AWG
DG1-347D6xx-xxxx	**DH1-349D0XX-XXXX**		5.3	14–10 AWG
DG1-349D0xx-xxxx	**DH1-34012XX-XXXX**		5.3	14–10 AWG
FR2				
DG1-34012xx-xxxx	**DH1-34016XX-XXXX**	L1, L2, L3, DC+, DC–, R+, R–, U, V, W	15.6	12–6 AWG
DG1-34016xx-xxxx	**DH1-34023XX-XXXX**		15.6	10–6 AWG
DG1-34023xx-xxxx	**DH1-34031XX-XXXX**		15.6	8–6 AWG
FR3				
DG1-34031xx-xxxx	**DH1-34038XX-XXXX**	L1, L2, L3, DC+, DC–, R+, R–, U, V, W	33	6–2 AWG
DG1-34038xx-xxxx	**DH1-34046XX-XXXX**		33	6–2 AWG
DG1-34046xx-xxxx	**DH1-34061XX-XXXX**		33	4–2 AWG
FR4				
DG1-34061xx-xxxx	**DH1-34072XX-XXXX**	L1, L2, L3, DC+, DC–, R+, R–, U, V, W	95	4–1/0 AWG
DG1-34072xx-xxxx	**DH1-34087XX-XXXX**		95	3–1/0 AWG
DG1-34087xx-xxxx	**DH1-34105XX-XXXX**		95	1–1/0 AWG
FR5				
DG1-34105xx-xxxx	**DH1-34140XX-XXXX**	L1, L2, L3, DC+, DC–, R+, R–, U, V, W	354	2/0 AWG–350 kcmil
DG1-34140xx-xxxx	**DH1-34170XX-XXXX**		354	3/0 AWG–350 kcmil
DG1-34170xx-xxxx	**DH1-34205XX-XXXX**		354	250–350 kcmil
FR6				
DG1-34205xx-xxxx	**DH1-34261XX-XXXX**	L1, L2, L3, DC+, DC–, R+, R–, U, V, W	480	2*(2/0–300 kcmil)
DG1-34245xx-xxxx	**DH1-34310XX-XXXX**		480	2*(4/0–300 kcmil)
All Frames Sizes (FR0–FR6)				
All models		Control terminal block	4.5	28~12 (Sol) AWG 30~12 (Str) AWG

- For 230 V Drive Series, required line and motor wire torque, type and size range are listed in **Table 83**

Table 83. Required line and motor wire torque (230 V)

DG1 catalog number	DH1 catalog number	Terminal type	Required torque (in-lb)	Required wire range
FR0				
DG1-323D7EB-C20C	**DH1-324D8EB-C20C**	L1, L2, L3, DC+, DC-, R+, R-, U, V, W	5.3	14–10 AWG
DG1-324D8EB-C20C	**DH1-326D6EB-C20C**		5.3	14–10 AWG
DG1-326D6EB-C20C	**DH1-327D8EB-C20C**		5.3	14–10 AWG
FR1				
DG1-323D7xx-xxxx	**DH1-324D8XX-XXXX**	L1, L2, L3, DC+, DC–, R+, R–, U, V, W	5.3	14–10 AWG
DG1-324D8xx-xxxx	**DH1-326D6XX-XXXX**		5.3	14–10 AWG
DG1-326D6xx-xxxx	**DH1-327D8XX-XXXX**		5.3	14–10 AWG
DG1-327D8xx-xxxx	**DH1-32011XX-XXXX**		5.3	14–10 AWG
DG1-32011xx-xxxx	**DH1-32012XX-XXXX**		5.3	12–10 AWG
FR2				
DG1-32012xx-xxxx	**DH1-32017XX-XXXX**	L1, L2, L3, DC+, DC–, R+, R–, U, V, W	15.6	10–6 AWG
DG1-32017xx-xxxx	**DH1-32025XX-XXXX**		15.6	8–6 AWG
DG1-32025xx-xxxx	**DH1-32031XX-XXXX**		15.6	8–6 AWG
FR3				
DG1-32031xx-xxxx	**DH1-32048XX-XXXX**	L1, L2, L3, DC+, DC–, R+, R–, U, V, W	33	6–2 AWG
DG1-32048xx-xxxx	**DH1-32061XX-XXXX**		33	4–2 AWG
FR4				
DG1-32061xx-xxxx	**DH1-32075XX-XXXX**	L1, L2, L3, DC+, DC–, R+, R–, U, V, W	95	3–1/0 AWG
DG1-32075xx-xxxx	**DH1-32088XX-XXXX**		95	2–1/0 AWG
DG1-32088xx-xxxx	**DH1-32114XX-XXXX**		95	1/0 AWG
FR5				
DG1-32114xx-xxxx	**DH1-32143XX-XXXX**	L1, L2, L3, DC+, DC–, R+, R–, U, V, W	354	3/0 AWG–350 kcmil
DG1-32143xx-xxxx	**DH1-32170XX-XXXX**		354	4/0 AWG–350 kcmil
DG1-32170xx-xxxx	**DH1-32211XX-XXXX**		354	300–350 kcmil
FR6				
DG1-32211xx-xxxx	**DH1-32261XX-XXXX**	L1, L2, L3, DC+, DC–, R+, R–, U, V, W	480	2*(2/0–300 kcmil)
DG1-32248xx-xxxx	**DH1-32312XX-XXXX**		480	2*(4/0–300 kcmil)
All Frames Sizes (FR0–FR6)				
All models		Control terminal block	4.5	28~12 (Sol) AWG 30~12 (Str) AWG

- For 575 V Drive Series, required line and motor wire torque, type and size range are listed in **Table 84**

Table 84. Required line and motor wire torque (575 V)

DG1 catalog number	DH1 catalog number	Terminal type	Required torque (in-lb)	Required wire range
FR1				
DG1-353D3xx-xxxx	**DH1-354D5XX-XXXX**	L1, L2, L3, DC+, DC-, R+, R-, U, V, W	5.3	14–10 AWG
DG1-354D5xx-xxxx	**DH1-357D5XX-XXXX**		5.3	14–10 AWG
DG1-357D5xx-xxxx	**DH1-35010XX-XXXX**		5.3	14–10 AWG
FR2				
DG1-35010xx-xxxx	**DH1-35013XX-XXXX**	L1, L2, L3, DC+, DC-, R+, R-, U, V, W	15.6	12–6 AWG
DG1-35013xx-xxxx	**DH1-35018XX-XXXX**		15.6	10–6 AWG
DG1-35018xx-xxxx	**DH1-35022XX-XXXX**		15.6	10–6 AWG
FR3				
DG1-35022xx-xxxx	**DH1-35027XX-XXXX**	L1, L2, L3, DC+, DC -, R+, R-, U, V, W	33	6–2 AWG
DG1-35027xx-xxxx	**DH1-35034XX-XXXX**		33	6–2 AWG
DG1-35034xx-xxxx	**DH1-35041XX-XXXX**		33	6–2 AWG
FR4				
DG1-35041xx-xxxx	**DH1-35052XX-XXXX**	L1, L2, L3, DC+, DC-, R+, R-, U, V, W	95	4–1/0 AWG
DG1-35052xx-xxxx	**DH1-35062XX-XXXX**		95	4–1/0 AWG
DG1-35062xx-xxxx	**DH1-35080XX-XXXX**		95	2–1/0 AWG
FR5				
DG1-35080xx-xxxx	**DH1-35100XX-XXXX**	L1, L2, L3, DC+, DC-, R+, R-, U, V, W	354	1/0 AWG–350 kcmil
DG1-35100xx-xxxx	**DH1-35125XX-XXXX**		354	2/0 AWG–350 kcmil
DG1-35125xx-xxxx	**DH1-35144XX-XXXX**		354	3/0 AWG–350 kcmil
FR6				
DG1-35144xx-xxxx	**DH1-35208XX-XXXX**	L1, L2, L3, DC+, DC-, R+, R-, U, V, W	480	2*(1/0–300 kcmil)
DG1-35208xx-xxxx	**DH1-35250XX-XXXX**		480	2*(2/0–300 kcmil)
All Frame Sizes (FR1–FR6)				
All models		Control Terminal Block	4.5	28~12 (Sol) AWG, 30~12 (Str) AWG

Grounding

- For 480 V Drive Series, required grounding wire torque, type and size range are listed in **Table 85**

Table 85. Required grounding wire torque (480 V)

DG1 catalog number	DH1 catalog number	Terminal type	Required torque (in-lb)	Required wire range
FR0				
DG1-342D2EB-C20C	**DH1-343D3EB-C20C**	Grounding terminal	14	14–10 AWG
DG1-343D3EB-C20C	**DH1-344D3EB-C20C**		14	14–10 AWG
DG1-344D3EB-C20C	**DH1-345D6EB-C20C**		14	14–10 AWG
DG1-345D6EB-C20C	**DH1-347D6EB-C20C**		14	14–10 AWG
FR1				
DG1-342D2xx-xxxx	**DH1-343D3XX-XXXX**	Grounding terminal	10	14–10 AWG
DG1-343D3xx-xxxx	**DH1-344D3XX-XXXX**		10	14–10 AWG
DG1-344D3xx-xxxx	**DH1-345D6XX-XXXX**		10	14–10 AWG
DG1-345D6xx-xxxx	**DH1-347D6XX-XXXX**		10	14–10 AWG
DG1-347D6xx-xxxx	**DH1-349D0XX-XXXX**		10	14–10 AWG
DG1-349D0xx-xxxx	**DH1-34012XX-XXXX**		10	14–10 AWG
FR2				
DG1-34012xx-xxxx	**DH1-34016XX-XXXX**	Grounding terminal	10	12–6 AWG
DG1-34016xx-xxxx	**DH1-34023XX-XXXX**		10	10–6 AWG
DG1-34023xx-xxxx	**DH1-34031XX-XXXX**		10	8–6 AWG
FR3				
DG1-34031xx-xxxx	**DH1-34038XX-XXXX**	Grounding terminal	10	8–4 AWG
DG1-34038xx-xxxx	**DH1-34046XX-XXXX**		10	8–4 AWG
DG1-34046xx-xxxx	**DH1-34061XX-XXXX**		10	6–4 AWG
FR4				
DG1-34061xx-xxxx	**DH1-34072XX-XXXX**	Grounding terminal	14	4–1/0 AWG
DG1-34072xx-xxxx	**DH1-34087XX-XXXX**		14	4–1/0 AWG
DG1-34087xx-xxxx	**DH1-34105XX-XXXX**		14	3–1/0 AWG
FR5				
DG1-34105xx-xxxx	**DH1-34140XX-XXXX**	Grounding terminal	35	3 AWG–250 kcmil
DG1-34140xx-xxxx	**DH1-34170XX-XXXX**		35	3 AWG–250 kcmil
DG1-34170xx-xxxx	**DH1-34205XX-XXXX**		35	3 AWG–250 kcmil
FR6				
DG1-34205xx-xxxx	**DH1-34261XX-XXXX**	Grounding terminal	35	3–300 kcmil
DG1-34245xx-xxxx	**DH1-34310XX-XXXX**		35	3–300 kcmil

- For 230 V Drive Series, required grounding wire torque, type and size range are listed in **Table 86**

Table 86. Required grounding wire torque (230 V)

DG1 catalog number	DH1 catalog number	Terminal type	Required torque (in-lb)	Required wire range
FR0				
DG1-323D7EB-C20C	**DH1-324D8EB-C20C**	Grounding terminal	14	14–10 AWG
DG1-324D8EB-C20C	**DH1-326D6EB-C20C**		14	14–10 AWG
DG1-326D6EB-C20C	**DH1-327D8EB-C20C**		14	14–10 AWG
FR1				
DG1-323D7xx-xxxx	**DH1-324D8XX-XXXX**	Grounding terminal	10	14–10 AWG
DG1-324D8xx-xxxx	**DH1-326D6XX-XXXX**		10	14–10 AWG
DG1-326D6xx-xxxx	**DH1-327D8XX-XXXX**		10	14–10 AWG
DG1-327D8xx-xxxx	**DH1-32011XX-XXXX**		10	14–10 AWG
DG1-32011xx-xxxx	**DH1-32012XX-XXXX**		10	12–10 AWG
FR2				
DG1-32012xx-xxxx	**DH1-32017XX-XXXX**	Grounding terminal	10	10–6 AWG
DG1-32017xx-xxxx	**DH1-32025XX-XXXX**		10	10–6 AWG
DG1-32025xx-xxxx	**DH1-32031XX-XXXX**		10	10–6 AWG
FR3				
DG1-32031xx-xxxx	**DH1-32048XX-XXXX**	Grounding terminal	10	6–4 AWG
DG1-32048xx-xxxx	**DH1-32061XX-XXXX**		10	6–4 AWG
FR4				
DG1-32061xx-xxxx	**DH1-32075XX-XXXX**	Grounding terminal	14	4–1/0 AWG
DG1-32075xx-xxxx	**DH1-32088XX-XXXX**		14	4–1/0 AWG
DG1-32088xx-xxxx	**DH1-32114XX-XXXX**		14	3–1/0 AWG
FR5				
DG1-32114xx-xxxx	**DH1-32143XX-XXXX**	Grounding terminal	35	3 AWG–250 kcmil
DG1-32143xx-xxxx	**DH1-32170XX-XXXX**		35	3 AWG–250 kcmil
DG1-32170xx-xxxx	**DH1-32211XX-XXXX**		35	3 AWG–250 kcmil
FR6				
DG1-32211xx-xxxx	**DH1-32261XX-XXXX**	Grounding terminal	35	3–300 kcmil
DG1-32248xx-xxxx	**DH1-32312XX-XXXX**		35	3–300 kcmil

- For 575 V Drive Series, required grounding wire torque, type and size range are listed in **Table 87**

Table 87. Required grounding wire torque (575 V)

DG1 catalog number	DH1 catalog number	Terminal type	Required torque (in-lb)	Required wire range
FR1				
DG1-353D3xx-xxxx	**DH1-354D5XX-XXXX**	Grounding terminal	10	14–10
DG1-354D5xx-xxxx	**DH1-357D5XX-XXXX**		10	12–10
DG1-357D5xx-xxxx	**DH1-35010XX-XXXX**		10	10
FR2				
DG1-35010xx-xxxx	**DH1-35013XX-XXXX**	Grounding terminal	10	10–6
DG1-35013xx-xxxx	**DH1-35018XX-XXXX**		10	10–6
DG1-35018xx-xxxx	**DH1-35022XX-XXXX**		10	8–6
FR3				
DG1-35022xx-xxxx	**DH1-35027XX-XXXX**	Grounding terminal	10	8–4
DG1-35027xx-xxxx	**DH1-35034XX-XXXX**		10	8–4
DG1-35034xx-xxxx	**DH1-35041XX-XXXX**		10	6–4
FR4				
DG1-35041xx-xxxx	**DH1-35052XX-XXXX**	Grounding terminal	14	6–1/0
DG1-35052xx-xxxx	**DH1-35062XX-XXXX**		14	6–1/0
DG1-35062xx-xxxx	**DH1-35080XX-XXXX**		14	4–1/0
FR5				
DG1-35080xx-xxxx	**DH1-35100XX-XXXX**	Grounding terminal	35	4 AWG–250 kcmil
DG1-35100xx-xxxx	**DH1-35125XX-XXXX**		35	4 AWG–250 kcmil
DG1-35125xx-xxxx	**DH1-35144XX-XXXX**		35	4 AWG–250 kcmil
FR6				
DG1-35144xx-xxxx	**DH1-35208XX-XXXX**	Grounding terminal	35	3–300 kcmil
DG1-35208xx-xxxx	**DH1-35250XX-XXXX**		35	3–300 kcmil

Appendix E—STO function

Description of safety function

Safety function and safe state

The STO (Safe Torque Off) function of PowerXL Series AC drive is implemented only by hardware and no software is involved to perform the STO function.

The STO function is available for operator to turn off the motor torque. It is intended to be used in the safety-related applications up to SIL 1 / SIL CL 1 acc. to IEC/EN 61800-5-2, IEC/EN 61508 and IEC/EN 62061, and up to Cat. 1 / PL c acc. to EN ISO 13849-1.

Safety function

The power that can cause rotation (or motion in the case of a linear motor) shall be switched off from the motor when demanded.

Safe state

The safe state is when the power supply of the motor is switched off.

System response time

The time from when the operator presses the emergency stop button to when the motor power supply switch is turned off is ≤ 1ms.

Table 88. Safety-related parameters

Operation mode	FR0	FR1–FR6
Operation mode	High demand	High demand
Safety integrity level	SIL 1 / SIL CL 1	SIL 1 / SIL CL 1
Systematic capability	SC 1	SC 1
Safety architecture	1oo1	1oo1
Category	1	1
Performance level	c	c
HFT	0	0
SFF of each element	> 78%	> 60%
PFDAVG	5.07E-03 (at PTI=20 years, 5.07% of SIL1)	8.60E-03 (at PTI=20 years, 8.6% of SIL1)
PFH	5.79E-08 (0.58% of SIL1)	9.82E-08 (1% of SIL1)
MTTFd	1972 years (high)	1162 years (high)
Proof Test Interval (PTI)	20 years	20 years
MRT	0 hour	0 hour
MTTR	0 hour	0 hour
λ (total failures)	268.08 FIT	944.04 FIT
λ_S (safe failures)	210.08 FIT	845.25 FIT
λ_{DD} (dangerous detected failures)	0.00 FIT	0.00 FIT
λ_{DU} (dangerous undetected failures)	57.89 FIT	98.21 FIT

Note: 1 FIT = 10^{-9}/h.

All the previously mentioned safety-related parameters are calculated based on the assumptions:

- Failure rate of each component is based on the Siemens SN29500 database
- Component failure rates are constant over the life of the device
- Operating at a maximum ambient temperature of 60 °C
- The equal distribution is used for the failure modes ratio of each component

NOTICE

THE ABOVE MENTIONED PARAMETERS ARE CALCULATED WITHOUT CONSIDERING FAILURE RATES OF EXTERNAL DEVICES E.G. BUTTONS, POWER SUPPLY, ETC.

Safety architecture and reliability block diagram

Figure 53. Functional block diagram

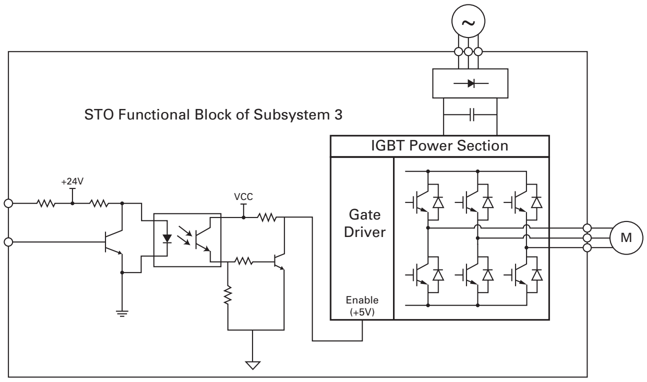


Figure 54. Reliability block diagram

Table 89. Power supply and input/output

Power supply	230 V series: 150–450 Vdc
	480 V series: 300–900 Vdc
	575 V series: 450–1100 Vdc
Overvoltage category	III
STO input signal voltage without demand	5 Vdc ~ 18 Vdc
STO input signal voltage when demand	< 0.55 Vdc

Table 90. Environmental and EMC conditions

Environmental	
Mains Supply System	TN, TT and IT Systems (including corner-earthed system)
Overvoltage	Overvoltage Category III
Pollution Degree	Pollution Degree 2
Ambient Operating Temperature	–10 °C (no frost) to +50 °C, up to +60 °C with derating (CT) –10 °C (no frost) to +40 °C, up to +60 °C with derating (VT)
Storage Temperature	–40°C to 70 °C
Relative Humidity	0–95% RH, non-condensing, non-corrosive
Altitude	100% load capacity (no derating) up to 3280 ft (1000 m); 1% derating for each 328 ft (100 m) above 3280 ft (1000 m); max. 9842 ft (3000 m) (2000 m for corner grounded earth main systems) For 600 V product, maximum altitude is 2000 m regardless of main system
Vibration	EN 61800-5-1, EN 60068-2-6; 5 to 150 Hz, Displacement amplitude: 1 mm (peak) at 5 to 15.8 Hz, Maximum acceleration amplitude: 1g at 15.8 to 150 Hz
Shock	ISTA 1 A, EN 60068-2-27 Storage and shipping: maximum 15g, 11 ms (in package)
Enclosure Class	FR0: Open Type /IP20 FR1–FR6: IP21/Type 1 standard in entire kW/hp range IP54/Type 12 option Note: Keypad or keypad hole plug required to be mounted in drive for IP54/Type 12 rating
EMC	
EMC	EN 61800-3, 2nd environment EN 61800-5-2, EN 61326-3-1

Applicable standards

IEC 61800-5-2:2016 / EN 61800-5-2:2017
Adjustable speed electrical power drive systems
Part 5-2: Safety requirements—Functional

IEC 61800-5-1: 2007+A1:2016 / EN 61800-5-1: 2007+A1:2017
Adjustable speed electrical power drive systems
Part 5-1: Safety requirements—Electrical, thermal and energy

IEC 61800-3:2017 / EN IEC 61800-3:2018
Adjustable speed electrical power drive systems
Part 3: EMC requirements and specific test methods

ISO 13849-1:2015 / EN ISO 13849-1:2015
Safety of Machinery—Safety Related Parts of Control Systems
Part 1: General principles for design

IEC 61508, Parts 1-7:2010 / EN 61508, Parts 1-7:2010
Functional safety of electrical/electronic/programmable electronic safety-related systems

IEC 62061:2021 / EN IEC 62061:2021
Safety of machinery – Functional safety of safety-related control systems

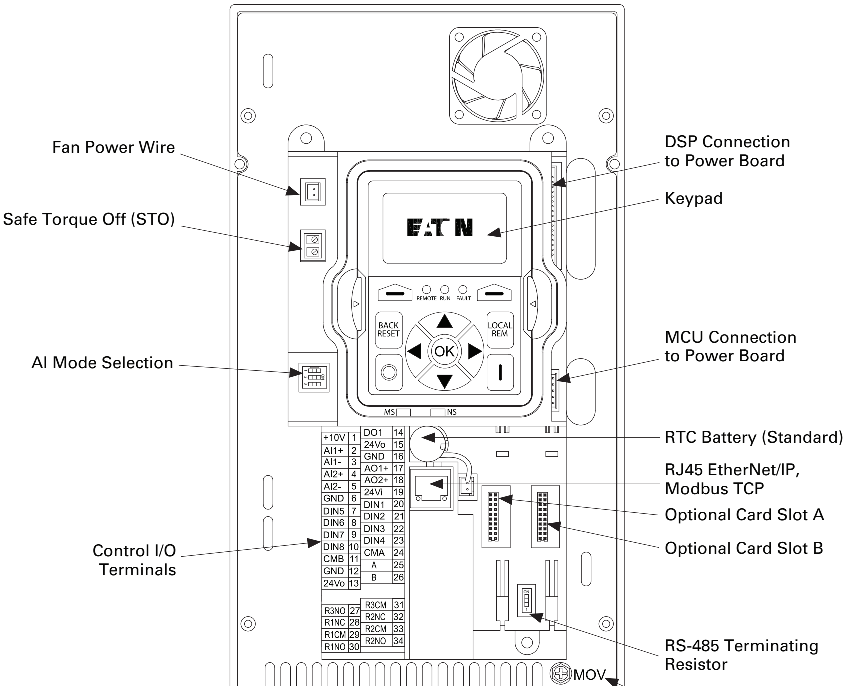
IEC 60204-1:2016 / EN 60204-1:2018
Safety of machinery—Electrical equipment of machines
Part 1: General requirements

IEC 61326-3-1:2017 / EN 61326-3-1:2017
Electrical equipment for measurement, control and laboratory use—EMC requirements
Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety)—General industrial applications

Requirement for installation, commission, maintenance

A two-pin terminal block in control board (STO in **Figure 55**) is used for customer to connect emergency stop switch or safety relay.

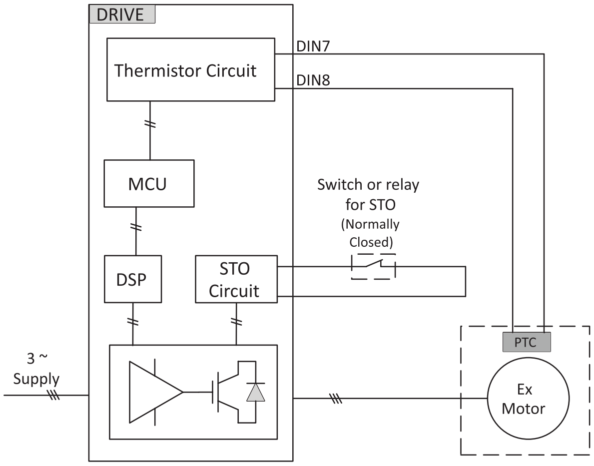
Figure 55. STO terminal block in PowerXL control board



The STO terminal block shall be short circuited by jumper if user doesn't needed STO function. If the function is used by customer, the STO terminal block shall be connected to emergency stop switch or safety relay. The STO function needs to be always on, which means the idle-current principle shall be followed by the end user.

For the requirements of fault exclusion measures against short circuits between two adjacent tracks/pads of internal PCB according to ISO 13849-2:2012, some measures shall be implemented at application level, i.e.: this device shall be installed in a cabinet with at least IP54.

Figure 56. Thermistor STO wiring diagram



Requirements of proof test

- This device must be subjected to a full test at least once every 20 years
- The STO function must be verified
- The system response time must be verified to check whether it is still ≤ 1ms

Note for EC Type-Examination Certificate

Only below models meet MD/LVD/EMC requirements and apply for the STO EC Type-Examination Certificate, all other models apply for the STO Certificate without EC Type-Examination:

- DG1 Series: DG1-32xxxEB-C20C, DG1-34xxxEB-C20C
  DG1-32xxxFx-xxxx, DG1-34xxxFx-xxxx,
  DG1-35xxxFx-xxxx
- DH1 Series: DH1-32xxxEB-C20C, DH1-34xxxEB-C20C
  DH1-32xxxFx-xxxx, DH1-34xxxFx-xxxx,
  DH1-35xxxFx-xxxx

Appendix F—Certification and compliance information

UL/cUL certificate of compliance

In accordance with: UL and cUL

Certificate number: E134360

Based on compliance with standards:

UL 508C

CSA C22.2 No. 274-13

CSA C22.2 No. 274-17

CE declaration of conformity

In accordance with:

2014/35/EU	Low Voltage Directive (LVD)
2014/30/EU	EMC Directive (EMC)
2011/65/EU	RoHS Directive (RoHS)
2009/125/EC	Ecodesign Directive (Eco-Design)
2006/42/EC	Machinery Directive (MD, not for all products)

UKCA declaration of conformity

In accordance with:

2016 No.1101	Electrical Equipment (Safety) Regulations 2016
2016 No.1091	Electromagnetic Compatibility Regulations 2016
2012 No.3032	Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012
2021 No.745	Ecodesign for Energy-Related Products and Energy Information Regulations 2021

Both based on compliance with standards:

EN 61800-5-1:2007+A1:2017

EN IEC 61800-3:2018

EN IEC 63000:2018

EN 61800-9-2:2017

EN 60204-1:2018

EN 61800-5-2:2017

EN ISO 13849-1:2015

EN 61508, Part 1-7:2010

EN IEC 62061:2021

EN 61326-3-1:2017

Eco-design information

IE2 acc. to EN 61800-9-2
(90;100) losses are marked on rating labels

Other details can be found at:
Eaton.com/EcoDesign-VFD or as in below:

Eaton.com/EcoDesign-VFD
MZ040046EN

Manufacturer and importer information

Manufacturer:
Eaton Corporation
W126N7250 Flint Drive
Menomonee Falls, WI
53051
USA

Importer to EU:
Eaton Industries GmbH
Hein-Moeller-Str. 7-11
53115 Bonn, Germany

Importer to UK:
Eaton Electric Ltd
PO Box 554
Abbey Park Southampton Road
Titchfield, PO14 4QA
United Kingdom

Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
United States
Eaton.com

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July 2022

Powering Business Worldwide

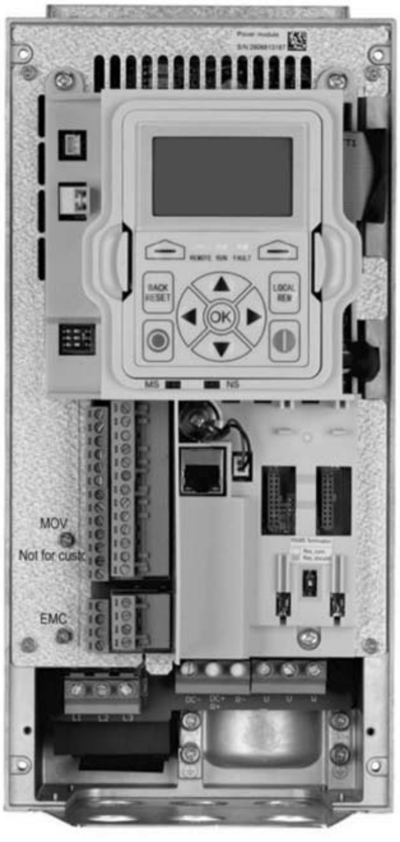
EATON

Powering Business Worldwide

PowerXL DG1 Series VFD

Effective January 2023
Supersedes November 2022

Application manual



EATON
Powering Business Worldwide

Supports Firmware Version
Bundle: DG1-V0037.04-ETN

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Cover Photo: Eaton PowerXL® Series Drives

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Support services

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Website address

www.eaton.com/drives

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After-Hours Emergency: 800-543-7038
(6:00 p.m.–8:00 a.m. EST)

Drives technical resource center

Voice: 877-ETN-CARE (386-2273) option 2, option 6
(8:00 a.m.–5:00 p.m. Central Time U.S. [UTC –6])
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Table of contents

Table of contents, continued

List of figures

List of figures, continued

List of tables

List of tables, continued

List of tables, continued

List of tables, continued

List of tables, continued

Safety

WARNING!
DANGEROUS ELECTRICAL VOLTAGE!

Before commencing the installation

- Disconnect the power supply of the device
- Ensure that devices cannot be accidentally restarted
- Verify isolation from the supply
- Earth and short circuit the device
- Cover or enclose any adjacent live components
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/system
- Before installation and before touching the device ensure that you are free of electrostatic charge
- The functional earth (FE, PES) must be connected to the protective earth (PE) or the potential equalization. The system installer is responsible for implementing this connection
- Connecting cables and signal lines should be installed so that inductive or capacitive interference does not impair the automation functions
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation
- Suitable safety hardware and software measures should be implemented for the I/O interface so that an open circuit on the signal side does not result in undefined states in the automation devices
- Ensure a reliable electrical isolation of the extra-low voltage of the 24 V supply. Only use power supply units complying with IEC 60364-4-41 (VDE 0100 Part 410) or HD384.4.41 S2
- Deviations of the input voltage from the rated value must not exceed the tolerance limits given in the specifications, otherwise this may cause malfunction and dangerous operation
- Emergency stop devices complying with IEC/EN 60204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency-stop devices must not cause a restart
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been installed and with the housing closed. Desktop or portable units must only be operated and controlled in enclosed housings
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency-stop devices should be implemented
- Wherever faults in the automation system may cause injury or material damage, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks, and so on)
- Depending on their degree of protection, adjustable frequency drives may contain live bright metal parts, moving or rotating components, or hot surfaces during and immediately after operation
- Removal of the required covers, improper installation, or incorrect operation of motor or adjustable frequency drive may cause the failure of the device and may lead to serious injury or damage
- The applicable national accident prevention and safety regulations apply to all work carried out on live adjustable frequency drives
- The electrical installation must be carried out in accordance with the relevant regulations (for example, with regard to cable cross sections, fuses, PE)
- Transport, installation, commissioning, and maintenance work must be carried out only by qualified personnel (IEC 60364, HD 384 and national occupational safety regulations)
- Installations containing adjustable frequency drives must be provided with additional monitoring and protective devices in accordance with the applicable safety regulations. Modifications to the adjustable frequency drives using the operating software are permitted
- All covers and doors must be kept closed during operation
- To reduce hazards for people or equipment, the user must include in the machine design measures that restrict the consequences of a malfunction or failure of the drive (increased motor speed or sudden standstill of motor). These measures include:
    - Other independent devices for monitoring safety-related variables (speed, travel, end positions, and so on)
    - Electrical or non-electrical system-wide measures (electrical or mechanical interlocks)
    - Never touch live parts or cable connections of the adjustable frequency drive after it has been disconnected from the power supply. Due to the charge in the capacitors, these parts may still be live after disconnection. Fit appropriate warning signs

Definitions and symbols

WARNING

This symbol indicates high voltage. It calls your attention to items or operations that could be dangerous to you and other persons operating this equipment. Read the message and follow the instructions carefully. This symbol is the "Safety Alert Symbol". It occurs with either of two signal words: CAUTION or WARNING, as described below.

WARNING

Indicates a potentially hazardous situation which, if not avoided, can result in serious injury or death.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, can result in minor to moderate injury, or serious damage to the product. The situation described in the CAUTION may, if not avoided, lead to serious results. Important safety measures are described in CAUTION (as well as WARNING).

Hazardous high voltage

WARNING

Motor control equipment and electronic controllers are connected to hazardous line voltages. When servicing drives and electronic controllers, there may be exposed components with housings or protrusions at or above line potential. Extreme care should be taken to protect against shock.

Stand on an insulating pad and make it a habit to use only one hand when checking components. Always work with another person in case an emergency occurs. Disconnect power before checking controllers or performing maintenance. Be sure equipment is properly grounded. Wear safety glasses whenever working on electronic controllers or rotating machinery.

Warnings and cautions

This manual contains clearly marked cautions and warnings which are intended for your personal safety and to avoid any unintentional damage to the product or connected appliances. Please read the information included in cautions and warnings carefully.

WARNING

The relay outputs and other I/O-terminals may have a dangerous control voltage present even when PowerXL DG1 is disconnected from mains.

WARNING

Be sure not to plug the Ethernet IP cable to the terminal under the keypad! This might harm your personal computer.

WARNING

Be sure not to plug the Modbus TCP cable to the terminal under the keypad! This might harm your personal computer.

CAUTION

Remove external control signal before resetting the fault to prevent unintentional restart of the drive.

Important safety information

Hazardous high voltage

⚠ WARNING

The components of the power unit of PowerXL Series are live when the AC drive is connected to mains potential. Coming into contact with this voltage is extremely dangerous and may cause death or severe injury.

⚠ WARNING

The motor terminals U, V, W and the brake resistor terminals are live when PowerXL Series is connected to mains, even if the motor is not running.

⚠ WARNING

After disconnecting the AC drive from the mains, wait until the indicators on the keypad go out (if no keypad is attached see the indicators on the cover). Wait 5 more minutes before doing any work on the connections of PowerXL Series. Do not open the cover before this time has expired. After expiration of this time, use a measuring equipment to absolutely ensure that no voltage is present. Always ensure absence of voltage before starting any electrical work!

⚠ WARNING

The control I/O-terminals are isolated from the mains potential. However, the relay outputs and other I/O-terminals may have a dangerous control voltage present even when PowerXL DG1 is disconnected from mains.

⚠ WARNING

Before connecting the AC drive to mains, confirm that the front and cable covers of PowerXL DG1 are closed.

⚠ WARNING

During a ramp stop (see the Application Manual), the motor is still generating voltage to the drive. Therefore, do not touch the components of the AC drive before the motor has completely stopped. Wait until the indicators on the keypad go out (if no keypad is attached see the indicators on the cover). Wait additional 5 minutes before starting any work on the drive.

Important warnings

⚠ WARNING

PowerXL Series AC drive is meant for fixed installations only.

⚠ WARNING

Do not perform any measurements when the AC drive is connected to the mains.

⚠ WARNING

The ground leakage current of PowerXL Series AC drives exceeds 3.5 mA AC. According to standard EN61800-5-1, a reinforced protective ground connection must be ensured.

⚠ WARNING

If the AC drive is used as a part of a machine, the machine manufacturer is responsible for providing the machine with a supply disconnecting device (EN 60204-1).

⚠ WARNING

Only spare parts delivered by Eaton can be used.

⚠ WARNING

At power-up, power brake or fault reset the motor will start immediately if the start signal is active, unless the pulse control for Start/Stop logic has been selected. Furthermore, the I/O functionalistic (including start inputs) may change if parameters, applications or software are changed. Disconnect, therefore, the motor if an unexpected start can cause danger.

⚠ WARNING

The motor starts automatically after automatic fault reset if the auto restart function is activated. See the Application Manual for more detailed information.

⚠ WARNING

Prior to measurements on the motor or the motor cable, disconnect the motor cable from the AC drive.

⚠ WARNING

Do not touch the components on the circuit boards. Static voltage discharge may damage the components.

⚠ WARNING

Check that the EMC level of the AC drive corresponds to the requirements of your supply network.

Additional cautions

⚠ CAUTION

The PowerXL DG1 AC drive must always be grounded with an grounding conductor connected to the grounding terminal marked with. The ground leakage current of PowerXL DG1 exceeds 3.5 mA AC. According to EN61800-5-1, one or more of the following conditions for the associated protective circuit shall be satisfied:

a) The protective conductor shall have a cross-sectional area of at least 10 mm^2 Cu or 16 mm^2 Al, through its total run

b) Where the protective conductor has a cross-sectional area of less than 10 mm^2 Cu or 16 mm^2 Al, a second protective conductor of at least the same cross-sectional area shall be provided up to a point where the protective conductor has a cross-sectional area not less than 10 mm^2 Cu or 16 mm^2 Al

c) Automatic disconnection of the supply in case of loss of continuity of the protective conductor. The cross-sectional area of every protective grounding conductor that does not form part of the supply cable or cable enclosure shall, in any case, be not less than:

- 2.5mm^2 if mechanical protection is provided or
- 4 mm^2 if mechanical protection is not provided.

The ground fault protection inside the AC drive protects only the drive itself against ground faults in the motor or the motor cable. It is not intended for personal safety. The ground fault protection inside the AC drive protects only the drive itself against ground faults in the motor or the motor cable. It is not intended for personal safety. Due to the high capacitive currents present in the AC drive, fault current protective switches may not function properly.

Do not perform any voltage withstand tests on any part of PowerXL Series. There is a certain procedure according to which the tests shall be performed. Ignoring this procedure may result in damaged product.

Sécurité

AVERTISSEMENT !
TENSION ÉLECTRIQUE DANGEREUSE !

Avant de commencer l’installation

- Débrancher l’alimentation de l’appareil
- S’assurer que les dispositifs ne peuvent pas être accidentellement redémarrés
- Vérifier l’isolement de l’alimentation
- Mettre l’appareil à la terre et le protéger contre les courts-circuits
- Couvrir ou enfermer tout composant sous tension adjacent
- Seul le personnel qualifié conformément à la norme EN 50110-1/-2 (VDE 0105 Partie 100) peut travailler sur cet appareil/ce système
- Avant l’installation et avant de toucher l’appareil, s’assurer de ne porter aucune charge électrostatique
- La terre fonctionnelle (FE, PSE) doit être raccordée à la terre de protection (PE) ou la compensation de potentiel. L’installateur du système a la responsabilité d’assurer cette connexion
- Les câbles de connexion et les lignes de signal doivent être installés de façon à ce que les interférences capacitives ou inductives ne compromettent pas les fonctions d’automatisation
- Installer les appareils d’automatisation et les éléments de fonctionnement associés de manière à ce qu’ils soient bien protégés contre tout fonctionnement accidentel
- Des dispositifs de sécurité matériels et logiciels appropriés doivent être utilisés en rapport avec l’interface des E/S afin qu’un circuit ouvert sur le côté signal ne résulte pas en états indéfinis dans les dispositifs d’automatisation
- Assurer une isolation électrique fiable sur le côté tension extra basse de l’alimentation 24 V. Utiliser uniquement des blocs d’alimentation conformes à la norme CEI 60364-4-41 (VDE 0100, partie 410) ou HD384.4.41 S2
- Les écarts entre la tension d’entrée et la tension nominale ne doivent pas dépasser les limites de tolérance indiquées dans les spécifications, au risque de provoquer un mauvais fonctionnement et une utilisation dangereuse du système
- Les dispositifs d’arrêt d’urgence conformes à la norme CEI/EN 60204-1 doivent être efficace dans tous les modes de fonctionnement des dispositifs d’automatisation. Le déverrouillage des dispositifs d’arrêt d’urgence ne doit pas entraîner un redémarrage
- Les dispositifs conçus pour un montage dans des boîtiers ou armoires de commande ne doivent être utilisés et contrôlés qu’après avoir été installés et avec le boîtier fermé. Les unités de bureau ou portatives ne doivent être utilisées et contrôlées que dans leurs boîtiers fermés
- Des mesures doivent être prises pour assurer un bon redémarrage des programmes interrompus après une chute ou une panne de tension. Ceci ne doit pas causer des états de fonctionnement dangereux, même pour un court laps de temps. Si nécessaire, des dispositifs d’arrêt d’urgence doivent être utilisés
- Quand des défaillances du système d’automatisation peuvent entraîner des blessures ou des dommages matériels, des mesures externes doivent être appliquées pour assurer un état de fonctionnement sans danger en cas de panne ou de mauvais fonctionnement (par exemple au moyen de disjoncteurs séparés, de verrouillages mécaniques, etc.)
- En fonction de leur degré de protection, les entraînements à fréquence variable peuvent contenir des pièces métalliques sous tension, des composants rotatifs ou en mouvement et des surfaces brûlantes, pendant le fonctionnement et immédiatement après l’arrêt
- Le retrait des protections requises, une installation incorrecte ou un mauvais fonctionnement du moteur ou de l’entraînement à fréquence variable peuvent causer la défaillance de l’appareil et entraîner des blessures graves et des dommages importants
- La réglementation nationale applicable en matière de sécurité et de prévention des accidents s’applique à tous les travaux effectués sur les entraînements à fréquence variable sous tension
- L’installation électrique doit être effectuée conformément aux réglementations applicables (par exemple, en ce qui concerne les sections transversales des câbles, les fusibles, la mise à la terre de protection)
- Le transport, l’installation, la mise en service et les travaux de maintenance doivent être effectués uniquement par un personnel qualifié (IEC 60364, HD 384 et règles de sécurité du travail)
- Les installations contenant des entraînements à fréquence variable doivent être équipées de dispositifs de surveillance et de protection, conformément aux réglementations applicables en matière de sécurité. Les modifications des entraînements à fréquence variable réalisées à l’aide du logiciel d’exploitation sont autorisées
- Toutes les protections et les portes doivent être maintenues fermées pendant le fonctionnement

- Pour réduire les risques d’accidents et de dommages matériels, l’utilisateur doit inclure dans la conception de la machine des mesures limitant les conséquences de panne ou de mauvais fonctionnement de l’entraînement (augmentation de la vitesse ou arrêt soudain du moteur). Ces mesures comprennent :
    - Autres dispositifs indépendants de surveillance des variables en rapport avec la sécurité (vitesse, voyages, positions d’extrémité, etc.)
    - Mesures électriques ou non électriques appliquées à l’ensemble du système (verrouillages électriques ou mécaniques)
    - Ne jamais toucher les pièces sous tension ni les connexions des câbles de l’entraînement à fréquence variable après leur déconnexion de l’alimentation. En raison de la charge dans les condensateurs, ces pièces peuvent être encore sous tension après la déconnexion. Installer les panneaux d’avertissement appropriés

Lire ce manuel en entier et s’assurer de bien comprendre les procédures avant de tenter d’installer, de configurer, d’utiliser et d’effectuer tout travail d’entretien sur cet entraînement à fréquence variable DG1.

Définitions et symboles

⚡ AVERTISSEMENT

Ce symbole indique une haute tension. Il attire l’attention sur les éléments ou les opérations qui pourraient être dangereux pour les personnes utilisant cet équipement. Lire attentivement le message et suivre attentivement les instructions.

⚠

Ce symbole est le « symbole d’alerte de sécurité ». Il accompagne les deux termes d’avertissement suivants : MISE EN GARDE ou AVERTISSEMENT, comme décrit ci-dessous.

⚠ AVERTISSEMENT

Indique une situation potentiellement dangereuse qui, si elle n’est pas évitée, peut entraîner des blessures graves ou la mort.

⚠ MISE EN GARDE

Indique une situation potentiellement dangereuse qui, si elle n’est pas évitée, peut entraîner des blessures légères à modérées et d’importants dégâts matériels. La situation décrite dans la MISE EN GARDE peut, si elle n’est pas évitée, entraîner des conséquences graves. Des mesures de sécurité importantes sont décrites dans les MISES EN GARDE (ainsi que dans les AVERTISSEMENTS).

Haute tension dangereuse

⚡ AVERTISSEMENT

L’équipement de contrôle du moteur et les contrôleurs électroniques sont branchés sur des tensions secteur dangereuses. Lors de l’entretien des entraînements et des contrôleurs électroniques, il peut y avoir des composants exposés avec des boîtiers ou des protubérances au niveau du potentiel du réseau ou au-dessus. Toutes les précautions doivent être prises pour se protéger contre les chocs électriques.

- **Se tenir sur un tapis isolant et prendre l’habitude de n’utiliser qu’une seule main pour vérifier les composants**
- **Toujours travailler avec une autre personne lorsqu’une situation d’urgence se produit**
- **Débrancher l’alimentation avant de vérifier les contrôleurs ou d’effectuer des travaux d’entretien**
- **S’assurer que l’équipement est correctement relié à la terre**
- **Porter des lunettes de sécurité lors des travaux sur les contrôleurs électroniques ou les machines rotatives**

⚡ AVERTISSEMENT

Les composants de la section d’alimentation de l’entraînement restent sous tension après la coupure de la tension d’alimentation. Après la déconnexion de l’alimentation, attendre au moins cinq minutes avant de retirer le couvercle pour permettre la décharge des condensateurs du circuit intermédiaire.

Prêter attention aux avertissements signalant des dangers !

⚡ ⚠

DANGER
5 MIN

⚡ AVERTISSEMENT

Risque de choc électrique – risque de blessures ! Effectuer le câblage uniquement si l’unité n’est plus sous tension.

⚡ AVERTISSEMENT

Ne pas effectuer de modifications sur l’entraînement CA lorsqu’il est connecté à l’alimentation secteur.

Avertissements et mises en garde

AVERTISSEMENT

S'assurer de mettre l'appareil à la terre en suivant les instructions de ce manuel. Les unités non mises à la terre peuvent causer des chocs électriques et des incendies.

AVERTISSEMENT

Cet équipement ne doit être installé, réglé et entretenu que par un personnel d'entretien électrique qualifié connaissant la construction et le fonctionnement de ce type d'équipement, ainsi que les risques encourus. Le non-respect de cette précaution peut entraîner la mort ou des blessures graves.

AVERTISSEMENT

Les composants à l'intérieur de l'entraînement sont sous tension lorsque l'entraînement est branché à l'alimentation. Le contact avec cette tension est extrêmement dangereux et peut causer la mort ou des blessures graves.

AVERTISSEMENT

Les bornes de phase (L1, L2, L3), les bornes du moteur (U, V, W) et les bornes de résistance de liaison CC/frein (DC-, DC+/R+, R-) sont sous tension lorsque l'entraînement est branché à l'alimentation, même si le moteur ne tourne pas. Le contact avec cette tension est extrêmement dangereux et peut causer la mort ou des blessures graves.

AVERTISSEMENT

Même si les bornes E/S de commande sont isolées de la tension secteur, les sorties de relais et les autres bornes E/S peuvent présenter une tension dangereuse même lorsque l'entraînement est débranché. Le contact avec cette tension est extrêmement dangereux et peut causer la mort ou des blessures graves.

AVERTISSEMENT

Cet équipement a un grand courant de fuite capacitif pendant le fonctionnement, ce qui peut mettre les pièces du boîtier à un niveau supérieur au potentiel de terre. Une mise à la terre appropriée, telle que décrite dans ce manuel, est nécessaire. Le non-respect de cette précaution peut entraîner la mort ou des blessures graves.

AVERTISSEMENT

Avant de mettre l'entraînement sous tension, s'assurer que les protections avant et des câbles sont fermées et attachées pour empêcher l'exposition à d'éventuelles défaillances électriques. Le non-respect de cette précaution peut entraîner la mort ou des blessures graves.

AVERTISSEMENT

Un dispositif de protection/déconnexion en amont doit être fourni, tel que requis par le code électrique national (NEC®). Le non-respect de cette précaution peut entraîner la mort ou des blessures graves.

AVERTISSEMENT

Cet entraînement peut causer un courant CC dans le conducteur de mise à la terre de protection. Lorsqu'un dispositif de protection ou de surveillance à courant résiduel est utilisé pour la protection en cas de contact direct ou indirect, seul un dispositif de type B est autorisé sur le côté alimentation de ce produit.

AVERTISSEMENT

Ne travailler sur le câblage qu'après que l'entraînement a été correctement monté et attaché.

AVERTISSEMENT

Avant d'ouvrir les couvercles de l'entraînement :

- **Débrancher toute l'alimentation allant à l'entraînement, y compris l'alimentation de commande externe pouvant être présente**
- **Attendre un minimum de cinq minutes après l'extinction de tous les voyants du clavier. Cela permet aux condensateurs de bus CC de se décharger**
- **Une tension dangereuse peut rester dans les condensateurs de bus CC même si l'alimentation a été coupée. Confirmer que les condensateurs sont entièrement déchargés en mesurant la tension à l'aide d'un multimètre réglé pour mesurer la tension CC**

Le non-respect de cette précaution peut entraîner la mort ou des blessures graves.

AVERTISSEMENT

L'ouverture du dispositif de protection du circuit de dérivation peut indiquer que le courant de défaut a été interrompu. Pour réduire le risque d'incendie ou de choc électrique, les pièces porteuses de courant et les autres composants du contrôleur doivent être examinés et remplacés s'ils sont endommagés. Si l'élément de courant d'un relais de surcharge a grillé, le relais de surcharge doit être intégralement remplacé.

AVERTISSEMENT

Le fonctionnement de cet équipement nécessite le respect des instructions d'installation et de fonctionnement détaillées fournies dans le manuel d'installation/de fonctionnement destiné à être utilisé avec ce produit. Ces informations sont fournies sur le CD-ROM, la disquette ou tout autre périphérique de stockage inclus dans l'emballage contenant ce dispositif. Ce support doit être conservé avec cet appareil à tout moment. Une copie papier de ces informations peut être commandée auprès du service de documentation Eaton.

AVERTISSEMENT

Avant de procéder à l'entretien de l'entraînement :

- **Débrancher toute l'alimentation allant à l'entraînement, y compris l'alimentation de commande externe pouvant être présente**
- **Placer une étiquette « NE PAS UTILISER » sur le dispositif de déconnexion**
- **Verrouiller le dispositif de déconnexion en position ouverte**

Le non-respect de ces instructions peut entraîner la mort ou des blessures graves.

AVERTISSEMENT

Les sorties de l'entraînement (U, V, W) ne doivent pas être connectées à la tension d'entrée ni à l'alimentation secteur, car ceci pourrait gravement endommager l'appareil et causer un incendie.

AVERTISSEMENT

Le dissipateur de chaleur et/ou le boîtier externe peuvent atteindre une température élevée.

Prêter attention aux avertissements signalant des dangers !

Surface brûlante – Risque de brûlure. NE PAS TOUCHER !

MISE EN GARDE

Toute modification électrique ou mécanique de cet entraînement sans consentement écrit préalable d'Eaton annule toutes les garanties, peut entraîner un danger pour la sécurité et annuler l'homologation UL®.

MISE EN GARDE

Installer cet entraînement sur une matière résistante aux flammes, telle qu'une plaque d'acier, pour réduire les risques d'incendie.

MISE EN GARDE

Installer cet entraînement sur une surface perpendiculaire capable de supporter le poids de l'entraînement et non soumise à des vibrations afin de diminuer les risques de chute et de dommage de l'entraînement, ainsi que les risques de blessures.

MISE EN GARDE

Empêcher la pénétration de corps étrangers, tels que morceaux de fils et copeaux métalliques, dans le boîtier de l'entraînement, car ceci pourrait provoquer la formation d'un arc électrique et un incendie.

MISE EN GARDE

Installer cet entraînement dans une pièce bien aérée non soumise à des températures extrêmes, à une forte humidité ou à la condensation. Éviter les endroits directement exposés au soleil ou présentant de fortes concentrations de poussières, des gaz corrosifs, des gaz explosifs, des gaz inflammables, ou des vapeurs de liquide de meulage, etc. Une installation inadéquate peut entraîner un risque d'incendie.

MISE EN GARDE

Lors de la sélection de la section transversale des câbles, prendre en compte la chute de tension dans des conditions de charge. La prise en compte d'autres paramètres relève de la responsabilité de l'utilisateur.

Il relève de la responsabilité de l'utilisateur de respecter toutes les normes électriques nationales et internationales en vigueur concernant la mise à la terre de protection de l'ensemble de l'équipement.

MISE EN GARDE

Les spécifications minimum relatives aux sections transversales des conducteurs de terre de protection indiquées dans ce manuel doivent être respectées.

Le courant de fuite de cet équipement dépasse 3,5 mA (CA). La taille minimum du conducteur de la mise à la terre de protection doit être conforme aux exigences de la norme EN 61800-5-1 et/ou aux réglementations de sécurité locales.

MISE EN GARDE

Les courants de fuite de ce convertisseur de fréquence sont supérieures à 3,5 mA (CA). Conformément à la norme CEI/EN 61800-5-1, un conducteur de mise à la terre de l'équipement supplémentaire possédant la même superficie de coupe transversale que le conducteur de mise à la terre de protection d'origine doit être branché, ou la section transversale du conducteur de mise à la terre de l'équipement doit être d'au moins 10 mm^2 Cu. Seul un conducteur en cuivre doit être utilisé avec cet entraînement.

⚠ MISE EN GARDE

Les entrées anti-rebond ne sont pas permises dans le schéma du circuit de sécurité. Des disjoncteurs de courant résiduel (RCD) ne peuvent être installés qu’entre le réseau de courant alternatif et l’entraînement.

⚠ MISE EN GARDE

Les entrées anti-rebond ne sont pas permises dans le schéma du circuit de sécurité. Si plusieurs moteurs sont connectés à un entraînement, des contacteurs doivent être conçus pour les moteurs individuels conformément à la catégorie d’utilisation AC-3.

Sélectionner du contacteur du moteur en fonction du courant de fonctionnement nominal du moteur à connecter.

⚠ MISE EN GARDE

Les entrées anti-rebond ne sont pas permises dans le schéma du circuit de sécurité. Une commutation entre l’entraînement et l’alimentation d’entrée doit avoir lieu dans un état sans tension.

⚠ MISE EN GARDE

Les entrées anti-rebond ne sont pas permises dans le schéma du circuit de sécurité. Risque d’incendie !

Utiliser uniquement des câbles, des interrupteurs de protection et des contacteurs indiquant le courant nominal permis.

⚠ MISE EN GARDE

Avant de connecter l’entraînement à l’alimentation secteur CA, s’assurer que les réglages de la classe de protection CEM sont correctement effectués selon les instructions de ce manuel.

- Si l’entraînement doit être utilisé dans un réseau de distribution flottant, retirer les vis au niveau des VOM et CEM. Voir « Installation dans un réseau à une phase connectée à la terre (corner-grounded) » et « Installation dans un réseau IT»
- Débrancher le filtre CEM interne lors de l’installation de l’entraînement sur un réseau IT (système d’alimentation non mis à la terre ou système d’alimentation électrique mis à la terre haute résistance [plus de 30 ohms]) pour ne pas que le système soit connecté au potentiel de terre via les condensateurs du filtre CEM. Ceci peut être une cause de dangers ou endommager l’entraînement
- Débrancher le filtre CEM interne lors de l’installation de l’entraînement sur un système TN à une phase connectée à la terre pour ne pas endommager l’entraînement

Note: Lorsque le filtre CEM interne est débranché, l’entraînement peut ne pas être conforme aux normes de compatibilité électromagnétique.

- Ne pas tenter d’installer ou de retirer les vis des VOM et CEM lorsque l’alimentation est appliquée aux bornes d’entrée de l’entraînement

Sécurité du moteur et de l’équipement

⚠ MISE EN GARDE

n’effectuer aucun test de résistance de tension ou au mégohmmètre sur toute partie de l’entraînement ou de ses composants. Un test inadéquat peut entraîner des dommages.

⚠ MISE EN GARDE

Avant tout test ou mesure du moteur ou du câble du moteur, débrancher le câble du moteur au niveau des bornes de sortie de l’entraînement (U, V, W) pour éviter d’endommager ce dernier lors des tests.

⚠ MISE EN GARDE

Ne toucher aucun composant sur les cartes de circuit. Les décharges d’électricité statique peuvent endommager les composants.

⚠ MISE EN GARDE

Avant de mettre le moteur en marche, vérifier qu’il est correctement monté et aligné avec l’équipement entraîné. S’assurer que le démarrage du moteur ne risque pas de provoquer des blessures ou d’endommager l’équipement connecté au moteur.

⚠ MISE EN GARDE

Régler la vitesse maximale du moteur (fréquence) dans l’entraînement conformément aux exigences du moteur et de l’équipement qui lui est connecté. Des réglages de fréquence maximum incorrects peuvent endommager le moteur ou l’équipement et causer des blessures.

⚠ MISE EN GARDE

Avant d’inverser le sens de rotation du moteur, veiller à ce que cela ne risque pas de provoquer des blessures ou des dommages matériels.

⚠ MISE EN GARDE

S’assurer qu’aucun condensateur de correction de puissance n’est connecté à la sortie de l’entraînement ou aux bornes du moteur pour éviter un mauvais fonctionnement de l’entraînement et des dommages potentiels.

⚠ MISE EN GARDE

S’assurer que les bornes de sortie de l’entraînement (U, V, W) ne sont pas connectées à l’alimentation secteur, ce qui pourrait causer de graves dommages à l’entraînement.

⚠ MISE EN GARDE

Lorsque les bornes de commande de deux ou plusieurs unités d'entraînement sont raccordées en parallèle, la tension auxiliaire de ces connexions de commande doit être fournie par une source unique, qui peut être soit l'une des unités, soit une alimentation externe.

⚠ MISE EN GARDE

L'entraînement démarre automatiquement après une interruption de la tension d'entrée si la commande de démarrage externe est active.

⚠ MISE EN GARDE

Ne pas commander le moteur avec le dispositif de déconnexion ; à la place, utiliser les touches de marche et d'arrêt du tableau de contrôle ou les commandes du tableau des E/S de l'entraînement. Le nombre de cycles de charge maximum permis des condensateurs CC (c'est-à-dire les mises sous tension par application de puissance) est de cinq en dix minutes.

⚠ MISE EN GARDE

Fonctionnement incorrect de l'entraînement :

- Si l'entraînement n'est pas mis en marche pendant une longue période, la performance de ses condensateurs électrolytiques sera réduite
- S'il est arrêté pour une période prolongée, le mettre en marche au moins tous les six mois pendant au moins 5 heures pour restaurer la performance des condensateurs, puis vérifier son fonctionnement. Il est recommandé de ne pas brancher l'entraînement directement sur la tension secteur. La tension doit être augmentée progressivement en utilisant une source CA réglable

Le non-respect de ces instructions peut entraîner des blessures ou des dégâts matériels.

Pour plus d'informations techniques, contacter l'usine ou le représentant commercial Eaton local.

Chapter 1—PowerXL series overview

This chapter describes the purpose and contents of this manual, the receiving inspection recommendations and the PowerXL Series Open Drive catalog numbering system.

How to use this manual

The purpose of this manual is to provide you with information necessary to install, set and customize parameters, start up, troubleshoot and maintain the Eaton PowerXL Series variable frequency drive (VFD). To provide for safe installation and operation of the equipment, read the safety guidelines at the beginning of this manual and follow the procedures outlined in the following chapters before connecting power to the PowerXL Series VFD. Keep this operating manual handy and distribute to all users, technicians and maintenance personnel for reference.

Receiving and inspection

The PowerXL Series VFD has met a stringent series of factory quality requirements before shipment. It is possible that packaging or equipment damage may have occurred during shipment. After receiving your PowerXL Series VFD, please check for the following:

Check to make sure that the package includes the Instruction Leaflet Quick Start Guide, and accessory packet. The accessory packet includes:

- Rubber grommets
- Control cable grounding clamps
- Additional grounding screw

Inspect the unit to ensure it was not damaged during shipment.

Make sure that the part number indicated on the nameplate corresponds with the catalog number on your order.

If shipping damage has occurred, please contact and file a claim with the carrier involved immediately.

If the delivery does not correspond to your order, please contact your Eaton Electrical representative.

Note: Do not destroy the packing. The template printed on the protective cardboard can be used for marking the mounting points of the PowerXL VFD on the wall or in a cabinet.

Real time clock battery activation

To activate the real time clock (RTC) functionality in the PowerXL Series VFD, the RTC battery (already mounted in the drive) must be connected to the control board.

Simply remove the primary drive cover, locate the RTC battery directly below the keypad, and connect the white 2-wire connector to the receptacle on the control board.

Figure 1. RTC battery connection.

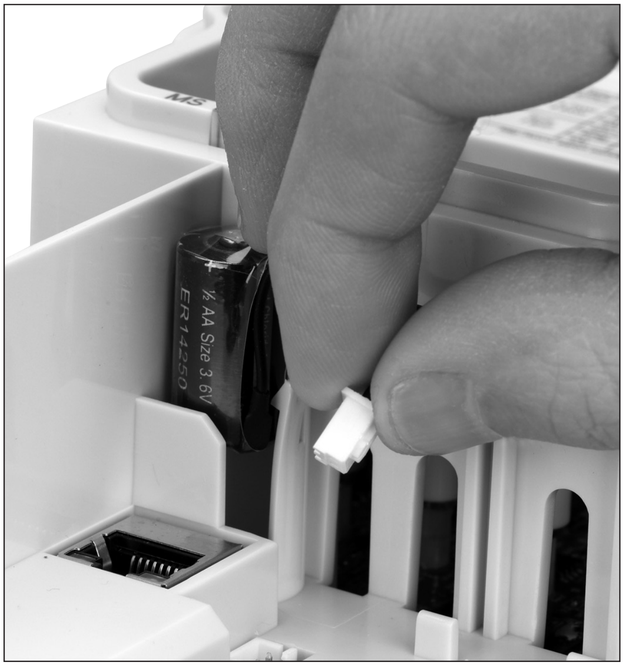
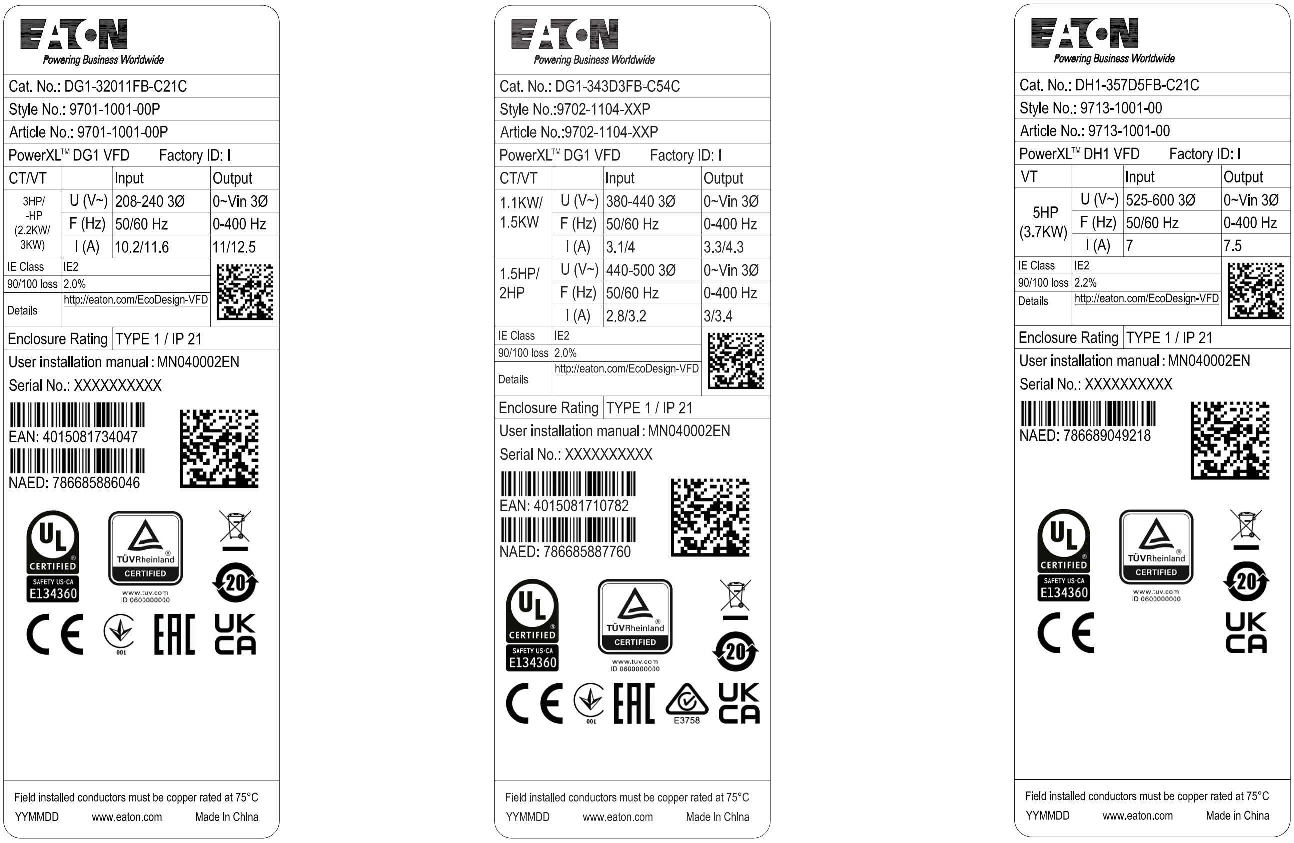


Table 1. Common abbreviations.

Abbreviation	Definition
CT	Constant torque with high overload rating (150%)
VT	Variable torque with low overload rating (110%)
IH	High overload current (150%)
I_L	Low overload current (110%)
VFD	Variable Frequency Drive
RTC	Real Time Clock

Rating label

Figure 2. Rating labels (samples).



230 V

EATON
Powering Business Worldwide

Cat. No.: DG1-32011FB-C21C
Style No.: 9701-1001-00P
Article No.: 9701-1001-00P
PowerXL™ DG1 VFD Factory ID: I

CT/VT		Input	Output
3HP/-HP (2.2KW/3KW)	U (V~)	208-240 3Ø	0~Vin 3Ø
	F (Hz)	50/60 Hz	0-400 Hz
	I (A)	10.2/11.6	11/12.5

IE Class	IE2
90/100 loss	2.0%
Details	http://eaton.com/EcoDesign-VFD

Enclosure Rating TYPE 1 / IP 21
User installation manual: MN040002EN
Serial No.: XXXXXXXXXX
EAN: 4015081734047
NAED: 786685886046

Field installed conductors must be copper rated at 75°C
YYMMDD www.eaton.com Made in China

480 V

EATON
Powering Business Worldwide

Cat. No.: DG1-343D3FB-C54C
Style No.:9702-1104-XXP
Article No.:9702-1104-XXP
PowerXL™ DG1 VFD Factory ID: I

CT/VT		Input	Output
1.1KW/1.5KW	U (V~)	380-440 3Ø	0~Vin 3Ø
	F (Hz)	50/60 Hz	0-400 Hz
	I (A)	3.1/4	3.3/4.3
1.5HP/2HP	U (V~)	440-500 3Ø	0~Vin 3Ø
	F (Hz)	50/60 Hz	0-400 Hz
	I (A)	2.8/3.2	3/3.4

IE Class	IE2
90/100 loss	2.0%
Details	http://eaton.com/EcoDesign-VFD

Enclosure Rating TYPE 1 / IP 21
User installation manual: MN040002EN
Serial No.: XXXXXXXXXX
EAN: 4015081710782
NAED: 786685887760

Field installed conductors must be copper rated at 75°C
YYMMDD www.eaton.com Made in China

575 V

EATON
Powering Business Worldwide

Cat. No.: DH1-357D5FB-C21C
Style No.: 9713-1001-00
Article No.: 9713-1001-00
PowerXL™ DH1 VFD Factory ID: I

VT		Input	Output
5HP (3.7KW)	U (V~)	525-600 3Ø	0~Vin 3Ø
	F (Hz)	50/60 Hz	0-400 Hz
	I (A)	7	7.5

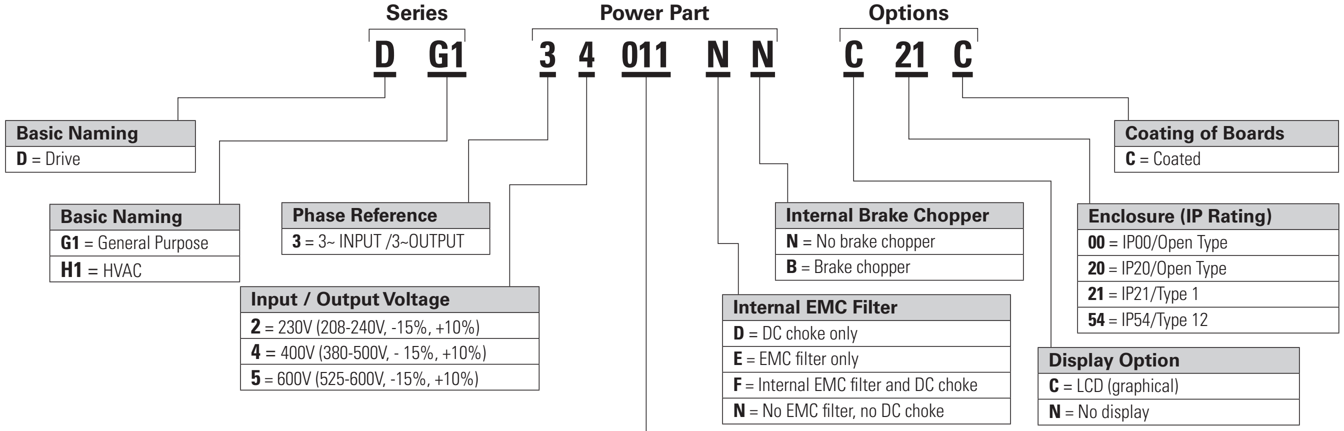
IE Class	IE2
90/100 loss	2.2%
Details	http://eaton.com/EcoDesign-VFD

Enclosure Rating TYPE 1 / IP 21
User installation manual: MN040002EN
Serial No.: XXXXXXXXXX
NAED: 786689049218

Field installed conductors must be copper rated at 75°C
YYMMDD www.eaton.com Made in China

Catalog number system

Figure 3. Catalog numbering system.



Basic Naming
D = Drive

Basic Naming
G1 = General Purpose
H1 = HVAC

Phase Reference
3 = 3~ INPUT /3~OUTPUT

Input / Output Voltage
2 = 230V (208-240V, -15%, +10%)
4 = 400V (380-500V, - 15%, +10%)
5 = 600V (525-600V, -15%, +10%)

Internal EMC Filter
D = DC choke only
E = EMC filter only
F = Internal EMC filter and DC choke
N = No EMC filter, no DC choke

Internal Brake Chopper
N = No brake chopper
B = Brake chopper

Display Option
C = LCD (graphical)
N = No display

Enclosure (IP Rating)
00 = IP00/Open Type
20 = IP20/Open Type
21 = IP21/Type 1
54 = IP54/Type 12

Coating of Boards
C = Coated

DG1 - Output Current Rating (CT)		
208-240V	**380-500V**	**525-600V**
3D7 =3.7 A, 0.55 kW, 0.75 hp	**2D2** =2.2 A, 0.75 kW, 1 hp	**3D3** =3.3 A, 1.5 kW, 2 hp
4D8 =4.8 A, 0.75 kW, 1 hp	**3D3** =3.3 A, 1.1 kW, 1.5 hp	**4D5** =4.5 A, 2.2 kW, 3 hp
6D6 =6.6 A, 1.1 kW, 1.5 hp	**4D3** =4.3 A, 1.5 kW, 2 hp	**7D5** =7.5 A, 3.7 kW, 5 hp
7D8 =7.8 A, 1.5 kW, 2 hp	**5D6** =5.6 A, 2.2 kW, 3 hp	**010** =10 A, 5.5 kW, 7.5 hp
011 =11 A, 2.2 kW, 3 hp	**7D6** =7.6 A, 3 kW, 5 hp	**013** =13.5 A, 7.5 kW, 10 hp
012 =12.5 A, 3 kW, 5 hp (VT)	**9D0** =9 A, 4 kW, 7.5 hp (VT)	**018** =18 A, 11 kW, 15 hp
017 =17.5 A, 3.7 kW, 5 hp	**012** =12 A, 5.5 kW, 7.5 hp	**022** =22 A, 15 kW, 20 hp
025 =25 A, 5.5 kW, 7.5 hp	**016** =16 A, 7.5 kW, 10 hp	**027** =27 A, 18.5 kW, 25 hp
031 =31 A, 7.5 kW, 10 hp	**023** =23 A, 11 kW, 15 hp	**034** =34 A, 22 kW, 30 hp
048 =48 A, 11 kW, 15 hp	**031** =31 A, 15 kW, 20 hp	**041** =41 A, 30 kW, 40 hp
061 =61 A, 15 kW, 20 hp	**038** =38 A, 18.5 kW, 25 hp	**052** =52 A, 37 kW, 50 hp
075 =75 A, 18.5 kW, 25 hp	**046** =46 A, 22 kW, 30 hp	**062** =62 A, 45 kW, 60 hp
088 =88 A, 22 kW, 30 hp	**061** =61 A, 30 kW, 40 hp	**080** =80 A, 55 kW, 75 hp
114 =114 A, 30 kW, 40 hp	**072** =72 A, 37 kW, 50 hp	**100** =100 A, 75 kW, 100 hp
143 =143 A, 37 kW, 50 hp	**087** =87 A, 45 kW, 60 hp	**125** =125 A, 90 kW, 125 hp
170 =170 A, 45 kW, 60 hp	**105** =105 A, 55 kW, 75 hp	**144** =144 A, 110 kW, 150 hp
211 =211 A, 55 kW, 75 hp	**140** =140 A, 75 kW, 100 hp	**208** =208 A, 132 kW, 200 hp
248 =248 A, 75 kW, 100 hp	**170** =170 A, 90 kW, 125 hp	**200** = 208 A, 200 kW, 200 hp
	205 =205 A, 110 kW, 150 hp	**261** = 261 A, 250 kW, 250 hp
	245 =245 A, 132 kW, 200 hp	**325** = 325 A, 315 kW, 300 hp
	310 = 310 A, 160 kW, 250 hp	**385** = 385 A, 355 kW, 300 hp
	385 = 385 A, 200 kW, 300 hp	**416** = 416 A, 400 kW, 400 hp
	460 = 460 A, 250 kW, 350 hp	**460** = 460 A, 450 kW, 450 hp
	520 = 520 A, 250 kW, 450 hp	**520** = 520 A, 500 kW, 500 hp
	590 = 590 A, 315 kW, 500 hp	**590** = 590 A, 560 kW, 600 hp
	650 = 650 A, 355 kW, 500 hp	**650** = 650 A, 630 kW, 650 hp
	730 = 730 A, 400 kW, 600 hp	**820** = 820 A, 800 kW, 800 hp (VT)
	820 = 820 A, 450 kW, 700 hp	
	920 = 920 A, 500 kW, 800 hp	
	1K0 = 1180 A, 630 kW, 1000 hp (VT)	

Power ratings and product selection

PowerXL Series drives—208-230 Volt

Table 2. Type/IP20.

	Constant torque (CT)/high overload (I_H)			Variable torque (VT)/low overload (I_L)			
Frame size	**230 V, 50 Hz kW rating**	**230 V, 60 Hz hp**	**Current A**	**230 V, 50 Hz kW rating**	**230 V, 60 Hz hp**	**Current A**	**DG1 Catalog number**
FR0	0.55	0.75	3.7	0.75	1	4.8	**DG1-323D7EB-C20C**
	0.75	1	4.8	1.1	1.5	6.6	**DG1-324D8EB-C20C**
	1.1	1.5	6.6	1.5	2	7.8	**DG1-326D6EB-C20C**

Table 3. Type 1/IP21.

	Constant torque (CT)/high overload (I_H)			Variable torque (VT)/low overload (I_L)			
Frame size	**230 V, 50 Hz kW rating**	**230 V, 60 Hz hp**	**Current A**	**230 V, 50 Hz kW rating**	**230 V, 60 Hz hp**	**Current A**	**Catalog number**
FR1	0.55	0.75	3.7	0.75	1	4.8	**DG1-323D7FB-C21C**
	0.75	1	4.8	1.1	1.5	6.6	**DG1-324D8FB-C21C**
	1.1	1.5	6.6	1.5	2	7.8	**DG1-326D6FB-C21C**
	1.5	2	7.8	2.2	3	11	**DG1-327D8FB-C21C**
	2.2	3	11	3	–	12.5	**DG1-32011FB-C21C**
FR2	3	–	12.5	3.7	5	17.5	**DG1-32012FB-C21C**
	3.7	5	17.5	5.5	7.5	25	**DG1-32017FB-C21C**
	5.5	7.5	25	7.5	10	31	**DG1-32025FB-C21C**
FR3	7.5	10	31	11	15	48	**DG1-32031FB-C21C**
	11	15	48	15	20	61	**DG1-32048FB-C21C**
FR4	15	20	61	18.5	25	75	**DG1-32061FN-C21C**
	18.5	25	75	22	30	88	**DG1-32075FN-C21C**
	22	30	88	30	40	114	**DG1-32088FN-C21C**
FR5	30	40	114	37	50	143	**DG1-32114FN-C21C**
	37	50	143	45	60	170	**DG1-32143FN-C21C**
	45	60	170	55	75	211	**DG1-32170FN-C21C**
FR6	55	75	211	75	100	261	**DG1-32211FN-C21C**
	75	100	248	90	125	312	**DG1-32248FN-C21C**

Table 4. Type 12/IP54.

	Constant torque (CT)/high overload (I_H)			Variable torque (VT)/low overload (I_L)			
Frame size	**230 V, 50 Hz kW rating**	**230 V, 60 Hz hp**	**Current A**	**230 V, 50 Hz kW rating**	**230 V, 60 Hz hp**	**Current A**	**Catalog number**
FR1	0.55	0.75	3.7	0.75	1	4.8	**DG1-323D7FB-C54C**
	0.75	1	4.8	1.1	1.5	6.6	**DG1-324D8FB-C54C**
	1.1	1.5	6.6	1.5	2	7.8	**DG1-326D6FB-C54C**
	1.5	2	7.8	2.2	3	11	**DG1-327D8FB-C54C**
	2.2	3	11	3	–	12.5	**DG1-32011FB-C54C**
FR2	3	–	12.5	3.7	5	17.5	**DG1-32012FB-C54C**
	3.7	5	17.5	5.5	7.5	25	**DG1-32017FB-C54C**
	5.5	7.5	25	7.5	10	31	**DG1-32025FB-C54C**
FR3	7.5	10	31	11	15	48	**DG1-32031FB-C54C**
	11	15	48	15	20	61	**DG1-32048FB-C54C**
FR4	15	20	61	18.5	25	75	**DG1-32061FN-C54C**
	18.5	25	75	22	30	88	**DG1-32075FN-C54C**
	22	30	88	30	40	114	**DG1-32088FN-C54C**
FR5	30	40	114	37	50	143	**DG1-32114FN-C54C**
	37	50	143	45	60	170	**DG1-32143FN-C54C**
	45	60	170	55	75	211	**DG1-32170FN-C54C**
FR6	55	75	211	75	100	261	**DG1-32211FN-C54C**
	75	100	248	90	125	312	**DG1-32248FN-C54C**

PowerXL Series drives—380-500 Volt

Table 5. Open type IP20.

	380-440 volts 50 Hz kW rating				440-500 volt 60 Hz HP rating				
Frame size	**CT kW**	**VT kW**	**CT output current**	**VT output current**	**CT HP**	**VT HP**	**CT output current**	**VT output current**	**Catalog**
FR0	0.75	1.1	2.2	3.3	1	1.5	2.1	3	**DG1-342D2EB-C20C**
	1.1	1.5	3.3	4.3	1.5	2	3	3.4	**DG1-343D3EB-C20C**
	1.5	2.2	4.3	5.6	2	3	3.4	4.8	**DG1-344D3EB-C20C**
	2.2	3	5.6	7.6	3	5	4.8	7.6	**DG1-345D6EB-C20C**

Table 6. Type 1/IP21.

	380-440 volts 50 Hz rating				440-500 volt 60 Hz rating				
Frame size	**CT kW**	**VT kW**	**CT output current**	**VT output current**	**CT HP**	**VT HP**	**CT output current**	**VT output current**	**Catalog**
FR1	0.75	1.1	2.2	3.3	1	1.5	2.1	3	**DG1-342D2FB--C21C**
	1.1	1.5	3.3	4.3	1.5	2	3	3.4	**DG1-343D3FB--C21C**
	1.5	2.2	4.3	5.6	2	3	3.4	4.8	**DG1-344D3FB-C21C**
	2.2	3	5.6	7.6	3	5	4.8	7.6	**DG1-345D6FB-C21C**
	3	4	7.6	9	5	-	7.6	-	**DG1-347D6FB-C21C**
	4	5.5	9	12	-	7.5	-	11	**DG1-349D0FB-C21C**
FR2	5.5	7.5	12	16	7.5	10	11	14	**DG1-34012FB-C21C**
	7.5	11	16	23	10	15	14	21	**DG1-34016FB-C21C**
	11	15	23	31	15	20	21	27	**DG1-34023FB-C21C**
FR3	15	18.5	31	38	20	25	27	34	**DG1-34031FB-C21C**
	18.5	22	38	46	25	30	34	40	**DG1-34038FB-C21C**
	22	30	46	61	30	40	40	52	**DG1-34046FB-C21C**
FR4	30	37	61	72	40	50	52	65	**DG1-34061FB-C21C**
	37	45	72	87	50	60	65	77	**DG1-34072FB-C21C**
	45	55	87	105	60	75	77	96	**DG1-34087FB-C21C**
FR5	55	75	105	140	75	100	96	124	**DG1-34105FB-C21C**
	75	90	140	170	100	125	124	156	**DG1-34140FB-C21C**
	90	110	170	205	125	150	156	180	**DG1-34170FB-C21C**
FR6	110	132	205	261	150	200	180	240	**DG1-34205FB-C21C**
	132	160	245	310	200	250	240	302	**DG1-34245FB-C21C**

Table 7. Type 12/IP54.

	380-440 volts 50 Hz kW rating				440-500 volt 60 Hz HP rating				
Frame size	**CT kW**	**VT kW**	**CT output current**	**VT output current**	**CT HP**	**VT HP**	**CT output current**	**VT output current**	**Catalog**
FR1	0.75	1.1	2.2	3.3	1	1.5	2.1	3	DG1-342D2FB-C54C
	1.1	1.5	3.3	4.3	1.5	2	3	3.4	**DG1-343D3FB-C54C**
	1.5	2.2	4.3	5.6	2	3	3.4	4.8	**DG1-344D3FB-C54C**
	2.2	3	5.6	7.6	3	5	4.8	7.6	**DG1-345D6FB-C54C**
	3	4	7.6	9	5	-	7.6	-	**DG1-347D6FB-C54C**
	4	5.5	9	12	-	7.5	-	11	**DG1-349D0FB-C54C**
FR2	5.5	7.5	12	16	7.5	10	11	14	**DG1-34012FB-C54C**
	7.5	11	16	23	10	15	14	21	**DG1-34016FB-C54C**
	11	15	23	31	15	20	21	27	**DG1-34023FB-C54C**
FR3	15	18.5	31	38	20	25	27	34	**DG1-34031FB-C54C**
	18.5	22	38	46	25	30	34	40	**DG1-34038FB-C54C**
	22	30	46	61	30	40	40	52	**DG1-34046FB-C54C**
FR4	30	37	61	72	40	50	52	65	**DG1-34061FB-C54C**
	37	45	72	87	50	60	65	77	**DG1-34072FB-C54C**
	45	55	87	105	60	75	77	96	**DG1-34087FB-C54C**
FR5	55	75	105	140	75	100	96	124	**DG1-34105FB-C54C**
	75	90	140	170	100	125	124	156	**DG1-34140FB-C54C**
	90	110	170	205	125	150	156	180	**DG1-34170FB-C54C**
FR6	110	132	205	261	150	200	180	240	**DG1-34205FB-C54C**
	132	160	245	310	200	250	240	302	**DG1-34245FB-C54C**

PowerXL Series drives—380, 500 Volt

Table 8. Type 0/IP00.

	Constant torque (CT)/high overload (I_H)			Variable torque (VT)/low overload (I_L)			
Frame size	**400 V, 50 Hz kW rating**	**480 V, 60 Hz hp**	**Current A**	**400 V, 50 Hz kW rating**	**480 V, 60 Hz hp**	**Current A**	**Catalog number**
FR7	160	250	311	200	300	385	**DG1-34310FN-C00C**
	200	300	385	250	350	460	**DG1-34385FN-C00C**
	250	350	460	250	450	520	**DG1-34460FN-C00C**
	250	450	520	315	500	590	**DG1-34520FN-C00C**
FR8	315	500	590	355	500	650	**DG1-34590FN-C00C**
	355	500	650	400	600	730	**DG1-34650FN-C00C**
	400	600	730	450	700	820	**DG1-34730FN-C00C**
	450	700	820	500	800	920	**DG1-34820FN-C00C**
	500	800	920	560	900	1040	**DG1-34920FN-C00C**
	500	800	920	630	1000	1180	**DG1-341K0FN-C00C**

PowerXL Series Drives—600 volt ①

Table 9. Type 1/IP21.

	Constant torque (CT)/high overload (I_H)			Variable torque (VT)/low overload (I_L)			
Frame size	600 V, 60 Hz kW rating	600 V, 60 Hz hp	Current A	600 V, 60 Hz kW rating	600 V, 60 Hz hp	Current A	Catalog number
FR1	1.5	2	3.3	2.2	3	4.5	**DG1-353D3FB-C21C**
	2.2	3	4.5	3.7	5	7.5	**DG1-354D5FB-C21C**
	3.7	5	7.5	5.5	7.5	10	**DG1-357D5FB-C21C**
FR2	5.5	7.5	10	7.5	10	13.5	**DG1-35010FB-C21C**
	7.5	10	13.5	11	15	18	**DG1-35013FB-C21C**
	11	15	18	15	20	22	**DG1-35018FB-C21C**
FR3	15	20	22	18.5	25	27	**DG1-35022FB-C21C**
	18.5	25	27	22	30	34	**DG1-35027FB-C21C**
	22	30	34	30	40	41	**DG1-35034FB-C21C**
FR4	30	40	41	37	50	52	**DG1-35041FN-C21C**
	37	50	52	45	60	62	**DG1-35052FN-C21C**
	45	60	62	55	75	80	**DG1-35062FN-C21C**
FR5	55	75	80	75	100	100	**DG1-35080FN-C21C**
	75	100	100	90	125	125	**DG1-35100FN-C21C**
	90	125	125	110	150	144	**DG1-35125FN-C21C**
FR6	110	150	144	150	200	208	**DG1-35144FN-C21C**
	150	200	208	187	250	250	**DG1-35208FN-C21C**

Table 10. Type 12/IP54.

	Constant torque (CT)/high overload (I_H)			Variable torque (VT)/low overload (I_L)			
Frame size	600 V, 60 Hz kW rating	600 V, 60 Hz hp	Current A	600 V, 60 Hz kW rating	600 V, 60 Hz hp	Current A	Catalog number
FR1	1.5	2	3.3	2.2	3	4.5	**DG1-353D3FB-C54C**
	2.2	3	4.5	3.7	5	7.5	**DG1-354D5FB-C54C**
	3.7	5	7.5	5.5	7.5	10	**DG1-357D5FB-C54C**
FR2	5.5	7.5	10	7.5	10	13.5	**DG1-35010FB-C54C**
	7.5	10	13.5	11	15	18	**DG1-35013FB-C54C**
	11	15	18	15	20	22	**DG1-35018FB-C54C**
FR3	15	20	22	18.5	25	27	**DG1-35022FB-C54C**
	18.5	25	27	22	30	34	**DG1-35027FB-C54C**
	22	30	34	30	40	41	**DG1-35034FB-C54C**
FR4	30	40	41	37	50	52	**DG1-35041FN-C54C**
	37	50	52	45	60	62	**DG1-35052FN-C54C**
	45	60	62	55	75	80	**DG1-35062FN-C54C**
FR5	55	75	80	75	100	100	**DG1-35080FN-C54C**
	75	100	100	90	125	125	**DG1-35100FN-C54C**
	90	125	125	110	150	144	**DG1-35125FN-C54C**
FR6	110	150	144	150	200	208	**DG1-35144FN-C54C**
	150	200	208	187	250	250	**DG1-35208FN-C54C**

PowerXL Series drives—525—600 Volt

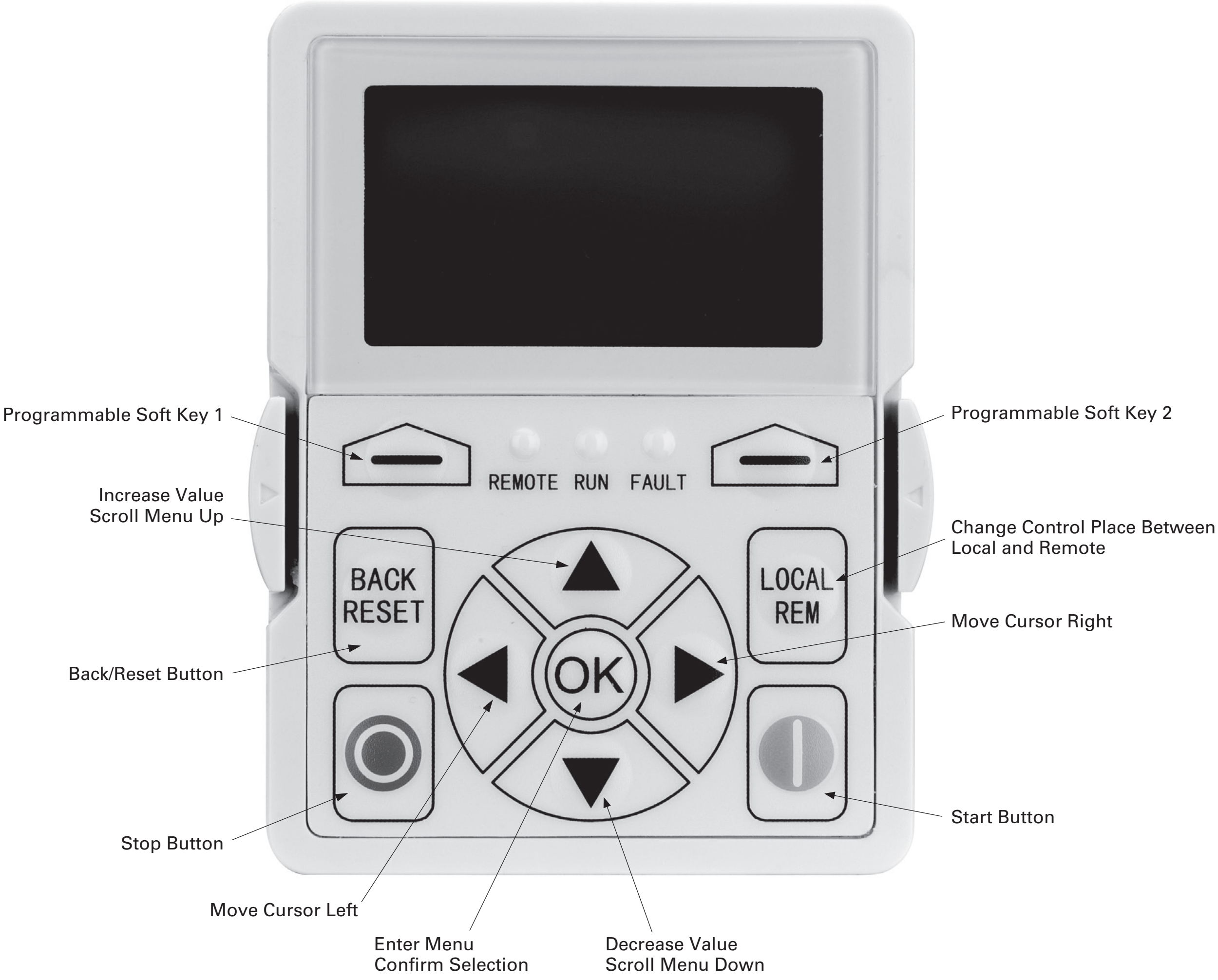
Table 11. Type 0/IP00.

Frame size	Constant torque (CT)/high overload (I_H) 600 V, 50 Hz kW rating	600 V, 60 Hz hp	Current A	Variable torque (VT)/low overload (I_L) 600 V, 50 Hz kW rating	600 V, 60 Hz hp	Current A	Catalog number
FR7	187	250	261	224	300	325	**DG1-35261FN-C00C**
	224	300	325	298	400	385	**DG1-35325FN-C00C**
	224	300	385	336	450	416	**DG1-35385FN-C00C**
FR8	298	400	416	336	450	460	**DG1-35416FN-C00C**
	336	450	460	373	500	520	**DG1-35460FN-C00C**
	373	500	520	448	600	590	**DG1-35520FN-C00C**
	448	600	590	485	650	650	**DG1-35590FN-C00C**
	485	650	650	522	700	750	**DG1-35650FN-C00C**
	485	650	650	597	800	820	**DG1-35820FN-C00C**

Chapter 2—Keypad overview

The keypad is the interface between the drive and the user. It features an LCD display, 3 LED lights and 11 buttons. With the control keypad, it is possible to control the speed of a motor, to supervise the state of the equipment and to set the frequency converter's parameters. See **Figure 4.**

Figure 4. Keypad and display.



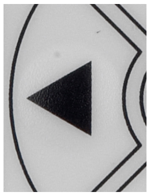
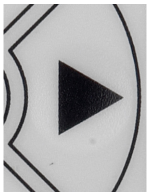
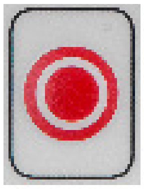
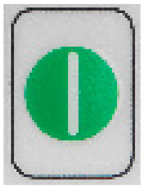
Keypad buttons

Buttons description

Table 12. Keypad buttons.

Icon	Button	Description
	Soft key 1, Soft key 2	**Soft key 1, soft key 2:** The functions of these two buttons shall be the following: • Forward/Reverse, this shall change motor's run direction. • Menu, this shall return to main menu. • Details, this shall display the details of the fault. • Bypass, this shall make drive go into bypass. • Jog, this shall activate jog. Jog can enabled via press OK Key and Soft2 Key (When the Soft2Key is Jog) and disabled via release any one of the two keys. • Favorite, this shall add this parameter to the Favorite menu. • Delete, this shall delete this parameter from the Favorite menu.
	Back/Reset	**Back/Reset:** This button has three integrated functions. The button operates as backward button during normal mode. In edit mode, it is used as cancel operate. It is also used to reset faults when faults occur. • Backs up one step. • Cancels Modify in edit mode. • Resets the active faults (all the active faults shall be reset by pressing this button more than 2 seconds in any page). • Hold Stop and Back Reset for 5 seconds to return drive to factory default. • At Main Menu page by hitting Back/Reset takes to Default Page.
	Local/Remote	**Local/Remote:** Switches between LOCAL and REMOTE control for start and speed reference. The control locations corresponding to local and remote shall be selected within an application.
 	Up Down	**Up and down arrows:** • Move either up or down a menu list to select the desired menu item. • Editing a parameter bit by bit, while the active digit is scrolled. • Increase/decrease the reference value of the selected parameter. • In parameter comparison mode, scroll through the parameters of which current value is different from comparison parameter value. • In parameter page when in read mode, move to the previous or next brother parameter of this parameter.

Table 12. Keypad buttons, continued.

Icon	Button	Description
	Left	**Left arrow:** • Navigation button, movement to left when editing a parameter digit by digit. • Backs up one step. • At Main Menu page by hitting Back/Reset takes to Default Page.
	Right	**Right arrow:** • Enter parameter group mode. • Enter parameter mode from group mode. • Enter parameter whole edit mode when this parameter can be written. • Enter parameter bit by bit edit mode from whole edit mode. • Navigation button, movement to right when editing a parameter bit by bit.
	OK	**OK:** • Will clear all the fault history if pressed for more than 5 seconds (including 5 seconds) in any page. • This button is used in the parameter edit mode to save the parameter setting. • To confirm the start-up list at the end of the Start-Up Wizard. • To confirm the comparison item in parameters comparison mode. The following is the same with Right key: • Enter parameter whole edit mode when this parameter can be written. • Enter parameter group mode. • Enter parameter mode from group mode.
	Stop	**Stop:** This button operates as the motor stop button for normal operation. The default is for this button to always be active. It can be changed in parameter P7.5 to only when "Keypad" is selected as the control source. • Motor stop from the keypad.
	Start	**Start:** This button operates as motor start button for normal operation when the "Keypad" is selected as the active control source. When Keypad is the reference place after hitting the start button, it will jump directly to the Keypad Ref Screen.

LED lights

Table 13. LED state indicators.

Indicator	Description
● Run	**Run:** Indicates that the VFD is running and controlling the load in Drive or Bypass. Blinks when a stop command has been given but the drive is still ramping down.
● Fault	**Fault:** Turn on when there is one or more active drive fault(s).
● Remote	**Local/Remote:** Local: If the local control place is selected, the light will be off. Remote: If the remote control place is selected, the light will be on.

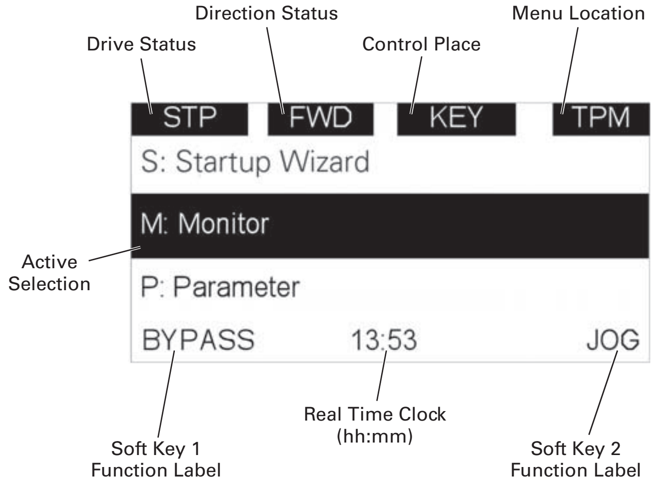
LCD display

The keypad LCD indicates the status of the motor and the drive and any faults in motor or drive functions. On the LCD, the user sees information about the current location in the menu structure and the item displayed.

Overview

Five lines shall be displayed in the screen. General view is as following in **Figure 5**.

Figure 5. General view of LCD.



The lines definition is as follows:

The first line is State line, shows:

- **RUN/STP/NRD/FIM/TFM**—If motor is running, the run state shall display “RUN”, otherwise the state display “STP”. “RUN” blinks when the stop command is sent but the drive is decelerating. “NRD” is displayed if the drive is not ready or does not have a signal “FIM” is displayed to indicate it is in Fire Mode and the drive is in a Run state. “TFM” is displayed when in the Fire Mode Test Mode and the drive is in a Run State.
- **FWD/REV/JOG**—If the motor running direction is clockwise, display “FWD”, otherwise display “REV” “Jog” if the drive is in Jog mode the status indication will occur.
- **KEY/I/O/BPS/RBP/BUS/OFF**—If it is in bypass currently, display “BPS”; when run command is given it will got to “RBP”. otherwise, if the current control source is I/O terminal, display “I/O”. If it is keypad, then display “KEY”; otherwise display “BUS.” if HOA enabled and switch to OFF, it shall show OFF.
- **PAR/MON/FLT/OPE/QSW/FAV/TPM/MS1/SL1/SL2/SL3/SL4/BUx.**—If the current page is parameter menu, display “PAR”; If monitor menu, then display “MON”; If fault menu, then display “FLT”; If operation menu, then display “OPE”; If quick start wizard, then display “QSW”; If optional card menu, then display “BOA”; If favorite menu, then display “FAV”; If main menu, then display “TPM” when doing the Multi-drive Pump and Fan mode, the drive mode will be defined with MS- Master and SL being a slave drive. The 1 through 4 will indicate the number in the series it is. “BUx” indicates the drive being a backup drive when in the redundant drive system. When in the MPFC mode, the last item of first line shows the information of master or slave, such as MS1, SL2, OFL. “OFL” normally means that the slave drive and master drive are not talking for various reasons, or the slave drive is not configure correctly.

The second line is the Code line and shows the menu code.

The third line is Name line, shows the menu name or parameters name.

The fourth line is Value line, shows the submenu name or parameters value.

The fifth line is Soft key line, the functions of Soft key 1 and Soft key 2 are changeable, and the real time is in the middle.

Welcome page

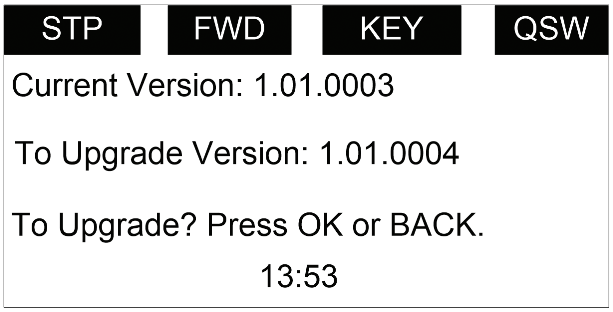
LCD shall show the welcome page when power on. See **Figure 6**.

Figure 6. Welcome page.

Upgrade page

After welcome page, keypad will check whether there is different keypad firmware version in MCU's serial flash. If yes, then ask user whether to upgrade the keypad.

Figure 7. Upgrade page.



Current Version: 1.01.0003

To Upgrade Version: 1.01.0004

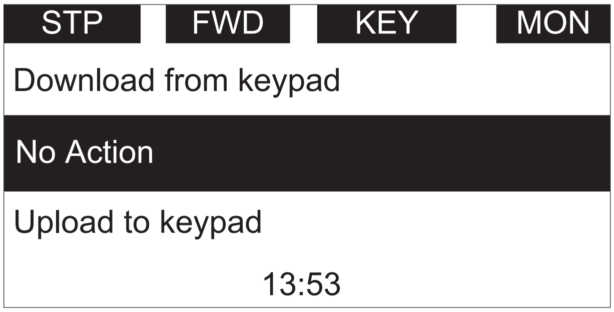
To Upgrade? Press OK or BACK.

13:53

Auto backup page

If keypad is plugged into a new drive, then auto backup page will be shown to notice the user whether to do the upload/download.

Figure 8. Auto backup page.



Download from keypad

No Action

Upload to keypad

13:53

Soft key description

There are two soft key buttons. They have different definitions under different pages.

Table 14. Soft keys.

Keypad Display page	Default Soft key 1	Default Soft key 2
Main menu page	Null or bypass	Jog*
Group node page	Reverse or forward*	Menu
Parameter node page	Null or favorite	Menu
Favorite page	Delete	Menu
Fault page	Detail	Menu

***Note:** If P21.1.18 or P21.1.19 is set to hidden it will hide this value.

1. In the main menu (root node), "JOG" shall be shown on the right. If bypass is enabled, then "BYPASS" shall be shown on the left. Otherwise, it will not be shown. See **Figure 9**

Figure 9. Main menu.

S: Startup Wizard

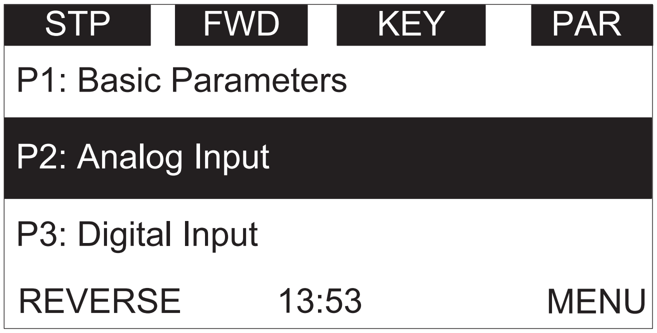
M: Monitor

P: Parameter

BYPASS 13:53 JOG

2. For the parameter group, the two soft keys "REVERSE/FORWARD" and "MENU" shall be shown. See **Figure 10**

Figure 10. Parent node page.



P1: Basic Parameters

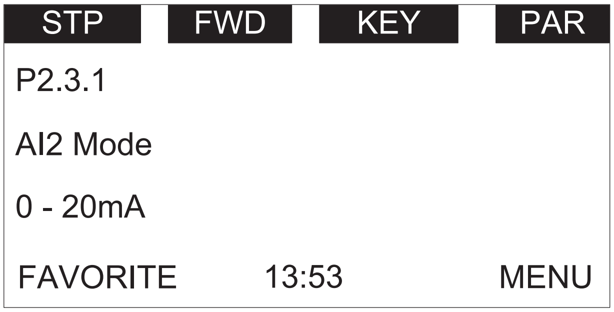
P2: Analog Input

P3: Digital Input

REVERSE 13:53 MENU

3. For the parameter menu, if this parameter hasn't been added into the favorite list, two soft keys "FAVORITE" and "MENU" shall be shown. If it has been added into the favorite list, only one soft key "MENU" is shown in the right.

Figure 11. Parameter page.



STP FWD KEY PAR

P2.3.1

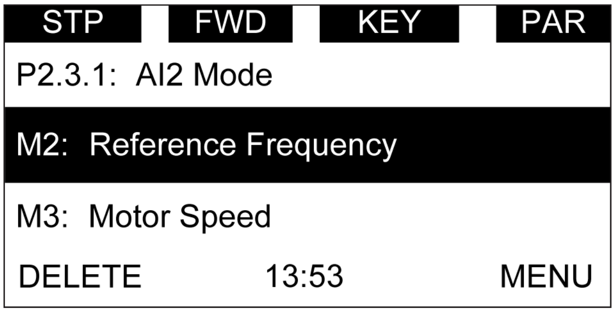
AI2 Mode

0 - 20mA

FAVORITE 13:53 MENU

4. If one parameter has been added to the favorite list, it shall appear in the favorite menu. Then when you enter into the favorite menu, two soft keys "DELETE" and "MENU" shall be shown, and "DELETE" means you can delete the selected parameter from favorite list. See **Figure 12**

Figure 12. Parameter page from favorite menu.



STP FWD KEY PAR

P2.3.1: AI2 Mode

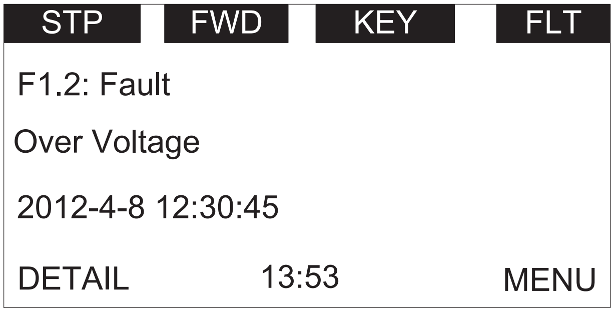
M2: Reference Frequency

M3: Motor Speed

DELETE 13:53 MENU

5. For the fault group, two soft keys "DETAIL" and "MENU" shall be shown. See **Figure 13.** For more information, see **Page 16**

Figure 13. Fault page.



STP FWD KEY FLT

F1.2: Fault

Over Voltage

2012-4-8 12:30:45

DETAIL 13:53 MENU

Chapter 3—Menu overview

Main menu page

The data on the keypad are arranged in menus and sub-menus. The first menu level consists of M, P, F, B, T, O and S, and it is called the Main menu.

Figure 14. Main menu page.

STP FWD KEY TPM

S: Startup Wizard

M: Monitor

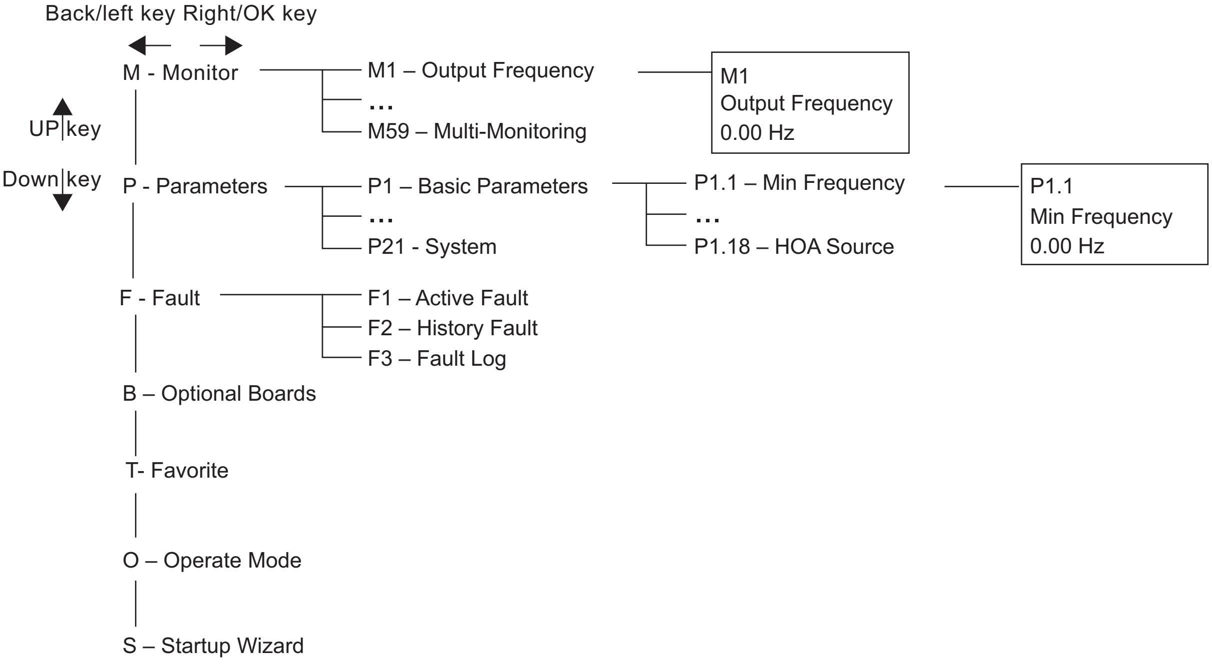
P: Parameter

BYPASS 13:53 JOG

Menu navigation

This section provides basic instruction on navigating each section in the menu structure.

Figure 15. Main menu navigation.



Menu structure

Table 15. Keypad menus.

Item	Description	
Monitor	M1—Output Frequency	M31—PID1 Feedback
	M2—Freq Reference	M32—PID1 Error Value
	M3—Motor Speed	M33—PID1 Output
	M5—Motor Torque	M35—PID2 Set Point
	M6—Motor Power	M36—PID2 Feedback
	M7—Motor Voltage	M37—PID2 Error Value
	M8—DC-link Voltage	M38—PID2 Output
	M9—Unit Temperature	M39—PID2 Status
	M10—Motor Temperature	M40—Running Motors
	M11—Torque Reference	M41—PT100 Temp
	M12—Analog Input 1	M42—Last Active Fault
	M13—Analog Input 2	M43—RTC Battery Status
	M14—Analog Output 1	M44—Instance Motor Power
	M15—Analog Output 2	M45—Energy Savings
	M16—DI1, DI2, DI3	M46—Control Board DIDO Status
	M17—DI4, DI5, DI6	M47—SlotA DIDO Status
	M18—DI7, DI8	M48—SlotB DIDO Status
	M19—DO1, Virtual RO1, Virtual RO2	M49—Application Status Word
	M20—RO1, RO2, RO3	M50—Standard Status Word
	M21—TC1, TC2, TC3	M51—Output
	M22—Interval 1	M52—Reference
	M23—Interval 2	M53—Total MWh Count
	M24—Interval 3	M54—Total Power Day Count
	M25—Interval 4	M55—Total Power Hr Count
	M26—Interval 5	M56—Trip MWh Count
	M27—Timer 1	M57—Trip Power Day Count
	M28—Timer 2	M58—Trip Power Hr Count
	M29—Timer 3	M59—Multi-Monitoring
	M30—PID1 Set Point	
Parameters	P1—Basic Parameters	
	P2—Analog Input	
	P3—Digital Input	
	P5—Digital Output	
	P6—Logic Function	
	P7—Drive Control	
	P8—Motor Control	
	P9—Protections	
	P10—PID Controller1	
	P11—PID Controller2	
	P12—Preset Speed	
	P13—Torque Control	
	P14—Brake	
	P15—Fire Mode	
	P16—Second Motor Para	
	P17—Bypass	
	P18—Pump Parameters	
	P19—Real Time Clock	
	P20—Communication	
	P21—System	
Fault	F1—Active Fault	
	F2—History Fault	
	F3—Fault Log	
Optional Boards	Bx—SlotA/SlotB	
Favorite	—	
Operate Mode	O1—Output Frequency	
	O2—Freq Reference	
	O3—Motor Speed	
	O4—Motor Current	
	O5—Motor Torque	
	O6—Motor Power	
	O7—Motor Voltage	
	O8—DC-Link Voltage	
	O9—Unit Temperature	
	O10—Motor Temperature	
	R11—Keypad Torque Ref	
	R12—Keypad Reference	
	R13—PID1 Keypad Setpoint 1	
	R14—PID1 Keypad Setpoint 2	
Startup Wizard	S—Startup Wizard	

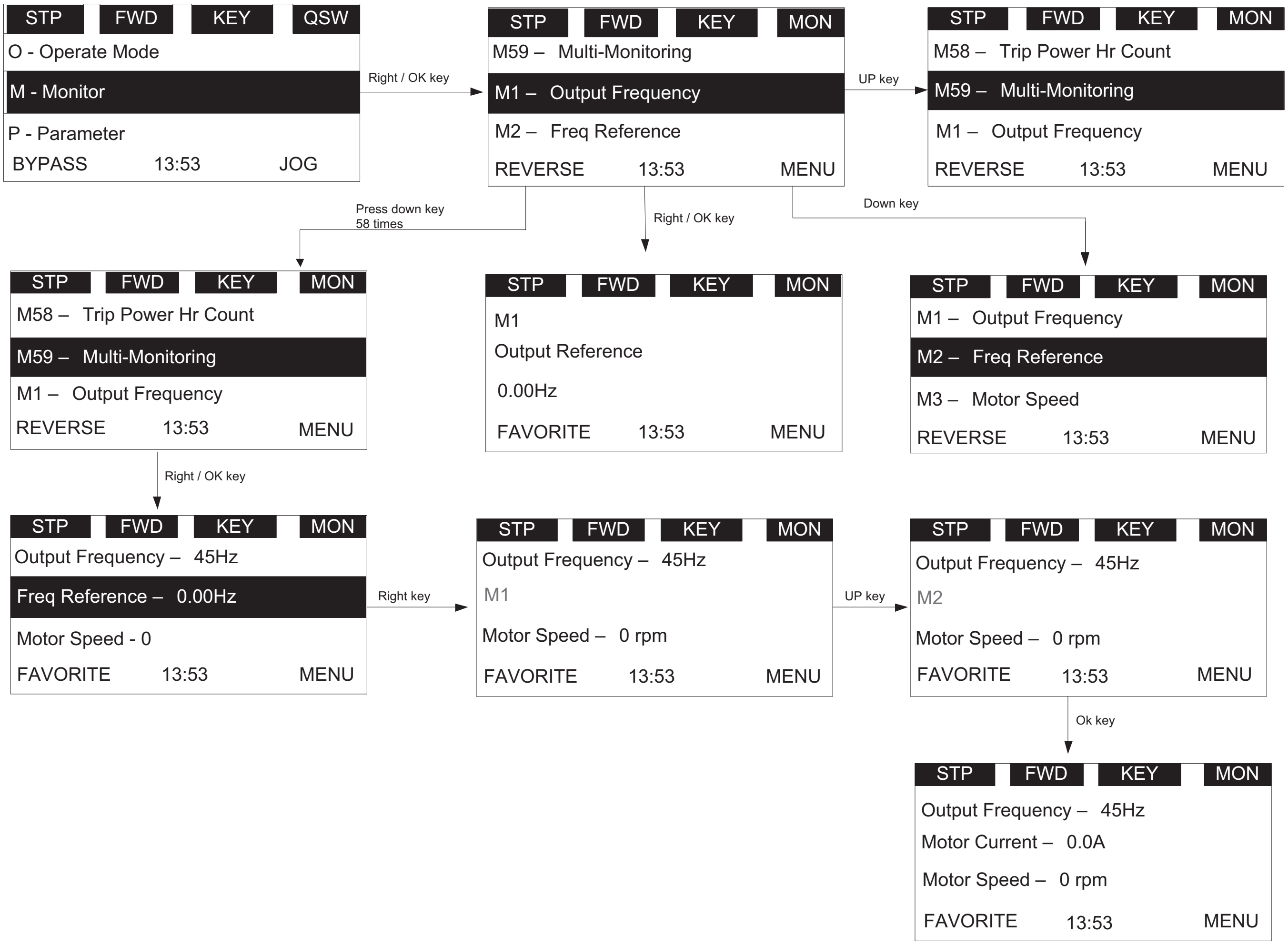
Note: Will vary depending on application selected.

M—Monitor

In monitor page, user shall not be able to edit the parameters except multi-monitor parameter. Multi-monitor parameters allow for displaying 3 monitor values on display. The three values can be changed to any of the listed values.

The navigation for monitor is as **Figure 16**.

Figure 16. M—Monitor.



F—Fault

There are four fault pages. The first one is F1 active faults; the second one will pop-up automatically when fault occurs; the third one is F2 fault history, and the fourth one is the fault log page

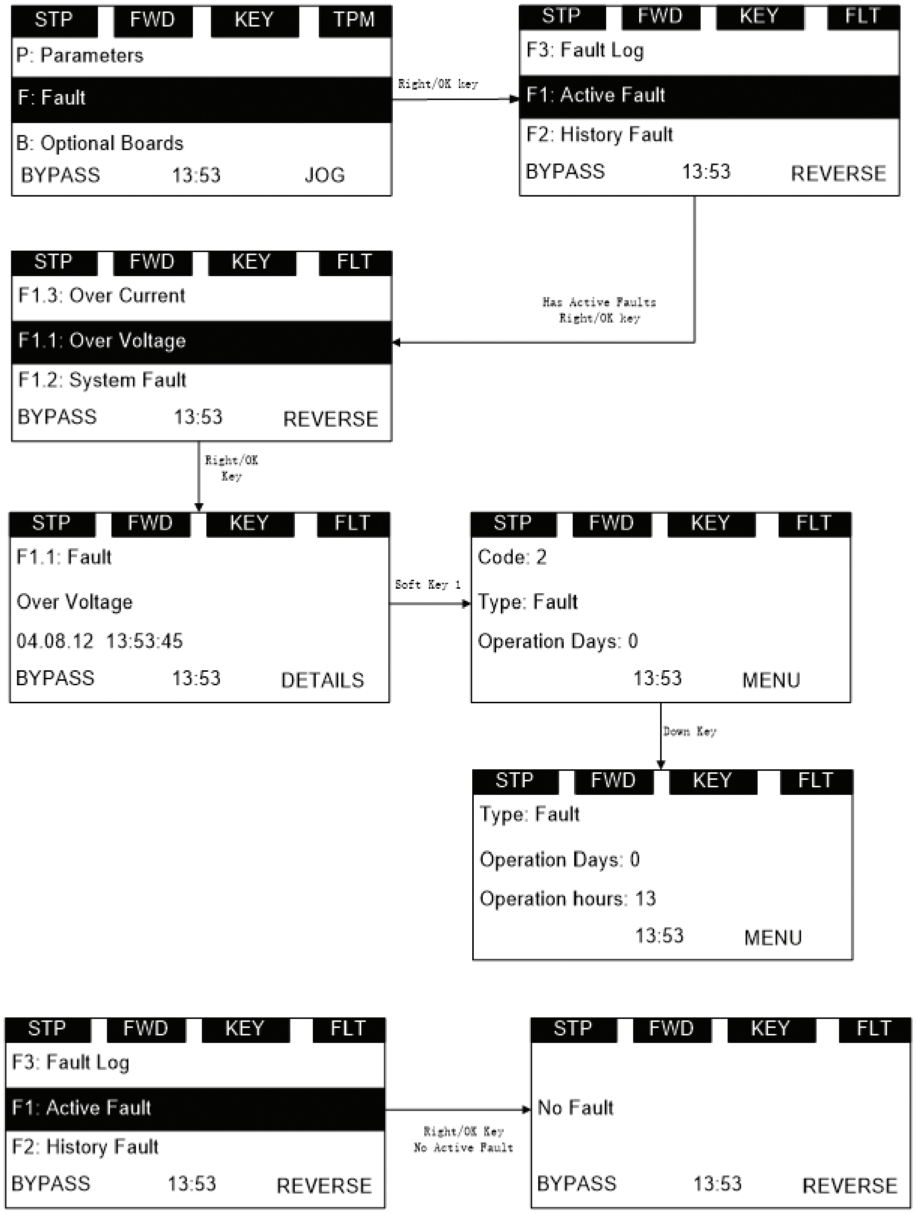
If there is no active fault/history fault, then "No fault" shall be shown.

Active fault

The navigation for active faults is as **Figure 17**.

After the DETAIL soft key is pressed, the following detail information about the fault shall be shown: fault code, type, power day count, power hour count, frequency, current, voltage, power, torque, DC voltage, unit temperature, run status, direction, warning, zero speed, Mwh count, at reference.

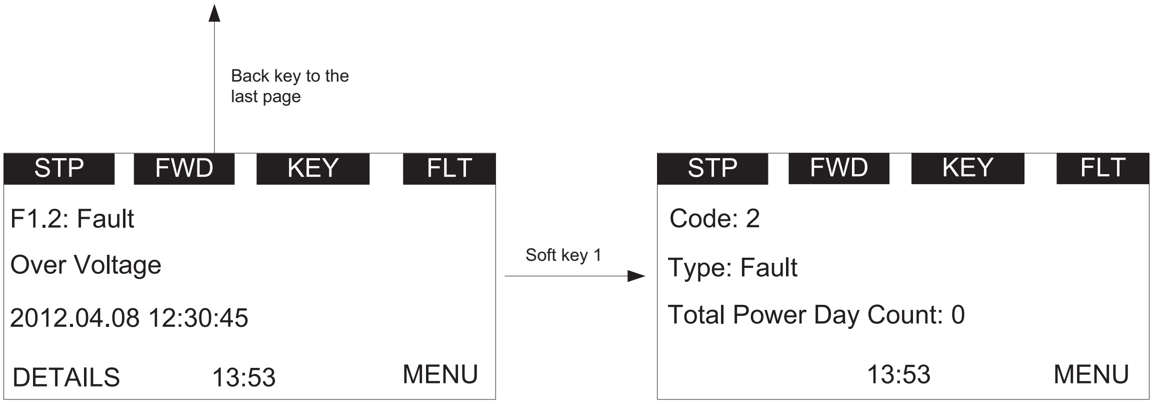
Figure 17. Active faults.



Pop-up fault

The navigation for the pop-up active fault is as **Figure 18**.

Figure 18. Pop-up active faults.



F1.2: Fault
Over Voltage
2012.04.08 12:30:45

Code: 2
Type: Fault
Total Power Day Count: 0

The latest active fault page shall pop up when there is a new active fault, the pop-up fault page is the same as the active fault page.

Pressing the back/reset key less than 2 seconds shall back to the last page user is watching.

Pressing the back/reset key more than 2 seconds shall reset all active faults when all the active fault condition is not satisfied.

User shall be able to navigate all the active faults by up/down key.

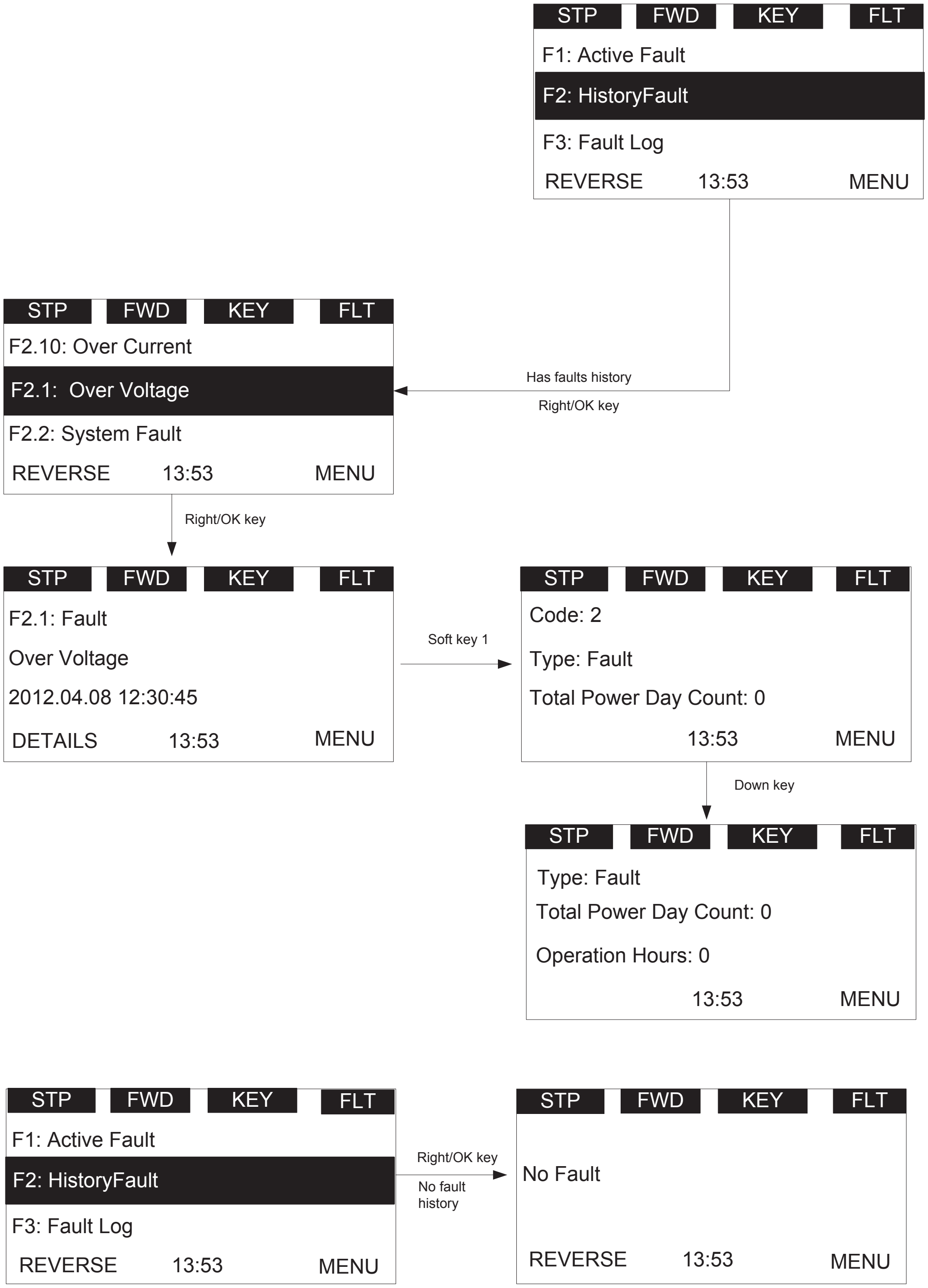
The page for active faults and pop-up faults are the same, except one: the response to the “Back” key. In active faults page, if the Back key is pressed, it returns to the last level menu. In pop-up faults page, it returns to the last page.

Fault history

The navigation for fault history is as **Figure 19**.

In any page, OK button is used to clear all the active faults and fault history by pressing more than 5s without password.

Figure 19. Fault history.



Fault Log

The Fault Log will store the last 50 faults in it with 1 being the most recent and 50 being the oldest. Only the fault code, name and time stamp are stored with these faults.

P—Parameter

The navigation for the parameter menu is shown in **Figure 20**.

In parameter page, the parameter code shall be shown in the second line (such as P1.1).

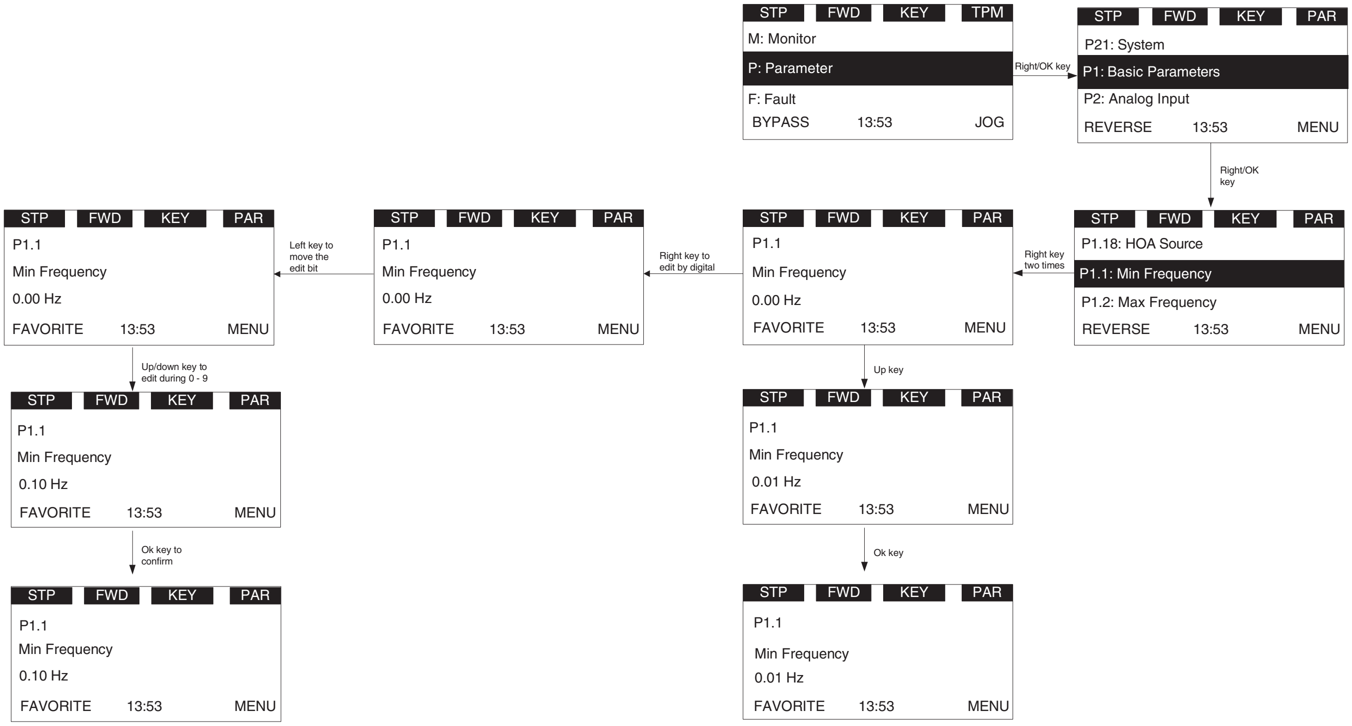
In parameter page, the parameter name shall be shown in the third line (such as Min Frequency).

In parameter page, the value of parameter and unit shall be shown in the fourth line (0.00 Hz).

If the parameter is read and write, then pressing the right key shall make the parameter value flash, which means that the value can be edited.

If the parameter is read only, then pressing the right key will not have any effect, which means that the value can not be edited.

Figure 20. Parameter menu overview.



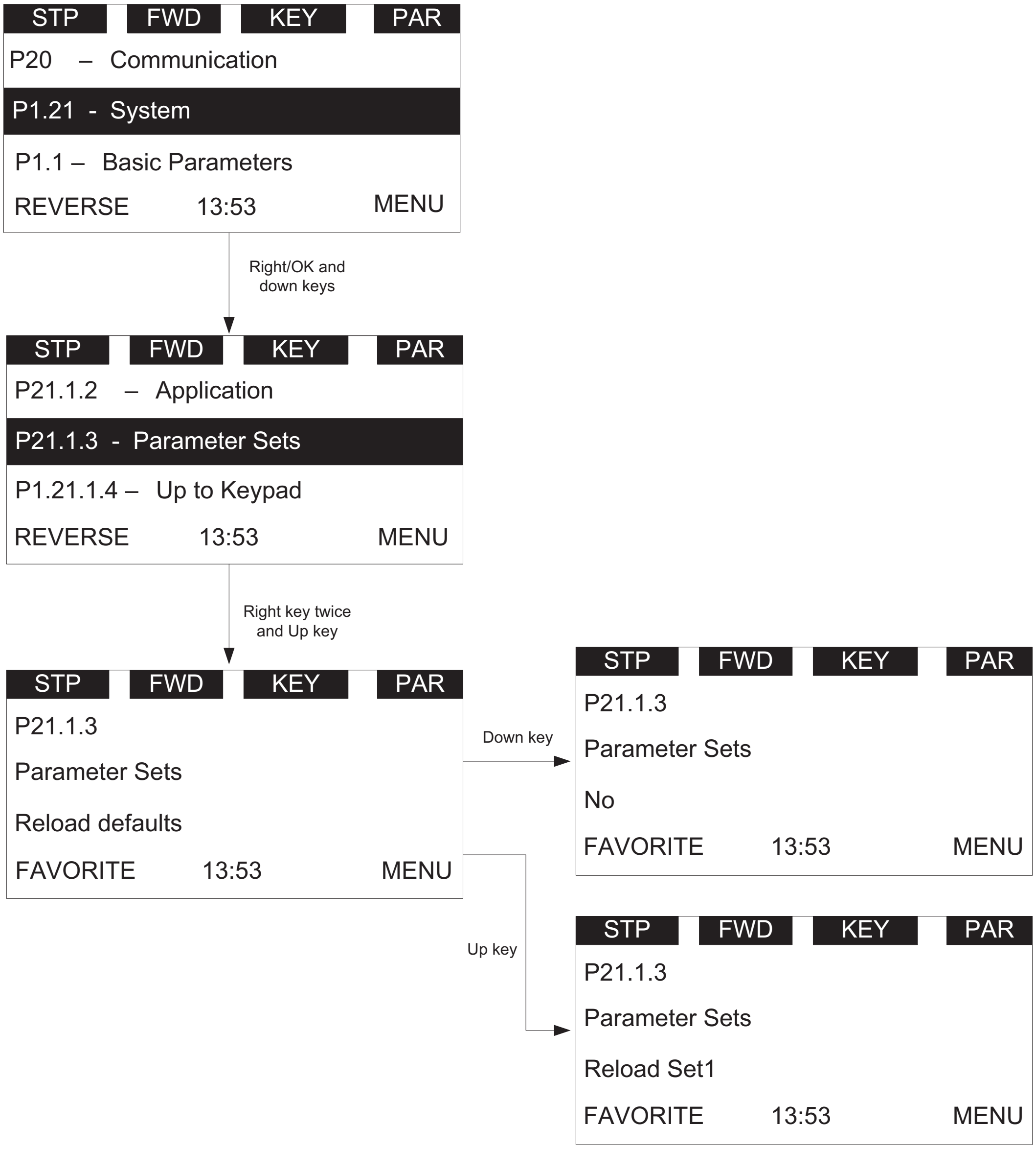
There are several special pages:

1. P21.1.3 Parameter Sets. See **Figure 21**.

User shall be able to load or store parameters. The options are as follows: Reload Defaults, Reload Set 1, Reload Set 2, Store Set 1, Store Set 2, Reset, Reload Defaults VM. The special points are:

- During this operation, "waiting…" shall flash, which means it is in process.
- When it is finished, "OK" shall be shown.
- Drive shall restart after default parameters are loaded.
- "Reload Defaults VM" is for the sales stand. Do not use on a fully functioning drive.

Figure 21. Parameter sets.

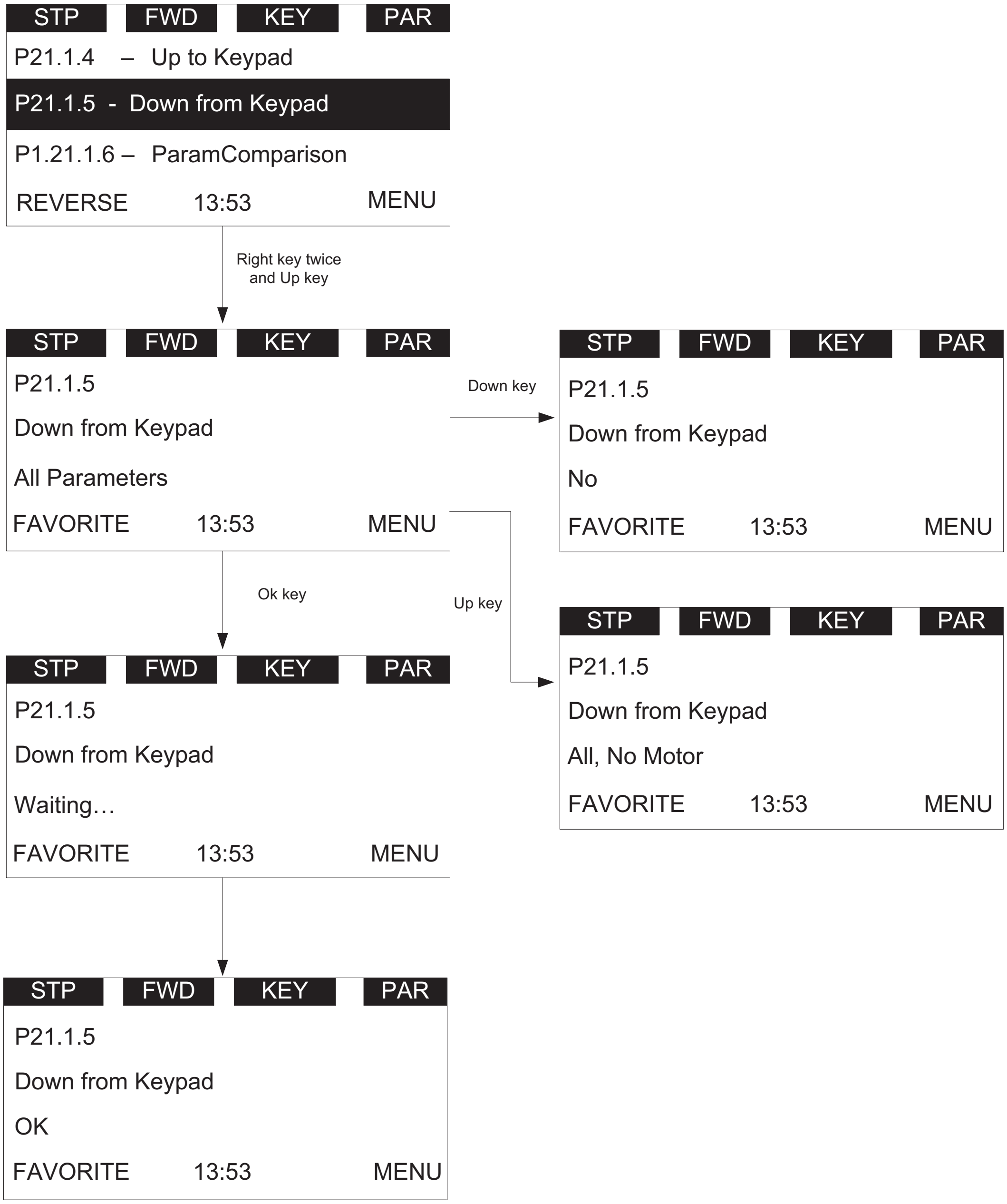


2. P21.1.4 Up to keypad and P21.1.5 Down from keypad

   During this operation, "waiting…" shall flash, which means it is in process. When it is finished, "OK" shall be shown.

This stores the parameters to keypad for transferring. Down from keypad is to download parameters from keypad to the drive. Up to keypad takes the parameters from the drive and loads them to the keypad.

Figure 22. Down from keypad.



3. P21.1.6 Parameters Comparison

   After the operation, the number of different parameter will be shown. Then press the right key; the first different parameter shall be shown.

   The parameter name shall be shown in the second line, and the value which is from keypad/default/set1/set2 shall be shown in the third line, the current value shall be shown in the fourth line.

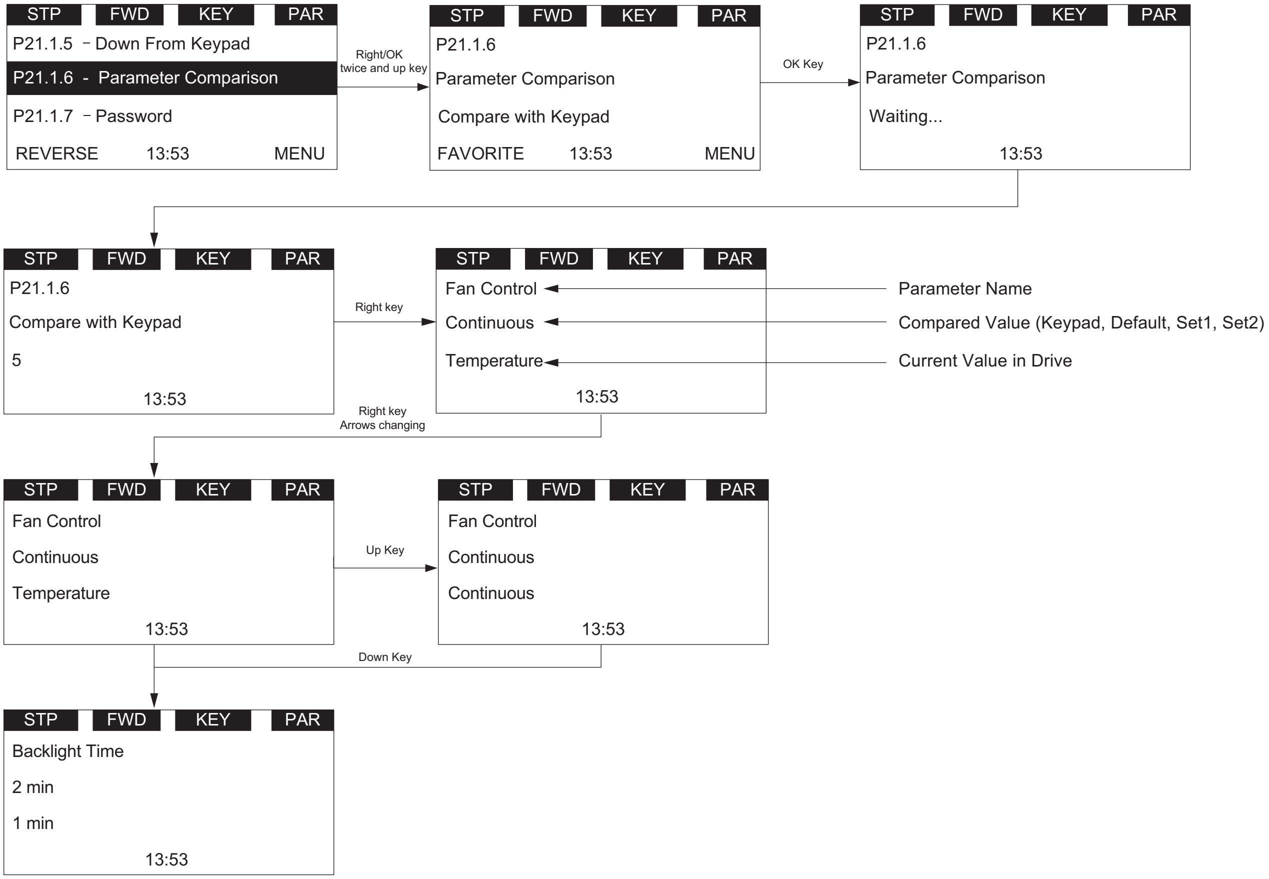
   If the user wants to modify the current value, the user shall be able to enter the edit mode by right key.

   The user shall be able to browse all the different parameters by up/down key.

   During this operation, "waiting…" shall flash, which means it is in process.

   When it is finished, "OK" shall be shown. See **Figure 23**.

Figure 23. Parameters comparison.



4. P21.1.7 Password

   Password protects the parameters' security. Zero means not used, otherwise in use. If password is in use, user can still see the values of parameters, but needs to enter the password before editing. The user must enter current password before changing the password.

   0000 shall mean that the password is not used, the password is 0000 by default.

   The password range shall be 0001–9999, the setting of password and checking of password are as Figure 24.

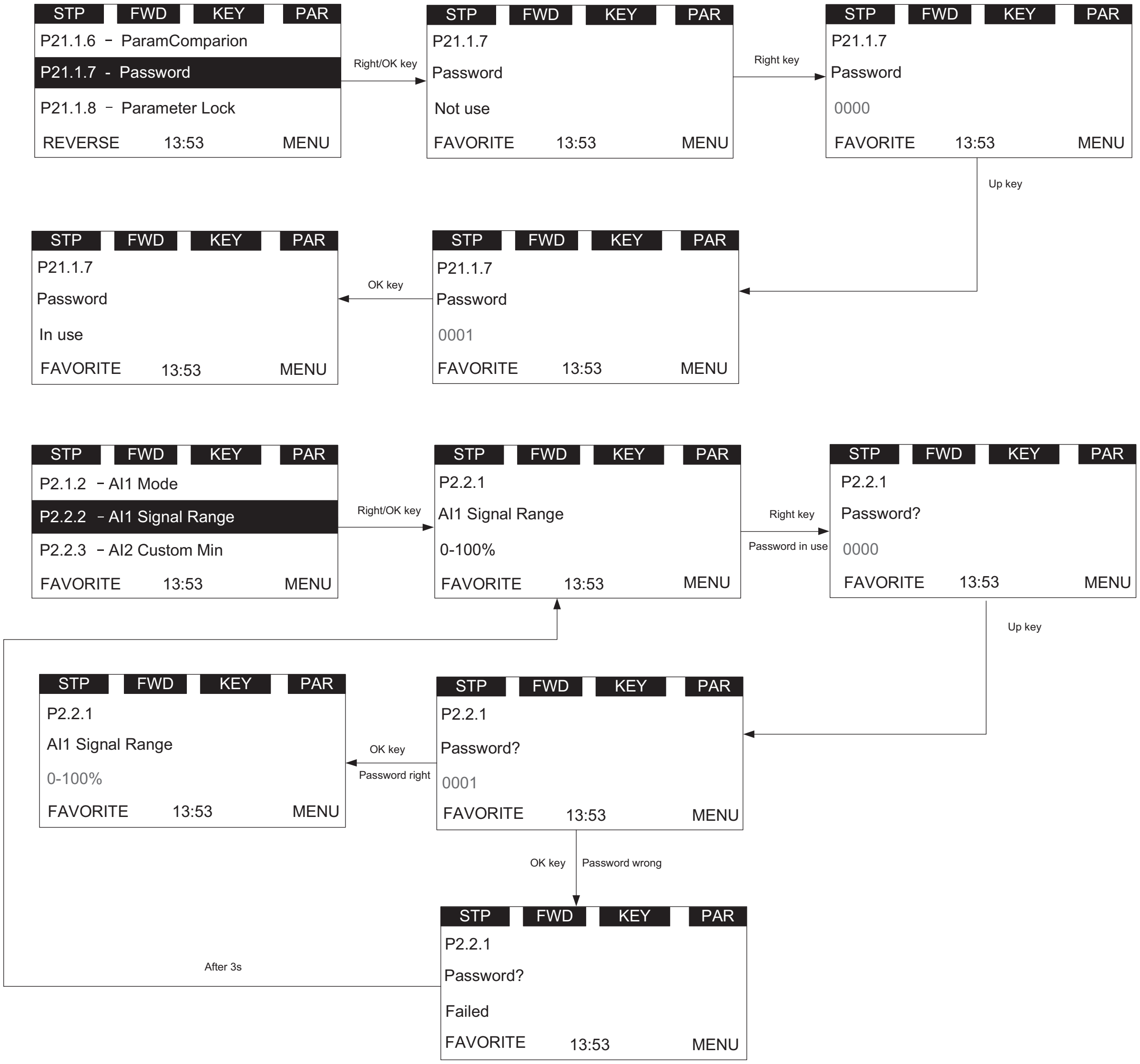
   Enter the password setting page. If the password is 0000, then the "Not use" shall be shown. If the password is not 0000, then the "in use" shall be shown.

   If the password is in use, and user inputs the wrong password, then the "failed" shall be shown.

   After "failed" is shown 3 seconds, the page shall return to the parameter read page.

   If the password is in use, and user inputs the right password, then the value shall flash, which indicates that it can be edited.

Figure 24. Password.



Value edit

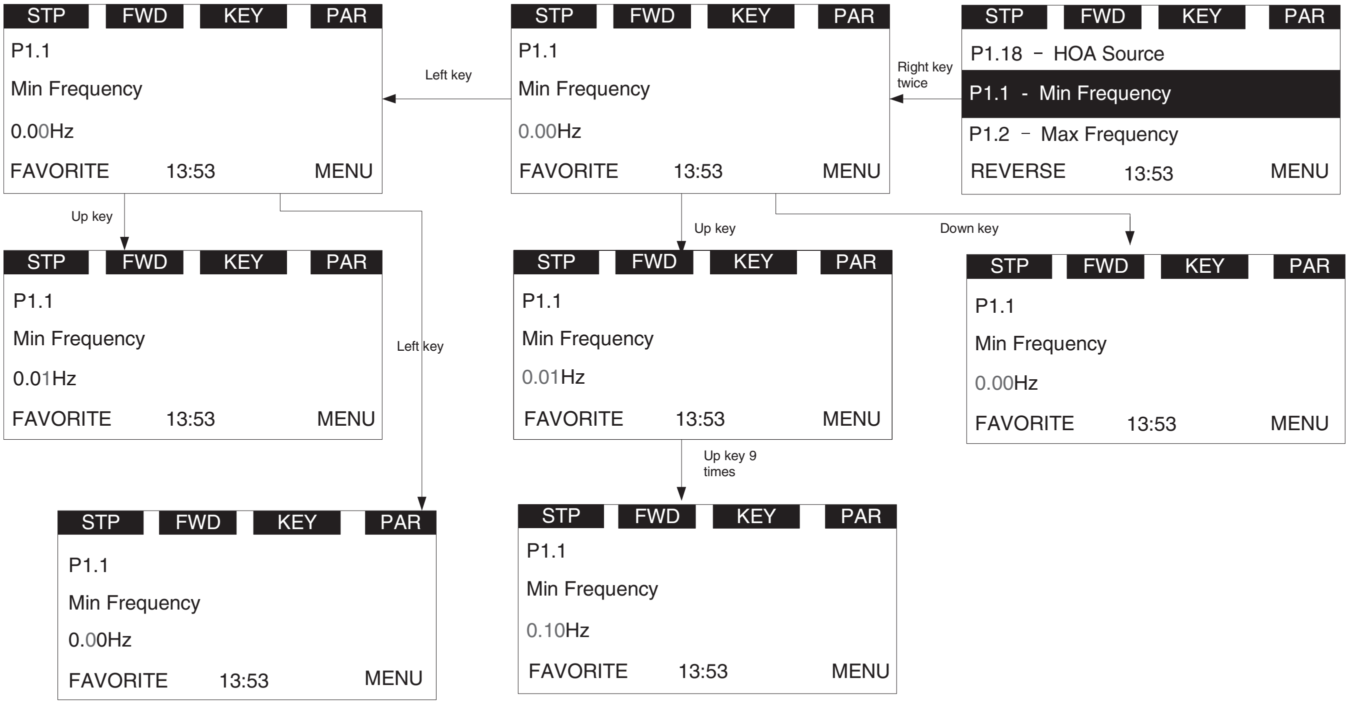
This topic shows the methods to edit value, and what will happen to edit value when password is in use and parameter lock is enabled.

We have three methods to edit value: edit by key press-hold, edit bit by bit, or edit click by click.

For details, please see **Figure 25**. For the editable parameter, press "Right" key once to enter the read mode (just read the value of this parameter), press "Right" key again to enter the edit mode (user can modify the value of this parameter), press "Right" key again to enter the bit-by-bit edit mode.

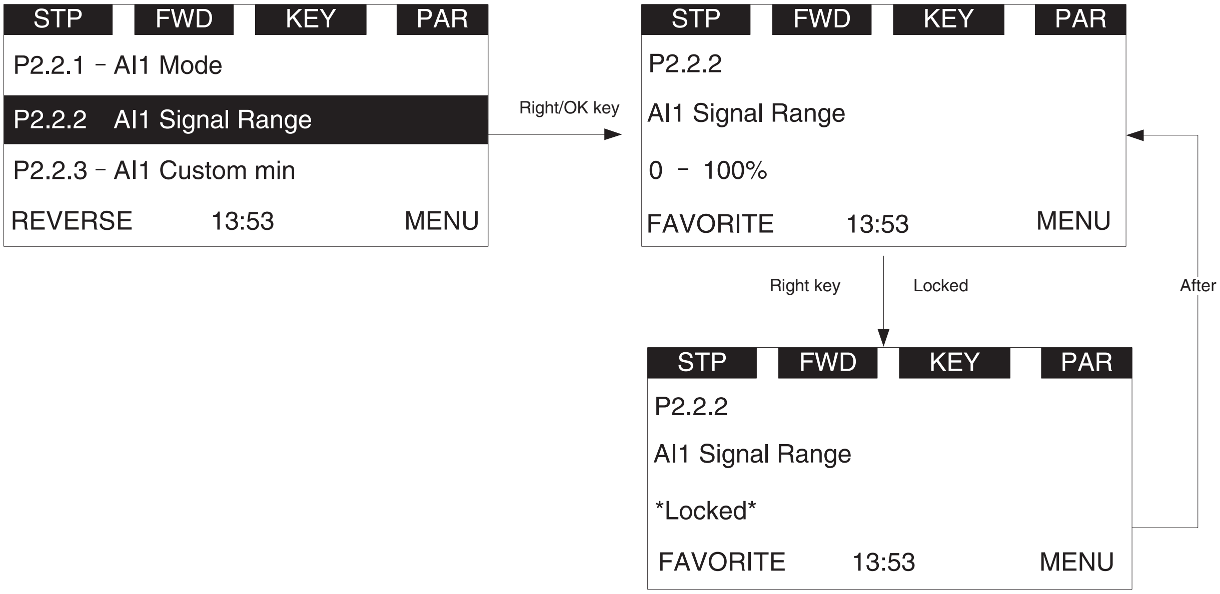
User shall use Left/Right key to change the current editable bit. When editing one number, it increases/decreases circularly, for example, pressing Up key can change to 9 from 0.

Figure 25. Edit parameter value.



1. If password is in use, password shall be needed to check before edit parameter value.
2. If no action in 1 min., the password shall need to be checked again.
3. If Parameter locked is enabled, *Locked* shall be shown if user tries to edit the parameter.

Figure 26. Parameter locked.



T—favorite

Favorites collect the user's favorite parameters. The user can add one parameter into favorite list by "FAVORITE" soft key, and can delete it from favorite list by "DELETE" soft key.

If a parameter has not been added into the favorite list, the soft keys "FAVORITE" will be shown in parameter page (see **Figure 11** on **Page 14**). If it has been added into the favorite list, the soft key "FAVORITE" will not be shown.

If a parameter has been added to the favorite list, it shall appear in the favorite menu. Then when you enter into the favorite menu, the soft keys "DELETE" will be shown. This allows you to remove the selected parameter from favorite list (see **Figure 12** on **Page 14**).

After one parameter is removed from favorite list, the next parameter in the favorite list will be selected by default.

Chapter 4—Startup

Startup wizard page

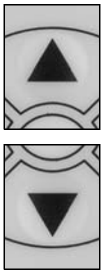
The Startup Wizard is a sub-menu of main menu. Once the user enters into this menu, the Startup Wizard will begin.

In the Startup Wizard, you will be prompted for essential information needed by the drive so that it can start controlling your motor. During this process, you can also select the application that best suits your needs.

If the user changes the Application, the drive and keypad will reset.

Startup wizard

In the *Startup Wizard*, you will be prompted for essential information needed by the drive so that it can start controlling your process. In the Wizard, you will need the following keypad buttons:



Up/Down buttons.

Use these to change value.

OK button.

Confirm selection with this button, and enter into next question.

Back/Reset button.

If this button was pressed at the first question, the Startup Wizard will be cancelled.

If this button is pressed in any step on the Startup Wizard, the Startup Wizard will be cancelled.

Once you have connected power to your Eaton PowerXL frequency converter, and the Startup Wizard is enabled, follow these instructions to easily set up your drive.

Table 16. Startup wizard instructions.

Item	Description	
1	Startup Wizard	Press OK?
2	Application	0 = Standard 1 = Multi-Pump 2 = Multi-PID 3 = Multi-Purpose
3	Language	0 = English 1 = 中文 2 = Deutsch
4	Real Time Clock	yy.mm.dd hh:mm:ss
5	Daylight Saving	0 = Off 1 = EU 2 = US
6	Min Frequency	Min: 0.00Hz Max: Max Frequency
7	Max Frequency	Min: Min Frequency Max: 400.00Hz
8	Motor Nom Current	Min: DriveNomCurrCT*1/10 Max: DriveNomCurrCT*2
9	Current Limit	Min: Ih*1/10 Max: Ih*2
10	Motor Nom Speed	Min: 300 Max: 20000
11	Motor PF	Min: 0.30 Max: 1.0
12	Motor Nom Volt	Min: 180 V Max: 690 V
13	Motor Nom Freq	Min: 30.00 Hz Max: 400.00 Hz
14	Accel Time 1	Min: 0.1 s Max: 3000.0 s
15	Decel Time 1	Min: 0.1 s Max: 3000.0 s
16	Local Control Place	0 = Keypad 1 = I/O terminal Start 1 2 = I/O Terminal Start 2 3 = Fieldbus
17	Local Reference	0 = AI1 1 = AI2 2 = Slot A: AI1 3 = Slot B: AI1 4 = AI1 Joystick 5 = AI2 Joystick 6 = Keypad 7 = Fieldbus Ref 8 = Motor Pot 9 = Max Frequency 10 = AI1 + AI2 11 = AI1 - AI2 12 = AI2 - AI1 13 = AI1 * AI2 14 = AI1 or AI2 15 = MIN(AI1,AI2) 16 = MAX(AI1,AI2) 17 = PID1 Control Output 18 = PID2 Control Output
18	Remote 1 Control Place	0 = Keypad 1 = I/O terminal Start 1 2 = I/O Terminal Start 2 3 = Fieldbus
19	Remote 1 Reference	0 = AI1 1 = AI2 2 = Slot A: AI1 3 = Slot B: AI1 4 = AI1 Joystick 5 = AI2 Joystick 6 = Keypad 7 = Fieldbus Ref 8 = Motor Pot 9 = Max Frequency 10 = AI1 + AI2 11 = AI1 - AI2 12 = AI2 - AI1 13 = AI1 * AI2 14 = AI1 or AI2 15 = MIN(AI1,AI2) 16 = MAX(AI1,AI2) 17 = PID1 Control Output 18 = PID2 Control Output

Now the Startup Wizard is done. It will not show again at the next power up. If you want to reset it, please select it from the main menu ("Startup Wizard").

Application macro Mini-Wizard

Multi-pump and fan control Mini-Wizard

Table 17. Multi-pump and fan control.

Item	Description	
20	PID 1 Process Unit	Select Units
21	PID1 Process Unit Min	Min: –99999.99 Max: PID1 Process Unit Max
22	PID1 Process Unit Max	Min: Process Unit Min Max: 99999.99
23	PID 1 Set Point 1 Source	Select Function
24	PID 1 Keypad Set Point 1	Min: PID 1 Process Unit Min Max: PID 1 Process Unit Max
25	PID 1 Feedback 1 Source	Select Input
26	PID 1 Feedback 1 Min	Min: –200% Max: 200%
27	PID 1 Feedback 1 Max	Min: –200% Max: 200%
28	Number of Pumps	Min: 1 Max: 5
29	PID Bandwidth	Min: 0% Max: 100%
30	Add/Remove Delay	Min: 0 s Max: 3600 s
31	Interlock Enable	0 = Disabled 1 = Enabled

PID Mini-Wizard

The PID Mini-Wizard is activated in the Quick Setup menu. This Wizard assumes that you are going to use the PID controller in the “one feedback/one setpoint” mode. The control place will be I/O A and the default process unit “%”. The PID Mini-Wizard asks for the following values to be set:

Table 18. PID Mini-Wizard values.

Item	Description	
20	PID 1 Process Unit	Select Units
21	PID1 Process Unit Min	Min: –99999.99 Max: PID1 Process Unit Max
22	PID1 Process Unit Max	Min: PID1 Process Unit Min Max: 99999.99
23	PID 1 Set Point 1 Source	Select Function
24	PID 1 Keypad Set Point 1	Min: PID 1 Process Unit Min Max: PID 1 Process Unit Max
25	PID 1 Feedback 1 Source	Select Input
26	PID 1 Feedback 1 Min	Min: –200% Max: 200%
27	PID 1 Feedback 1 Max	Min: –200% Max: 200%

Chapter 5—Standard application

Introduction

The Standard Application is typically used in basic motor control scenarios where multiple pump control, PID loops, or advanced control loops are not required. It provides the ability for the user to define its local and remote control and reference signals. In addition, there is the ability to scale the analog input and output signals to be read based off the desired motor response. There are also 8 digital inputs, 3 relay outputs, and 1 digital output that can be programmed to allow for control schemes that require the drive to have certain functions. It provides full customization on the motor control sequence with the ability to be in frequency or speed control mode, and tuning of the V/Hz curve can be selected. Drive/motor protections can be customized to defined actions for added user control. Below is a list of other features that are available in the Standard Application.

Standard Application includes functions:

- Selectable digital input function
- Selectable digital output function
- Reference filter, scaling, inversion, offset, and range
- Output signal filter, scaling, inversion, offset, and range
- Selectable analog output function
- Programmable start/stop and reverse signal logic
- Two independent sets of acceleration/deceleration ramps
- S curves
- Skip frequency
- Start source (local/remote control function)
- Reference source
- Flying start
- Jog
- Volts per Hertz control
- Real time clock function—RTC time display
- Drive temperature limit supervision
- Output frequency 1 limit supervision
- Output frequency 2 limit supervision
- Torque limit supervision
- Reference frequency limit supervision
- Power limit supervision
- Analog input limit supervision
- Auto restart
- Power loss ride through
- Trend buffer
- Programmable switching frequency
- Multi-preset speeds
- Emergency stop
- Line start lockout
- Fan control
- DC brake
- Flux brake
- Dynamic brake
- Motor current limit supervision

I/O controls

- “Terminal to Function” (TTF) programming

The design behind the programming of the digital inputs in the DG1 drive is to use “Terminal to Function” programming, which is composed of multiple functions that get assigned a digital input to that function. The parameters in the drive are set up with specific functions and by defining the digital input and slot in some cases, depending on which options are available. For use of the drives control board inputs, they will be referred to as DigIN:1 through DigIN:8. When additional option cards are used, they will be defined as DigIN:X:IOY:Z. The X indicates the slot that the card is being installed in, which will be either A or B. The IOY determines the type of card it is, which would be IO1 or IO5. The Z indicates which input is being used on that available option card.

- “Function to Terminal” (FTT) programming

The design behind the programming of the relay outputs and digital output in the DG1 drive is to use “Function to Terminal” programming. It is composed of a terminal, be it a relay output or a digital output, that is assigned a parameter. Within that parameter, it has different functions that can be set.

The parameters of the Standard Application are explained on **Page 35** of this manual, "Description of Parameters". The explanations are arranged according to the parameter number.

For the DI function, we use terminal programming method to function (TTF), where there is a fixed input that gets programmed to a list of functions. This allows for multiple inputs to be used for different functions. Connecting a certain input with a certain parameter function is done by give a parameter an appropriate value. The value is formed by the location of the input, either being on the standard control board or an external option board and the slot it is located in.

Force open/force close selection

The Force Open selection would make the selected function always off. Essentially this is a virtual switch that is always open.

The Force Close selection would make the selected function always on. Essentially this is a virtual switch that is always closed.

These options are assigned to a function if we want to force a state without using a hardware input.

Example:

If we set Run Enable to Force Closed, the drive is always enabled. If we set the same function to Force Open, the drive would never be Enabled. If a digital input is to be used to activate this Run Enable, the function should be assigned to a hardware input (see below for DIGIN Selections).

DIGIN selection

This allows assignment of a hardware digital input to a function, this is set in a format of DigIN:X where X is one of the 8 digital inputs on the main control board.

Example:

If we set Run Enable to DigIN:6, the drive will be enabled when digital input 6 (Terminal 8) is closed, and would not be enabled when digital input 6 (Terminal 8) is open.

Option board DIGIN selection

This allows assignment of a hardware digital input on an option card to a function, this is set in a format of DigIN: Y:IO1:X where Y is the slot the option card is inserted on the Main control board and X is the Input on the Board and IO1 is the type of option board used.

Example:

If we set Run Enable to DigIN:A:IO5:6, the drive will be enabled when digital input 6 is closed on the IO5 option card which is inserted in Slot A, and would not be enabled when digital input 6 on the option card is open.

Timer channel selection

A Time Channel is a virtual path to link the digital output of a timer function to a digital input function. To utilize this feature, a timer or interval would need to be assigned to a time channel 1 through 3, and the input function to be controlled would need to be assigned to the same time channel.

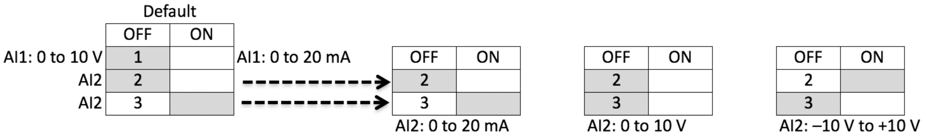
Example:

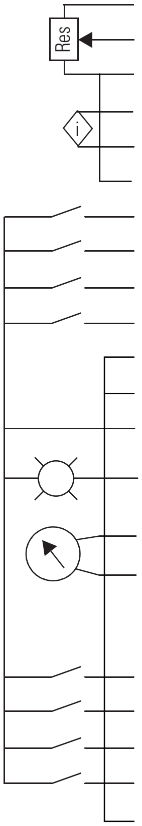
If we set Run Enable to DigIN:TimeChannel1, the drive will be enabled when the timer assigned to Time Channel 1 is active or High, and would not be enabled when the Time Channel is inactive or Low.

Control I/O configuration

- Run 240 Vac and 24 Vdc control wiring in separate conduit
- Communication wire to be shielded

Table 19. I/O connection.





External Wiring	Pin	Signal Name	Signal	Default Setting	Description
	1	+10 V	Ref. Output Voltage	—	10 Vdc Supply Source
	2	AI1+ ①	Analog Input 1	0–10 V	Voltage Speed Reference (Programmable to 4 mA to 20 mA)
	3	AI1–	Analog Input 1 Ground	—	Analog Input 1 Common (Ground)
	4	AI2+ ①	Analog Input 2	4 mA to 20 mA	Current Speed Reference (Programmable to 0–10 V)
	5	AI2–	Analog Input 2 Ground	—	Analog Input 2 Common (Ground)
	6	GND	I/O Signal Ground	—	I/O Ground for Reference and Control
	7	DIN5	Digital Input 5	Preset Speed B0	Sets frequency output to Preset Speed 1
	8	DIN6	Digital Input 6	Preset Speed B1	Sets frequency output to Preset Speed 2
	9	DIN7	Digital Input 7	Not used (TI–)	Input forces VFD output to shut off
	10	DIN8	Digital Input 8	Force Remote (TI+)	Input takes VFD from Local to Remote
	11	CMB	DI5 to DI8 Common	Grounded	Allows source input
	12	GND	I/O Signal Ground	—	I/O Ground for Reference and Control
	13	24 V	+24 Vdc Output	—	Control voltage output (100 mA max.)
	14	DO1	Digital Output 1	Ready	Shows the drive is ready to run
	15	24 Vo	+24 Vdc Output	—	Control voltage output (100 mA max.)
	16	GND	I/O Signal Ground	—	I/O Ground for Reference and Control
	17	AO1+	Analog Output 1	Output Frequency	Shows Output frequency to motor 0–60 Hz (4 mA to 20 mA)
	18	AO2+	Analog Output 2	Motor Current	Shows Motor current of motor 0–FLA (4 mA to 20 mA)
	19	24 Vi	+24 Vdc Input	—	External control voltage input
	20	DIN1	Digital Input 1	Run Forward	Input starts drive in forward direction (start enable)
	21	DIN2	Digital Input 2	Run Reverse	Input starts drive in reverse direction (start enable)
	22	DIN3	Digital Input 3	External Fault	Input causes drive to fault
	23	DIN4	Digital Input 4	Fault Reset	Input resets active faults
	24	CMA	DI1 to DI4 Common	Grounded	Allows source input
	25	A/+	RS-485 Signal A	—	Fieldbus Communication (Modbus, BACnet)
	26	B/-	RS-485 Signal B	—	Fieldbus Communication (Modbus, BACnet)
	27	R3NO	Relay 3 Normally Open	At Speed	Relay output 3 shows VFD is at Ref. Frequency
	28	R1NC	Relay 1 Normally Closed	Run	Relay output 1 shows VFD is in a run state
	29	R1CM	Relay 1 Common		
	30	R1NO	Relay 1 Normally Open		
	31	R3CM	Relay 3 Common	At Speed	Relay output 3 shows VFD is at Ref. Frequency
	32	R2NC	Relay 2 Normally Closed	Fault	Relay output 2 shows VFD is in a fault state
	33	R2CM	Relay 2 Common		
	34	R2NO	Relay 2 Normally Open		

Notes: The above wiring demonstrates a SINK configuration. It is important that CMA and CMB are wired to ground (as shown by dashed line). If a SOURCE configuration is desired, wire 24 V to CMA and CMB and close the inputs to ground. When using the +10 V for AI1, it is important to wire AI1—to ground (as shown by dashed line). If using +10 V for AI1 or AI2, terminals 3, 5, and 6 need to be jumpered together.

① AI1+ and AI2+ support 10K potentiometer.

Table 20. Drive communication ports.

Port	Communication
RJ45 Keypad Port	
Upload/Download Parameters	USB to RJ45
Remote Mount Keypad	Ethernet
Upgrade Drive Firmware	USB to RJ45
RJ45 Ethernet Port	
Upload/Download Parameters	Ethernet
Ethernet IP Communications	Ethernet
Modbus TCP Communications	Ethernet
RS-485 Serial Port ①	
Upload/Download Parameters	Two-Wire Twisted Pair
Upgrade Drive Firmware	Two-Wire Twisted Pair
Modbus RTU Communications	Two-Wire Twisted Pair
BACnet MS/TP Communications	Two-Wire Twisted Pair

① Shielded wire recommended.

Standard application—parameters list

On the next pages you will find the lists of parameters within the respective parameter groups. The parameter descriptions are given on **Page 194,** "Description of Parameters." The descriptions are arranged according to the parameter number.

Column explanations:

Code = Location indication on the keypad; shows the operator the present parameter number
Parameter = Name of parameter
Min. = Minimum value of parameter
Max. = Maximum value of parameter
Unit = Unit of parameter value; given if available
Default = Value preset by factory
ID = ID number of the parameter

Table 21. Monitor—M.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
M1	Output Frequency			Hz		1	
M2	Freq Reference			Hz		24	
M3	Motor Speed			rpm		2	
M4	Motor Current			A		3	
M5	Motor Torque			%		4	
M6	Motor Power			%		5	
M7	Motor Voltage			V		6	
M8	DC-link Voltage			V		7	
M9	Unit Temperature			Deg. C		8	
M10	Motor Temperature			%		9	
M12	Analog Input 1			Varies		10	
M13	Analog Input 2			Varies		11	
M14	Analog Output 1			Varies		25	
M15	Analog Output 2			Varies		575	
M16	DI1, DI2, DI3					12	
M17	DI4, DI5, DI6					13	
M18	DI7, DI8					576	
M19	DO1,Virtual RO1,Virtual RO2					14	
M20	RO1, RO2, RO3					557	
M41	PT100 Temperture			Deg. C	1000.0	27	
M42	Latest Fault Code					28	
M43	RTC Battery Status				0	583	0 = Not Installed 1 = Installed 2 = Change Battery 3 = OverVoltage
M44	Instant Motor Power			kW		1686	
M45	Energy Savings			Varies	0.000	2120	
M46	Control Board DIDO Status					2209	
M47	SlotA DIDO Status					2210	
M48	SlotB DIDO Status					2211	
M49	Application Status Word					29	
M50	Standard Status Word					2414	
M51	Output			Varies		2445	
M52	Reference			Varies		2447	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 21. Monitor—M, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
M53	Total MWh Count			Mwh		601	
M54	Total Power Day Count					603	
M55	Total Power Hr Count					606	
M56	Trip MWh Count			Mwh		604	
M57	Trip Power Day Count					636	
M58	Trip Power Hr Count					637	
M59	Total Run time Count			h		2827	
M60	Numbers Of Start					2830	
M61	Trip Run Time Count			h		2829	
M62	FB Status Word					2101	
M63	FB Ctrol Word					2001	
M64	FB Speed Reference	0.00	200.00	%		2003	
M67	Control board DI status					3214	
M68	SlotA DI status					3248	
M69	SlotB DI status					3249	
M70	Multi-Monitoring				2,1,3,2,1,3,2,1,3	1753	

Parameters

Table 22. Basic parameters—P1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P1.1	Min Frequency	0.00	See Par ID 102	Hz	0.00	101	
P1.2 ①	Max Frequency	See Par ID 101	400.00	Hz	MaxFreqMFG	102	
P1.3	Accel Time 1	0.1	3000.0	s	3.0	103	
P1.4	Decel Time 1	0.1	3000.0	s	3.0	104	
P1.5 ①	Motor Nom Current	DriveNomCurrCT*1/10	DriveNomCurrCT*2	A	DriveNomCurrCT	486	
P1.6 ①	Motor Nom Speed	300	24000	rpm	MotorNomSpeedMFG	489	
P1.7 ①	Motor PF	0.30	1.00		0.85	490	
P1.8 ①	Motor Nom Voltage	180	690	V	MotorNomVoltMFG	487	
P1.9 ①	Motor Nom Frequency	8.00	400.00	Hz	MotorNomFreqMFG	488	
P1.10	Power Up Local Remote Select				0	1685	0 = Hold Last 1 = Local Control 2 = Remote control
P1.11	Remote 1 Control Place				0	135	0 = I/O Terminal Start 1 1 = Fieldbus 2 = I/O Terminal Start 2 3 = Keypad
P1.12	Local Control Place				0	1695	0 = Keypad 1 = I/O Terminal Start 1 2 = I/O Terminal Start 2 3 = Fieldbus
P1.13	Bumpless Enable				0	2462	0 = Disabled 1 = Enabled

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 22. Basic parameters—P1, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P1.14 ①②	Local Reference				6	136	0 = AI1 1 = AI2 2 = Slot A: AI1 3 = Slot B: AI1 4 = AI1 Joystick 5 = AI2 Joystick 6 = Keypad 7 = Fieldbus Ref 9 = Max Frequency 10 = AI1 + AI2 11 = AI1 - AI2 12 = AI2 - AI1 13 = AI1 * AI2 14 = AI1 or AI2 15 = MIN (AI1,AI2) 16 = MAX (AI1,AI2)
P1.15 ①②	Remote 1 Reference				0	137	See Par ID 136
P1.16 ①	Reverse Enable				1	1679	See Par ID 2462
P1.17	Run Delay Time	0	32500	s	0	2423	
P1.18 ①	HOA Source				0	2465	0 = Disabled 1 = IO Terminal 2 = Keypad
P1.19 ①	Minimum Run Time	0	32500	s	0	1813	
P1.20	Frequency Reference Upper Limit	See Par ID 101	See Par ID 102	Hz	50.00	2840	
P1.21	Frequency Reference Upper Limit Source				0	2841	0 = Not Used 1 = Freq. Ref. Upper 2 = AI1 3 = AI2

Analog Input

Table 23. Basic setting—P2.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P2.1.1	AI Ref Scale Min Value	0.00	See Par ID 145	Hz	0.00	144	
P2.1.2	AI Ref Scale Max Value	See Par ID 144	400.00	Hz	0.00	145	

Table 24. AI1 settings—P2.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P2.2.1	AI1 Mode				1	222	0 = 0–20 mA 1 = 0–10 V
P2.2.2	AI1 Signal Range				0	175	0 = 0–100%/ 0–20 mA/0–10 V 1 = 20–100%/ 4–20 mA/2–10 V 2 = Customized
P2.2.3	AI1 Custom Min	0.00	See Par ID 177	%	0.00	176	
P2.2.4	AI1 Custom Max	See Par ID 176	100.00	%	100.00	177	
P2.2.5	AI1 Filter Time	0.00	10.00	s	0.10	174	
P2.2.6	AI1 Signal Invert				0	181	0 = Not Inverted 1 = Inverted
P2.2.7	AI1 Joystick Hyst	0.00	20.00	%	0.00	178	
P2.2.8	AI1 Sleep Limit	0.00	100.00	%	0.00	179	
P2.2.9	AI1 Sleep Delay	0.00	320.00	s	0.00	180	
P2.2.10	AI1 Joystick Offset	-50.00	50.00	%	0.00	133	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 25. AI2 settings—P2.3.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P2.3.1	AI2 Mode				0	223	0 = 0–20 mA 1 = 0–10 V 2 = -10 to +10 V
P2.3.2	AI2 Signal Range				1	183	0 = 0–100%/0–20mA/ 0–10 V/–10 to 10 V 1 = 20–100%/4–20 mA/ 2–10 V/–6 to 10 V 2 = Customized
P2.3.3	AI2 Custom Min	0.00	See Par ID 185	%	0.00	184	
P2.3.4	AI2 Custom Max	See Par ID 184	100.00	%	100.00	185	
P2.3.5	AI2 Filter Time	0.00	10.00	s	0.10	182	
P2.3.6	AI2 Signal Invert				0	189	See Par ID 181
P2.3.7	AI2 Joystick Hyst	0.00	20.00	%	0.00	186	
P2.3.8	AI2 Sleep Limit	0.00	100.00	%	0.00	187	
P2.3.9	AI2 Sleep Delay	0.00	320.00	s	0.00	188	
P2.3.10	AI2 Joystick Offset	-50.00	50.00	%	0.00	134	

Table 26. Fine adjust—P2.4.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P2.4.1 ①	Fine Tuning Input				0	2484	0 = Not Used 1 = AI1 2 = AI2 3 = Slot A: AI1 4 = Slot B: AI1 5 = Fieldbus
P2.4.2 ①	Fine Tuning Min	0.0	100.0	%	0.0	2485	
P2.4.3 ①	Fine Tuning Max	0.0	100.0	%	0.0	2486	

Table 27. Digital input—P3.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P3.1 ①	IO Terminal 1 Start Stop Logic				0	143	0 = Forward - Reverse 1 = Start - Reverse 2 = Start - Enable 3 = 3 Wire Control
P3.2 ②⑤	IO Terminal 1 Start Signal 1				2	190	0 = DigIN:NormallyOpen 1 = DigIN:NormallyClose 2 = DigIN: 1 3 = DigIN: 2 4 = DigIN: 3 5 = DigIN: 4 6 = DigIN: 5 7 = DigIN: 6 8 = DigIN: 7 9 = DigIN: 8 10 = DigIN: A: IO1: 1 11 = DigIN: A: IO1: 2 12 = DigIN: A: IO1: 3 13 = DigIN: A: IO5: 1 14 = DigIN: A: IO5: 2 15 = DigIN: A: IO5: 3 16 = DigIN: A: IO5: 4 17 = DigIN: A: IO5: 5 18 = DigIN: A: IO5: 6

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 27. Digital Input—P3, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P3.2 ②⑤, continued	IO Terminal 1 Start Signal 1				2	190	19 = DigIN: B: IO1: 1 20 = DigIN: B: IO1: 2 21 = DigIN: B: IO1: 3 22 = DigIN: B: IO5: 1 23 = DigIN: B: IO5: 2 24 = DigIN: B: IO5: 3 25 = DigIN: B: IO5: 4 26 = DigIN: B: IO5: 5 27 = DigIN: B: IO5: 6 31 = RO1 Function 32 = RO2 Function 33 = RO3 Function 34 = Virtual RO1 Function 35 = Virtual RO2 Function
P3.3 ②⑤	IO Terminal 1 Start Signal 2				3	191	See Par ID 190
P3.4 ①	Thermistor Input Select				0	881	0 = Digital Input 1 = Thermistor Input
P3.5 ②③	Reverse				0	198	See Par ID 190
P3.6 ②③	Ext. Fault 1 NO				4	192	See Par ID 190
P3.7 ②③	Ext. Fault 1 NC				1	193	See Par ID 190
P3.8 ②④	Fault Reset				5	200	See Par ID 190
P3.9 ②③	Run Enable				1	194	See Par ID 190
P3.10 ②③	Preset Speed B0				6	205	See Par ID 190
P3.11 ②③	Preset Speed B1				7	206	See Par ID 190
P3.12 ②③	Preset Speed B2				0	207	See Par ID 190
P3.15 ②③	Accel/Decel Time Set				0	195	See Par ID 190
P3.16 ②③	Accel/Decel Prohibit				0	201	See Par ID 190
P3.17 ②④	No Access To Param				0	215	See Par ID 190
P3.21 ②③	Remote Control				9	196	See Par ID 190
P3.22 ②③	Local Control				0	197	See Par ID 190
P3.23 ②③	Remote 1/2 Select				0	209	See Par ID 190
P3.26 ②③	DC Brake Active				0	202	See Par ID 190
P3.32 ②③	Jog Enable				0	199	See Par ID 190
P3.36 ②③	AI Ref Source Select				0	208	See Par ID 190
P3.42 ②③	Ext Fault-AR				1	747	See Par ID 190
P3.45 ①	IO Terminal 2 Start Stop Logic				0	2206	See Par ID 143
P3.46 ②⑤	IO Terminal 2 Start Signal 1				2	2207	See Par ID 190
P3.47 ②⑤	IO Terminal 2 Start Signal 2				3	2208	See Par ID 190
P3.48 ②③	Ext. Fault 2 NO				0	2293	See Par ID 190
P3.49 ②③	Ext. Fault 2 NC				1	2294	See Par ID 190
P3.50 ②③	Ext. Fault 3 NO				0	2295	See Par ID 190
P3.51 ②③	Ext. Fault 3 NC				1	2296	See Par ID 190

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 27. Digital Input—P3, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P3.52	Ext. Fault 1 Text				0	2297	0 = External Fault 1 = Vibration Cut out 2 = High Motor temp 3 = Low Pressure 4 = High Pressure 5 = Low Water 6 = Damper Interlock 7 = Run Enable 8 = Freeze Stat Trip 9 = Smoke Detect 10 = Seal Leakage 11 = Rod Breakage 12 = Torque Limit
P3.53	Ext. Fault 2 Text				1	2298	See Par ID 2297
P3.54	Ext. Fault 3 Text				2	2299	See Par ID 2297
P3.55 ②④	Parameter Set1/2 Sel				0	2312	See Par ID 190
P3.57 ②③	HOA On/Off				1	2395	See Par ID 190
P3.59 ②③	OP Cont Interlock NO				4	2801	See Par ID 190
P3.60 ②③	OP Cont Interlock NC				1	2802	See Par ID 190
P3.61 ③	CP Interlock NC				1	2894	See Par ID 190

Table 28. Analog output—P4.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P4.1	AO1 Mode				0	227	See Par ID 222
P4.2 ②	AO1 Function				1	146	0 = Not Used 1 = Output Frequency 2 = Freq Reference 3 = Motor Speed 4 = Motor Current 5 = Motor Torque (0–Nom) 6 = Motor Power 7 = Motor Voltage 8 = DC-Bus Voltage 19 = AI1 20 = AI2 21 = Output Freq (–2 ± 2N) 22 = Motor Torque (–2 ± 2N) 23 = Motor Power (–2 ± 2N) 24 = PT100 Temperature 33 = SlotA PT100 Temp Channel 1 34 = SlotA PT100 Temp Channel 2 35 = SlotA PT100 Temp Channel 3 36 = SlotB PT100 Temp Channel 1 37 = SlotB PT100 Temp Channel 2 38 = SlotB PT100 Temp Channel 3 39 = User Defined Output 40 = Motor Current (–2 ± 2N)
P4.3	AO1 Minimum				1	149	0 = 0 V/0 mA 1 = 2 V/4 mA
P4.4	AO1 Filter Time	0.00	10.00	s	1.00	147	
P4.5	AO1 Scale	10	1000	%	100	150	
P4.6	AO1 Inversion				0	148	See Par ID 181

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 28. Analog Output—P4, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P4.7	AO1 Offset	-100.00	100.00	%	0.00	173	
P4.8	AO2 Mode				0	228	See Par ID 222
P4.9 ②	AO2 Function				4	229	See Par ID 146
P4.10	AO2 Minimum				1	232	See Par ID 149
P4.11	AO2 Filter Time	0.00	10.00	s	1.00	230	
P4.12	AO2 Scale	10	1000	%	100	233	
P4.13	AO2 Inversion				0	231	See Par ID 181
P4.14	AO2 Offset	-100.00	100.00	%	0.00	234	

Table 29. Digital output—P5.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P5.1 ②	DO1 Function				1	151	0 = Not Used 1 = Ready 2 = Run 3 = Fault 4 = Fault Invert 5 = Warning 6 = Reversed 7 = At Speed 8 = Zero Frequency 9 = Freq Limit 1 Superv 10 = Freq Limit 2 Superv 13 = OverHeat Warning - Drive Over Heat Has occured 14 = OCurrent Fault 15 = OVolt Fault 16 = UVolt Fault Resp 17 = 4 mA Ref Fault/ Warning 20 = Torq Limit Superv 21 = Ref Limit Superv 22 = Control from I/O 23 = Un-Requested Rotation Direction 24 = Thermistor Fault Output 27 = Ext Fault/Warning 28 = Remote Control 29 = Jog Speed Select 30 = Motor Therm Protection 31 = FB Digital Input 1 32 = FB Digital Input 2 33 = FB Digital Input 3 34 = FB Digital Input 4 39 = In E-Stop 40 = Power Limit Superv 41 = Temp Limit Superv 42 = Analog Input Superv 51 = Motor Current 1 Supv 52 = Motor Current 2 Supv 53 = Second AI Limit Supv 54 = DC Charge Switch Close 55 = Preheat Active 56 = Cold Weather Active

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 29. Digital Output—P5, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P5.1 ②, continued	DO1 Function				1	151	58 = 2nd Stage Ramp Frequency Active 59 = STO Fault Output 60 = Run Bypass/Drive 63 = Auto Local On COM Fault 64 = FieldBus RTU Fault 65 = FieldBus TCP Fault 66 = FieldBus MSTP Fault 67 = FieldBus EIP Fault 68 = FieldBus SlotA Fault 69 = FieldBus SlotB Fault 70 = FieldBus SWD Fault 78 = CP Interlock Fault
P5.2 ②	RO1 Function				2	152	See Par ID 151
P5.3 ②	RO2 Function				3	153	See Par ID 151
P5.4 ②	RO3 Function				7	538	See Par ID 151
P5.5 ②	Virtual RO1 Function				0	2463	See Par ID 151
P5.6 ②	Virtual RO2 Function				0	2464	See Par ID 151
P5.7 ②	Freq Limit 1 Supv				0	154	0 = No Limit 1 = Low Limit Superv 2 = High Limit Superv
P5.8	Freq Limit 1 Supv Val	0.00	See Par ID 102	Hz	0.00	155	
P5.9 ②	Freq Limit 2 Supv				0	157	0 = No Limit 1 = Low Limit Superv 2 = High Limit Superv
P5.10	Freq Limit 2 Supv Val	0.00	See Par ID 102	Hz	0.00	158	
P5.11 ②	Torque Limit Supv				0	159	0 = No Limit 1 = Low Limit Superv 2 = High Limit Superv
P5.12 ②	Torque Limit Supv Val	-1000.0	1000.0	%	100.0	160	
P5.13	Ref Limit Supv				0	161	0 = No Limit 1 = Low Limit Superv 2 = High Limit Superv
P5.14	Ref Limit Supv Val	0.00	See Par ID 102	Hz	0.00	162	
P5.17	Temp Limit Supv				0	165	See Par ID 161
P5.18	Temp Limit Supv Val	-10.0	75.0	Deg. C	40.0	166	
P5.19	Power Limit Supv				0	167	See Par ID 161
P5.20	Power Limit Supv Val	-200.0	200.0	%	0.0	168	
P5.21	AI Supv Select				0	170	0 = AI1 1 = AI2
P5.22	AI Limit Supv				0	171	See Par ID 161
P5.23	AI Limit Supv Val	0.00	100.00	%	0.00	172	
P5.32	RO1 On Delay	0.0	320.0	s	0.0	2112	
P5.33	RO1 Off Delay	0.0	320.0	s	0.0	2113	
P5.34	RO2 On Delay	0.0	320.0	s	0.0	2114	
P5.35	RO2 Off Delay	0.0	320.0	s	0.0	2115	
P5.36	RO3 On Delay	0.0	320.0	s	0.0	2116	
P5.37	RO3 Off Delay	0.0	320.0	s	0.0	2117	
P5.38	RO3 Reverse				0	2118	0 = No 1 = Yes
P5.39 ②	Motor Current 1 Supv				0	2189	See Par ID 159
P5.40	Motor Current 1 Supv Value	0.0	DriveNomCurrCT*2	A	DriveNomCurrCT	2190	
P5.41 ②	Motor Current 2 Supv				0	2191	See Par ID 159

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 29. Digital Output—P5, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P5.42	Motor Current 2 Supv Value	0.0	DriveNomCurrCT*2	A	DriveNomCurrCT	2192	
P5.43	Second AI Supv Select				0	2193	See Par ID 170
P5.44	Second AI Limit Supv				0	2194	See Par ID 161
P5.45	Second AI Limit Supv Val	0.00	100.00	%	0.00	2195	
P5.46	Motor Current 1 Supv Hyst	0.1	1.0	A	0.1	2196	
P5.47	Motor Current 2 Supv Hyst	0.1	1.0	A	0.1	2197	
P5.48	AI Supv Hyst	1.00	10.00	%	1.00	2198	
P5.49	Second AI Supv Hyst	1.00	10.00	%	1.00	2199	
P5.50	Freq Limit 1 Supv Hyst	0.10	1.00	Hz	0.10	2200	
P5.51	Freq Limit 2 Supv Hyst	0.10	1.00	Hz	0.10	2201	
P5.52	Torque Limit Supv Hyst	1.0	5.0	%	1.0	2202	
P5.53	Ref Limit Supv Hyst	0.10	1.00	Hz	0.10	2203	
P5.54	Temp Limit Supv Hyst	1.0	10.0	Deg. C	1.0	2204	
P5.55	Power Limit Supv Hyst	0.1	10.0	%	0.1	2205	
P5.56	Virtual RO1 On Delay	0.0	320.0	s	0.0	2848	
P5.57	Virtual RO1 Off Delay	0.0	320.0	s	0.0	2849	
P5.58	Virtual RO2 On Delay	0.0	320.0	s	0.0	2850	
P5.59	Virtual RO2 Off Delay	0.0	320.0	s	0.0	2851	

Table 30. Drive control—P7.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P7.1	Remote 2 Control Place				1	138	See Par ID 135
P7.2 ①②	Remote 2 Reference				7	139	See Par ID 136
P7.3	Keypad Reference	See Par ID 101	See Par ID 102	Hz	0.00	141	
P7.4	Keypad Direction				0	116	0 = Forward 1 = Reverse
P7.5	Keypad Stop				1	114	0 = Enabled-Keypad Operation 1 = Always Enabled
P7.6	Jog Reference	0.00	See Par ID 102	Hz	5.00	117	
P7.9	Start Mode				0	252	0 = Ramp 1 = Flying Start From Stop Frequency 2 = Flying Start From Max Frequency
P7.10	Stop Mode				1	253	0 = Coasting 1 = Ramp
P7.11	Ramp 1 Shape	0.0	10.0	s	0.0	247	
P7.12	Ramp 2 Shape	0.0	10.0	s	0.0	248	
P7.13	Accel Time 2	0.1	3000.0	s	10.0	249	
P7.14	Decel Time 2	0.1	3000.0	s	10.0	250	
P7.15	Skip F1 Low Limit	0.00	See Par ID 257	Hz	0.00	256	
P7.16	Skip F1 High Limit	See Par ID 256	400.00	Hz	0.00	257	
P7.17	Skip F2 Low Limit	0.00	See Par ID 259	Hz	0.00	258	
P7.18	Skip F2 High Limit	See Par ID 258	400.00	Hz	0.00	259	
P7.19	Skip F3 Low Limit	0.00	See Par ID 261	Hz	0.00	260	
P7.20	Skip F3 High Limit	See Par ID 260	400.00	Hz	0.00	261	
P7.21	Skip Range Ramp Factor	0.1	10.0		1.0	264	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 30. Drive Control—P7, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P7.22	Power Loss Function				0	267	0 = Disabled 1 = Decel Mode 2 = Coast Mode
P7.23	Power Loss Time	0.3	5.0	s	2.0	268	
P7.24	Currency				0	2122	0 = \$ 1 = £ 2 = € 3 = ¥ 4 = Rs 5 = R\$ 6 = Fr 7 = kr
P7.25	Energy Cost			Varies	0.00	2123	
P7.26	Data Type				0	2124	0 = Cumulative 1 = Daily Avg 2 = Weekly Avg 3 = Monthly Avg 4 = Yearly Avg
P7.27	Energy Savings Reset					2125	0 = Not Reset 1 = Reset
P7.28 ①	2nd Stage Ramp Frequency	See Par ID 101	See Par ID 102	Hz	30.00	2444	
P7.29	Change PhaseSequence Motor				0	2515	0 = Change Disable 1 = Change Enable
P7.30	Run Remove Stop Mode				0	2667	See Par ID 253

Table 31. Motor control—P8.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P8.1 ①②	Motor Control Mode				0	287	0 = Freq Control 1 = Speed Control
P8.2 ①	Current Limit	DriveNomCurrCT*1/10	DriveNomCurrCT*2	A	DriveNomCurrVT	107	
P8.3 ①	V/Hz Optimization				0	109	See Par ID 2462
P8.4 ①	V/Hz Ratio				0	108	0 = Linear 1 = Squared 2 = Programmable 3 = Linear + Flux Optimization
P8.5 ①	Field Weakening Point	8.00	400.00	Hz	FieldWeakPointMFG	289	
P8.6 ①	Voltage at FWP	10.00	200.00	%	100.00	290	
P8.7 ①	V/Hz Mid Frequency	0.00	See Par ID 289	Hz	VHzCurveMidFreqMFG	291	
P8.8 ①	V/Hz Mid Voltage	0.00	100.00	%	100.00	292	
P8.9 ①	Zero Frequency Voltage	0.00	40.00	%	0.00	293	
P8.10	Switching Frequency	MinSwitchFreq	MaxSwitchFreq	kHz	DefaultSwitchFreqCT	2522	
P8.11	Sine Filter Enable				0	1665	See Par ID 2462
P8.12 ①	OverVoltage Control				3	294	0 = Disabled 1 = REF + 8Hz 2 = Max Freq 3 = Max Freq + 8Hz
P8.14 ②	Identification				0	299	0 = No Action 1 = Identification Only Stator Resistor

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 31. Motor control—P8 Continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P8.17 ②	Frequency Ramp Out Filter Time Constant	0	3000	ms	0	1585	
P8.50 ①	Stator Resistor	0.001	65.535	ohm	0.001	771	
P8.59	V/F Stable Kd	0	3000	%	100	1656	
P8.60	V/F Stable Kq	0	3000	%	100	1657	
P8.61 ①	Overmodulation Enable				0	2835	See Par ID 2462
P8.71	Slip Compensation Coefficient	0	500	%	100	1664	

Table 32. Protections—P9.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P9.1 ①	4 mA Input Fault				0	306	0 = No Action 1 = Warning 2 = Warning: Previous Freq 3 = Warning: Preset Freq 4 = Fault 5 = Fault, Coast
P9.2 ①	4 mA Fault Frequency	0.00	See Par ID 102	Hz	0.00	331	
P9.3 ①	External Fault				2	307	0 = No Action 1 = Warning 2 = Fault 3 = Fault, Coast
P9.4 ①	Input Phase Fault				2	332	0 = No Action 1 = Warning 2 = Fault 3 = Fault, Coast 4 = Single Phase Power Limit
P9.5 ①	Uvolt Fault Response				2	330	See Par ID 307
P9.6 ①	Output Phase Fault				2	308	See Par ID 307
P9.7 ①	Ground Fault				2	309	See Par ID 307
P9.8 ①	Motor Thermal Protection				2	310	See Par ID 307
P9.9	Motor Thermal F0 Current	0.0	150.0	%	100.0	311	
P9.11 ①	Stall Protection				0	313	See Par ID 307
P9.12	Stall Current Limit	0.1	ActiveMotor NomCurr*2	A	ActiveMotor NomCurr*13/10	314	
P9.13	Stall Time Limit	1.0	120.0	s	15.0	315	
P9.14	Stall Frequency Limit	1.00	See Par ID 102	Hz	25.00	316	
P9.15 ①	Underload Protection				0	317	See Par ID 307
P9.16	Underload Fnom Torque	10.0	150.0	%	50.0	318	
P9.17	Underload F0 Torque	5.0	150.0	%	10.0	319	
P9.18	Underload Time Limit	2.00	600.00	s	20.00	320	
P9.19 ①	Thermistor Fault Response				2	333	See Par ID 307
P9.20	Line Start Lockout				2	750	0 = Disabled, No Change 1 = Enable, No Change 2 = Disabled, Changed 3 = Enable, Changed
P9.21 ①	Fieldbus Fault Response				2	334	0 = No Action 1 = Warning 2 = Fault 3 = Fault, Coast 4 = Warning, Coast 5 = Warning, Auto Switch To Local 6 = Warning, Auto Switch To Preset Speed 1

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 32. Protections—P9, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P9.22 ①	OPTCard Fault Response				2	335	See Par ID 307
P9.23 ①	Unit Under Temp Prot				2	1564	See Par ID 307
P9.24	AR Wait Time	1.00	300.00	s	1.00	321	
P9.25	AR Trail Time	0.00	600.00	s	30.00	322	
P9.26	AR Start Function				0	323	0 = Flying Start From Stop Frequency 1 = Ramp 2 = Flying Start From Max Frequency
P9.27	Undervoltage Attempts	0	10		1	324	
P9.28	OverVoltage Attempts	0	10		1	325	
P9.29	OverCurrent Attempts	0	3		1	326	
P9.30	4 mA Fault Attempts	0	10		1	327	
P9.31	Motor Temp Fault Attempts	0	10		1	329	
P9.32	External Fault Attempts	0	10		1	328	
P9.33	Underload Attempts	0	10		1	336	
P9.34 ①	RTC Fault				1	955	See Par ID 307
P9.35 ①	PT100 Fault Response				2	337	See Par ID 307
P9.36 ①	Replace Battery Fault Response				1	1256	See Par ID 307
P9.37 ①	Replace Fan Fault Response				1	1257	See Par ID 307
P9.38 ①	IP Address Confliction Resp				1	1678	See Par ID 307
P9.39	Cold Weather Mode				0	2126	See Par ID 2462
P9.40	Cold Weather Volt. Level	0.0	20.0	%	2.0	2127	
P9.41	Cold Weather Time Out	0	10	min	3	2128	
P9.42	Cold Weather Password					2129	
P9.43	Under Temp Fault Override					2130	See Par ID 2118
P9.44	Ground Fault Limit	0	30	%	15	2158	
P9.45 ①	Keypad Comm Fault Response				2	2157	See Par ID 307
P9.46	Preheat Mode				0	2159	See Par ID 2462

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 32. Protections—P9, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P9.47 ②	Preheat Control Source				31	2160	0 = DigIN:NormallyOpen 1 = DigIN:NormallyClose 2 = DigIN: 1 3 = DigIN: 2 4 = DigIN: 3 5 = DigIN: 4 6 = DigIN: 5 7 = DigIN: 6 8 = DigIN: 7 9 = DigIN: 8 10 = DigIN: A: IO1: 1 11 = DigIN: A: IO1: 2 12 = DigIN: A: IO1: 3 13 = DigIN: A: IO5: 1 14 = DigIN: A: IO5: 2 15 = DigIN: A: IO5: 3 16 = DigIN: A: IO5: 4 17 = DigIN: A: IO5: 5 18 = DigIN: A: IO5: 6 19 = DigIN: B: IO1: 1 20 = DigIN: B: IO1: 2 21 = DigIN: B: IO1: 3 22 = DigIN: B: IO5: 1 23 = DigIN: B: IO5: 2 24 = DigIN: B: IO5: 3 25 = DigIN: B: IO5: 4 26 = DigIN: B: IO5: 5 27 = DigIN: B: IO5: 6 31 = Drive Temperature 32 = SlotA PT100 Temp Channel 1 33 = SlotA PT100 Temp Channel 2 34 = SlotA PT100 Temp Channel 3 35 = SlotA Max PT100 Temp 36 = SlotB PT100 Temp Channel 1 37 = SlotB PT100 Temp Channel 2 38 = SlotB PT100 Temp Channel 3 39 = SlotB Max PT100 Temp 40 = SlotA and SlotB Max PT100 Temp
P9.48	Preheat Enter Temp	-20.0	20.0	Deg. C	10.0	2161	
P9.49	Preheat Quit Temp	-10.0	40.0	Deg. C	20.0	2162	
P9.50	Preheat Output Volt	0.0	20.0	%	2.0	2163	
P9.56	STO Fault Response				2	2427	0 = No Action 1 = Warning 2 = Fault
P9.57	Fault Reset Start				0	2483	0 = Follow Run Command 1 = Rising Edge After Fault Reset
P9.58	Warning Operation Mode				1	2657	0 = No Action 1 = Warning, No Store 2 = Warning, Store
P9.59	Fan Protection				2	2664	See Par ID 307
P9.60	Under Voltage Trip Level	DCLinkUnder VoltStopLimit	DCLinkOver VoltStopLimit	V	DCLinkUnder VoltProtectLimit	2666	
P9.61	OP Cont Interlock Attempts	0	10		1	2803	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 32. Protections—P9, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P9.62 ①	OP Cont Interlock Protection				2	2831	See Par ID 307
P9.63 ①	CP Interlock Run Protection				2	2895	See Par ID 307
P9.64 ①	CP Interlock Stop Protection				1	2896	0 = No Action 1 = Warning, No Store
P9.65	CP Interlock Attempts	0	10		1	2897	

Table 33. Preset speed—P12.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P12.1	Preset Speed 1	0.00	See Par ID 102	Hz	5.00	105	
P12.2	Preset Speed 2	0.00	See Par ID 102	Hz	10.00	106	
P12.3	Preset Speed 3	0.00	See Par ID 102	Hz	15.00	118	
P12.4	Preset Speed 4	0.00	See Par ID 102	Hz	20.00	119	
P12.5	Preset Speed 5	0.00	See Par ID 102	Hz	25.00	120	
P12.6	Preset Speed 6	0.00	See Par ID 102	Hz	30.00	121	
P12.7	Preset Speed 7	0.00	See Par ID 102	Hz	35.00	122	

Table 34. Brake—P14.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P14.1 ①	DC-Brake Current	DriveNom CurrCT*15/100	DriveNom CurrCT*15/10	A	DriveNom CurrCT*1/2	254	
P14.2 ①	Start DC-Brake Time	0.00	600.00	s	0.00	263	
P14.3 ①	Stop DC-Brake Frequency	0.10	10.00	Hz	1.50	262	
P14.4 ①	Stop DC-Brake Time	0.00	600.00	s	0.00	255	
P14.5 ①	Brake Chopper Mode				0	251	0 = Disabled 1 = B(Run) T(Rdy) 2 = External 3 = B(Rdy) T(Rdy) 4 = B(Run) T(No)
P14.6 ①	Flux Brake				0	266	0 = Off 1 = On
P14.7 ①	Flux Brake Current	ActiveMotor NomCurr*1/10	See Par ID 107	A	ActiveMotor NomCurr*1/2	265	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Communication

Table 35. FB process data input Sel—P20.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.1.1	FB Process Data Input 1 Sel	0	3000		2541	2533	
P20.1.2	FB Process Data Input 2 Sel	0	See Par ID 2533		2542	2534	
P20.1.3	FB Process Data Input 3 Sel	0	See Par ID 2533		2550	2535	
P20.1.4	FB Process Data Input 4 Sel	0	See Par ID 2533		0	2536	
P20.1.5	FB Process Data Input 5 Sel	0	See Par ID 2533		0	2537	
P20.1.6	FB Process Data Input 6 Sel	0	See Par ID 2533		0	2538	
P20.1.7	FB Process Data Input 7 Sel	0	See Par ID 2533		0	2539	
P20.1.8	FB Process Data Input 8 Sel	0	See Par ID 2533		0	2540	

Table 36. FB process data output Sel—P20.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.2.1	FB Process Data Output 1 Sel				1	1556	
P20.2.2	FB Process Data Output 2 Sel				2	1557	
P20.2.3	FB Process Data Output 3 Sel				3	1558	
P20.2.4	FB Process Data Output 4 Sel				4	1559	
P20.2.5	FB Process Data Output 5 Sel				5	1560	
P20.2.6	FB Process Data Output 6 Sel				6	1561	
P20.2.7	FB Process Data Output 7 Sel				7	1562	
P20.2.8	FB Process Data Output 8 Sel				28	1563	
P20.2.9 ②	Standard Status Word Bit0 Function Select				1	2415	0 = Not Used 1 = Ready 2 = Run 3 = Fault 4 = Fault Invert 5 = Warning 6 = Reversed 7 = At Speed 8 = Zero Frequency 9 = Freq Limit 1 Superv 10 = Freq Limit 2 Superv 13 = OverHeat Fault 14 = OCurrent Fault 15 = OVolt Fault 16 = UVolt Fault Resp 17 = 4 mA Ref Fault/ Warning 20 = Torq Limit Superv 21 = Ref Limit Superv 22 = Control from I/O 23 = Un-Requested Rotation Direction

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 36. FB Process Data Output Sel—P20.2, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.2.9 ②, continued	Standard Status Word Bit0 Function Select				1	2415	24 = Thermistor Fault Output 27 = Ext Fault/Warning 28 = Remote Control 29 = Jog Speed Select 30 = Motor Therm Protection 31 = FB Digital Input 1 32 = FB Digital Input 2 33 = FB Digital Input 3 34 = FB Digital Input 4 39 = In E-Stop 40 = Power Limit Superv 41 = Temp Limit Superv 42 = Analog Input Superv 51 = Motor Current 1 Supv 52 = Motor Current 2 Supv 53 = Second AI Limit Supv 54 = DC Charge Switch Close 55 = Preheat Active 56 = Cold Weather Active 58 = 2nd Stage Ramp Frequency Active 59 = STO Fault Output 60 = Run Bypass/Drive 63 = Auto Local On COM Fault 64 = FieldBus RTU Fault 65 = FieldBus_TCP_Fault 66 = FieldBus_MSTP_Fault 67 = FieldBus_EIP_Fault 68 = FieldBus_SlotA_Fault 69 = FieldBus_SlotB_Fault 70 = FieldBus SWD Fault 78 = CP Interlock Fault
P20.2.10 ②	Standard Status Word Bit1 Function Select				2	2416	See Par ID 2415
P20.2.11 ②	Standard Status Word Bit2 Function Select				3	2417	See Par ID 2415
P20.2.12 ②	Standard Status Word Bit3 Function Select				4	2418	See Par ID 2415
P20.2.13 ②	Standard Status Word Bit4 Function Select				5	2419	See Par ID 2415
P20.2.14 ②	Standard Status Word Bit5 Function Select				6	2420	See Par ID 2415
P20.2.15 ②	Standard Status Word Bit6 Function Select				7	2421	See Par ID 2415
P20.2.16 ②	Standard Status Word Bit7 Function Select				8	2422	See Par ID 2415

RS-485 Bus

Table 37. Basic setting—P20.3.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.3.1.1 ①	RS485 Comm Set				0	586	0 = Modbus RTU 1 = BACnet MS/TP 2 = SWD

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 38. Modbus RTU—P20.3.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.3.2.1 ①	Slave Address	1	247		1	587	
P20.3.2.2 ①	Baud Rate				1	584	0 = 9600 1 = 19200 2 = 38400 3 = 57600 4 = 115200
P20.3.2.3 ①	Parity Type And Stop Bit				2	585	0 = None and 2 stop bits 1 = Odd and 1 stop bit 2 = Even and 1 stop bit 3 = None and 1 stop bit
P20.3.2.4	Modbus RTU Protocol Status					588	0 = Initial 1 = Stopped 2 = Operational 3 = Faulted
P20.3.2.5	Comm Timeout Modbus RTU	0	60000	ms	10000	593	
P20.3.2.6	Modbus RTU Fault Response				0	2516	0 = in Fieldbus Control 1 = in all Control

Table 39. BACnet MS/TP—P20.3.3.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.3.3.1 ①	MSTP Baud Rate				2	594	0 = 9600 1 = 19200 2 = 38400 3 = 76800 4 = 115200
P20.3.3.2 ①	MSTP Device Address	0	127		1	595	
P20.3.3.3 ①	MSTP Instance Number	0	4194302		0	596	
P20.3.3.4	MSTP Comm Timeout	0	60000	ms	10000	598	
P20.3.3.5	MSTP Protocol Status				0	599	0 = Stopped 1 = Operational 2 = Faulted
P20.3.3.6	MSTP Fault Code				0	600	0 = None 1 = Sole Master 2 = Duplicate MAC ID 3 = Baud rate fault
P20.3.3.7	MSTP Fault Response				0	2526	See Par ID 2516
P20.3.3.8 ①	MSTP Max Master	1	127		127	1537	

Table 40. Terminal: SWD—P20.3.4

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.3.4.1	Parameter Access				1	2630	0 = Local Control 1 = Fieldbus
P20.3.4.2 ①	Process Data Access				4	2631	0 = Local Control 1 = Fieldbus 2 = Mixed Interface 4 = NET, Local on Fault 5 = Dual Mode
P20.3.4.3	Fault Situation Counter					2632	
P20.3.4.4	Board Status					2609	
P20.3.4.5	Firmware Version					2610	
P20.3.4.6	Protocol Status					2612	0 = Not Configured 1 = Operational 2 = Diagnostics

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 40. Terminal: SWD—P20.3.4, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.3.4.7	Operation Mode					2613	0 = PD2x16Bit Profil 1 = 8Bit Profil 2 = 1-0–A Switch
P20.3.4.8	PDP-Telegram Selection				1	2614	1 = Standard Telegram 1
P20.3.4.9	Fault Counter PDP				0	2615	
P20.3.4.10	Fault Situations Max				8,8	2616	
P20.3.4.11	PDP-Profil Number				809	2618	
P20.3.4.12	PDP-Control Word					2619	
P20.3.4.13	PDP-Status Word				64	2620	
P20.3.4.14	PDP-MaxBlockLength				512	2621	
P20.3.4.15	PDP-NoOfMultiparameter				64	2622	
P20.3.4.16	PDP-MaxLatency				0	2623	
P20.3.4.17	PDP-DO Manufacturer					2624	
P20.3.4.18	PDP-DO Device Type					1451	
P20.3.4.19	PDP-DO FW-Interface					2625	
P20.3.4.20	PDP-DO FW-Year					2626	
P20.3.4.21	PDP-DO FW-DayMonth					2627	
P20.3.4.22	PDP-DO NoOfDOs				1	2628	
P20.3.4.23	PDP-DO Subclass				1	2629	

Table 41. EtherNet/IP—P20.4.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.4.1 ①	IP Address Mode				0	1500	0 = Static IP 1 = DHCP with AutoIP
P20.4.2	Active IP Address					1507	
P20.4.3	Active Subnet Mask					1509	
P20.4.4	Active Default Gateway					1511	
P20.4.5	MAC Address					1513	
P20.4.6 ①	Static IP Address				192.168.1.254	1501	
P20.4.7 ①	Static Subnet Mask				255.255.255.0	1503	
P20.4.8 ①	Static Default Gateway				192.168.1.1	1505	
P20.4.9	Ethernet IP Protocol Status					608	0 = Off 1 = Operational 2 = Faulted
P20.4.10	EIP Fault Response				0	2518	See Par ID 2516

Table 42. Modbus TCP—P20.5.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.5.1	Connection Limit				5	609	
P20.5.2	Modbus TCP Unit ID				1	610	
P20.5.3	Comm Timeout Modbus TCP	0	60000	ms	10000	611	
P20.5.4	Modbus TCP Protocol Status					612	See Par ID 599
P20.5.5	Modbus TCP Fault Response				0	2517	See Par ID 2516
P20.5.6	Modbus TCP Trusted IP Enable				1	74	See Par ID 2462
P20.5.7	Trusted IP White List				0xC0.0xA8.0x01.0xFF.0x00.0x00.0x00.0x00.0x00.0x00.0x00.0x00	68	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 43. WebUI—P20.6.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.6.1	WebUI Protocol Status					2915	See Par ID 608
P20.6.2	WebUI Fault Response				0	2916	See Par ID 2516
P20.6.3	WebUI Communication Timeout	30000	60000	ms	60000	2919	

Table 44. Protocol Enable — P20.7①⑥

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.7.1 ①⑥	Ethernet based protocol select				0	1997	0 = Disabled 1 = Ethernet IP
P20.7.2 ①⑥	Modbus TCP enable				0	1942	0 = Disabled 1 = Enable
P20.7.3 ①⑥	WebUI Enable				1	2921	See Par ID 2462

System

Table 45. Basic setting—P21.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P21.1.1	Language				0	340	0 = English 1 = 中文 2 = Deutsch
P21.1.2 ①	Application					142	0 = Standard 1 = Multi-Pump 2 = Multi-PID 3 = Multi-Purpose
P21.1.3 ①	Parameter Sets					619	0 = No 1 = Reload Defaults 2 = Reload Set 1 3 = Reload Set 2 4 = Store Set 1 5 = Store Set 2 6 = Reset 7 = Reload Defaults VM
P21.1.4	Up To Keypad					620	See Par ID 2118
P21.1.5 ①	Down From Keypad					621	0 = No 1 = All Parameters 2 = All, No Motor 3 = App Parameters
P21.1.6	Parameter Comparison					623	0 = No 1 = Compare with Keypad 2 = Compare with Default 3 = Compare with Set 1 4 = Compare with Set 2
P21.1.7	Password	0	9999		0	624	
P21.1.8	Parameter Lock				0	625	0 = Change Enable 1 = Change Disable
P21.1.9	Multimonitor Set				0	627	See Par ID 625
P21.1.10	Default Page				2	628	0 = None 1 = Main Menu 2 = Multi-Monitor 3 = Favorite Menu 4 = Keypad Reference
P21.1.11	Timeout Time	0	65535	s	30	629	
P21.1.12	Contrast Adjust	5	18		12	630	
P21.1.13	Backlight Time	1	65535	min	10	631	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 45. Basic setting—P21.1, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P21.1.14	Fan Control				1	632	0 = Continuous 1 = Temperature 2 = Run Follow
P21.1.15	Keypad ACK Timeout	200	5000	ms	200	633	
P21.1.16	Keypad Retry Number	1	10		5	634	
P21.1.17	Startup Wizard				0	626	0 = Yes 1 = No
P21.1.18	Jog Softkey Hidden				0	2412	See Par ID 2462
P21.1.19	Reverse Softkey Hidden				0	2413	See Par ID 2462
P21.1.20	Output Display Unit				45	2424	0 = % 1 = 1/min 2 = rpm 3 = ppm 4 = pps 5 = l/s 6 = l/min 7 = l/h 8 = kg/s 9 = kg/min 10 = kg/h 11 = m3/s 12 = m3/min 13 = m3/h 14 = m/s 15 = mbar 16 = bar 17 = Pa 18 = kPa 19 = mVS 20 = kW 21 = Deg. C 22 = GPM 23 = gal/s 24 = gal/min 25 = gal/h 26 = lb/s 27 = lb/min 28 = lb/h 29 = CFM 30 = ft3/s 31 = ft3/min 32 = ft3/h 33 = ft/s 34= in wg 35 = ft wg
P21.1.20 (cont.)	Output Display Unit				45	2424	36 = PSI 37 = lb/in2 38 = HP 39 = Deg. F 40 = PA 41 = WC 42 = HG 43 = ft 44 = m 45 = Hz 46 = strokes/min
P21.1.21	Output Display Unit Min	-60000.00	See Par ID 2425	Varies	0.00	2460	
P21.1.22	Output Display Unit Max	See Par ID 2460	60000.00	Varies	MotorNomFreqMFG	2425	
P21.1.23	Keypad Lock Password	0	9999		0	75	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 46. Version info.—P21.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P21.2.1	Keypad Software Version					640	
P21.2.2	Motor Control Software Version					642	
P21.2.3	Application Software Version					644	
P21.2.4	Software Bundle Version					1714	

Table 47. Application info.—P21.3.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P21.3.1	Brake Chopper Status					646	See Par ID 2118
P21.3.2	Brake Resistor Status					647	See Par ID 2118
P21.3.3	Serial Number					648	
P21.3.4	Power Unit Serial Number					1270	
P21.3.5	Control Unit Serial Number					1276	

Table 48. User info.—P21.4.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P21.4.1	Real Time Clock				0.0.0.1:1:13	566	
P21.4.2	Daylight Saving				0	582	0 = Off 1 = EU 2 = US
P21.4.3	Total MWh Count			Mwh		601	
P21.4.4	Total Power Day Count					603	
P21.4.5	Total Power Hr Count					606	
P21.4.6	Trip MWh Count			Mwh		604	
P21.4.7	Clear Trip MWh Count					635	See Par ID 2125
P21.4.8	Trip Power Day Count					636	
P21.4.9	Trip Power Hr Count					637	
P21.4.10	Clear Trip Power Count					639	See Par ID 2125

Table 49. Operate mode—O.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
O1	Output Frequency			Hz		1	
O2	Freq Reference			Hz		24	
O3	Motor Speed			rpm		2	
O4	Motor Current			A		3	
O5	Motor Torque			%		4	
O6	Motor Power			%		5	
O7	Motor Voltage			V		6	
O8	DC-link Voltage			V		7	
O9	Unit Temperature			Deg. C		8	
O10	Motor Temperature			%		9	
R12 ②	Keypad Reference	See Par ID 101	See Par ID 102	Hz	0.00	141	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Chapter 6 — Multi-pump and fan control application

Introduction

The Multi-pump and fan control application is designed to be used in applications where multiple pumps or fan systems are used to maintain a desired flow rate, pressure, or temperature value. It gives the ability to use a single PID loop to control one drive and have auxiliary motors connected via drives or contactors start and stop based off the desired process. It also gives the ability to use a single PID loop and operate using a Multi-Master/Lead-Lag scheme using up to 5 drives. It also provides the ability to auto-change between the multiple motors to keep run times equal. Control-wise it allows for 2 control and reference place selections with 8 digital inputs and 2 analog inputs that are programmable. For monitoring the system and turning on aux motors, there are 3 programmable relay outputs, 1 digital output, and 2 sets of analog outputs that are programmable. The application allows for full customization of the motor control scheme with frequency or speed control along with customizing the V/Hz curve. Drive/motor protections can be customized to defined actions. Below is a list of other features in addition to the standard application features that are available in the multi-pump and fan control application.

Select the Multi-Pump and Fan Application in menu **P21.1.2**.

Multi-pump and fan includes all the functions in standard application and additional functions:

- Damper control
- Fire mode
- Smoke purge mode
- Interlock for motors
- Multi-pump control
- Auto change function
- Bypass
- Real time clock function—Timer
- Real time clock function—Interval
- PM setback
- Two independent set of motor parameter
- PID
- Multi-Master/Lead-Lag

Note: When Fire mode is enabled, this causes the drive to ignore any fault and run till its death. Warranty will be none valid in the case this is enabled and the drive causes issues to the system.

I/O controls

- "Terminal to Function" (TTF) programming

The design behind the programming of the digital inputs in the DG1 drive is to use "Terminal to Function" programming, which is composed of multiple functions that get assigned a digital input to that function. The parameters in the drive are set up with specific functions and by defining the digital input and slot in some cases, depending on which options are available. For use of the drives control board inputs, they will be referred to as DigIN:1 through DigIN:8. When additional option cards are used, they will be defined as DigIN:X:IOY:Z. The X indicates the slot that the card is being installed in, which will be either A or B. The IOY determines the type of card it is, which would be IO1 or IO5. The Z indicates which input is being used on that available option card.

- "Function to Terminal" (FTT) Programming

The design behind the programming of the relay outputs and digital output in the DG1 drive is to use "Function to Terminal" programming. It is composed of a terminal, be it a relay output or a digital output, that is assigned a parameter. Within that parameter, it has different functions that can be set.

The parameters of the Multi-pump and fan control application are explained on **Page 68** of this manual, "Description of Parameters." The explanations are arranged according to the parameter.

For the DI function, we use terminal programming method to function (TTF), where there is a fixed input that gets programmed to a list of functions. This allows for multiple inputs to be used for different functions. Connecting a certain input with a certain parameter function is done by give a parameter an appropriate value. The value is formed by the location of the input, either being on the standard control board or an external option board and the slot in which it is located.

Force open/force close selection

The Force Open selection would make the selected function always off. Essentially this is a virtual switch that is always open.

The Force Close selection would make the selected function always on. Essentially this is a virtual switch that is always closed.

These options are assigned to a function if we want to force a state without using a hardware input.

Example:

If we set Run Enable to Force Closed, the drive is always enabled. If we set the same function to Force Open, the drive would never be Enabled. If a digital input is to be used to activate this Run Enable, the function should be assigned to a hardware input (see below for DIGIN Selections).

DIGIN selection

This allows assignment of a hardware digital input to a function, this is set in a format of DigIN:X where X is one of the 8 Digital inputs on the main control board.

Example:

If we set Run Enable to DigIN:6, the drive will be enabled when digital input 6 (terminal 8) is closed, and would not be enabled when digital input 6 (terminal 8) is open.

Option board DigIN selection

This allows assignment of a hardware digital input on an option card to a function. This is set in a format of DigIN: Y:IO1:X where Y is the slot the option card is inserted on the main control board and X is the Input on the board and IO1 is the type of option board used.

Example:

If we set Run Enable to DigIN:A:IO5:6, the drive will be enabled when digital input 6 is closed on the IO5 option card which is inserted in Slot A, and would not be enabled when digital input 6 on the option card is open.

Timer channel selection

A Time Channel is a virtual path to link the digital output of a timer function to a digital input function. To utilize this feature a timer or interval would need to be assigned to a time channel 1 through 3, and the input function to be controlled would need to be assigned to the same time channel.

Example:

If we set Run Enable to DigIN:TimeChannel1, the drive will be enabled when the timer assigned to Time Channel 1 is active or High, and would not be enabled when the Time Channel is inactive or Low.

Control examples

Single drive

Figure 27. Example of two-pump autochange, main diagram.

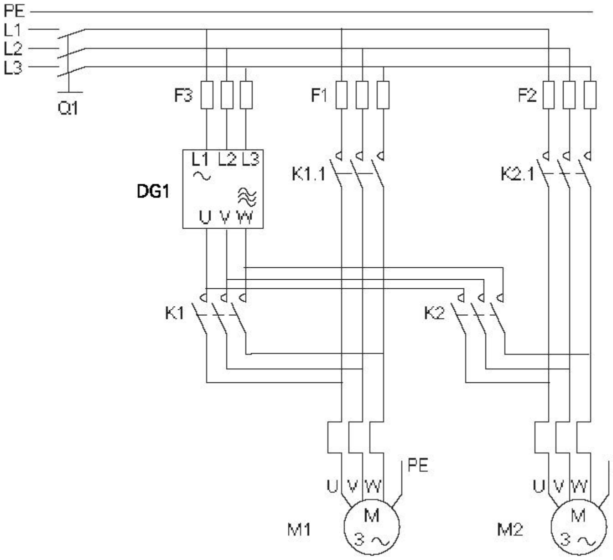


Figure 28. Two-pump autochange system principal control diagram.

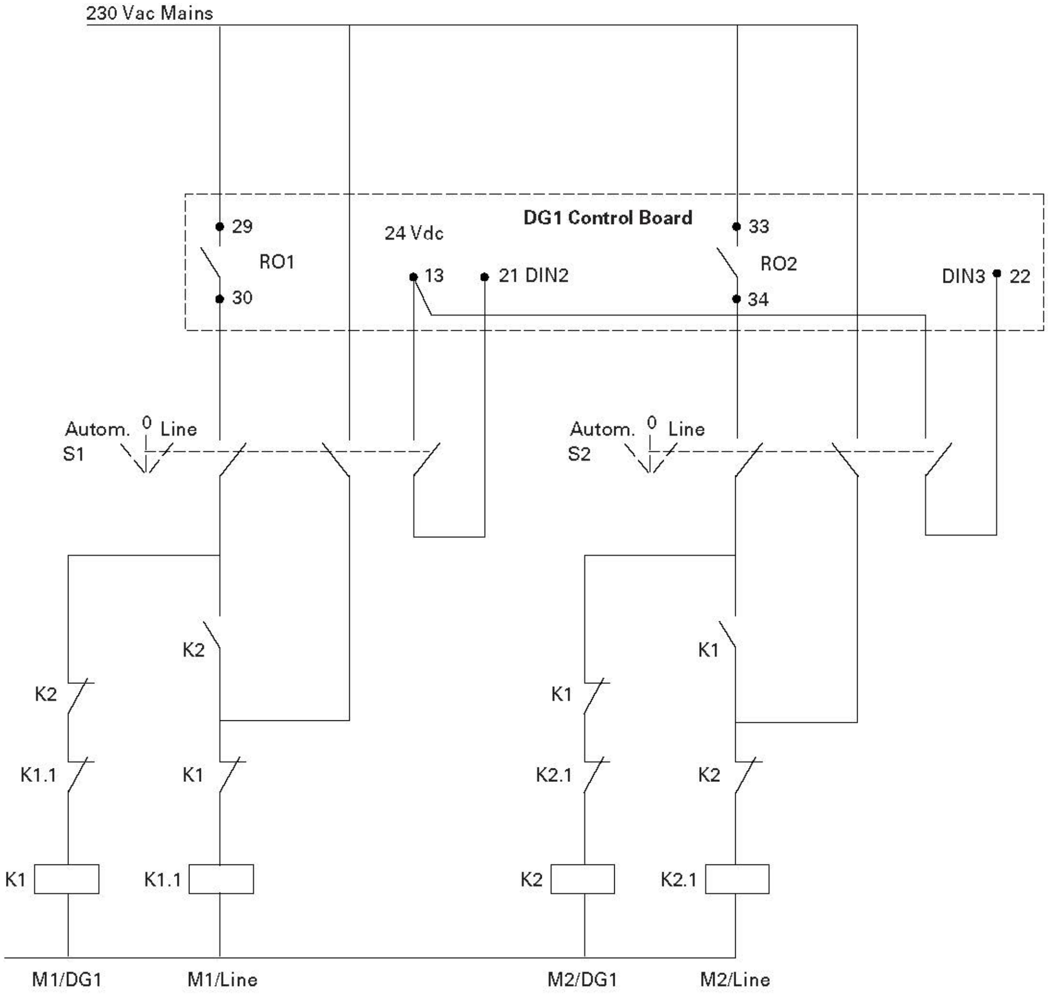


Figure 29. Example of three-pump autochange, main diagram.

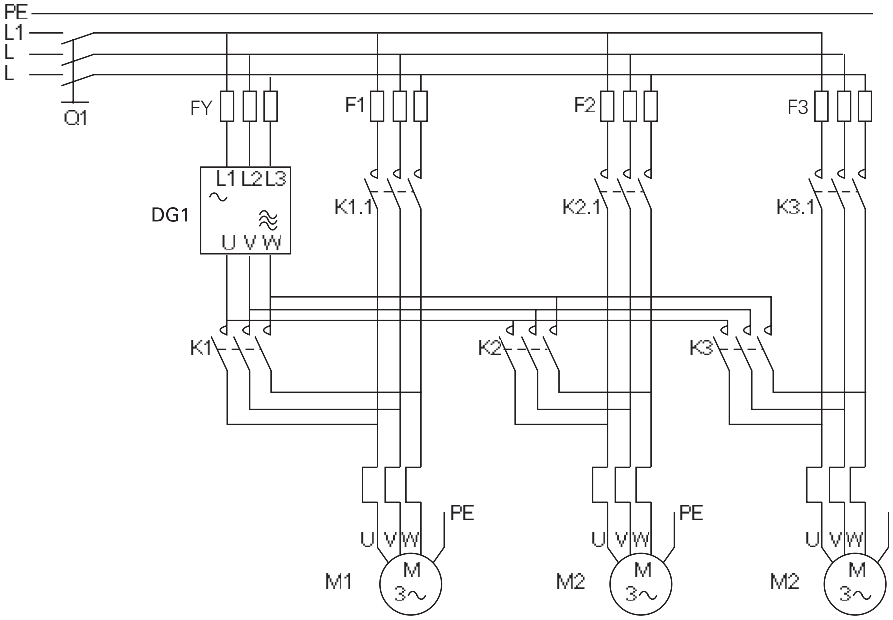


Figure 30. Three-pump autochange system principal control diagram.

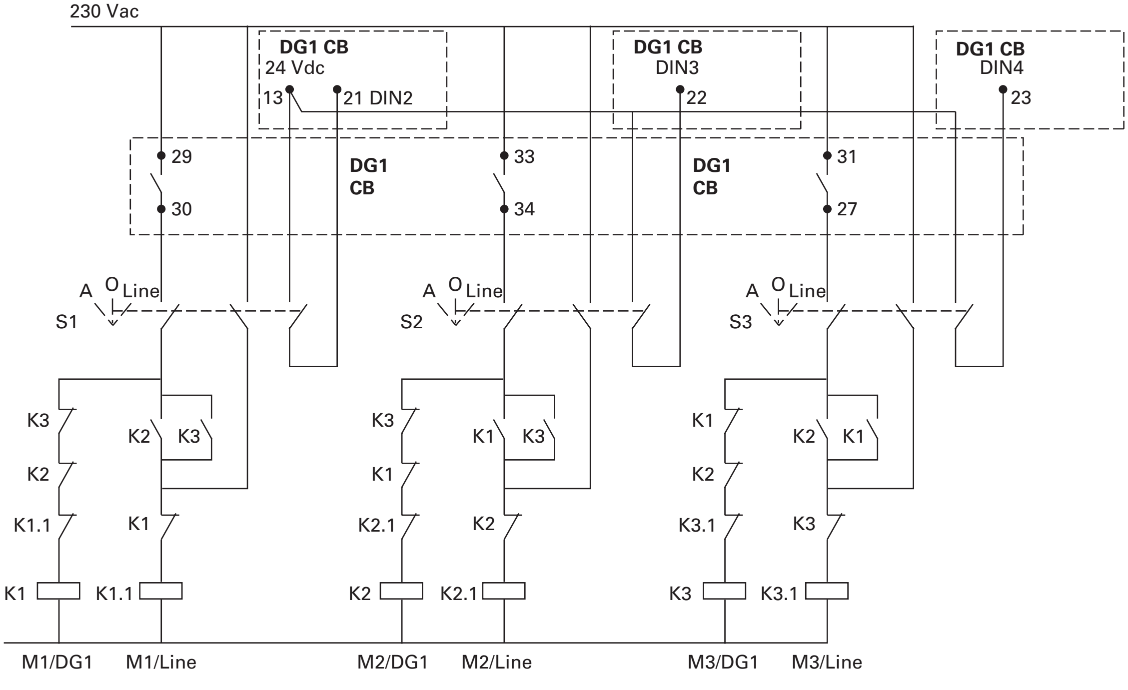


Figure 31. Example of the function of the PFC application with three auxiliary drives.

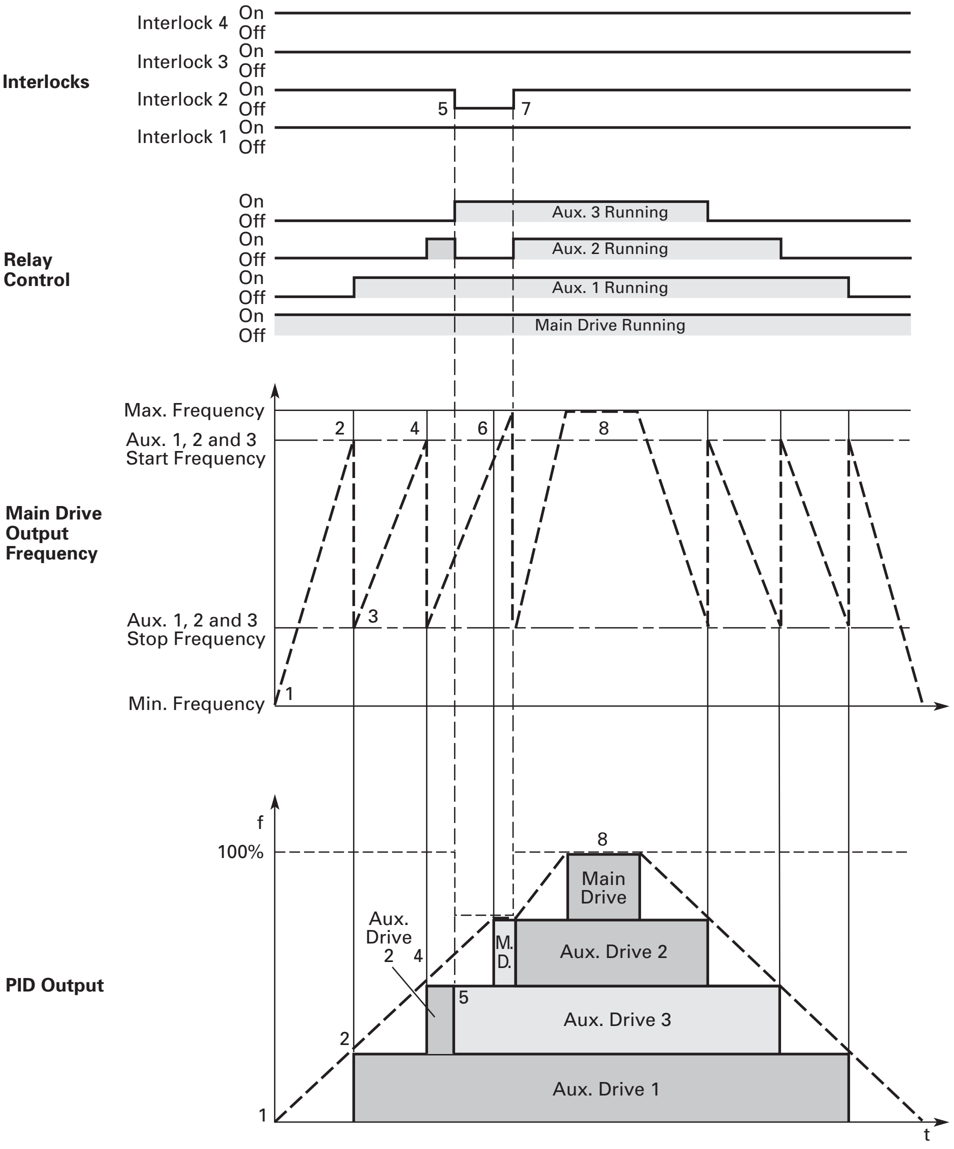


Figure 32. Multi-pump control curve.

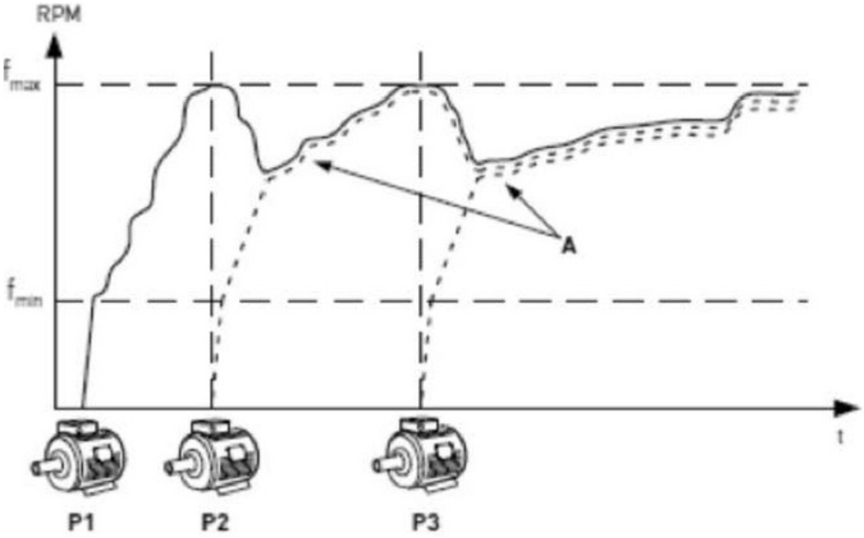


Figure 33. Multi-drive/multi-pump layout.

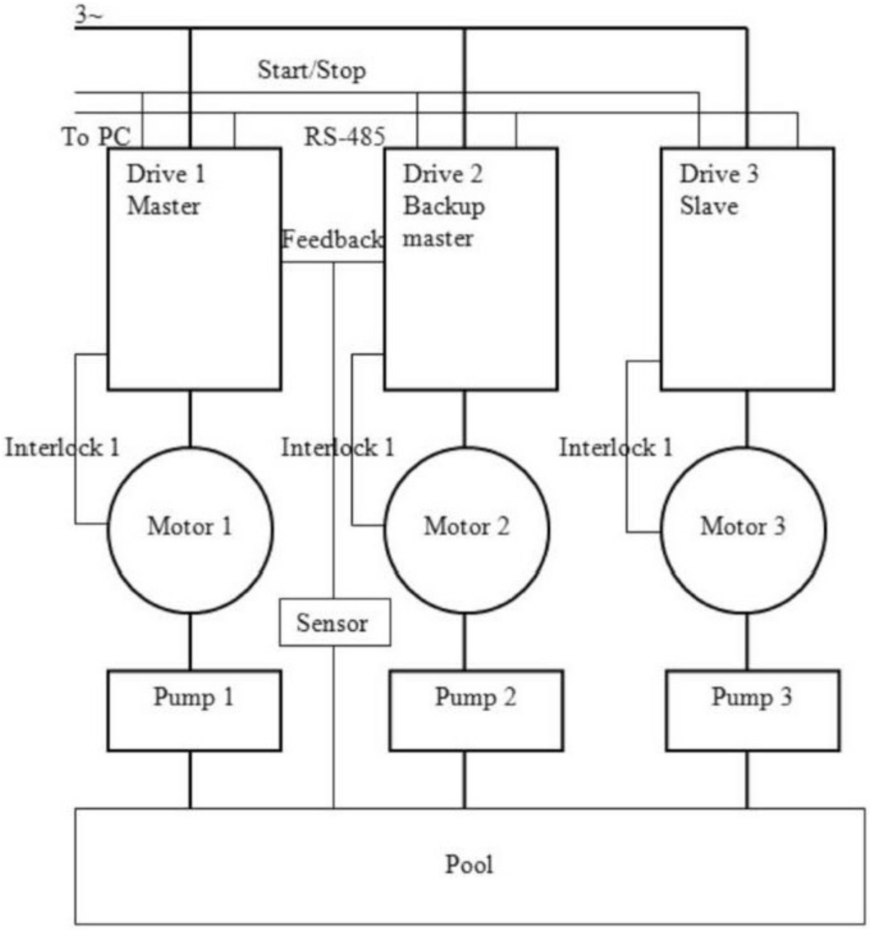
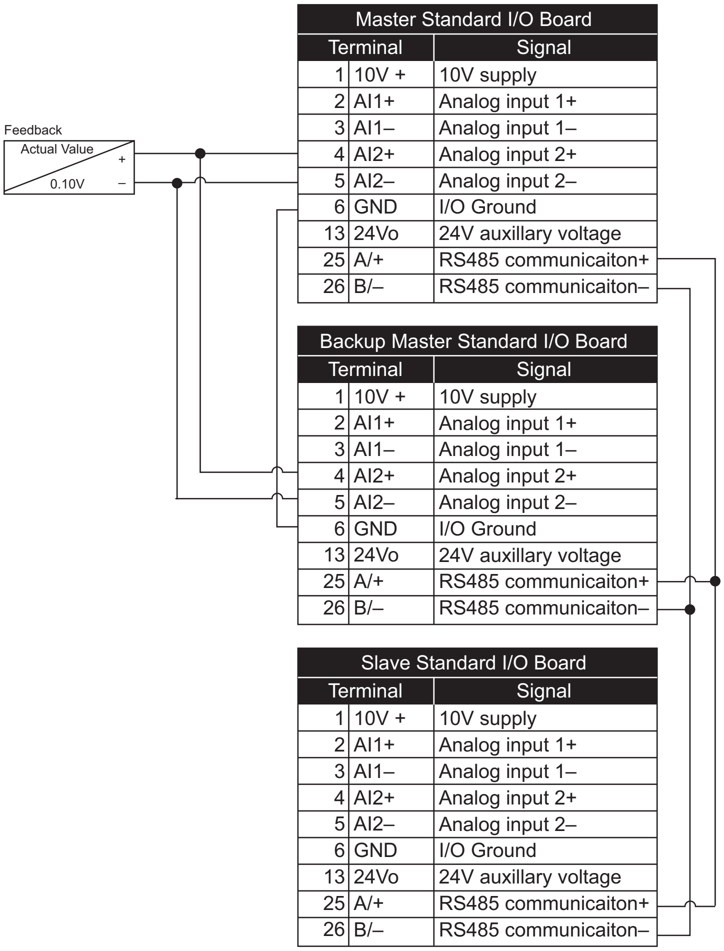


Figure 34. PowerXL drives with 10 V supply with a 0–10 V transducer.

Note
– 10V+/24V Supplies along with grounds for each Master should be connected for the Reference/Setpoint And Start signal if using I/O. (There could be up to 1-5 Masters, anything not considered a master could be a slave with a max of 4 slaves)
–The feedback is wired' to each Master, since it is a voltage signal they are connected in parallel
– Check the Analog input jumpers to be sure they match signal.



Master Standard I/O Board

Terminal		Signal
1	10V +	10V supply
2	AI1+	Analog input 1+
3	AI1–	Analog input 1–
4	AI2+	Analog input 2+
5	AI2–	Analog input 2–
6	GND	I/O Ground
13	24Vo	24V auxillary voltage
25	A/+	RS485 communicaiton+
26	B/–	RS485 communicaiton–

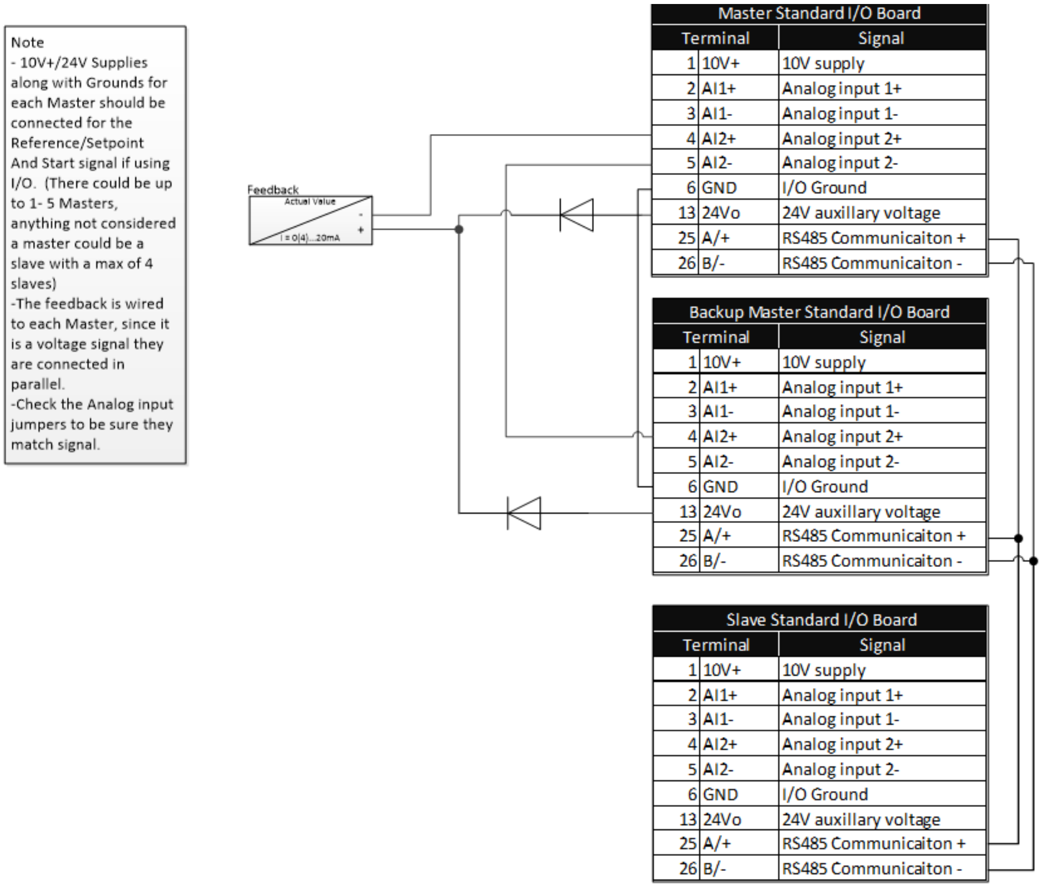
Backup Master Standard I/O Board

Terminal		Signal
1	10V +	10V supply
2	AI1+	Analog input 1+
3	AI1–	Analog input 1–
4	AI2+	Analog input 2+
5	AI2–	Analog input 2–
6	GND	I/O Ground
13	24Vo	24V auxillary voltage
25	A/+	RS485 communicaiton+
26	B/–	RS485 communicaiton–

Slave Standard I/O Board

Terminal		Signal
1	10V +	10V supply
2	AI1+	Analog input 1+
3	AI1–	Analog input 1–
4	AI2+	Analog input 2+
5	AI2–	Analog input 2–
6	GND	I/O Ground
13	24Vo	24V auxillary voltage
25	A/+	RS485 communicaiton+
26	B/–	RS485 communicaiton–

Figure 35. PowerXL drives with 24 V supply with a 4–20 mA transducer.



Note
- 10V+/24V Supplies along with Grounds for each Master should be connected for the Reference/Setpoint And Start signal if using I/O. (There could be up to 1- 5 Masters, anything not considered a master could be a slave with a max of 4 slaves)
-The feedback is wired to each Master, since it is a voltage signal they are connected in parallel.
-Check the Analog input jumpers to be sure they match signal.

Master Standard I/O Board

Terminal		Signal
1	10V+	10V supply
2	AI1+	Analog input 1+
3	AI1-	Analog input 1-
4	AI2+	Analog input 2+
5	AI2-	Analog input 2-
6	GND	I/O Ground
13	24Vo	24V auxillary voltage
25	A/+	RS485 Communicaiton +
26	B/-	RS485 Communicaiton -

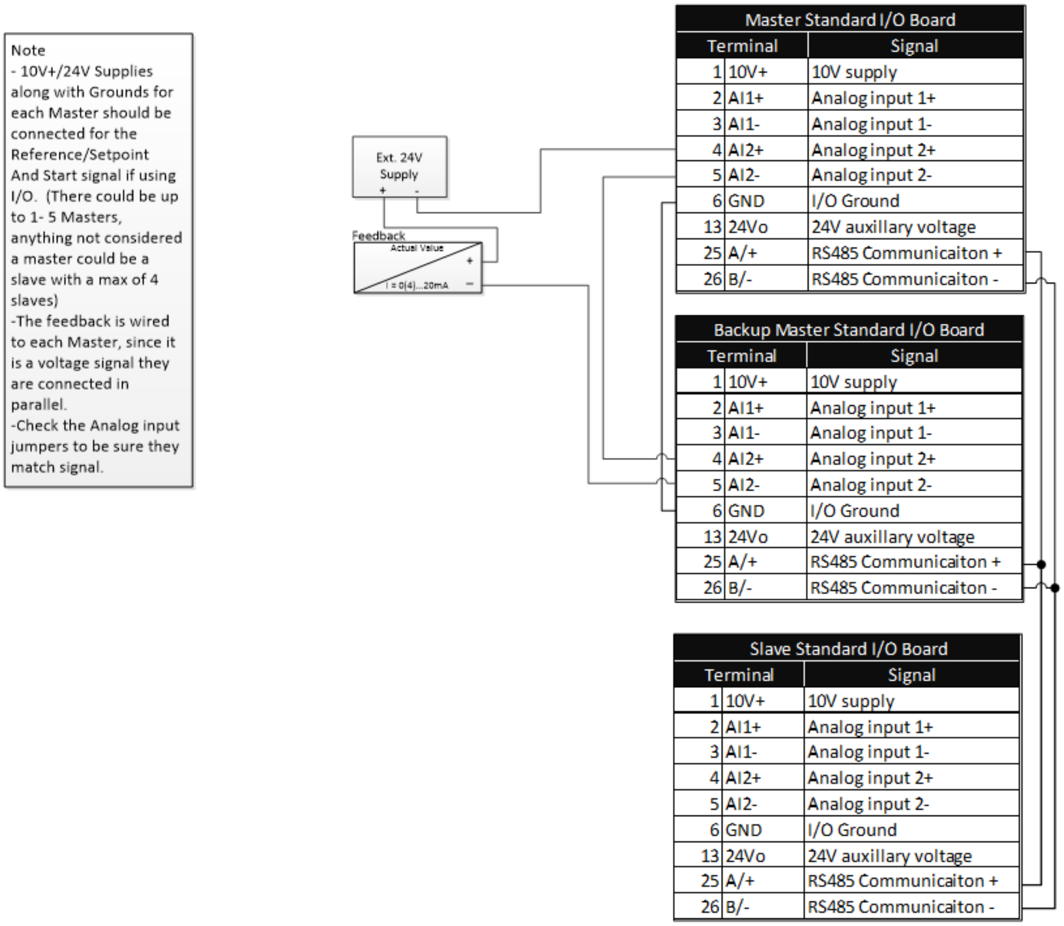
Backup Master Standard I/O Board

Terminal		Signal
1	10V+	10V supply
2	AI1+	Analog input 1+
3	AI1-	Analog input 1-
4	AI2+	Analog input 2+
5	AI2-	Analog input 2-
6	GND	I/O Ground
13	24Vo	24V auxillary voltage
25	A/+	RS485 Communicaiton +
26	B/-	RS485 Communicaiton -

Slave Standard I/O Board

Terminal		Signal
1	10V+	10V supply
2	AI1+	Analog input 1+
3	AI1-	Analog input 1-
4	AI2+	Analog input 2+
5	AI2-	Analog input 2-
6	GND	I/O Ground
13	24Vo	24V auxillary voltage
25	A/+	RS485 Communicaiton +
26	B/-	RS485 Communicaiton -

Figure 36. PowerXL drives with ext. supply with a 4–20 mA transducer.



Note
- 10V+/24V Supplies along with Grounds for each Master should be connected for the Reference/Setpoint And Start signal if using I/O. (There could be up to 1- 5 Masters, anything not considered a master could be a slave with a max of 4 slaves)
-The feedback is wired to each Master, since it is a voltage signal they are connected in parallel.
-Check the Analog input jumpers to be sure they match signal.

Master Standard I/O Board

Terminal		Signal
1	10V+	10V supply
2	AI1+	Analog input 1+
3	AI1-	Analog input 1-
4	AI2+	Analog input 2+
5	AI2-	Analog input 2-
6	GND	I/O Ground
13	24Vo	24V auxillary voltage
25	A/+	RS485 Communicaiton +
26	B/-	RS485 Communicaiton -

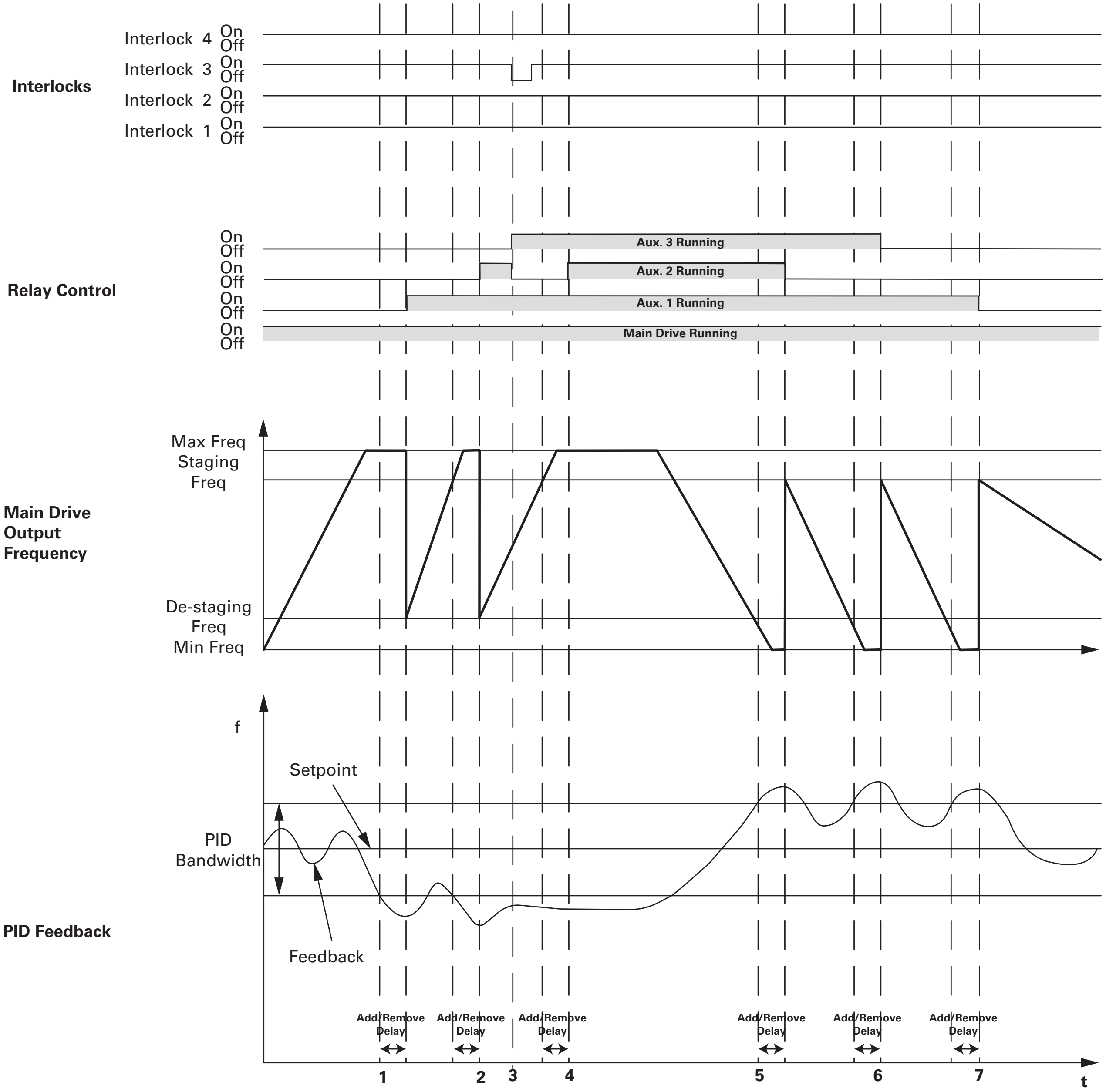
Backup Master Standard I/O Board

Terminal		Signal
1	10V+	10V supply
2	AI1+	Analog input 1+
3	AI1-	Analog input 1-
4	AI2+	Analog input 2+
5	AI2-	Analog input 2-
6	GND	I/O Ground
13	24Vo	24V auxillary voltage
25	A/+	RS485 Communicaiton +
26	B/-	RS485 Communicaiton -

Slave Standard I/O Board

Terminal		Signal
1	10V+	10V supply
2	AI1+	Analog input 1+
3	AI1-	Analog input 1-
4	AI2+	Analog input 2+
5	AI2-	Analog input 2-
6	GND	I/O Ground
13	24Vo	24V auxillary voltage
25	A/+	RS485 Communicaiton +
26	B/-	RS485 Communicaiton -

Figure 37. Bandwidth feedback.

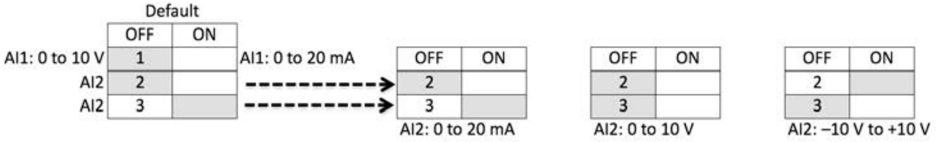


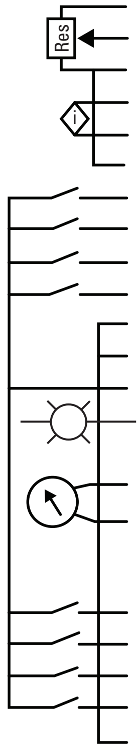
1. Feedback out of bandwidth, output frequency over staging frequency, start delay counter; delay times out, and interlock 2 is OK, add aux. 1 motor by closing its corresponding relay.
2. As above, add aux. 2 motor.
3. Aux. 2’s interlock lost, add aux. 3 as backup immediately.
4. Add aux. 2 motor again since its interlock resumed.
5. Feedback out of bandwidth, output frequency below de-staging frequency, start delay counter; delay times out, remove aux. 2 motor first because it’s the last one which been added.
6. As above, remove aux. 3 motor.
7. As above, remove aux. 1 motor.

Control I/O configuration

- Run 240 Vac and 24 Vdc control wiring in separate conduit
- Communication wire to be shielded

Table 50. Multi-pump and fan application default I/O connection.



External Wiring	Pin	Signal Name	Signal	Default Setting	Description
	1	+10 V	Ref. Output Voltage	—	10 Vdc Supply Source
	2	AI1+ ①	Analog Input 1	0–10 V	Voltage Speed Reference (Programmable to 4 mA to 20 mA)
	3	AI1–	Analog Input 1 Ground	—	Analog Input 1 Common (Ground)
	4	AI2+ ①	Analog Input 2	4 mA to 20 mA	Current Speed Reference (Programmable to 0–10 V)
	5	AI2–	Analog Input 2 Ground	—	Analog Input 2 Common (Ground)
	6	GND	I/O Signal Ground	—	I/O Ground for Reference and Control
	7	DIN5	Digital Input 5	Preset Speed B0	Sets frequency output to Preset Speed 1
	8	DIN6	Digital Input 6	Preset Speed B1	Sets frequency output to Preset Speed 2
	9	DIN7	Digital Input 7	Not Used (TI–)	Input forces VFD output to shut off
	10	DIN8	Digital Input 8	Force Remote (TI+)	Input takes VFD from Local to Remote
	11	CMB	DI5 to DI8 Common	Grounded	Allows source input
	12	GND	I/O Signal Ground	—	I/O Ground for Reference and Control
	13	24 V	+24 Vdc Output	—	Control voltage output (100 mA max.)
	14	DO1	Digital Output 1	Ready	Shows the drive is ready to run
	15	24 Vo	+24 Vdc Output	—	Control voltage output (100 mA max.)
	16	GND	I/O Signal Ground	—	I/O Ground for Reference and Control
	17	AO1+	Analog Output 1	Output Frequency	Shows Output frequency to motor 0–60 Hz (4 mA to 20 mA)
	18	AO2+	Analog Output 2	Motor Current	Shows Motor current of motor 0–FLA (4 mA to 20 mA)
	19	24 Vi	+24 Vdc Input	—	External control voltage input
	20	DIN1	Digital Input 1	Run Forward	Input starts drive in forward direction (start enable)
	21	DIN2	Digital Input 2	Run Reverse	Input starts drive in reverse direction (start enable)
	22	DIN3	Digital Input 3	External Fault	Input causes drive to fault
	23	DIN4	Digital Input 4	Fault Reset	Input resets active faults
	24	CMA	DI1 to DI4 Common	Grounded	Allows source input
	25	A/+	RS-485 Signal A	—	Fieldbus Communication (Modbus, BACnet)
	26	B/-	RS-485 Signal B	—	Fieldbus Communication (Modbus, BACnet)
	27	R3NO	Relay 3 Normally Open	At Speed	Relay output 3 shows VFD is at Ref. Frequency
	28	R1NC	Relay 1 Normally Closed	Run	Relay output 1 shows VFD is in a run state
	29	R1CM	Relay 1 Common		
	30	R1NO	Relay 1 Normally Open		
	31	R3CM	Relay 3 Common	At Speed	Relay output 3 shows VFD is at Ref. Frequency
	32	R2NC	Relay 2 Normally Closed	Fault	Relay output 2 shows VFD is in a fault state
	33	R2CM	Relay 2 Common		
	34	R2NO	Relay 2 Normally Open		

Note: The above wiring demonstrates a SINK configuration. It is important that CMA and CMB are wired to ground (as shown by dashed line). If a SOURCE configuration is desired, wire 24 V to CMA and CMB and close the inputs to ground. When using the +10 V for AI1, it is important to wire AI1—to ground (as shown by dashed line). If using +10 V for AI1 or AI2, terminals 3, 5, and 6 need to be jumpered together.
① AI1+ and AI2+ support 10K potentiometer.

Table 51. Drive communication ports.

Port	Communication
RJ45 Keypad Port	
Upload/Download Parameters	USB to RJ45
Remote Mount Keypad	Ethernet
Upgrade Drive Firmware	USB to RJ45
RJ45 Ethernet Port	
Upload/Download Parameters	Ethernet
Ethernet IP Communications	Ethernet
Modbus TCP Communications	Ethernet
RS-485 Serial Port ①	
Upload/Download Parameters	Two-Wire Twisted Pair
Upgrade Drive Firmware	Two-Wire Twisted Pair
Modbus RTU Communications	Two-Wire Twisted Pair
BACnet MS/TP Communications	Two-Wire Twisted Pair
SmartWire-DT Communications	Two-Wire Shielded Cable

① Shielded wire recommended.

Pump and fan application—parameters list

On the next pages you will find the lists of parameters within the respective parameter groups. The parameter descriptions are given on **Page 194,** "Description of Parameters." The descriptions are arranged according to the parameter number.

Column explanations:

Code = Location indication on the keypad; shows the operator the present parameter number
Parameter = Name of parameter
Min = Minimum value of parameter
Max = Maximum value of parameter
Unit = Unit of parameter value; given if available
Default = Value preset by factory
ID = ID number of the parameter

Table 52. Monitor—M.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
M1	Output Frequency			Hz		1	
M2	Freq Reference			Hz		24	
M3	Motor Speed			rpm		2	
M4	Motor Current			A		3	
M5	Motor Torque			%		4	
M6	Motor Power			%		5	
M7	Motor Voltage			V		6	
M8	DC-link Voltage			V		7	
M9	Unit Temperature			Deg. C		8	
M10	Motor Temperature			%		9	
M12	Analog Input 1			Varies		10	
M13	Analog Input 2			Varies		11	
M14	Analog Output 1			Varies		25	
M15	Analog Output 2			Varies		575	
M16	DI1, DI2, DI3					12	
M17	DI4, DI5, DI6					13	
M18	DI7, DI8					576	
M19	DO1,Virtual RO1,Virtual RO2					14	
M20	RO1, RO2, RO3					557	
M21	TC1, TC2, TC3					558	
M22	Interval 1					559	0 = Inactive 1 = Active
M23	Interval 2					560	See Par ID 559
M24	Interval 3					561	See Par ID 559
M25	Interval 4					562	See Par ID 559
M26	Interval 5					563	See Par ID 559
M27	Timer 1			s	0	569	
M28	Timer 2			s	0	571	
M29	Timer 3			s	0	573	
M30	PID1 Set Point			Varies		16	
M31	PID1 Feedback			Varies		18	
M32	PID1 Error Value			Varies		20	
M33	PID1 Output			%		22	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 52. Monitor—M, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
M34	PID1 Status					23	0 = Stopped 1 = Running 2 = Sleep Mode
M40	Running Motors					26	
M41	PT100 Temperture			Deg. C	1000.0	27	
M42	Latest Fault Code					28	
M43	RTC Battery Status				0	583	0 = Not Installed 1 = Installed 2 = Change Battery 3 = OverVoltage
M44	Instant Motor Power			kW		1686	
M45	Energy Savings			Varies	0.000	2120	
M46	Control Board DIDO Status					2209	
M47	SlotA DIDO Status					2210	
M48	SlotB DIDO Status					2211	
M49	Application Status Word					29	
M50	Standard Status Word					2414	
M51	Output			Varies		2445	
M52	Reference			Varies		2447	
M53	Total MWh Count			Mwh		601	
M54	Total Power Day Count					603	
M55	Total Power Hr Count					606	
M56	Trip MWh Count			Mwh		604	
M57	Trip Power Day Count					636	
M58	Trip Power Hr Count					637	
M59	Total Run time Count			h		2827	
M60	Numbers Of Start					2830	
M61	Trip Run Time Count			h		2829	
M62	FB Status Word					2101	
M63	FB Ctrol Word					2001	
M64	FB Speed Reference	0.00	200.00	%		2003	
M67	Control board DI status					3214	
M68	SlotA DI status					3248	
M69	SlotB DI status					3249	
M70	Multi-Monitoring				2,1,3,2,1,3,2,1,3	1753	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Parameters

Table 53. Basic parameters—P1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P1.1	Min Frequency	0.00	See Par ID 102	Hz	0.00	101	
P1.2 ①	Max Frequency	See Par ID 101	400.00	Hz	MaxFreqMFG	102	
P1.3	Accel Time 1	0.1	3000.0	s	3.0	103	
P1.4	Decel Time 1	0.1	3000.0	s	3.0	104	
P1.5 ①	Motor Nom Current	DriveNomCurrCT*1/10	DriveNomCurrCT*2	A	DriveNomCurrCT	486	
P1.6 ①	Motor Nom Speed	300	24000	rpm	MotorNomSpeedMFG	489	
P1.7 ①	Motor PF	0.30	1.00		0.85	490	
P1.8 ①	Motor Nom Voltage	180	690	V	MotorNomVoltMFG	487	
P1.9 ①	Motor Nom Frequency	8.00	400.00	Hz	MotorNomFreqMFG	488	
P1.10	Power Up Local Remote Select				0	1685	0 = Hold Last 1 = Local Control 2 = Remote control
P1.11	Remote 1 Control Place				0	135	0 = I/O Terminal Start 1 1 = Fieldbus 2 = I/O Terminal Start 2 3 = Keypad
P1.12	Local Control Place				0	1695	0 = Keypad 1 = I/O Terminal Start 1 2 = I/O Terminal Start 2 3 = Fieldbus
P1.13	Bumpless Enable				0	2462	0 = Disabled 1 = Enabled
P1.14 ①②	Local Reference				6	136	0 = AI1 1 = AI2 2 = Slot A: AI1 3 = Slot B: AI1 4 = AI1 Joystick 5 = AI2 Joystick 6 = Keypad 7 = Fieldbus Ref 9 = Max Frequency 10 = AI1 + AI2 11 = AI1 - AI2 12 = AI2 - AI1 13 = AI1 * AI2 14 = AI1 or AI2 15 = MIN(AI1,AI2) 16 = MAX(AI1,AI2) 17 = PID1 Control Output
P1.15 ①②	Remote 1 Reference				0	137	See Par ID 136
P1.16 ①	Reverse Enable				1	1679	See Par ID 2462
P1.17	Run Delay Time	0	32500	s	0	2423	
P1.18 ①	HOA Source				0	2465	0 = Disabled 1 = IO Terminal 2 = Keypad
P1.19 ①	Minimum Run Time	0	32500	s	0	1813	
P1.20	Frequency reference upper limit	See Par ID 101	See Par ID 102	Hz	50.00	2840	
P1.21	Frequency reference upper limit source				0	2841	0 = Not Used 1 = Freq Ref Upper 2 = AI1 3 = AI2

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Analog input

Table 54. Basic setting—P2.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P2.1.1	AI Ref Scale Min Value	0.00	See Par ID 145	Hz	0.00	144	
P2.1.2	AI Ref Scale Max Value	See Par ID 144	400.00	Hz	0.00	145	

Table 55. AI1 settings—P2.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P2.2.1	AI1 Mode				1	222	0 = 0–20 mA 1 = 0–10 V
P2.2.2	AI1 Signal Range				0	175	0 = 0–100%/ 0–20 mA/0–10 V 1 = 20–100%/ 4–20 mA/2–10 V 2 = Customized
P2.2.3	AI1 Custom Min	0.00	See Par ID 177	%	0.00	176	
P2.2.4	AI1 Custom Max	See Par ID 176	100.00	%	100.00	177	
P2.2.5	AI1 Filter Time	0.00	10.00	s	0.10	174	
P2.2.6	AI1 Signal Invert				0	181	0 = Not Inverted 1 = Inverted
P2.2.7	AI1 Joystick Hyst	0.00	20.00	%	0.00	178	
P2.2.8	AI1 Sleep Limit	0.00	100.00	%	0.00	179	
P2.2.9	AI1 Sleep Delay	0.00	320.00	s	0.00	180	
P2.2.10	AI1 Joystick Offset	-50.00	50.00	%	0.00	133	

Table 56. AI2 settings—P2.3.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P2.3.1	AI2 Mode				0	223	0 = 0–20 mA 1 = 0–10 V 2 = –10 to +10 V
P2.3.2	AI2 Signal Range				1	183	0 = 0–100%/0–20 mA/ 0–10 V –10 to +10 V 1 = 20–100%/ 4–20 mA/2–10 V/–6 to 10 V 2 = Customized
P2.3.3	AI2 Custom Min	0.00	See Par ID 185	%	0.00	184	
P2.3.4	AI2 Custom Max	See Par ID 184	100.00	%	100.00	185	
P2.3.5	AI2 Filter Time	0.00	10.00	s	0.10	182	
P2.3.6	AI2 Signal Invert				0	189	See Par ID 181
P2.3.7	AI2 Joystick Hyst	0.00	20.00	%	0.00	186	
P2.3.8	AI2 Sleep Limit	0.00	100.00	%	0.00	187	
P2.3.9	AI2 Sleep Delay	0.00	320.00	s	0.00	188	
P2.3.10	AI2 Joystick Offset	-50.00	50.00	%	0.00	134	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 57. Fine adjust—P2.4.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P2.4.1 ①	Fine Tuning Input				0	2484	0 = Not Used 1 = AI1 2 = AI2 3 = Slot A: AI1 4 = Slot B: AI1 5 = Fieldbus
P2.4.2 ①	Fine Tuning Min	0.0	100.0	%	0.0	2485	
P2.4.3 ①	Fine Tuning Max	0.0	100.0	%	0.0	2486	

Table 58. Digital input—P3.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P3.1 ①	IO Terminal 1 Start Stop Logic				0	143	0 = Forward - Reverse 1 = Start - Reverse 2 = Start - Enable 3 = 3 Wire Control
P3.2 ② ⑤	IO Terminal 1 Start Signal 1				2	190	0 = DigIN:NormallyOpen 1 = DigIN:NormallyClose 2 = DigIN: 1 3 = DigIN: 2 4 = DigIN: 3 5 = DigIN: 4 6 = DigIN: 5 7 = DigIN: 6 8 = DigIN: 7 9 = DigIN: 8 10 = DigIN: A: IO1: 1 11 = DigIN: A: IO1: 2 12 = DigIN: A: IO1: 3 13 = DigIN: A: IO5: 1 14 = DigIN: A: IO5: 2 15 = DigIN: A: IO5: 3 16 = DigIN: A: IO5: 4 17 = DigIN: A: IO5: 5 18 = DigIN: A: IO5: 6 19 = DigIN: B: IO1: 1 20 = DigIN: B: IO1: 2 21 = DigIN: B: IO1: 3 22 = DigIN: B: IO5: 1 23 = DigIN: B: IO5: 2 24 = DigIN: B: IO5: 3 25 = DigIN: B: IO5: 4 26 = DigIN: B: IO5: 5 27 = DigIN: B: IO5: 6 28 = Time Channel 1 29 = Time Channel 2 30 = Time Channel 3 31 = RO1 Function 32 = RO2 Function 33 = RO3 Function 34 = Virtual RO1 Function 35 = Virtual RO2 Function
P3.3 ②⑤	IO Terminal 1 Start Signal 2				3	191	See Par ID 190
P3.4 ①	Thermistor Input Select				0	881	0 = Digital Input 1 = Thermistor Input
P3.5 ②③	Reverse				0	198	See Par ID 190
P3.6 ②③	Ext. Fault 1 NO				4	192	See Par ID 190
P3.7 ②③	Ext. Fault 1 NC				1	193	See Par ID 190
P3.8 ②④	Fault Reset				5	200	See Par ID 190
P3.9 ②③	Run Enable				1	194	See Par ID 190
P3.10 ②③	Preset Speed B0				6	205	See Par ID 190

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 58. Digital input—P3, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P3.11 ②③	Preset Speed B1				7	206	See Par ID 190
P3.12 ②③	Preset Speed B2				0	207	See Par ID 190
P3.13 ②③	PID1 Control Enable				1	550	See Par ID 190
P3.15 ②③	Accel/Decel Time Set				0	195	See Par ID 190
P3.16 ②③	Accel/Decel Prohibit				0	201	See Par ID 190
P3.17 ②④	No Access To Param				0	215	See Par ID 190
P3.21 ②③	Remote Control				9	196	See Par ID 190
P3.22 ②③	Local Control				0	197	See Par ID 190
P3.23 ②③	Remote 1/2 Select				0	209	See Par ID 190
P3.24 ②③	Second Motor Para Select				0	217	See Par ID 190
P3.25 ②③	Force Bypass				0	218	See Par ID 190
P3.26 ②③	DC Brake Active				0	202	See Par ID 190
P3.27 ②③	Smoke Mode				0	219	See Par ID 190
P3.28 ②③	Fire Mode				0	220	See Par ID 190
P3.29 ②③	Fire Mode Ref 1/2 Select				0	221	See Par ID 190
P3.30 ②③	PID1 Set Point Select				0	351	See Par ID 190
P3.32 ②③	Jog Enable				0	199	See Par ID 190
P3.33 ③	Start Timer 1				0	224	See Par ID 190
P3.34 ③	Start Timer 2				0	225	See Par ID 190
P3.35 ③	Start Timer 3				0	226	See Par ID 190
P3.36 ②③	AI Ref Source Select				0	208	See Par ID 190
P3.37 ②③	Motor Interlock 1				0	210	See Par ID 190
P3.38 ②③	Motor Interlock 2				0	211	See Par ID 190
P3.39 ②③	Motor Interlock 3				0	212	See Par ID 190
P3.40 ②③	Motor Interlock 4				0	213	See Par ID 190
P3.41 ②③	Motor Interlock 5				0	214	See Par ID 190
P3.42 ②③	Ext Fault-AR				1	747	See Par ID 190
P3.43 ②③	Bypass Overload				0	1246	See Par ID 190
P3.44 ②③	Fire Mode Direction Invert				0	2119	See Par ID 190
P3.45 ①	IO Terminal 2 Start Stop Logic				0	2206	See Par ID 143
P3.46 ②⑤	IO Terminal 2 Start Signal 1				2	2207	See Par ID 190
P3.47 ②⑤	IO Terminal 2 Start Signal 2				3	2208	See Par ID 190
P3.48 ②③	Ext. Fault 2 NO				0	2293	See Par ID 190
P3.49 ②③	Ext. Fault 2 NC				1	2294	See Par ID 190
P3.50 ②③	Ext. Fault 3 NO				0	2295	See Par ID 190
P3.51 ②③	Ext. Fault 3 NC				1	2296	See Par ID 190

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 58. Digital input—P3, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P3.52	Ext. Fault 1 Text					2297	0 = External Fault 1 = Vibration Cut out 2 = High Motor temp 3 = Low Pressure 4 = High Pressure 5 = Low Water 6 = Damper Interlock 7 = Run Enable 8 = Freeze Stat Trip 9 = Smoke Detect 10 = Seal Leakage 11 = Rod Breakage 12 = Torque Limit
P3.53	Ext. Fault 2 Text				1	2298	See Par ID 2297
P3.54	Ext. Fault 3 Text				2	2299	See Par ID 2297
P3.55 ②④	Parameter Set1/2 Sel				0	2312	See Par ID 190
P3.56 ②③	Deragging Enable				0	2394	See Par ID 190
P3.57 ②③	HOA On/Off				1	2395	See Par ID 190
P3.58 ③	Multi-pump Mode 1/2 Select				0	2658	See Par ID 190
P3.59 ②③	OP Cont Interlock NO				4	2801	See Par ID 190
P3.60 ②③	OP Cont Interlock NC				1	2802	See Par ID 190
P3.61 ③	CP Interlock NC				1	2894	See Par ID 190

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 59. Analog output—P4.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P4.1	AO1 Mode				0	227	See Par ID 222
P4.2 ②	AO1 Function				1	146	0 = Not Used 1 = Output Frequency 2 = Freq Reference 3 = Motor Speed 4 = Motor Current 5 = Motor Torque (0-Nom) 6 = Motor Power 7 = Motor Voltage 8 = DC-Bus Voltage 9 = PID1 Setpoint 10 = PID1 Feedback 1 11 = PID1 Feedback 2 12 = PID1 Control Error Value 13 = PID1 Control Output 19 = AI1 20 = AI2 21 = Output Freq (-2-+2N) 22 = Motor Torque (-2-+2N) 23 = Motor Power (-2-+2N) 24 = PT100 Temperature 25 = FB Process Data Input 1 26 = FB Process Data Input 2 27 = FB Process Data Input 3 28 = FB Process Data Input 4 29 = FB Process Data Input 5 30 = FB Process Data Input 6 31 = FB Process Data Input 7 32 = FB Process Data Input 8 33 = SlotA PT100 Temp Channel 1 34 = SlotA PT100 Temp Channel 2 35 = SlotA PT100 Temp Channel 3 36 = SlotB PT100 Temp Channel 1 37 = SlotB PT100 Temp Channel 2 38 = SlotB PT100 Temp Channel 3 39 = User Defined Output 40 = Motor Current (-2-+2N)
P4.3	AO1 Minimum				1	149	0 = 0 V / 0 mA 1 = 2 V / 4 mA
P4.4	AO1 Filter Time	0.00	10.00	s	1.00	147	
P4.5	AO1 Scale	10	1000	%	100	150	
P4.6	AO1 Inversion				0	148	See Par ID 181
P4.7	AO1 Offset	-100.00	100.00	%	0.00	173	
P4.8	AO2 Mode				0	228	See Par ID 222
P4.9 ②	AO2 Function				4	229	See Par ID 146
P4.10	AO2 Minimum				1	232	See Par ID 149
P4.11	AO2 Filter Time	0.00	10.00	s	1.00	230	
P4.12	AO2 Scale	10	1000	%	100	233	
P4.13	AO2 Inversion				0	231	See Par ID 181
P4.14	AO2 Offset	-100.00	100.00	%	0.00	234	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 60. Digital output—P5.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P5.1 ②	DO1 Function				1	151	0 = Not Used 1 = Ready 2 = Run 3 = Fault 4 = Fault Invert 5 = Warning 6 = Reversed 7 = At Speed 8 = Zero Frequency 9 = Freq Limit 1 Superv 10 = Freq Limit 2 Superv 11 = PID1 Superv 13 = OverHeat Fault 14 = OCurrent Fault 15 = OVolt Fault 16 = UVolt Fault Resp 17 = 4mA Ref Fault/Warning 20 = Torq Limit Superv 21 = Ref Limit Superv 22 = Control from I/O 23 = Un-Requested Rotation Direction 24 = Thermistor Fault Output 25 = Fire Mode 26 = In Bypass Mode 27 = Ext Fault/Warning 28 = Remote Control 29 = Jog Speed Select 30 = Motor Therm Protection 31 = FB Digital Input 1 32 = FB Digital Input 2 33 = FB Digital Input 3 34 = FB Digital Input 4

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 60. Digital output—P5, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P5.1 ②, continued	DO1 Function				1	151	35 = Damper Control 36 = TC1 Status 37 = TC2 Status 38 = TC3 Status 39 = In E-Stop 40 = Power Limit Superv 41 = Temp Limit Superv 42 = Analog Input Superv 43 = Motor 1 Control 44 = Motor 2 Control 45 = Motor 3 Control 46 = Motor 4 Control 47 = Motor 5 Control 49 = PID1 Sleep 51 = Motor Current 1 Supv 52 = Motor Current 2 Supv 53 = Second AI Limit Supv 54 = DC Charge Switch Close 55 = Preheat Active 56 = Cold Weather Active 57 = Prime Pump Active 58 = 2nd Stage Ramp Frequency Active 59 = STO Fault Output 60 = Run Bypass/Drive 61 = Bypass Overload 62 = Bypass Run 63 = Auto Local On COM Fault 64 = FieldBus RTU Fault 65 = FieldBus TCP Fault 66 = FieldBus MSTP Fault 67 = FieldBus EIP Fault 68 = FieldBus SlotA Fault 69 = Fieldbus SlotB Fault 70 = FieldBus SWD Fault 71 = Jockey Pump Active 72 = Lube Pump Active 73 = PID1 Low Feedback 74 = PID1 High Feedback 77 = Master in MPFC 78 = CP Interlock Fault
P5.2 ②	RO1 Function				2	152	See Par ID 151
P5.3 ②	RO2 Function				3	153	See Par ID 151
P5.4 ②	RO3 Function				7	538	See Par ID 151
P5.5 ②	Virtual RO1 Function				0	2463	See Par ID 151
P5.6 ②	Virtual RO2 Function				0	2464	See Par ID 151
P5.7 ②	Freq Limit 1 Supv				0	154	0 = No Limit 1 = Low Limit Superv 2 = High Limit Superv
P5.8	Freq Limit 1 Supv Val	0.00	See Par ID 102	Hz	0.00	155	
P5.9 ②	Freq Limit 2 Supv				0	157	0 = No Limit 1 = Low Limit Superv 2 = High Limit Superv
P5.10	Freq Limit 2 Supv Val	0.00	See Par ID 102	Hz	0.00	158	
P5.11 ②	Torque Limit Supv				0	159	0 = No Limit 1 = Low Limit Superv 2 = High Limit Superv
P5.12 ②	Torque Limit Supv Val	-1000.0	1000.0	%	100.0	160	
P5.13	Ref Limit Supv				0	161	0 = No Limit 1 = Low Limit Superv 2 = High Limit Superv
P5.14	Ref Limit Supv Val	0.00	See Par ID 102	Hz	0.00	162	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 60. Digital output—P5, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P5.17	Temp Limit Supv				0	165	See Par ID 161
P5.18	Temp Limit Supv Val	-10.0	75.0	Deg. C	40.0	166	
P5.19	Power Limit Supv				0	167	See Par ID 161
P5.20	Power Limit Supv Val	-200.0	200.0	%	0.0	168	
P5.21	AI Supv Select				0	170	0 = AI1 1 = AI2
P5.22	AI Limit Supv				0	171	See Par ID 161
P5.23	AI Limit Supv Val	0.00	100.00	%	0.00	172	
P5.24	PID1 Superv Enable				0	1346	See Par ID 2462
P5.25	PID1 Superv Upper Limit	See Par ID 1298	See Par ID 1300	Varies	0.00	1347	
P5.26	PID1 Superv Lower Limit	See Par ID 1298	See Par ID 1300	Varies	0.00	1349	
P5.27	PID1 Superv Delay	0	3000	s	0	1351	
P5.32	RO1 On Delay	0.0	320.0	s	0.0	2112	
P5.33	RO1 Off Delay	0.0	320.0	s	0.0	2113	
P5.34	RO2 On Delay	0.0	320.0	s	0.0	2114	
P5.35	RO2 Off Delay	0.0	320.0	s	0.0	2115	
P5.36	RO3 On Delay	0.0	320.0	s	0.0	2116	
P5.37	RO3 Off Delay	0.0	320.0	s	0.0	2117	
P5.38	RO3 Reverse				0	2118	0 = No 1 = Yes
P5.39 ②	Motor Current 1 Supv				0	2189	See Par ID 159
P5.40	Motor Current 1 Supv Value	0.0	DriveNomCurrCT*2	A	DriveNomCurrCT	2190	
P5.41 ②	Motor Current 2 Supv				0	2191	See Par ID 159
P5.42	Motor Current 2 Supv Value	0.0	DriveNomCurrCT*2	A	DriveNomCurrCT	2192	
P5.43	Second AI Supv Select				0	2193	See Par ID 170
P5.44	Second AI Limit Supv				0	2194	See Par ID 161
P5.45	Second AI Limit Supv Val	0.00	100.00	%	0.00	2195	
P5.46	Motor Current 1 Supv Hyst	0.1	1.0	A	0.1	2196	
P5.47	Motor Current 2 Supv Hyst	0.1	1.0	A	0.1	2197	
P5.48	AI Supv Hyst	1.00	10.00	%	1.00	2198	
P5.49	Second AI Supv Hyst	1.00	10.00	%	1.00	2199	
P5.50	Freq Limit 1 Supv Hyst	0.10	1.00	Hz	0.10	2200	
P5.51	Freq Limit 2 Supv Hyst	0.10	1.00	Hz	0.10	2201	
P5.52	Torque Limit Supv Hyst	1.0	5.0	%	1.0	2202	
P5.53	Ref Limit Supv Hyst	0.10	1.00	Hz	0.10	2203	
P5.54	Temp Limit Supv Hyst	1.0	10.0	Deg. C	1.0	2204	
P5.55	Power Limit Supv Hyst	0.1	10.0	%	0.1	2205	
P5.56	Virtual RO1 On Delay	0.0	320.0	s	0.0	2848	
P5.57	Virtual RO1 Off Delay	0.0	320.0	s	0.0	2849	
P5.58	Virtual RO2 On Delay	0.0	320.0	s	0.0	2850	
P5.59	Virtual RO2 Off Delay	0.0	320.0	s	0.0	2851	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 61. Drive control—P7.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P7.1	Remote 2 Control Place				1	138	See Par ID 135
P7.2 ①②	Remote 2 Reference				7	139	See Par ID 136
P7.3	Keypad Reference	See Par ID 101	See Par ID 102	Hz	0.00	141	
P7.4	Keypad Direction				0	116	0 = Forward 1 = Reverse
P7.5	Keypad Stop				1	114	0 = Enabled-Keypad Operation 1 = Always Enabled
P7.6	Jog Reference	0.00	See Par ID 102	Hz	5.00	117	
P7.9	Start Mode				0	252	0 = Ramp 1 = Flying Start From Stop Frequency 2 = Flying Start From Max Frequency
P7.10	Stop Mode					2531	0 = Coasting 1 = Ramp
P7.11	Ramp 1 Shape	0.0	10.0	s	0.0	247	
P7.12	Ramp 2 Shape	0.0	10.0	s	0.0	248	
P7.13	Accel Time 2	0.1	3000.0	s	10.0	249	
P7.14	Decel Time 2	0.1	3000.0	s	10.0	250	
P7.15	Skip F1 Low Limit	0.00	See Par ID 257	Hz	0.00	256	
P7.16	Skip F1 High Limit	See Par ID 256	400.00	Hz	0.00	257	
P7.17	Skip F2 Low Limit	0.00	See Par ID 259	Hz	0.00	258	
P7.18	Skip F2 High Limit	See Par ID 258	400.00	Hz	0.00	259	
P7.19	Skip F3 Low Limit	0.00	See Par ID 261	Hz	0.00	260	
P7.20	Skip F3 High Limit	See Par ID 260	400.00	Hz	0.00	261	
P7.21	Skip Range Ramp Factor	0.1	10.0		1.0	264	
P7.22	Power Loss Function				0	267	0 = Disabled 1 = Decel Mode 2 = Coast Mode
P7.23	Power Loss Time	0.3	5.0	s	2.0	268	
P7.24	Currency				0	2122	0 = $ 1 = £ 2 = € 3 = ¥ 4 = Rs 5 = R$ 6 = Fr 7 = kr
P7.25	Energy Cost			Varies	0.00	2123	
P7.26	Data Type				0	2124	0 = Cumulative 1 = Daily Avg 2 = Weekly Avg 3 = Monthly Avg 4 = Yearly Avg
P7.27	Energy Savings Reset					2125	0 = Not Reset 1 = Reset
P7.28①	2nd Stage Ramp Frequency	See Par ID 101	See Par ID 102	Hz	30.00	2444	
P7.29	Change PhaseSequence Motor				0	2515	0 = Change Disable 1 = Change Enable
P7.30	Run Remove Stop Mode				0	2667	See Par ID 253

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 62. Motor Control—P8.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P8.1 ①②	Motor Control Mode				0	287	0 = Freq Control 1 = Speed Control
P8.2 ①	Current Limit	DriveNomCurrCT*1/10	DriveNomCurrCT*2	A	DriveNomCurrVT	107	
P8.3 ①	V/Hz Optimization				0	109	See Par ID 2462
P8.4 ①	V/Hz Ratio				0	108	0 = Linear 1 = Squared 2 = Programmable 3 = Linear + Flux Optimization
P8.5 ①	Field Weakening Point	8.00	400.00	Hz	FieldWeakPointMFG	289	
P8.6 ①	Voltage at FWP	10.00	200.00	%	100.00	290	
P8.7 ①	V/Hz Mid Frequency	0.00	See Par ID 289	Hz	VHzCurveMidFreqMFG	291	
P8.8 ①	V/Hz Mid Voltage	0.00	100.00	%	100.00	292	
P8.9 ①	Zero Frequency Voltage	0.00	40.00	%	0.00	293	
P8.10	Switching Frequency	MinSwitchFreq	MaxSwitchFreq	kHz	DefaultSwitchFreqCT	2522	
P8.11	Sine Filter Enable				0	1665	See Par ID 2462
P8.12 ①	OverVoltage Control				3	297	0 = Disabled 1 = REF + 8Hz 2 = Max Freq 3 = Max Freq + 8Hz
P8.14 ②	Identification				0	299	0 = No Action 1 = Identification Only Stator Resistor
P8.17	Frequency Ramp Out FilterTime Constant	0	3000	ms	0	1585	
P8.50 ①	Stator Resistor	0.001	65.535	ohm	0.001	771	
P8.59	V/F Stable Kd	0	3000	%	100	1656	
P8.60	V/F Stable Kq	0	3000	%	100	1657	
P8.61 ①	Overmodulation Enable				0	2835	See Par ID 2462
P8.71	Slip Compensation Coefficient	0	500	%	100	1664	

Table 63. Protections—P9.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P9.1 ①	4mA Input Fault				0	306	0 = No Action 1 = Warning 2 = Warning: Previous Freq 3 = Warning: Preset Freq 4 = Fault 5 = Fault, Coast
P9.2 ①	4mA Fault Frequency	0.00	See Par ID 102	Hz	0.00	331	
P9.3 ①	External Fault				2	307	0 = No Action 1 = Warning 2 = Fault 3 = Fault, Coast
P9.4 ①	Input Phase Fault				2	332	0 = No Action 1 = Warning 2 = Fault 3 = Fault, Coast 4 = Single Phase Power Limit
P9.5 ①	Uvolt Fault Response				2	330	See Par ID 307
P9.6 ①	Output Phase Fault				2	308	See Par ID 307
P9.7 ①	Ground Fault				2	309	See Par ID 307
P9.8 ①	Motor Thermal Protection				2	310	See Par ID 307

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 63. Protections—P9, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P9.9	Motor Thermal F0 Current	0.0	150.0	%	100.0	311	
P9.11 ①	Stall Protection				0	313	See Par ID 307
P9.12	Stall Current Limit	0.1	ActiveMotor NomCurr*2	A	ActiveMotor NomCurr*13/10	314	
P9.13	Stall Time Limit	1.0	120.0	s	15.0	315	
P9.14	Stall Frequency Limit	1.00	See Par ID 102	Hz	25.00	316	
P9.15 ①	Underload Protection				0	317	See Par ID 307
P9.16	Underload Fnom Torque	10.0	150.0	%	50.0	318	
P9.17	Underload F0 Torque	5.0	150.0	%	10.0	319	
P9.18	Underload Time Limit	2.00	600.00	s	20.00	320	
P9.19 ①	Thermistor Fault Response				2	333	See Par ID 307
P9.20	Line Start Lockout				2	750	0 = Disabled, No Change 1 = Enable, No Change 2 = Disabled, Changed 3 = Enable, Changed
P9.21 ①	Fieldbus Fault Response				2	334	0 = No Action 1 = Warning 2 = Fault 3 = Fault, Coast 4 = Warning, Coast 5 = Warning, Auto Switch To Local 6 = Warning, Auto Switch To Preset Speed 1
P9.22 ①	OPTCard Fault Response				2	335	See Par ID 307
P9.23 ①	Unit Under Temp Prot				2	1564	See Par ID 307
P9.24	AR Wait Time	1.00	300.00	s	1.00	321	
P9.25	AR Trail Time	0.00	600.00	s	30.00	322	
P9.26	AR Start Function				0	323	0 = Flying Start From Stop Frequency 1 = Ramp 2 = Flying Start From Max Frequency
P9.27	Undervoltage Attempts	0	10		1	324	
P9.28	OverVoltage Attempts	0	10		1	325	
P9.29	OverCurrent Attempts	0	3		1	326	
P9.30	4mA Fault Attempts	0	10		1	327	
P9.31	Motor Temp Fault Attempts	0	10		1	329	
P9.32	External Fault Attempts	0	10		1	328	
P9.33	Underload Attempts	0	10		1	336	
P9.34 ①	RTC Fault				1	955	See Par ID 307
P9.35 ①	PT100 Fault Response				2	337	See Par ID 307
P9.36 ①	Replace Battery Fault Response				1	1256	See Par ID 307
P9.37 ①	Replace Fan Fault Response				1	1257	See Par ID 307
P9.38 ①	IP Address Confliction Resp				1	1678	See Par ID 307
P9.39	Cold Weather Mode				0	2126	See Par ID 2462

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 63. Protections—P9, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P9.40	Cold Weather Volt. Level	0.0	20.0	%	2.0	2127	
P9.41	Cold Weather Time Out	0	10	min	3	2128	
P9.42	Cold Weather Password					2129	
P9.43	Under Temp Fault Override					2130	See Par ID 2118
P9.44	Ground Fault Limit	0	30	%	15	2158	
P9.45 ①	Keypad Comm Fault Response				2	2157	See Par ID 307
P9.46	Preheat Mode				0	2159	See Par ID 2462
P9.47 ②	Preheat Control Source				31	2160	0 = DigIN:NormallyOpen 1 = DigIN:NormallyClose 2 = DigIN: 1 3 = DigIN: 2 4 = DigIN: 3 5 = DigIN: 4 6 = DigIN: 5 7 = DigIN: 6 8 = DigIN: 7 9 = DigIN: 8 10 = DigIN: A: IO1: 1 11 = DigIN: A: IO1: 2 12 = DigIN: A: IO1: 3 13 = DigIN: A: IO5: 1 14 = DigIN: A: IO5: 2 15 = DigIN: A: IO5: 3 16 = DigIN: A: IO5: 4 17 = DigIN: A: IO5: 5 18 = DigIN: A: IO5: 6 19 = DigIN: B: IO1: 1 20 = DigIN: B: IO1: 2 21 = DigIN: B: IO1: 3 22 = DigIN: B: IO5: 1 23 = DigIN: B: IO5: 2 24 = DigIN: B: IO5: 3 25 = DigIN: B: IO5: 4 26 = DigIN: B: IO5: 5 27 = DigIN: B: IO5: 6 28 = Time Channel 1 29 = Time Channel 2 30 = Time Channel 3 31 = Drive Temperature 32 = SlotA PT100 Temp Channel 1 33 = SlotA PT100 Temp Channel 2 34 = SlotA PT100 Temp Channel 3 35 = SlotA Max PT100 Temp 36 = SlotB PT100 Temp Channel 1 37 = SlotB PT100 Temp Channel 2 38 = SlotB PT100 Temp Channel 3 39 = SlotB Max PT100 Temp 40 = SlotA and SlotB Max PT100 Temp
P9.48	Preheat Enter Temp	-20.0	20.0	Deg. C	10.0	2161	
P9.49	Preheat Quit Temp	-10.0	40.0	Deg. C	20.0	2162	
P9.50	Preheat Output Volt	0.0	20.0	%	2.0	2163	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 63. Protections—P9, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P9.51 ①	PID Feedback AI Loss Response				0	2401	0 = No Action 1 = Warning 2 = Fault 3 = Warning: Preset Freq 4 = Warning: Analog->Net
P9.52 ②	PID Feedback AI Loss Pre Freq	0.00	400.00	Hz	0.00	2402	
P9.53	PID Feedback AI Loss Pipe Fill Loss Level	0.0	1000.0	Varies	0.0	2403	
P9.54	PID Feedback AI Loss PreFreq Timeout	0	6000	s	0	2404	
P9.55	PID Feedback AI Loss Attempts	0	10		1	2405	
P9.56	STO Fault Response				2	2427	0 = No Action 1 = Warning 2 = Fault
P9.57	Fault Reset Start				0	2483	0 = Follow Run Command 1 = Rising Edge After Fault Reset
P9.58	Warning Operation Mode				1	2657	0 = No Action 1 = Warning, No Store 2 = Warning, Store
P9.59	Fan Protection				2	2664	See Par ID 307
P9.60	Under Voltage Trip Level	DCLinkUnderVolt StopLimit	DCLinkOverVolt StopLimit	V	DCLinkUnderVolt ProtectLimit	2666	
P9.61	OP Cont Interlock Attempts	0	10		1	2803	
P9.62 ①	OP Cont Interlock Protection				2	2831	See Par ID 307
P9.63 ①	CP Interlock Run Protection				2	2895	See Par ID 307
P9.64 ①	CP Interlock Stop Protection				1	2896	0 = No Action 1 = Warning, No Store
P9.65	CP Interlock Attempts	0	10		1	2897	

Table 64. PID Controller 1—P10.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P10.1	PID1 Control Gain	0.00	200.00	%	100.00	1294	
P10.2	PID1 Control ITime	0.00	600.00	s	1.00	1295	
P10.3	PID1 Control DTime	0.00	100.00	s	0.00	1296	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 64. PID controller 1—P10, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P10.4 ①	PID1 Process Unit				0	1297	0 = % 1 = 1/min 2 = rpm 3 = ppm 4 = pps 5 = l/s 6 = l/min 7 = l/h 8 = kg/s 9 = kg/min 10 = kg/h 11 = m3/s 12 = m3/min 13 = m3/h 14 = m/s 15 = mbar 16 = bar 17 = Pa 18 = kPa 19 = mVS 20 = kW 21 = Deg. C 22 = GPM 23 = gal/s 24 = gal/min 25 = gal/h 26 = lb/s 27 = lb/min 28 = lb/h 29 = CFM 30 = ft3/s 31 = ft3/min 32 = ft3/h 33 = ft/s 34 = in wg 35 = ft wg 36 = PSI 37 = lb/in2 38 = HP 39 = Deg. F 40 = PA 41 = WC 42 = HG 43 = ft 44 = m
P10.5	PID1 Process Unit Min	-99999.99	See Par ID 1300	Varies	0.00	1298	
P10.6	PID1 Process Unit Max	See Par ID 1298	99999.99	Varies	100.00	1300	
P10.7	PID1 Process Unit Decimal	0	4		2	1302	
P10.8 ①	PID1 Error Inversion				0	1303	See Par ID 181
P10.9	PID1 Dead Band	0.00	99999.99	Varies	0.00	1304	
P10.10	PID1 Dead Band Delay	0.00	320.00	s	0.00	1306	
P10.11	PID1 Keypad Set Point 1	See Par ID 1298	See Par ID 1300	Varies	0.00	1307	
P10.12	PID1 Keypad Set Point 2	See Par ID 1298	See Par ID 1300	Varies	0.00	1309	
P10.13	PID1 Ramp Time	0.00	300.00	s	0.00	1311	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 64. PID controller 1—P10, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P10.14 ①②	PID1 Set Point 1 Source				1	1312	0 = Not Used 1 = PID1 Keypad Set Point 1 2 = PID1 Keypad Set Point 2 3 = AI1 4 = AI2 5 = Slot A: AI1 6 = Slot B: AI1 7 = FB Process Data Input 1 8 = FB Process Data Input 2 9 = FB Process Data Input 3 10 = FB Process Data Input 4 11 = FB Process Data Input 5 12 = FB Process Data Input 6 13 = FB Process Data Input 7 14 = FB Process Data Input 8 16 = Multi Drive Network 17 = FB PID1 Set Point 1 18 = FB PID1 Set Point 2
P10.15	PID1 Set Point 1 Min	-200.00	200.00	%	0.00	1313	
P10.16	PID1 Set Point 1 Max	-200.00	200.00	%	100.00	1314	
P10.17 ①	PID1 Set Point 1 Sleep Enable				0	1315	See Par ID 2462
P10.18 ①	PID1 Set Point 1 Sleep Unit Sel				0	2396	0 = Output Frequency 1 = Motor Speed 2 = Motor Current 3 = PID1 Feedback
P10.19	PID1 Set Point 1 Sleep Level			Varies	0.00	2450	
P10.20	PID1 Set Point 1 Sleep Delay	0	3000	s	0	1317	
P10.21	PID1 Set Point 1 Wake Up Level	-99999.99	99999.99	Varies	0.00	1318	
P10.22	PID1 Set Point 1 Boost	-2.0	2.0		1.0	1320	
P10.23 ①②	PID1 Set Point 2 Source				2	1321	See Par ID 1312
P10.24	PID1 Set Point 2 Min	-200.00	200.00	%	0.00	1322	
P10.25	PID1 Set Point 2 Max	-200.00	200.00	%	100.00	1323	
P10.26 ①	PID1 Set Point 2 Sleep Enable				0	1324	See Par ID 2462
P10.27 ①	PID1 Set Point 2 Sleep Unit Sel				0	2397	See Par ID 2396
P10.28	PID1 Set Point 2 Sleep Level			Varies	0.00	2452	
P10.29	PID1 Set Point 2 Sleep Delay	0	3000	s	0	1326	
P10.30	PID1 Set Point 2 Wake Up Level	-99999.99	99999.99	Varies	0.00	1327	
P10.31	PID1 Set Point 2 Boost	-2.0	2.0		1.0	1329	
P10.32 ①	PID1 Feedback Function				0	1330	0 = Source 1 1 = SQRT(Source 1) 2 = SQRT(Source 1 - Source 2) 3 = SQRT(Source 1) + SQRT(Source 2) 4 = Source 1 + Source 2 5 = Source 1 - Source 2 6 = MIN(Source 1,Source 2) 7 = MAX(Source 1,Source 2) 8 = MEAN(Source1,Source2) 9 = Source1*Source2
P10.33	PID1 Feedback Gain	-1000.0	1000.0	%	100.0	1331	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 64. PID controller 1—P10, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P10.34 ①②	PID1 Feedback 1 Source				2	1332	0 = Not Used 1 = AI1 2 = AI2 3 = Slot A: AI1 4 = Slot B: AI1 5 = FB Process Data Input 1 6 = FB Process Data Input 2 7 = FB Process Data Input 3 8 = FB Process Data Input 4 9 = FB Process Data Input 5 10 = FB Process Data Input 6 11 = FB Process Data Input 7 12 = FB Process Data Input 8 13 = PT100 Temperture 15 = SlotA PT100 Temp Channel 1 16 = SlotA PT100 Temp Channel 2 17 = SlotA PT100 Temp Channel 3 18 = SlotB PT100 Temp Channel 1 19 = SlotB PT100 Temp Channel 2 20 = SlotB PT100 Temp Channel 3 21 = FB PID1 Feedback 1 22 = FB PID1 Feedback 2
P10.35	PID1 Feedback 1 Min	-200.00	200.00	%	0.00	1333	
P10.36	PID1 Feedback 1 Max	-200.00	200.00	%	100.00	1334	
P10.37 ①②	PID1 Feedback 2 Source				0	1335	See Par ID 1332
P10.38	PID1 Feedback 2 Min	-200.00	200.00	%	0.00	1336	
P10.39	PID1 Feedback 2 Max	-200.00	200.00	%	100.00	1337	
P10.40 ①	PID1 Feedforward Func				0	1338	See Par ID 1330
P10.41	PID1 Feedforward Gain	-1000.0	1000.0	%	100.0	1339	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 64. PID controller 1—P10, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P10.42 ①②	PID1 Feedforward 1 Source				0	1340	0 = Not Used 1 = AI1 2 = AI2 3 = Slot A: AI1 4 = Slot B: AI1 5 = FB Process Data Input 1 6 = FB Process Data Input 2 7 = FB Process Data Input 3 8 = FB Process Data Input 4 9 = FB Process Data Input 5 10 = FB Process Data Input 6 11 = FB Process Data Input 7 12 = FB Process Data Input 8 13 = PT100 Temperture 15 = SlotA PT100 Temp Channel 1 16 = SlotA PT100 Temp Channel 2 17 = SlotA PT100 Temp Channel 3 18 = SlotB PT100 Temp Channel 1 19 = SlotB PT100 Temp Channel 2 20 = SlotB PT100 Temp Channel 3 21 = FB PID1 Feedforward 1 22 = FB PID1 Feedforward 2
P10.43	PID1 Feedforward 1 Min	-200.00	200.00	%	0.00	1341	
P10.44	PID1 Feedforward 1 Max	-200.00	200.00	%	100.00	1342	
P10.45 ①②	PID1 Feedforward 2 Source				0	1343	See Par ID 1340
P10.46	PID1 Feedforward 2 Min	-200.00	200.00	%	0.00	1344	
P10.47	PID1 Feedforward 2 Max	-200.00	200.00	%	100.00	1345	
P10.48	PID1 Set Point 1 Comp Enable				0	1352	See Par ID 2462
P10.49	PID1 Set Point 1 Comp Max	-200.00	200.00	%	0.00	1353	
P10.50	PID1 Set Point 2 Comp Enable				0	1354	See Par ID 2462
P10.51	PID1 Set Point 2 Comp Max	-200.00	200.00	%	0.00	1355	
P10.52	PID1 Wake Up Action				0	2466	0 = Below Wake Up Level 1 = Above Wake Up Level 2 = Below Wake Up Level (PID ref.) 3 = Above Wake Up Level (PID ref.)
P10.53	FB PID1 Set Point 1	See Par ID 1298	See Par ID 1300	Varies		2542	
P10.54	FB PID1 Set Point 2	See Par ID 1298	See Par ID 1300	Varies		2544	
P10.55	FB PID1 Feedback 1			%		2550	
P10.56	FB PID1 Feedback 2			%		2551	
P10.57	FB PID1 Feedforward 1			%		2554	
P10.58	FB PID1 Feedforward 2			%		2555	
P10.59	PID1 Sleep Boost level	-9999	9999	Varies	0	2660	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 64. PID controller 1—P10, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P10.60	PID1 Sleep Boost Max Time	1	300	s	30	2661	
P10.61	PID1 Low Feedback Level	0.0	6000.0	Varies	0.0	2811	
P10.62	PID1 Low Feedback Time	0	3600	s	10	2812	
P10.63 ①	PID1 Low Feedback Protection				0	2813	See Par ID 307
P10.64	PID1 High Feedback Level	0.0	6000.0	Varies	150.0	2814	
P10.65	PID1 High Feedback Time	0	3600	s	5	2815	
P10.66 ①	PID1 High Feedback Protection				0	2816	See Par ID 307
P10.67 ①	PID1 Hysteresis Level	0.0	100.0	Varies	0.0	2817	
P10.68	PID1 Backup Feedback Source				0	2825	0 = Not Used 1 = AI1 2 = AI2 3 = Slot A: AI1 4 = Slot B: AI1

Table 65. Preset speed—P12.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P12.1	Preset Speed 1	0.00	See Par ID 102	Hz	5.00	105	
P12.2	Preset Speed 2	0.00	See Par ID 102	Hz	10.00	106	
P12.3	Preset Speed 3	0.00	See Par ID 102	Hz	15.00	118	
P12.4	Preset Speed 4	0.00	See Par ID 102	Hz	20.00	119	
P12.5	Preset Speed 5	0.00	See Par ID 102	Hz	25.00	120	
P12.6	Preset Speed 6	0.00	See Par ID 102	Hz	30.00	121	
P12.7	Preset Speed 7	0.00	See Par ID 102	Hz	35.00	122	

Table 66. Brake—P14.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P14.1 ①	DC-Brake Current	Drive NomCurrCT*15/100	Drive NomCurrCT*15/10	A	DriveNomCurrCT*1/2	254	
P14.2 ①	Start DC-Brake Time	0.00	600.00	s	0.00	263	
P14.3 ①	Stop DC-Brake Frequency	0.10	10.00	Hz	1.50	262	
P14.4 ①	Stop DC-Brake Time	0.00	600.00	s	0.00	255	
P14.5 ①	Brake Chopper Mode				0	251	0 = Disabled 1 = B(Run) T(Rdy) 2 = External 3 = B(Rdy) T(Rdy) 4 = B(Run) T(No)
P14.6 ①	Flux Brake				0	266	0 = Off 1 = On
P14.7 ①	Flux Brake Current	ActiveMotor NomCurr*1/10	See Par ID 107	A	ActiveMotorNomCurr*1/2	265	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 67. Fire mode—P15.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P15.1 ①	Fire Mode Function				0	535	0 = Closing Contact 1 = Opening Contact
P15.2 ①②	Fire Mode Ref Select Function				0	536	0 = Fire Mode Min Frequency 1 = Fire Mode Ref 2 = Fieldbus Ref 3 = AI1 4 = AI2 5 = AI1 + AI2 6 = PID1 Control Output
P15.3	Fire Mode Frequency	See Par ID 101	See Par ID 102	Hz	MotorNomFreqMFG	537	
P15.4	Fire Mode % Speed Ref 1	0.0	100.0	%	75.0	565	
P15.5	Fire Mode % Speed Ref 2	0.0	100.0	%	100.0	564	
P15.6 ①	Smoke Purge Frequency	0.0	100.0	%	50.0	554	
P15.7	Fire Mode Test Enable					2443	See Par ID 2462

Table 68. Second motor parameter—P16.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P16.1 ①	Motor Nom Current 2	DriveNomCurrCT*1/10	DriveNomCurrCT*2	A	DriveNomCurrCT	577	
P16.2 ①	Motor Nom Speed 2	300	20000	rpm	SecdMotorNomSpeedMFG	578	
P16.3 ①	Motor PF 2	0.30	1.00		0.85	579	
P16.4 ①	Motor Nom Volt 2	180	690	V	SecdMotorNomVoltMFG	580	
P16.5 ①	Motor Nom Freq 2	8.00	400.00	Hz	SecdMotorNomFreqMFG	581	
P16.6 ①	Stator Resistor 2	0.001	65.535	ohm	0.033	1419	

Bypass

Table 69. Basic setting—P17.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P17.1.1 ①	Bypass Enable				0	1418	See Par ID 2462
P17.1.2 ①	Bypass Start Delay	1	32765	s	5	544	
P17.1.3 ①	Auto Bypass				0	542	See Par ID 2462
P17.1.4 ①	Auto Bypass Delay	0	32765	s	10	543	
P17.1.5 ①	OverCurrent Bypass Enable				0	547	See Par ID 2462
P17.1.6 ①	IGBT Fault Bypas Enable				0	546	See Par ID 2462
P17.1.7 ①	4mA Fault Bypass Enable				0	548	See Par ID 2462
P17.1.8 ①	UnderVoltage Bypass Enable				0	545	See Par ID 2462
P17.1.9 ①	OverVoltage Bypass Enable				0	549	See Par ID 2462
P17.1.10 ①	Motor OverTemp Bypass Enable				0	1698	See Par ID 2462
P17.1.11 ①	UnderLoad Bypass Enable				0	1699	See Par ID 2462
P17.1.12 ①	External Bypass Enable				0	1700	See Par ID 2462
P17.1.13 ①	Charge Switch Fault Bypass Enable				0	1701	See Par ID 2462

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 69 Basic setting—P17.1, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P17.1.14 ①	Saturation Trip Fault Bypass Enable				0	1702	See Par ID 2462
P17.1.15 ①	Under Temp Fault Bypass Enable				0	1703	See Par ID 2462
P17.1.16 ①	EEPROM Fault Bypass Enable				0	1704	See Par ID 2462
P17.1.17 ①	Control board EEPROM Fault Bypass Enable				0	1705	See Par ID 2462
P17.1.18 ①	Watchdog Fault Bypass Enable				0	1706	See Par ID 2462
P17.1.19 ①	Fan Cooling Fault Bypass Enable				0	1707	See Par ID 2462
P17.1.20 ①	Keypad Com Fault Bypass Enable				0	1708	See Par ID 2462
P17.1.21 ①	Option Card Fault Bypass Enable				0	1709	See Par ID 2462
P17.1.22 ①	RTC Clock Fault Bypass Enable				0	1710	See Par ID 2462
P17.1.23 ①	Ctrl Board OverTemp Fault Bypass Enable				0	1711	See Par ID 2462
P17.1.24 ①	Fieldbus Fault Bypass Enable				0	1713	See Par ID 2462
P17.1.25 ①	Op Cont Interlock Fault Bypass Enable				0	2832	See Par ID 2462

Table 70. Redundant drive—P17.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P17.2.1 ①	Redundant Drive Enable				0	2476	See Par ID 2462
P17.2.2 ①	Drive ID	0	5		0	2278	
P17.2.3	Redundant Run Time Enable				0	2477	See Par ID 2462
P17.2.4	Redundant Run Time Reset					2478	See Par ID 2125
P17.2.5	Redundant RunTime Limit	0.00	300000.00	h	0.00	2479	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Pump parameters

Table 71. Basic setting—P18.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.1.1 ①	Multi-pump Mode				0	2279	0 = Disabled 1 = Single Drive Control 2 = Multi Drive Network
P18.1.2 ①	Drive ID	0	5		0	2278	
P18.1.3	PID Bandwidth	0.00	6000.00	Varies	10.00	2458	
P18.1.4 ①	Staging Frequency	See Par ID 101	400.00		50.00	2315	
P18.1.5 ①	De-Staging Frequency	0.00	See Par ID 102		0.00	2316	
P18.1.6	Add/Remove Delay	0	3600	s	10	344	
P18.1.7	Interlock Enable				0	350	See Par ID 2462
P18.1.8 ①	Damper Start				0	483	0 = Normal 1 = Interlock Start 2 = Interlock Tout 3 = Interlock Delay
P18.1.9 ①	Damper Time Out	1	32500	s	5	484	
P18.1.10 ①	Damper Delay	1	32500	s	5	485	
P18.1.11	Derag Cycles	0	10		3	2468	
P18.1.12	Derag at Start/Stop				0	2469	0 = Off 1 = Start 2 = Stop 3 = Start and Stop 4 = Digital Input
P18.1.13	Deragging Run Time	0	3600	s	0	2470	
P18.1.14	Derag Speed	See Par ID 101	See Par ID 102	Hz	5.00	2471	
P18.1.15	Derag Off Delay	1	600	s	10	2472	
P18.1.16 ①	Multi-pump Mode 2				0	2659	See Par ID 2279

Multi-pump status

Table 72. Operation mode—P18.2.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.2.1.1	MPC Drive1 Operate Mode					2218	0 = Offline 1 = Slave Drive 2 = Master Drive 3 = Redundant Drive
P18.2.1.2	MPC Drive2 Operate Mode					2230	See Par ID 2218
P18.2.1.3	MPC Drive3 Operate Mode					2242	See Par ID 2218
P18.2.1.4	MPC Drive4 Operate Mode					2254	See Par ID 2218
P18.2.1.5	MPC Drive5 Operate Mode					2266	See Par ID 2218

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 73. Multi-pump status—P18.2.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.2.2.1	MPC Drive1 Status				5	2219	0 = Stopped 1 = Sleep 2 = Regulating 3 = Wait for CMD 4 = Following 5 = Unknown 6 = Master Local Control 7 = Slave Local Control
P18.2.2.2	MPC Drive2 Status				5	2231	See Par ID 2219
P18.2.2.3	MPC Drive3 Status				5	2243	See Par ID 2219
P18.2.2.4	MPC Drive4 Status				5	2255	See Par ID 2219
P18.2.2.5	MPC Drive5 Status				5	2267	See Par ID 2219

Table 74. Network status—P18.2.3.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.2.3.1	MPC Drive1 NetworkStatus					2220	0 = Disconnected 1 = Fault 2 = Local Control 3 = Pump Lost 4 = Need Alternation 5 = No Error
P18.2.3.2	MPC Drive2 NetworkStatus					2232	See Par ID 2220
P18.2.3.3	MPC Drive3 NetworkStatus					2244	See Par ID 2220
P18.2.3.4	MPC Drive4 NetworkStatus					2256	See Par ID 2220
P18.2.3.5	MPC Drive5 NetworkStatus					2268	See Par ID 2220

Multi-pump measurement

Table 75. Latest fault code—P18.3.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.3.1.1	MPC Drive1 Last Fault Code					2221	
P18.3.1.2	MPC Drive2 Last Fault Code					2233	
P18.3.1.3	MPC Drive3 Last Fault Code					2245	
P18.3.1.4	MPC Drive4 Last Fault Code					2257	
P18.3.1.5	MPC Drive5 Last Fault Code					2269	

Table 76. Output frequency—P18.3.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.3.2.1	MPC Drive1 f-Out			Hz		2222	
P18.3.2.2	MPC Drive2 f-Out			Hz		2234	
P18.3.2.3	MPC Drive3 f-Out			Hz		2246	
P18.3.2.4	MPC Drive4 f-Out			Hz		2258	
P18.3.2.5	MPC Drive5 f-Out			Hz		2270	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 77. Motor voltage—P18.3.3.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.3.3.1	MPC Drive1 V-Out			V		2223	
P18.3.3.2	MPC Drive2 V-Out			V		2235	
P18.3.3.3	MPC Drive3 V-Out			V		2247	
P18.3.3.4	MPC Drive4 V-Out			V		2259	
P18.3.3.5	MPC Drive5 V-Out			V		2271	

Table 78. Motor current—P18.3.4.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.3.4.1	MPC Drive1 I-Out			A		2224	
P18.3.4.2	MPC Drive2 I-Out			A		2236	
P18.3.4.3	MPC Drive3 I-Out			A		2248	
P18.3.4.4	MPC Drive4 I-Out			A		2260	
P18.3.4.5	MPC Drive5 I-Out			A		2272	

Table 79. Motor torque—P18.3.5.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.3.5.1	MPC Drive1 M-Out			%		2225	
P18.3.5.2	MPC Drive2 M-Out			%		2237	
P18.3.5.3	MPC Drive3 M-Out			%		2249	
P18.3.5.4	MPC Drive4 M-Out			%		2261	
P18.3.5.5	MPC Drive5 M-Out			%		2273	

Table 80. Motor power—P18.3.6.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.3.6.1	MPC Drive1 P-Out			%		2226	
P18.3.6.2	MPC Drive2 P-Out			%		2238	
P18.3.6.3	MPC Drive3 P-Out			%		2250	
P18.3.6.4	MPC Drive4 P-Out			%		2262	
P18.3.6.5	MPC Drive5 P-Out			%		2274	

Table 81. Motor speed—P18.3.7.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.3.7.1	MPC Drive1 n-Out			rpm		2227	
P18.3.7.2	MPC Drive2 n-Out			rpm		2239	
P18.3.7.3	MPC Drive3 n-Out			rpm		2251	
P18.3.7.4	MPC Drive4 n-Out			rpm		2263	
P18.3.7.5	MPC Drive5 n-Out			rpm		2275	

Table 82. Run time—P18.3.8.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.3.8.1	MPC Drive1 t-Run			h		2228	
P18.3.8.2	MPC Drive2 t-Run			h		2240	
P18.3.8.3	MPC Drive3 t-Run			h		2252	
P18.3.8.4	MPC Drive4 t-Run			h		2264	
P18.3.8.5	MPC Drive5 t-Run			h		2276	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 83. Multi-Pump Single Drive—P18.4.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.4.1 ①	Number of Pumps	1	5		1	342	
P18.4.2	Include Freq Converter				1	346	See Par ID 2462
P18.4.3	Auto-Change Enable				0	345	See Par ID 2462
P18.4.4	Auto-Change Interval	0.0	3000.0	h	48.0	347	
P18.4.5	Auto-Change Freq Limit	See Par ID 101	See Par ID 102	Hz	25.00	349	
P18.4.6	Auto-Change Pump Limit	0	5		1	348	
P18.4.7 ①	Pipe Fill Aux Pump Select				0	2439	0 = Disabled 1 = Aux Motor 1 2 = Aux Motor 2 3 = Aux Motor 3 4 = Aux Motor 4
P18.4.8 ①	Pipe Fill Aux Pump Run Time	0.0	3600.0	min	0.0	2440	
P18.4.9 ①	Pipe Fill Aux Pump Operation				0	2441	0 = Automatic 1 = Stop
P18.4.10 ①	Pipe Fill Aux Pump Delay	0.0	600.0	min	2.0	2442	

Table 84. Multi-Pump Multi Drive—P18.5.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.5.1 ①	Number of Drives	1	5		1	2449	
P18.5.2 ①	Regulation Source				0	2284	0 = Network Only 1 = PID Controller 1
P18.5.3 ①	Recovery Method				0	2285	See Par ID 2441
P18.5.4 ①	Callback Source				0	2286	0 = No Action 1 = Safety Torque Off
P18.5.5	Add/Remove Drive Selection				0	2311	0 = Drive ID 1 = Run Time
P18.5.6	Run Time Enable				0	2280	See Par ID 2462
P18.5.7	Run Time Limit	0.0	300000.0	h	0.0	2281	
P18.5.8	Run Time Reset					2283	0 = No Action 1 = Reset
P18.5.9	Master Drive Mode				0	2473	0 = Follow PID 1 = Fixed Speed 2 = Turn Off
P18.5.10	Master Fixed Speed	See Par ID 101	See Par ID 102	Hz	50.00	2474	
P18.5.11	Master Fixed Speed Delay	0	1000	s	5	2475	

Table 85. Protections—P18.6.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.6.1 ①	Pipe Fill Loss Detection Method				0	2406	0 = Motor Current 1 = Motor Power 2 = Motor Torque
P18.6.2	Pipe Fill Loss Level	0.0	1000.0	Varies	0.0	2407	
P18.6.3	Pipe Fill Loss Time	0	600	s	0	2408	
P18.6.4 ①	Pipe Fill Loss Frequency	0.00	See Par ID 102	Hz	0.00	2409	
P18.6.5 ①	Pipe Fill Loss Response				0	2410	See Par ID 2427
P18.6.6	Pipe Fill Loss Attempts	0	10		1	2411	
P18.6.7	Prime Pump Enable				0	2428	See Par ID 190

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 85. Protections—P18.6, continued

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.6.8	Prime Pump Level	0.00	6000.00	Varies	0.00	2429	
P18.6.9	Prime Pump Frequency	See Par ID 101	See Par ID 102	Hz	0.00	2431	
P18.6.10	Prime Pump Delay Time	0.0	3600.0	min	0.0	2432	
P18.6.11	Prime Pump Loss of Prime Level	0.0	1000.0	Varies	0.0	2433	
P18.6.12	Prime Pump Level 2	0.00	6000.00	Varies	0.00	2434	
P18.6.13	Prime Pump Frequency 2	See Par ID 101	See Par ID 102	Hz	0.00	2436	
P18.6.14	Prime Pump Delay Time 2	0.0	3600.0	min	0.0	2437	
P18.6.15	Prime Pump Loss of Prime Level 2	0.0	1000.0	Varies	0.0	2438	
P18.6.16 ①	Broken Pipe Fault Response				0	1853	See Par ID 307
P18.6.17	Broken Pipe Level	0.0	6000.0	Varies	15.0	1854	
P18.6.18	Broken Pipe Delay	1.0	120.0	s	15.0	1855	
P18.6.19	Broken Pipe Frequency	1.00	See Par ID 102	Hz	25.00	1856	
P18.6.20	Jockey Pump Enable				0	2804	0 = Not Used 1 = PID Sleep 2 = PID Sleep(Level)
P18.6.21	Jockey Start Level	-99999.99	See Par ID 2807	Varies	0.00	2805	
P18.6.22	Jockey Stop Level	See Par ID 2805	99999.99	Varies	0.00	2807	
P18.6.23	Lube Pump Enable				0	2809	See Par ID 2462
P18.6.24	Lube Pump Time	0.0	300.0	s	0.0	2810	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 86. Real time clock—P19.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P19.1	Interval 1 On Time				0,0,0	491	
P19.2	Interval 1 Off Time				0,0,0	493	
P19.3	Interval 1 From Day				0	517	0 = Sunday 1 = Monday 2 = Tuesday 3 = Wednesday 4 = Thursday 5 = Friday 6 = Saturday
P19.4	Interval 1 To Day				0	518	See Par ID 517
P19.5	Interval 1 Channel				0	519	0 = Not Used 1 = Time Channel 1 2 = Time Channel 2 3 = Time Channel 3
P19.6	Interval 2 On Time				0,0,0	495	
P19.7	Interval 2 Off Time				0,0,0	497	
P19.8	Interval 2 From Day				0	520	See Par ID 517
P19.9	Interval 2 To Day				0	521	See Par ID 517
P19.10	Interval 2 Channel				0	522	See Par ID 519
P19.11	Interval 3 On Time				0,0,0	499	
P19.12	Interval 3 Off Time				0,0,0	501	
P19.13	Interval 3 From Day				0	523	See Par ID 517
P19.14	Interval 3 To Day				0	524	See Par ID 517
P19.15	Interval 3 Channel				0	525	See Par ID 519
P19.16	Interval 4 On Time				0,0,0	503	
P19.17	Interval 4 Off Time				0,0,0	505	
P19.18	Interval 4 From Day				0	526	See Par ID 517
P19.19	Interval 4 To Day				0	527	See Par ID 517
P19.20	Interval 4 Channel				0	528	See Par ID 519
P19.21	Interval 5 On Time				0,0,0	507	
P19.22	Interval 5 Off Time				0,0,0	509	
P19.23	Interval 5 From Day				0	529	See Par ID 517
P19.24	Interval 5 To Day				0	530	See Par ID 517
P19.25	Interval 5 Channel				0	531	See Par ID 519
P19.26	Timer 1 Duration	0	72000	s	0	511	
P19.27	Timer 1 Channel				0	532	See Par ID 519
P19.28	Timer 2 Duration	0	72000	s	0	513	
P19.29	Timer 2 Channel				0	533	See Par ID 519
P19.30	Timer 3 Duration	0	72000	s	0	515	
P19.31	Timer 3 Channel				0	534	See Par ID 519
P19.32	Interval 1 Setting				0	2487	0 = Weekly 1 = Daily
P19.33	Interval 2 Setting				0	2488	See Par ID 2487
P19.34	Interval 3 Setting				0	2489	See Par ID 2487
P19.35	Interval 4 Setting				0	2490	See Par ID 2487
P19.36	Interval 5 Setting				0	2491	See Par ID 2487

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Communication

Table 87. FB process data input Sel—P20.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.1.1	FB Process Data Input 1 Sel	0	3000		2541	2533	
P20.1.2	FB Process Data Input 2 Sel	0	See Par ID 2533		2542	2534	
P20.1.3	FB Process Data Input 3 Sel	0	See Par ID 2533		2550	2535	
P20.1.4	FB Process Data Input 4 Sel	0	See Par ID 2533		0	2536	
P20.1.5	FB Process Data Input 5 Sel	0	See Par ID 2533		0	2537	
P20.1.6	FB Process Data Input 6 Sel	0	See Par ID 2533		0	2538	
P20.1.7	FB Process Data Input 7 Sel	0	See Par ID 2533		0	2539	
P20.1.8	FB Process Data Input 8 Sel	0	See Par ID 2533		0	2540	

Table 88. FB process data output Sel—P20.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.2.1	FB Process Data Output 1 Sel				1	1556	
P20.2.2	FB Process Data Output 2 Sel				2	1557	
P20.2.3	FB Process Data Output 3 Sel				3	1558	
P20.2.4	FB Process Data Output 4 Sel				4	1559	
P20.2.5	FB Process Data Output 5 Sel				5	1560	
P20.2.6	FB Process Data Output 6 Sel				6	1561	
P20.2.7	FB Process Data Output 7 Sel				7	1562	
P20.2.8	FB Process Data Output 8 Sel				28	1563	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 88 FB Process data output Sel—P20.2, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.2.9 ②	Standard Status Word Bit0 Function Select				1	2415	0 = Not Used 1 = Ready 2 = Run 3 = Fault 4 = Fault Invert 5 = Warning 6 = Reversed 7 = At Speed 8 = Zero Frequency 9 = Freq Limit 1 Superv 10 = Freq Limit 2 Superv 11 = PID1 Superv 13 = OverHeat Fault 14 = OCurrent Fault 15 = OVolt Fault 16 = UVolt Fault resp 17 = 4mA Ref Fault/Warning 20 = Torq Limit Superv 21 = Ref Limit Superv 22 = Control from I/O 23 = Un-Requested Rotation Direction 24 = Thermistor Fault Output 25 = Fire Mode 26 = In Bypass Mode 27 = Ext Fault/Warning 28 = Remote Control 29 = Jog Speed Select 30 = Motor Therm Protection 31 = FB Digital Input 1 32 = FB Digital Input 2 33 = FB Digital Input 3 34 = FB Digital Input 4 35 = Damper Control 36 = TC1 Status 37 = TC2 Status 38 = TC3 Status 39 = In E-Stop 40 = Power Limit Superv 41 = Temp Limit Superv 42 = Analog Input Superv 43 = Motor 1 Control 44 = Motor 2 Control 45 = Motor 3 Control 46 = Motor 4 Control 47 = Motor 5 Control 49 = PID1 Sleep 51 = Motor Current 1 Supv 52 = Motor Current 2 Supv 53 = Second AI Limit Supv 54 = DC Charge Switch Close 55 = Preheat Active 56 = Cold Weather Active 57 = Prime Pump Active 58 = 2nd Stage Ramp Frequency Active 59 = STO Fault Output 60 = Run Bypass/Drive 61 = Bypass Overload 62 = Bypass Run 63 = Auto Local On COM Fault 64 = FieldBus RTU Fault 65 = FieldBus TCP Fault

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 88 FB Process data output Sel—P20.2, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.2.9 ②, continued	Standard Status Word Bit0 Function Select				1	2415	66 = FieldBus MSTP Fault 67 = FieldBus EIP Fault 68 = FieldBus SlotA Fault 69 = Fieldbus SlotB Fault 70 = FieldBus SWD Fault 71 = Jockey Pump Active 72 = Lube Pump Active 73 = PID1 Low Feedback 74 = PID1 High Feedback 77 = Master in MPFC 78 = CP Interlock Fault
P20.2.10 ②	Standard Status Word Bit1 Function Select				2	2416	See Par ID 2415
P20.2.11 ②	Standard Status Word Bit2 Function Select				3	2417	See Par ID 2415
P20.2.12 ②	Standard Status Word Bit3 Function Select				4	2418	See Par ID 2415
P20.2.13 ②	Standard Status Word Bit4 Function Select				5	2419	See Par ID 2415
P20.2.14 ②	Standard Status Word Bit5 Function Select				6	2420	See Par ID 2415
P20.2.15 ②	Standard Status Word Bit6 Function Select				7	2421	See Par ID 2415
P20.2.16 ②	Standard Status Word Bit7 Function Select				8	2422	See Par ID 2415

RS-485 Bus

Table 89. Basic setting—P20.3.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.3.1.1 ①	RS485 Comm Set				0	586	0 = Modbus RTU 1 = BACnet MS/TP 2 = SWD

Table 90. Modbus RTU—P20.3.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.3.2.1 ①	Slave Address	1	247		1	587	
P20.3.2.2 ①	Baud Rate				1	584	0 = 9600 1 = 19200 2 = 38400 3 = 57600 4 = 115200
P20.3.2.3 ①	Parity Type And Stop Bit				2	585	0 = None and 2 stop bits 1 = Odd and 1 stop bit 2 = Even and 1 stop bit 3 = None and 1 stop bit
P20.3.2.4	Modbus RTU Protocol Status					588	0 = Initial 1 = Stopped 2 = Operational 3 = Faulted
P20.3.2.5	Comm Timeout Modbus RTU	0	60000	ms	10000	593	
P20.3.2.6	Modbus RTU Fault Response				0	2516	0 = in Fieldbus Control 1 = in all Control

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 91. BACnet MS/TP—P20.3.3.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.3.3.1	MSTP Baud Rate				2	594	0 = 9600 1 = 19200 2 = 38400 3 = 76800 4 = 115200
P20.3.3.2	MSTP Device Address	0	127		1	595	
P20.3.3.3	MSTP Instance Number	0	4194302		0	596	
P20.3.3.4	MSTP Comm Timeout	0	60000	ms	10000	598	
P20.3.3.5	MSTP Protocol Status				0	599	0 = Stopped 1 = Operational 2 = Faulted
P20.3.3.6	MSTP Fault Code				0	600	0 = None 1 = Sole Master 2 = Duplicate MAC ID 3 = Baud rate fault
P20.3.3.7	MSTP Fault Response				0	2526	See Par ID 2516
P20.3.3.8 ①	MSTP Max Master	1	127		127	1537	

Table 92. Terminal: SWD—P20.3.4.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.3.4.1	Parameter Access				1	2360	0 = Local Control 1 = Fieldbus
P20.3.4.2 ①	Process Data Access				4	2631	0 = Local Control 1 = Fieldbus 2 = Mixed Interface 4 = NET, Local on Fault 5 = Dual Mode
P20.3.4.3	Fault Situation Counter					2632	
P20.3.4.4	Board Status					2609	
P20.3.4.5	Firmware Version					2610	
P20.3.4.6	Protocol Status					2612	0 = Not Configured 1 = Operational 2 = Diagnostics
P20.3.4.7	Operation Mode					2613	0 = PD2x16Bit Profil 1 = 8Bit Profil 2 = 1-0-A Switch
P20.3.4.8	PDP-Telegram Selection				1	2614	1 = Standard Telegram 1
P20.3.4.9	Fault Counter PDP				0	2615	
P20.3.4.10	Fault Situations Max				8,8	2616	
P20.3.4.11	PDP-Profil Number				809	2618	
P20.3.4.12	PDP-Control Word					2619	
P20.3.4.13	PDP-Status Word				64	2620	
P20.3.4.14	PDP-MaxBlockLength				512	2621	
P20.3.4.15	PDP-NoOfMultiparameter				64	2622	
P20.3.4.16	PDP-MaxLatency				0	2623	
P20.3.4.17	PDP-DO Manufacturer					2624	
P20.3.4.18	PDP-DO Device Type					1451	
P20.3.4.19	PDP-DO FW-Interface					2625	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 92. Terminal: SWD—P20.3.4, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.3.4.20	PDP-DO FW-Year					2626	
P20.3.4.21	PDP-DO FW-DayMonth					2627	
P20.3.4.22	PDP-DO NoOfDOs				1	2628	
P20.3.4.23	PDP-DO Subclass				1	2629	

Table 93. EtherNet/IP—P20.4.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.4.1 ①	IP Address Mode				0	1500	0 = Static IP 1 = DHCP with AutoIP
P20.4.2	Active IP Address					1507	
P20.4.3	Active Subnet Mask					1509	
P20.4.4	Active Default Gateway					1511	
P20.4.5	MAC Address					1513	
P20.4.6 ①	Static IP Address				192.168.1.254	1501	
P20.4.7 ①	Static Subnet Mask				255.255.255.0	1503	
P20.4.8 ①	Static Default Gateway				192.168.1.1	1505	
P20.4.9	Ethernet IP Protocol Status					608	0 = Off 1 = Operational 2 = Faulted
P20.4.10	EIP Fault Response				0	2518	See Par ID 2516

Table 94. Modbus TCP—P20.5.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.5.1	Connection Limit				5	609	
P20.5.2	Modbus TCP Unit ID				1	610	
P20.5.3	Comm Timeout Modbus TCP	0	60000	ms	10000	611	
P20.5.4	Modbus TCP Protocol Status					612	See Par ID 599
P20.5.5	Modbus TCP Fault Response				0	2517	See Par ID 2516
P20.5.6	Modbus TCP Trusted IP Enable				1	74	See Par ID 2462
P20.5.7	Trusted IP White List				0xC0.0xA8.0x01.0xFF. 0x00.0x00.0x00.0x00. 0x00.0x00.0x00.0x00	68	

Table 95. WebUI—P20.6.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.6.1	WebUI Protocol Status					2915	See Par ID 608
P20.6.2	WebUI Fault Response				0	2916	See Par ID 2516
P20.6.3	WebUI Communication Timeout	30000	60000	ms	60000	2919	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 96. Protocol Enable—P20.7

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.7.1 ①⑥	Ethernet based protocol select				0	1997	0 = Disabled 1 = Ethernet IP
P20.7.2 ①⑥	Modbus TCP enable				0	1942	0 = Disabled 1 = Ethernet IP
P20.7.3 ①⑥	WebUI Enable				1	2921	See Par ID 2462

System

Table 97. Basic setting—P21.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P21.1.1	Language				0	340	0 = English 1 = 中文 2 = Deutsch
P21.1.2 ①	Application					142	0 = Standard 1 = Multi-Pump 2 = Multi-PID 3 = Multi-Purpose
P21.1.3 ①	Parameter Sets					619	0 = No 1 = Reload Defaults 2 = Reload Set 1 3 = Reload Set 2 4 = Store Set 1 5 = Store Set 2 6 = Reset 7 = Reload Defaults VM
P21.1.4	Up To Keypad					620	See Par ID 2118
P21.1.5 ①	Down From Keypad					621	0 = No 1 = All Parameters 2 = All, No Motor 3 = App Parameters
P21.1.6	Parameter Comparison					623	0 = No 1 = Compare with Keypad 2 = Compare with Default 3 = Compare with Set 1 4 = Compare with Set 2
P21.1.7	Password	0	9999		0	624	
P21.1.8	Parameter Lock				0	625	0 = Change Enable 1 = Change Disable
P21.1.9	Multi-monitor Set				0	627	See Par ID 625
P21.1.10	Default Page				2	628	
P21.1.11	Timeout Time	0	65535	s	30	629	
P21.1.12	Contrast Adjust	5	18		12	630	
P21.1.13	Backlight Time	1	65535	min	10	631	
P21.1.14	Fan Control				1	632	
P21.1.15	Keypad ACK Timeout	200	5000	ms	200	633	
P21.1.16	Keypad Retry Number	1	10		5	634	
P21.1.17	Startup Wizard				0	626	
P21.1.18	Jog Softkey Hidden				0	2412	See Par ID 2462
P21.1.19	Reverse Softkey Hidden				0	2413	See Par ID 2462
P21.1.20	Output Display Unit				45	2424	
P21.1.21	Output Display Unit Min	-60000.00	See Par ID 2425	Varies	0.00	2460	
P21.1.22	Output Display Unit Max	See Par ID 2460	60000.00	Varies	MotorNomFreqMFG	2425	
P21.1.23	Keypad Lock Password	0	9999		0	75	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 98. Version info.—P21.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P21.2.1	Keypad Software Version					640	
P21.2.2	Motor Control Software Version					642	
P21.2.3	Application Software Version					644	
P21.2.4	Software Bundle Version					1714	

Table 99. Application info.—P21.3.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P21.3.1	Brake Chopper Status					646	See Par ID 2118
P21.3.2	Brake Resistor Status					647	See Par ID 2118
P21.3.3	Serial Number					648	
P21.3.4	Power Unit Serail Number					1270	
P21.3.5	Control Unit Serial Number					1276	

Table 100. User info.—P21.4.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P21.4.1	Real Time Clock				0.0.0.1:1:13	566	
P21.4.2	Daylight Saving				0	582	
P21.4.3	Total MWh Count			Mwh		601	0 = Off 1 = EU 2 = US
P21.4.4	Total Power Day Count					603	
P21.4.5	Total Power Hr Count					606	
P21.4.6	Trip MWh Count			Mwh		604	
P21.4.7	Clear Trip MWh Count					635	See Par ID 2125
P21.4.8	Trip Power Day Count					636	
P21.4.9	Trip Power Hr Count					637	
P21.4.10	Clear Trip Power Count					639	See Par ID 2125

Table 101. Operate mode—O.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
O1	Output Frequency			Hz		1	
O2	Freq Reference			Hz		24	
O3	Motor Speed			rpm		2	
O4	Motor Current			A		3	
O5	Motor Torque			%		4	
O6	Motor Power			%		5	
O7	Motor Voltage			V		6	
O8	DC-link Voltage			V		7	
O9	Unit Temperature			Deg. C		8	
O10	Motor Temperature			%		9	
R12	Keypad Reference	See Par ID 101	See Par ID 102	Hz	0.00	141	
R13	PID1 Keypad Set Point 1	See Par ID 1298	See Par ID 1300	Varies	0.00	1307	
R14	PID1 Keypad Set Point 2	See Par ID 1298	See Par ID 1300	Varies	0.00	1309	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Chapter 7—Multi-PID application

Introduction

The Multi-PID application is designed to be used with up to 2 PID control applications determined by the use of a digital input; it is typically used with pumps and fans to maintain a desired set-point. With PID, the frequency converter is given a set reference from a keypad, analog inputs, or fieldbus data-in. It also uses an analog probe that measures flow, temperature, and pressure in the system referred to as feedback. The frequency converter takes the feedback signal and compares it to the set point. From there based off the Gain, Integral time, and Derivative time, it corrects the speed of the motor to meet the set point value and maintain it; no additional components. Drive controlwise it provides the ability to have 2 control and reference locations with 8 digital inputs, 2 analog inputs, 3 relay outputs, 1 digital output, and 2 analog outputs that are programmable. Motor control is customizable to frequency or speed control, and the V/Hz curve can be programmable. Drive/motor protection selections can be programmable to defined actions. Below is a list of additional features available in addition to the Standard and Multi-pump and Fan application features that are available in the Multi-PID application.

Multi-PID Application includes all the functions in Multi-pump and Fan application, and additional functions:

- The Second PID control

I/O controls

- “Terminal to Function” (TTF) programming

The design behind the programming of the digital inputs in the DG1 drive is to use “Terminal to Function” programming, which is composed of multiple functions that get assigned a digital input to that function. The parameters in the drive are set up with specific functions and by defining the digital input and slot in some cases, depending on which options are available. For use of the drives control board inputs, they will be referred to as DigIN:1 through DigIN:8. When additional option cards are used, they will be defined as DigIN:X:IOY:Z. The X indicates the slot that the card is being installed in, which will be either A or B. The IOY determines the type of card it is, which would be IO1 or IO5. The Z indicates which input is being used on that available option card.

- “Function to Terminal” (FTT) programming

The design behind the programming of the relay outputs and digital output in the DG1 drive is to use “Function to Terminal” programming. It is composed of a terminal, be it a relay output or a digital output, that is assigned a parameter. Within that parameter, it has different functions that can be set.

The parameters of the Multi-PID Application are explained on **page 108** of this manual, “Description of Parameters.” The explanations are arranged according to the parameter number.

Force Open/Force Close Selection

The Force Open selection would make the selected function always off. Essentially this is a virtual switch that is always open.

The Force Close selection would make the selected function always on. Essentially this is a virtual switch that is always closed.

These options are assigned to a function if we want to force a state without using a hardware input.

Example:

If we set Run Enable to Force Closed, the drive is always enabled. If we set the same function to Force Open, the drive would never be enabled. If a digital input is to be used to activate this Run Enable, the function should be assigned to a hardware input (see below for DIGIN selections).

DIGIN Selection

This allows assignment of a hardware digital input to a function, this is set in a format of DigIN:X where X is one of the 8 Digital inputs on the Main control board.

Example:

If we set Run Enable to DigIN:6, the drive will be enabled when digital input 6 (terminal 8) is closed, and would not be enabled when digital input 6 (terminal 8) is open.

Option Board DigIN Selection

This allows assignment of a hardware digital input on an option card to a function, this is set in a format of DigIN: Y:IO1:X where Y is the slot the option card is inserted on the main control board and X is the Input on the board and IO1 is the type of option board used.

Example:

If we set Run Enable to DigIN:A:IO5:6, the drive will be enabled when digital input 6 is closed on the IO5 option card which is inserted in Slot A, and would not be enabled when digital input 6 on the option card is open.

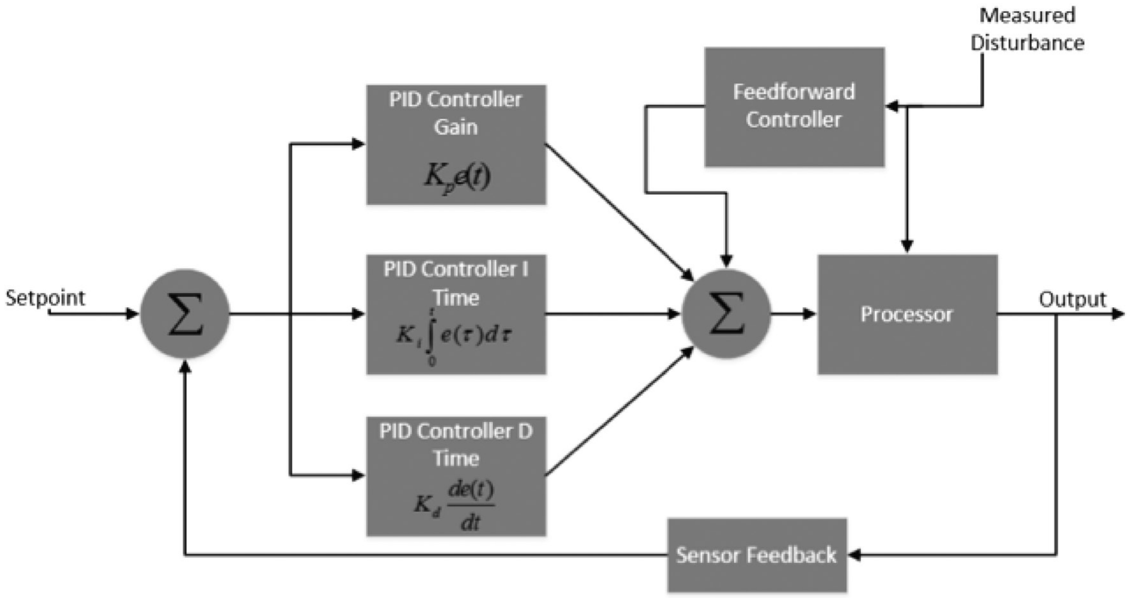
Timer Channel Selection

A Time Channel is a virtual path to link the digital output of a timer function to a digital input function. To utilize this feature, a timer or interval would need to be assigned to a Time Channel 1 through 3, and the input function to be controlled would need to be assigned to the same time channel.

Example:

If we set Run Enable to DigIN:TimeChannel1, the drive will be enabled when the timer assigned to Time Channel 1 is active or High, and would not be enabled when the Time Channel is inactive or Low.

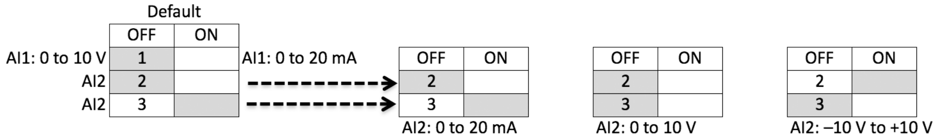
Figure 38. PID controller flowchart.



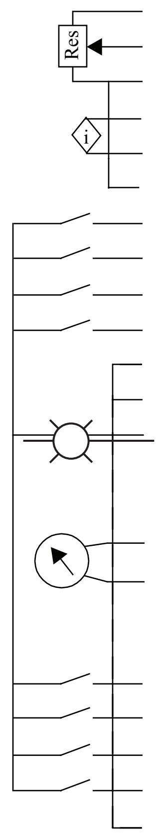
Control I/O configuration

- Run 240 Vac and 24 Vdc control wiring in separate conduit
- Communication wire to be shielded

Table 102. Multi-PID application default I/O configuration.



External Wiring



Pin	Signal Name	Signal	Default Setting	Description
1	+10 V	Ref. Output Voltage	—	10 Vdc Supply Source
2	AI1+ ①	Analog Input 1	0–10 V	Voltage Speed Reference (Programmable to 4 mA to 20 mA)
3	AI1–	Analog Input 1 Ground	—	Analog Input 1 Common (Ground)
4	AI2+ ①	Analog Input 2	4 mA to 20 mA	Current Speed Reference (Programmable to 0–10 V)
5	AI2–	Analog Input 2 Ground	—	Analog Input 2 Common (Ground)
6	GND	I/O Signal Ground	—	I/O Ground for Reference and Control
7	DIN5	Digital Input 5	Preset Speed B0	Sets frequency output to Preset Speed 1
8	DIN6	Digital Input 6	Preset Speed B1	Sets frequency output to Preset Speed 2
9	DIN7	Digital Input 7	Not Used (TI–)	Input forces VFD output to shut off
10	DIN8	Digital Input 8	Force Remote (TI+)	Input takes VFD from Local to Remote
11	CMB	DI5 to DI8 Common	Grounded	Allows source input
12	GND	I/O Signal Ground	—	I/O Ground for Reference and Control
13	24 V	+24 Vdc Output	—	Control voltage output (100 mA max.)
14	DO1	Digital Output 1	Ready	Shows the drive is ready to run
15	24 Vo	+24 Vdc Output	—	Control voltage output (100 mA max.)
16	GND	I/O Signal Ground	—	I/O Ground for Reference and Control
17	AO1+	Analog Output 1	Output Frequency	Shows Output frequency to motor 0–60 Hz (4 mA to 20 mA)
18	AO2+	Analog Output 2	Motor Current	Shows Motor current of motor 0–FLA (4 mA to 20 mA)
19	24 Vi	+24 Vdc Input	—	External control voltage input
20	DIN1	Digital Input 1	Run Forward	Input starts drive in forward direction (start enable)
21	DIN2	Digital Input 2	Run Reverse	Input starts drive in reverse direction (start enable)
22	DIN3	Digital Input 3	External Fault	Input causes drive to fault
23	DIN4	Digital Input 4	Fault Reset	Input resets active faults
24	CMA	DI1 to DI4 Common	Grounded	Allows source input
25	A/+	RS-485 Signal A	—	Fieldbus Communication (Modbus, BACnet)
26	B/-	RS-485 Signal B	—	Fieldbus Communication (Modbus, BACnet)
27	R3NO	Relay 3 Normally Open	At Speed	Relay output 3 shows VFD is at Ref. Frequency
28	R1NC	Relay 1 Normally Closed	Run	Relay output 1 shows VFD is in a run state
29	R1CM	Relay 1 Common		
30	R1NO	Relay 1 Normally Open		
31	R3CM	Relay 3 Common	At Speed	Relay output 3 shows VFD is at Ref. Frequency
32	R2NC	Relay 2 Normally Closed	Fault	Relay output 2 shows VFD is in a fault state
33	R2CM	Relay 2 Common		
34	R2NO	Relay 2 Normally Open		

Notes: The above wiring demonstrates a SINK configuration. It is important that CMA and CMB are wired to ground (as shown by dashed line). If a SOURCE configuration is desired, wire 24 V to CMA and CMB and close the inputs to ground. When using the +10 V for AI1, it is important to wire AI1—to ground (as shown by dashed line). If using +10 V for AI1 or AI2, terminals 3, 5, and 6 need to be jumpered together.
① AI1+ and AI2+ Support 10K potentiometer.

Table 103. Drive communication ports.

Port	Communication
RJ45 Keypad Port	
Upload/Download Parameters	USB to RJ45
Remote Mount Keypad	Ethernet
Upgrade Drive Firmware	USB to RJ45
RJ45 Ethernet Port	
Upload/Download Parameters	Ethernet
Ethernet IP Communications	Ethernet
Modbus TCP Communications	Ethernet
RS-485 Serial Port ①	
Upload/Download Parameters	Two-Wire Twisted Pair
Upgrade Drive Firmware	Two-Wire Twisted Pair
Modbus RTU Communications	Two-Wire Twisted Pair
BACnet MS/TP Communications	Two-Wire Twisted Pair

① Shielded wire recommended.

Multi-PID application—parameters list

On the next pages you will find the lists of parameters within the respective parameter groups. The parameter descriptions are given on **Page 194**, "Description of Parameters." The descriptions are arranged according to the parameter number.

Column explanations:

Code = Location indication on the keypad; shows the operator the present parameter number
Parameter = Name of parameter
Min = Minimum value of parameter
Max = Maximum value of parameter
Unit = Unit of parameter value; given if available
Default = Value preset by factory
ID = ID number of the parameter

Table 104. Monitor—M.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
M1	Output Frequency			Hz		1	
M2	Freq Reference			Hz		24	
M3	Motor Speed			rpm		2	
M4	Motor Current			A		3	
M5	Motor Torque			%		4	
M6	Motor Power			%		5	
M7	Motor Voltage			V		6	
M8	DC-link Voltage			V		7	
M9	Unit Temperature			Deg, C		8	
M10	Motor Temperature			%		9	
M12	Analog Input 1			Varies		10	
M13	Analog Input 2			Varies		11	
M14	Analog Output 1			Varies		25	
M15	Analog Output 2			Varies		575	
M16	DI1, DI2, DI3					12	
M17	DI4, DI5, DI6					13	
M18	DI7, DI8					576	
M19	DO1,Virtual RO1,Virtual RO2					14	
M20	RO1, RO2, RO3					557	
M21	TC1, TC2, TC3					558	
M22	Interval 1					559	0 = Inactive 1 = Active
M23	Interval 2					560	See Par ID 559
M24	Interval 3					561	See Par ID 559
M25	Interval 4					562	See Par ID 559
M26	Interval 5					563	See Par ID 559
M27	Timer 1			s	0	569	
M28	Timer 2			s	0	571	
M29	Timer 3			s	0	573	
M30	PID1 Set Point			Varies		16	
M31	PID1 Feedback			Varies		18	
M32	PID1 Error Value			Varies		20	
M33	PID1 Output			%		22	

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 104. Monitor—M, continued

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
M34	PID1 Status					23	0 = Stopped 1 = Running 2 = Sleep Mode
M35	PID2 Set Point			Varies		32	
M36	PID2 Feedback			Varies		34	
M37	PID2 Error Value			Varies		36	
M38	PID2 Output			%		38	
M39	PID2 Status					39	See Par ID 23
M40	Running Motors					26	
M41	PT100 Temperture			Deg. C	1000.0	27	
M42	Latest Fault Code					28	
M43	RTC Battery Status				0	583	0 = Not Installed 1 = Installed 2 = Change Battery 3 = OverVoltage
M44	Instant Motor Power			kW		1686	
M45	Energy Savings			Varies	0.000	2120	
M46	Control Board DIDO Status					2209	
M47	SlotA DIDO Status					2210	
M48	SlotB DIDO Status					2211	
M49	Application Status Word					29	
M50	Standard Status Word					2414	
M51	Output			Varies		2445	
M52	Reference			Varies		2447	
M53	Total MWh Count			Mwh		601	
M54	Total Power Day Count					603	
M55	Total Power Hr Count					606	
M56	Trip MWh Count			Mwh		604	
M57	Trip Power Day Count					636	
M58	Trip Power Hr Count					637	
M59	Total Run time Count			h		2827	
M60	Numbers Of Start					2830	
M61	Trip Run Time Count			h		2829	
M62	FB Status Word					2101	
M63	FB Ctrol Word					2001	
M64	FB Speed Reference	0.00	200.00	%		2003	
M67	Control board DI status					3214	
M68	SlotA DI status					3248	
M69	SlotB DI status					3249	
M70	Multi-Monitoring				2,1,3,2,1,3,2,1,3	1753	

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Parameters

Table 105. Basic parameters—P1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P1.1	Min Frequency	0.00	See Par ID 102	Hz	0.00	101	
P1.2 ①	Max Frequency	See Par ID 101	400.00	Hz	MaxFreqMFG	102	
P1.3	Accel Time 1	0.1	3000.0	s	3.0	103	
P1.4	Decel Time 1	0.1	3000.0	s	3.0	104	
P1.5 ①	Motor Nom Current	DriveNomCurrCT*1/10	DriveNomCurrCT*2	A	DriveNomCurrCT	486	
P1.6 ①	Motor Nom Speed	300	24000	rpm	MotorNomSpeedMFG	489	
P1.7 ①	Motor PF	0.30	1.00		0.85	490	
P1.8 ①	Motor Nom Voltage	180	690	V	MotorNomVoltMFG	487	
P1.9 ①	Motor Nom Frequency	8.00	400.00	Hz	MotorNomFreqMFG	488	
P1.10	Power Up Local Remote Select				0	1685	0 = Hold Last 1 = Local Control 2 = Remote control
P1.11	Remote 1 Control Place				0	135	0 = I/O Terminal Start 1 1 = Fieldbus 2 = I/O Terminal Start 2 3 = Keypad
P1.12	Local Control Place				0	1695	0 = Keypad 1 = I/O Terminal Start 1 2 = I/O Terminal Start 2 3 = Fieldbus
P1.13	Bumpless Enable				0	24620	0 = Disabled 1 = Enabled
P1.14 ①②	Local Reference				6	136	0 = AI1 1 = AI2 2 = Slot A: AI1 3 = Slot B: AI1 4 = AI1 Joystick 5 = AI2 Joystick 6 = Keypad 7 = Fieldbus Ref 9 = Max Frequency 10 = AI1 + AI2 11 = AI1 - AI2 12 = AI2 - AI1 13 = AI1 * AI2 14 = AI1 or AI2 15 = MIN(AI1,AI2) 16 = MAX(AI1,AI2) 17 = PID1 Control Output 18 = PID2 Control Output
P1.15 ①②	Remote 1 Reference				0	137	See Par ID 136
P1.16 ①	Reverse Enable				1	1679	See Par ID 2462
P1.17	Run Delay Time	0	32500	s	0	2423	
P1.18 ①	HOA Source				0	2465	0 = Disabled 1 = IO Terminal 2 = Keypad
P1.19 ①	Minimum Run Time	0	32500	s	0	1813	
P1.20	Frequency reference upper limit	See Par ID 101	See Par ID 102	Hz	50.00	2840	
P1.21	Frequency reference upper limit source				0	2841	0 = Not Used 1 = Freq Ref Upper 2 = AI1 3 = AI2

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Analog input

Table 106. Basic setting—P2.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P2.1.1	AI Ref Scale Min Value	0.00	See Par ID 145	Hz	0.00	144	
P2.1.2	AI Ref Scale Max Value	See Par ID 144	400.00	Hz	0.00	145	

Table 107. AI1 settings—P2.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P2.2.1	AI1 Mode				1	222	0 = 0–20 mA 1 = 0–10 V
P2.2.2	AI1 Signal Range				0	175	0 = 0–100%/ 0–20 mA/0–10 V 1 = 20–100%/ 4–20 mA/2–10 V 2 = Customized
P2.2.3	AI1 Custom Min	0.00	See Par ID 177	%	0.00	176	
P2.2.4	AI1 Custom Max	See Par ID 176	100.00	%	100.00	177	
P2.2.5	AI1 Filter Time	0.00	10.00	s	0.10	174	
P2.2.6	AI1 Signal Invert				0	181	0 = Not Inverted 1 = Inverted
P2.2.7	AI1 Joystick Hyst	0.00	20.00	%	0.00	178	
P2.2.8	AI1 Sleep Limit	0.00	100.00	%	0.00	179	
P2.2.9	AI1 Sleep Delay	0.00	320.00	s	0.00	180	
P2.2.10	AI1 Joystick Offset	-50.00	50.00	%	0.00	133	

Table 108. AI2 settings—P2.3.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P2.3.1	AI2 Mode				0	223	0 = 0–20 mA 1 = 0 -10 V 2 = –10 to +10 V
P2.3.2	AI2 Signal Range				1	183	0 = 0–100%/ 0–20 mA/0–10 V/–10 to 10 V 1 = 20–100%/ 4–20 mA/2–10 V/–6- to 10 V 2 = Customized
P2.3.3	AI2 Custom Min	0.00	See Par ID 185	%	0.00	184	
P2.3.4	AI2 Custom Max	See Par ID 184	100.00	%	100.00	185	
P2.3.5	AI2 Filter Time	0.00	10.00	s	0.10	182	
P2.3.6	AI2 Signal Invert				0	189	See Par ID 181
P2.3.7	AI2 Joystick Hyst	0.00	20.00	%	0.00	186	
P2.3.8	AI2 Sleep Limit	0.00	100.00	%	0.00	187	
P2.3.9	AI2 Sleep Delay	0.00	320.00	s	0.00	188	
P2.3.10	AI2 Joystick Offset	-50.00	50.00	%	0.00	134	

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 109. Fine adjust—P2.4.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P2.4.1 ①	Fine Tuning Input				0	2484	0 = Not Used 1 = AI1 2 = AI2 3 = Slot A: AI1 4 = Slot B: AI1 5 = Fieldbus
P2.4.2 ①	Fine Tuning Min	0.0	100.0	%	0.0	2485	
P2.4.3 ①	Fine Tuning Max	0.0	100.0	%	0.0	2486	

Table 110. Digital input—P3.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P3.1 ①	IO Terminal 1 Start Stop Logic				0	143	0 = Forward - Reverse 1 = Start - Reverse 2 = Start - Enable 3 = 3 Wire Control
P3.2 ②⑤	IO Terminal 1 Start Signal 1				2	190	0 = DigIN:NormallyOpen 1 = DigIN:NormallyClose 2 = DigIN: 1 3 = DigIN: 2 4 = DigIN: 3 5 = DigIN: 4 6 = DigIN: 5 7 = DigIN: 6 8 = DigIN: 7 9 = DigIN: 8 10 = DigIN: A: IO1: 1 11 = DigIN: A: IO1: 2 12 = DigIN: A: IO1: 3 13 = DigIN: A: IO5: 1 14 = DigIN: A: IO5: 2 15 = DigIN: A: IO5: 3 16 = DigIN: A: IO5: 4 17 = DigIN: A: IO5: 5 18 = DigIN: A: IO5: 6 19 = DigIN: B: IO1: 1 20 = DigIN: B: IO1: 2 21 = DigIN: B: IO1: 3 22 = DigIN: B: IO5: 1 23 = DigIN: B: IO5: 2 24 = DigIN: B: IO5: 3 25 = DigIN: B: IO5: 4 26 = DigIN: B: IO5: 5 27 = DigIN: B: IO5: 6 28 = Time Channel 1 29 = Time Channel 2 30 = Time Channel 3 31 = RO1 Function 32 = RO2 Function 33 = RO3 Function 34 = Virtual RO1 Function 35 = Virtual RO2 Function
P3.3 ② ⑤	IO Terminal 1 Start Signal 2				3	191	See Par ID 190
P3.4 ①	Thermistor Input Select				0	881	0 = Digital Input 1 = Thermistor Input
P3.5 ②③	Reverse				0	198	See Par ID 190
P3.6 ②③	Ext. Fault 1 NO				4	192	See Par ID 190
P3.7 ②③	Ext. Fault 1 NC				1	193	See Par ID 190
P3.8 ②④	Fault Reset				5	200	See Par ID 190
P3.9 ②③	Run Enable				1	194	See Par ID 190
P3.10 ②③	Preset Speed B0				6	205	See Par ID 190

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 110. Digital input—P3, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P3.11 ②③	Preset Speed B1				7	206	See Par ID 190
P3.12 ②③	Preset Speed B2				0	207	See Par ID 190
P3.13 ②③	PID1 Control Enable				1	550	See Par ID 190
P3.14 ②③	PID2 Control Enable				1	553	See Par ID 190
P3.15 ②③	Accel/Decel Time Set				0	195	See Par ID 190
P3.16 ②③	Accel/Decel Prohibit				0	201	See Par ID 190
P3.17 ②④	No Access To Param				0	215	See Par ID 190
P3.21 ②③	Remote Control				9	196	See Par ID 190
P3.22 ②③	Local Control				0	197	See Par ID 190
P3.23 ②③	Remote 1/2 Select				0	209	See Par ID 190
P3.24 ②③	Second Motor Para Select				0	217	See Par ID 190
P3.25 ②③	Force Bypass				0	218	See Par ID 190
P3.26 ②③	DC Brake Active				0	202	See Par ID 190
P3.27 ②③	Smoke Mode				0	219	See Par ID 190
P3.28 ②③	Fire Mode				0	220	See Par ID 190
P3.29 ②③	Fire Mode Ref 1/2 Select				0	221	See Par ID 190
P3.30 ②③	PID1 Set Point Select				0	351	See Par ID 190
P3.31 ②③	PID2 Set Point Select				0	352	See Par ID 190
P3.32 ②③	Jog Enable				0	199	See Par ID 190
P3.33 ③	Start Timer 1				0	224	See Par ID 190
P3.34 ③	Start Timer 2				0	225	See Par ID 190
P3.35 ③	Start Timer 3				0	226	See Par ID 190
P3.36 ②③	AI Ref Source Select				0	208	See Par ID 190
P3.37 ②③	Motor Interlock 1				0	210	See Par ID 190
P3.38 ②③	Motor Interlock 2				0	211	See Par ID 190
P3.39 ②③	Motor Interlock 3				0	212	See Par ID 190
P3.40 ②③	Motor Interlock 4				0	213	See Par ID 190
P3.41 ②③	Motor Interlock 5				0	214	See Par ID 190
P3.42 ②③	Ext Fault-AR				1	747	See Par ID 190
P3.43 ②③	Bypass Overload				0	1246	See Par ID 190
P3.44 ②③	Fire Mode Direction Invert				0	2119	See Par ID 190
P3.45 ①	IO Terminal 2 Start Stop Logic				0	2206	See Par ID 143
P3.46 ②⑤	IO Terminal 2 Start Signal 1				2	2207	See Par ID 190
P3.47 ②⑤	IO Terminal 2 Start Signal 2				3	2208	See Par ID 190
P3.48 ②③	Ext. Fault 2 NO				0	2293	See Par ID 190
P3.49 ②③	Ext. Fault 2 NC				1	2294	See Par ID 190
P3.50 ②③	Ext. Fault 3 NO				0	2295	See Par ID 190
P3.51 ②③	Ext. Fault 3 NC				1	2296	See Par ID 190

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 110. Digital input—P3, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P3.52	Ext. Fault 1 Text				0	2297	0 = External Fault 1 = Vibration Cut out 2 = High Motor temp 3 = Low Pressure 4 = High Pressure 5 = Low Water 6 = Damper Interlock 7 = Run Enable 8 = Freeze Stat Trip 9 = Smoke Detect 10 = Seal Leakage 11 = Rod Breakage 12= Torque Limit
P3.53	Ext. Fault 2 Text				1	2298	See Par ID 2297
P3.54	Ext. Fault 3 Text				2	2299	See Par ID 2297
P3.55 ②④	Parameter Set1/2 Sel				0	2312	See Par ID 190
P3.56 ②③	Deragging Enable				0	2394	See Par ID 190
P3.57 ②③	HOA On/Off				1	2395	See Par ID 190
P3.58 ③	Multi-pump Mode 1/2 Select				0	2658	See Par ID 190
P3.59 ②③	OP Cont Interlock NO				4	2801	See Par ID 190
P3.60 ②③	OP Cont Interlock NC				1	2802	See Par ID 190
P3.61 ③	CP Interlock NC				1	2894	See Par ID 190

Table 111. Analog output—P4.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P4.1	AO1 Mode				0	227	See Par ID 222
P4.2 ②	AO1 Function				1	146	0 = Not Used 1 = Output Frequency 2 = Freq Reference 3 = Motor Speed 4 = Motor Current 5 = Motor Torque (0-Nom) 6 = Motor Power 7 = Motor Voltage 8 = DC-Bus Voltage 9 = PID1 Setpoint 10 = PID1 Feedback 1 11 = PID1 Feedback 2 12 = PID1 Control Error Value 13 = PID1 Control Output 14 = PID2 Setpoint 15 = PID2 Feedback 1 16 = PID2 Feedback 2 17 = PID2 Control Error Value 18 = PID2 Control Output 19 = AI1 20 = AI2 21 = Output Freq (-2-+2N) 22 = Motor Torque (-2-+2N) 23 = Motor Power (-2-+2N) 24 = PT100 Temperature 25 = FB Process Data Input 1 26 = FB Process Data Input 2 27 = FB Process Data Input 3 28 = FB Process Data Input 4 29 = FB Process Data Input 5 30 = FB Process Data Input 6 31 = FB Process Data Input 7 32 = FB Process Data Input 8

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 111. Analog output—P4, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P4.2 ②, continued	AO1 Function				1	146	33 = SlotA PT100 Temp Channel 1 34 = SlotA PT100 Temp Channel 2 35 = SlotA PT100 Temp Channel 3 36 = SlotB PT100 Temp Channel 1 37 = SlotB PT100 Temp Channel 2 38 = SlotB PT100 Temp Channel 3 39 = User Defined Output 40 = Motor Current (-2-+2N)
P4.3	AO1 Minimum				1	149	0 = 0V / 0 mA 1 = 2V / 4 mA
P4.4	AO1 Filter Time	0.00	10.00	s	1.00	147	
P4.5	AO1 Scale	10	1000	%	100	150	
P4.6	AO1 Inversion				0	148	See Par ID 181
P4.7	AO1 Offset	-100.00	100.00	%	0.00	173	
P4.8	AO2 Mode				0	228	See Par ID 222
P4.9 ②	AO2 Function				4	229	See Par ID 146
P4.10	AO2 Minimum				1	232	See Par ID 149
P4.11	AO2 Filter Time	0.00	10.00	s	1.00	230	
P4.12	AO2 Scale	10	1000	%	100	233	
P4.13	AO2 Inversion				0	231	See Par ID 181
P4.14	AO2 Offset	-100.00	100.00	%	0.00	234	

Table 112. Digital output—P5.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P5.1 ②	DO1 Function				1	151	0 = Not Used 1 = Ready 2 = Run 3 = Fault 4 = Fault Invert 5 = Warning 6 = Reversed 7 = At Speed 8 = Zero Frequency 9 = Freq Limit 1 Superv 10 = Freq Limit 2 Superv 11 = PID1 Superv 12 = PID2 Superv 13 = OverHeat Fault 14 = OCurrent Fault 15 = OVolt Fault 16 = UVolt Fault Resp 17 = 4mA Ref Fault/Warning 20 = Torq Limit Superv 21 = Ref Limit Superv 22 = Control from I/O 23 = Un-Requested Rotation Direction 24 = Thermistor Fault Output 25 = Fire Mode 26 = In Bypass Mode 27 = Ext Fault/Warning 28 = Remote Control 29 = Jog Speed Select

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 112. Digital output—P5, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P5.1 ②, continued	DO1 Function				1	151	30 = Motor Therm Protection 31 = FB Digital Input 1 32 = FB Digital Input 2 33 = FB Digital Input 3 34 = FB Digital Input 4 35 = Damper Control 36 = TC1 Status 37 = TC2 Status 38 = TC3 Status 39 = In E-Stop 40 = Power Limit Superv 41 = Temp Limit Superv 42 = Analog Input Superv 43 = Motor 1 Control 44 = Motor 2 Control 45 = Motor 3 Control 46 = Motor 4 Control 47 = Motor 5 Control 49 = PID1 Sleep 50 = PID2 Sleep 51 = Motor Current 1 Supv 52 = Motor Current 2 Supv 53 = Second AI Limit Supv 54 = DC Charge Switch Close 55 = Preheat Active 56 = Cold Weather Active 57 = Prime Pump Active 58 = 2nd Stage Ramp Frequency Active 59 = STO Fault Output 60 = Run Bypass/Drive 61 = Bypass Overload 62 = Bypass Run 63 = Auto Local On COM Fault 64 = FieldBus RTU Fault 65 = FieldBus TCP Fault 66 = FieldBus MSTP Fault 67 = FieldBus EIP Fault 68 = FieldBus SlotA Fault 69 = FieldBus SlotB Fault 70 = FieldBus SWD Fault 71 = Jockey Pump Active 72 = Lube Pump Active 73 = PID1 Low Feedback 74 = PID1 High Feedback 75 = PID2 Low Feedback 76 = PID2 High Feedback 77 = Master in MPFC 78 = CP Interlock Fault
P5.2 ②	RO1 Function				2	152	See Par ID 151
P5.3 ②	RO2 Function				3	153	See Par ID 151
P5.4 ②	RO3 Function				7	538	See Par ID 151
P5.5 ②	Virtual RO1 Function				0	2463	See Par ID 151
P5.6 ②	Virtual RO2 Function				0	2464	See Par ID 151
P5.7 ②	Freq Limit 1 Supv				0	154	0 = No Limit 1 = Low Limit Superv 2 = High Limit Superv
P5.8	Freq Limit 1 Supv Val	0.00	See Par ID 102	Hz	0.00	155	
P5.9 ②	Freq Limit 2 Supv				0	157	0 = No Limit 1 = Low Limit Superv 2 = High Limit Superv
P5.10	Freq Limit 2 Supv Val	0.00	See Par ID 102	Hz	0.00	158	

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 112. Digital output—P5, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P5.11 ②	Torque Limit Supv				0	159	0 = No Limit 1 = Low Limit Superv 2 = High Limit Superv
P5.12 ②	Torque Limit Supv Val	-1000.0	1000.0	%	100.0	160	
P5.13	Ref Limit Supv				0	161	0 = No Limit 1 = Low Limit Superv 2 = High Limit Superv
P5.14	Ref Limit Supv Val	0.00	See Par ID 102	Hz	0.00	162	
P5.17	Temp Limit Supv				0	165	See Par ID 161
P5.18	Temp Limit Supv Val	-10.0	75.0	Deg. C	40.0	166	
P5.19	Power Limit Supv				0	167	See Par ID 161
P5.20	Power Limit Supv Val	-200.0	200.0	%	0.0	168	
P5.21	AI Supv Select				0	170	0 = AI1 1 = AI2
P5.22	AI Limit Supv				0	171	See Par ID 161
P5.23	AI Limit Supv Val	0.00	100.00	%	0.00	172	
P5.24	PID1 Superv Enable				0	1346	See Par ID 2462
P5.25	PID1 Superv Upper Limit	See Par ID 1298	See Par ID 1300	Varies	0.00	1347	
P5.26	PID1 Superv Lower Limit	See Par ID 1298	See Par ID 1300	Varies	0.00	1349	
P5.27	PID1 Superv Delay	0	3000	s	0	1351	
P5.28	PID2 Superv Enable				0	1408	See Par ID 2462
P5.29	PID2 Superv Upper Limit	See Par ID 1360	See Par ID 1362	Varies	0.00	1409	
P5.30	PID2 Superv Lower Limit	See Par ID 1360	See Par ID 1362	Varies	0.00	1411	
P5.31	PID2 Superv Delay	0	3000	s	0	1413	
P5.32	RO1 On Delay	0.0	320.0	s	0.0	2112	
P5.33	RO1 Off Delay	0.0	320.0	s	0.0	2113	
P5.34	RO2 On Delay	0.0	320.0	s	0.0	2114	
P5.35	RO2 Off Delay	0.0	320.0	s	0.0	2115	
P5.36	RO3 On Delay	0.0	320.0	s	0.0	2116	
P5.37	RO3 Off Delay	0.0	320.0	s	0.0	2117	
P5.38	RO3 Reverse				0	2118	0 = No 1 = Yes
P5.39 ②	Motor Current 1 Supv				0	2189	See Par ID 159
P5.40	Motor Current 1 Supv Value	0.0	DriveNomCurrCT*2	A	DriveNomCurrCT	2190	
P5.41 ②	Motor Current 2 Supv				0	2191	See Par ID 159
P5.42	Motor Current 2 Supv Value	0.0	DriveNomCurrCT*2	A	DriveNomCurrCT	2192	
P5.43	Second AI Supv Select				0	2193	See Par ID 170
P5.44	Second AI Limit Supv				0	2194	See Par ID 161
P5.45	Second AI Limit Supv Val	0.00	100.00	%	0.00	2195	
P5.46	Motor Current 1 Supv Hyst	0.1	1.0	A	0.1	2196	
P5.47	Motor Current 2 Supv Hyst	0.1	1.0	A	0.1	2197	
P5.48	AI Supv Hyst	1.00	10.00	%	1.00	2198	
P5.49	Second AI Supv Hyst	1.00	10.00	%	1.00	2199	
P5.50	Freq Limit 1 Supv Hyst	0.10	1.00	Hz	0.10	2200	

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 112. Digital output—P5, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P5.51	Freq Limit 2 Supv Hyst	0.10	1.00	Hz	0.10	2201	
P5.52	Torque Limit Supv Hyst	1.0	5.0	%	1.0	2202	
P5.53	Ref Limit Supv Hyst	0.10	1.00	Hz	0.10	2203	
P5.54	Temp Limit Supv Hyst	1.0	10.0	Deg. C	1.0	2204	
P5.55	Power Limit Supv Hyst	0.1	10.0	%	0.1	2205	
P5.56	Virtual RO1 On Delay	0.0	320.0	s	0.0	2848	
P5.57	Virtual RO1 Off Delay	0.0	320.0	s	0.0	2849	
P5.58	Virtual RO2 On Delay	0.0	320.0	s	0.0	2850	
P5.59	Virtual RO2 Off Delay	0.0	320.0	s	0.0	2851	

Table 113. Drive control—P7.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P7.1	Remote 2 Control Place				1	138	See Par ID 135
P7.2 ①②	Remote 2 Reference				7	139	See Par ID 136
P7.3	Keypad Reference	See Par ID 101	See Par ID 102	Hz	0.00	141	
P7.4	Keypad Direction				0	116	0 = Forward 1 = Reverse
P7.5	Keypad Stop				1	114	0 = Enabled-Keypad Operation 1 = Always Enabled
P7.6	Jog Reference	0.00	See Par ID 102	Hz	5.00	117	
P7.9	Start Mode				0	252	0 = Ramp 1 = Flying Start From Stop Frequency 2 = Flying Start From Max Frequency
P7.10	Stop Mode				1	253	0 = Coasting 1 = Ramp
P7.11	Ramp 1 Shape	0.0	10.0	s	0.0	247	
P7.12	Ramp 2 Shape	0.0	10.0	s	0.0	248	
P7.13	Accel Time 2	0.1	3000.0	s	10.0	249	
P7.14	Decel Time 2	0.1	3000.0	s	10.0	250	
P7.15	Skip F1 Low Limit	0.00	See Par ID 257	Hz	0.00	256	
P7.16	Skip F1 High Limit	See Par ID 256	400.00	Hz	0.00	257	
P7.17	Skip F2 Low Limit	0.00	See Par ID 259	Hz	0.00	258	
P7.18	Skip F2 High Limit	See Par ID 258	400.00	Hz	0.00	259	
P7.19	Skip F3 Low Limit	0.00	See Par ID 261	Hz	0.00	260	
P7.20	Skip F3 High Limit	See Par ID 260	400.00	Hz	0.00	261	
P7.21	Skip Range Ramp Factor	0.1	10.0		1.0	264	
P7.22	Power Loss Function				0	267	0 = Disabled 1 = Decel Mode 2 = Coast Mode
P7.23	Power Loss Time	0.3	5.0	s	2.0	268	
P7.24	Currency				0	2122	0 = $ 1 = £ 2 = € 3 = ¥ 4 = Rs 5 = R$ 6 = Fr 7 = kr
P7.25	Energy Cost			Varies	0.00	2123	

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 113. Drive control—P7, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P7.26	Data Type				0	2124	0 = Cumulative 1 = Daily Avg 2 = Weekly Avg 3 = Monthly Avg 4 = Yearly Avg
P7.27	Energy Savings Reset					2125	0 = Not Reset 1 = Reset
P7.28 ①	2nd Stage Ramp Frequency	See Par ID 101	See Par ID 102	Hz	30.00	2444	
P7.29	Change PhaseSequence Motor				0	2515	0 = Change Disable 1 = Change Enable
P7.30	Run Remove Stop Mode				0	2667	See Par ID 253

Table 114. Motor control—P8.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P8.1 ①②	Motor Control Mode				0	287	0 = Freq Control 1 = Speed Control
P8.2 ①	Current Limit	DriveNomCurrCT*1/10	DriveNomCurrCT*2	A	DriveNomCurrVT	107	
P8.3 ①	V/Hz Optimization				0	109	See Par ID 2462
P8.4 ①	V/Hz Ratio				0	108	0 = Linear 1 = Squared 2 = Programmable 3 = Linear + Flux Optimization
P8.5 ①	Field Weakening Point	8.00	400.00	Hz	FieldWeakPointMFG	289	
P8.6 ①	Voltage at FWP	10.00	200.00	%	100.00	290	
P8.7 ①	V/Hz Mid Frequency	0.00	See Par ID 289	Hz	VHzCurveMidFreqMFG	291	
P8.8 ①	V/Hz Mid Voltage	0.00	100.00	%	100.00	292	
P8.9 ①	Zero Frequency Voltage	0.00	40.00	%	0.00	293	
P8.10	Switching Frequency	MinSwitchFreq	MaxSwitchFreq	kHz	DefaultSwitchFreqCT	2522	
P8.11	Sine Filter Enable				0	1665	See Par ID 2462
P8.12 ①	OverVoltage Control				3	294	0 = Disabled 1 = REF + 8Hz 2 = Max Freq 3 = Max Freq + 8Hz
P8.14 ②	Identification				0	299	0 = No Action 1 = Identification Only Stator Resistor
P8.17	Frequency Ramp Out FilterTime Constant	0	3000	ms	0	1585	
P8.50 ①	Stator Resistor	0.001	65.535	ohm	0.001	771	
P8.59	V/F Stable Kd	0	3000	%	100	1656	
P8.60	V/F Stable Kq	0	3000	%	100	1657	
P8.61 ①	Overmodulation Enable				0	2835	See Par ID 2462
P8.71	Slip Compensation Coefficient	0	500	%	100	1664	

Table 115. Protections—P9.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 115. Protections—P9, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P9.1 ①	4mA Input Fault				0	306	0 = No Action 1 = Warning 2 = Warning: Previous Freq 3 = Warning: Preset Freq 4 = Fault 5 = Fault, Coast
P9.2 ①	4mA Fault Frequency	0.00	See Par ID 102	Hz	0.00	331	
P9.3 ①	External Fault				2	307	0 = No Action 1 = Warning 2 = Fault 3 = Fault, Coast
P9.4 ①	Input Phase Fault				2	332	0 = No Action 1 = Warning 2 = Fault 3 = Fault, Coast 4 = Single Phase Power Limit
P9.5 ①	Uvolt Fault Response				2	330	See Par ID 307
P9.6 ①	Output Phase Fault				2	308	See Par ID 307
P9.7 ①	Ground Fault				2	309	See Par ID 307
P9.8 ①	Motor Thermal Protection				2	310	See Par ID 307
P9.9	Motor Thermal F0 Current	0.0	150.0	%	100.0	311	
P9.11 ①	Stall Protection				0	313	See Par ID 307
P9.12	Stall Current Limit	0.1	ActiveMotor NomCurr*2	A	ActiveMotor NomCurr*13/10	314	
P9.13	Stall Time Limit	1.0	120.0	s	15.0	315	
P9.14	Stall Frequency Limit	1.00	See Par ID 102	Hz	25.00	316	
P9.15 ①	Underload Protection				0	317	See Par ID 307
P9.16	Underload Fnom Torque	10.0	150.0	%	50.0	318	
P9.17	Underload F0 Torque	5.0	150.0	%	10.0	319	
P9.18	Underload Time Limit	2.00	600.00	s	20.00	320	
P9.19 ①	Thermistor Fault Response				2	333	See Par ID 307
P9.20	Line Start Lockout				2	750	0 = Disabled, No Change 1 = Enable, No Change 2 = Disabled, Changed 3 = Enable, Changed
P9.21 ①	Fieldbus Fault Response				2	334	0 = No Action 1 = Warning 2 = Fault 3 = Fault, Coast 4 = Warning, Coast 5 = Warning, Auto Switch To Local 6 = Warning, Auto Switch To Preset Speed 1
P9.22 ①	OPTCard Fault Response				2	335	See Par ID 307
P9.23 ①	Unit Under Temp Prot				2	1564	See Par ID 307
P9.24	AR Wait Time	1.00	300.00	s	1.00	321	
P9.25	AR Trail Time	0.00	600.00	s	30.00	322	
P9.26	AR Start Function				0	323	0 = Flying Start From Stop Frequency 1 = Ramp 2 = Flying Start From Max Frequency

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 115. Protections—P9, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P9.27	Undervoltage Attempts	0	10		1	324	
P9.28	OverVoltage Attempts	0	10		1	325	
P9.29	OverCurrent Attempts	0	3		1	326	
P9.30	4mA Fault Attempts	0	10		1	327	
P9.31	Motor Temp Fault Attempts	0	10		1	329	
P9.32	External Fault Attempts	0	10		1	328	
P9.33	Underload Attempts	0	10		1	336	
P9.34 ①	RTC Fault				1	955	See Par ID 307
P9.35 ①	PT100 Fault Response				2	337	See Par ID 307
P9.36 ①	Replace Battery Fault Response				1	1256	See Par ID 307
P9.37 ①	Replace Fan Fault Response				1	1257	See Par ID 307
P9.38 ①	IP Address Confliction Resp				1	1678	See Par ID 307
P9.39	Cold Weather Mode				0	2126	See Par ID 2462
P9.40	Cold Weather Volt. Level	0.0	20.0	%	2.0	2127	
P9.41	Cold Weather Time Out	0	10	min	3	2128	
P9.42	Cold Weather Password					2129	
P9.43	Under Temp Fault Override					2130	See Par ID 2118
P9.44	Ground Fault Limit	0	30	%	15	2158	
P9.45 ①	Keypad Comm Fault Response				2	2157	See Par ID 307
P9.46	Preheat Mode				0	2159	See Par ID 2462

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 115. Protections—P9, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P9.47 ②	Preheat Control Source				31	2160	0 = DigIN:NormallyOpen 1 = DigIN:NormallyClose 2 = DigIN: 1 3 = DigIN: 2 4 = DigIN: 3 5 = DigIN: 4 6 = DigIN: 5 7 = DigIN: 6 8 = DigIN: 7 9 = DigIN: 8 10 = DigIN: A: IO1: 1 11 = DigIN: A: IO1: 2 12 = DigIN: A: IO1: 3 13 = DigIN: A: IO5: 1 14 = DigIN: A: IO5: 2 15 = DigIN: A: IO5: 3 16 = DigIN: A: IO5: 4 17 = DigIN: A: IO5: 5 18 = DigIN: A: IO5: 6 19 = DigIN: B: IO1: 1 20 = DigIN: B: IO1: 2 21 = DigIN: B: IO1: 3 22 = DigIN: B: IO5: 1 23 = DigIN: B: IO5: 2 24 = DigIN: B: IO5: 3 25 = DigIN: B: IO5: 4 26 = DigIN: B: IO5: 5 27 = DigIN: B: IO5: 6 28 = Time Channel 1 29 = Time Channel 2 30 = Time Channel 3 31 = Drive Temperature 32 = SlotA PT100 Temp Channel 1 33 = SlotA PT100 Temp Channel 2 34 = SlotA PT100 Temp Channel 3 35 = SlotA Max PT100 Temp 36 = SlotB PT100 Temp Channel 1 37 = SlotB PT100 Temp Channel 2 38 = SlotB PT100 Temp Channel 3 39 = SlotB Max PT100 Temp 40 = SlotA and SlotB Max PT100 Temp
P9.48	Preheat Enter Temp	-20.0	20.0	Deg. C	10.0	2161	
P9.49	Preheat Quit Temp	-10.0	40.0	Deg. C	20.0	2162	
P9.50	Preheat Output Volt	0.0	20.0	%	2.0	2163	
P9.51 ①	PID Feedback AI Loss Response				0	2410	0 = No Action 1 = Warning 2 = Fault 3 = Warning: Preset Freq 4 = Warning: Analog->Net
P9.52 ①	PID Feedback AI Loss Pre Freq	0.00	400.00	Hz	0.00	2402	
P9.53	PID Feedback AI Loss Pipe Fill Loss Level	0.0	1000.0	Varies	0.0	2403	
P9.54	PID Feedback AI Loss PreFreq Timeout	0	6000	s	0	2404	
P9.55	PID Feedback AI Loss Attempts	0	10		1	2405	

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 115. Protections—P9, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P9.56	STO Fault Response				2	2427	0 = No Action 1 = Warning 2 = Fault
P9.57	Fault Reset Start				0	2483	0 = Follow Run Command 1 = Rising Edge After Fault Reset
P9.58	Warning Operation Mode				1	2657	0 = No Action 1 = Warning, No Store 2 = Warning, Store
P9.59	Fan Protection				2	2664	See Par ID 307
P9.60	Under Voltage Trip Level	DCLinkUnderVolt StopLimit	DCLinkOverVolt StopLimit	V	DCLinkUnderVolt ProtectLimit	2666	
P9.61	OP Cont Interlock Attempts	0	10		1	2803	
P9.62 ①	OP Cont Interlock Protection				2	2831	See Par ID 307
P9.63 ①	CP Interlock Run Protection				2	2895	See Par ID 307
P9.64 ①	CP Interlock Stop Protection				1	2896	0 = No Action 1 = Warning, No Store
P9.65	CP Interlock Attempts	0	10		1	2897	

Table 116. PID controller 1—P10.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P10.1	PID1 Control Gain	0.00	200.00	%	100.00	1294	
P10.2	PID1 Control ITime	0.00	600.00	s	1.00	1295	
P10.3	PID1 Control DTime	0.00	100.00	s	0.00	1296	
P10.4 ①	PID1 Process Unit				0	1297	0 = % 1 = 1/min 2 = rpm 3 = ppm 4 = pps 5 = l/s 6 = l/min 7 = l/h

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 116. PID controller 1—P10, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P10.4 ①②, continued	PID1 Process Unit				0	1297	8 = kg/s 9 = kg/min 10 = kg/h 11 = m3/s 12 = m3/min 13 = m3/h 14 = m/s 15 = mbar 16 = bar 17 = Pa 18 = kPa 19 = mVS 20 = kW 21 = Deg. C 22 = GPM 23 = gal/s 24 = gal/min 25 = gal/h 26 = lb/s 27 = lb/min 28 = lb/h 29 = CFM 30 = ft3/s 31 = ft3/min 32 = ft3/h 33 = ft/s 34 = in wg 35 = ft wg 36 = PSI 37 = lb/in2 38 = HP 39 = Deg. F 40 = PA 41 = WC 42 = HG 43 = ft 44 = m
P10.5	PID1 Process Unit Min	-99999.99	See Par ID 1300	Varies	0.00	1298	
P10.6	PID1 Process Unit Max	See Par ID 1298	99999.99	Varies	100.00	1300	
P10.7	PID1 Process Unit Decimal	0	4		2	1302	
P10.8 ①	PID1 Error Inversion				0	1303	See Par ID 181
P10.9	PID1 Dead Band	0.00	99999.99	Varies	0.00	1304	
P10.10	PID1 Dead Band Delay	0.00	320.00	s	0.00	1306	
P10.11	PID1 Keypad Set Point 1	See Par ID 1298	See Par ID 1300	Varies	0.00	1307	
P10.12	PID1 Keypad Set Point 2	See Par ID 1298	See Par ID 1300	Varies	0.00	1309	
P10.13	PID1 Ramp Time	0.00	300.00	s	0.00	1311	
P10.14 ①②	PID1 Set Point 1 Source				1	1312	0 = Not Used 1 = PID1 Keypad Set Point 1 2 = PID1 Keypad Set Point 2 3 = AI1 4 = AI2 5 = Slot A: AI1 6 = Slot B: AI1 7 = FB Process Data Input 1 8 = FB Process Data Input 2 9 = FB Process Data Input 3 10 = FB Process Data Input 4 11 = FB Process Data Input 5

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 116. PID controller 1—P10, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P10.14 ①②, continued	PID1 Set Point 1 Source				1	1312	12 = FB Process Data Input 6 13 = FB Process Data Input 7 14 = FB Process Data Input 8 15 = PID2 Output 16 = Multi Drive Network 17 = FB PID1 Set Point 1 18 = FB PID1 Set Point 2
P10.15	PID1 Set Point 1 Min	-200.00	200.00	%	0.00	1313	
P10.16	PID1 Set Point 1 Max	-200.00	200.00	%	100.00	1314	
P10.17 ①	PID1 Set Point 1 Sleep Enable				0	1315	See Par ID 2462
P10.18 ①	PID1 Set Point 1 Sleep Unit Sel				0	2396	0 = Output Frequency 1 = Motor Speed 2 = Motor Current 3 = PID1 Feedback
P10.19	PID1 Set Point 1 Sleep Level			Varies	0.00	2450	
P10.20	PID1 Set Point 1 Sleep Delay	0	3000	s	0	1317	
P10.21	PID1 Set Point 1 Wake Up Level	-99999.99	99999.99	Varies	0.00	1318	
P10.22	PID1 Set Point 1 Boost	-2.0	2.0		1.0	1320	
P10.23 ①②	PID1 Set Point 2 Source				2	1321	See Par ID 1312
P10.24	PID1 Set Point 2 Min	-200.00	200.00	%	0.00	1322	
P10.25	PID1 Set Point 2 Max	-200.00	200.00	%	100.00	1323	
P10.26 ①	PID1 Set Point 2 Sleep Enable				0	1324	See Par ID 2462
P10.27 ①	PID1 Set Point 2 Sleep Unit Sel				0	2397	See Par ID 2396
P10.28	PID1 Set Point 2 Sleep Level			Varies	0.00	2452	
P10.29	PID1 Set Point 2 Sleep Delay	0	3000	s	0	1326	
P10.30	PID1 Set Point 2 Wake Up Level	-99999.99	99999.99	Varies	0.00	1327	
P10.31	PID1 Set Point 2 Boost	-2.0	2.0		1.0	1329	
P10.32 ①	PID1 Feedback Function				0	1330	0 = Source 1 1 = SQRT(Source 1) 2 = SQRT(Source 1 - Source 2) 3 = SQRT(Source 1) + SQRT(Source 2) 4 = Source 1 + Source 2 5 = Source 1 - Source 2 6 = MIN(Source 1,Source 2) 7 = MAX(Source 1,Source 2) 8 = MEAN(Source1,Source2) 9 = Source1*Source2
P10.33	PID1 Feedback Gain	-1000.0	1000.0	%	100.0	1331	
P10.34 ①②	PID1 Feedback 1 Source				2	1332	0 = Not Used 1 = AI1 2 = AI2 3 = Slot A: AI1 4 = Slot B: AI1 5 = FB Process Data Input 1 6 = FB Process Data Input 2 7 = FB Process Data Input 3 8 = FB Process Data Input 4 9 = FB Process Data Input 5

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 116. PID controller 1—P10, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P10.34 ①②, continued	PID1 Feedback 1 Source				2	1332	10 = FB Process Data Input 6 11 = FB Process Data Input 7 12 = FB Process Data Input 8 13 = PT100 Temperture 14 = PID2 Output 15 = SlotA PT100 Temp Channel 1 16 = SlotA PT100 Temp Channel 2 17 = SlotA PT100 Temp Channel 3 18 = SlotB PT100 Temp Channel 1 19 = SlotB PT100 Temp Channel 2 20 = SlotB PT100 Temp Channel 3 21 = FB PID1 Feedback 1 22 = FB PID1 Feedback 2
P10.35	PID1 Feedback 1 Min	-200.00	200.00	%	0.00	1333	
P10.36	PID1 Feedback 1 Max	-200.00	200.00	%	100.00	1334	
P10.37 ①②	PID1 Feedback 2 Source				0	1335	See Par ID 1332
P10.38	PID1 Feedback 2 Min	-200.00	200.00	%	0.00	1336	
P10.39	PID1 Feedback 2 Max	-200.00	200.00	%	100.00	1337	
P10.40 ①	PID1 Feedforward Func				0	1338	See Par ID 1330
P10.41	PID1 Feedforward Gain	-1000.0	1000.0	%	100.0	1339	
P10.42 ①②	PID1 Feedforward 1 Source				0	1340	0 = Not Used 1 = AI1 2 = AI2 3 = Slot A: AI1 4 = Slot B: AI1 5 = FB Process Data Input 1 6 = FB Process Data Input 2 7 = FB Process Data Input 3 8 = FB Process Data Input 4 9 = FB Process Data Input 5 10 = FB Process Data Input 6 11 = FB Process Data Input 7 12 = FB Process Data Input 8 13 = PT100 Temperture 14 = PID2 Output 15 = SlotA PT100 Temp Channel 1 16 = SlotA PT100 Temp Channel 2 17 = SlotA PT100 Temp Channel 3 18 = SlotB PT100 Temp Channel 1 19 = SlotB PT100 Temp Channel 2 20 = SlotB PT100 Temp Channel 3 21 = FB PID1 Feedforward 1 22 = FB PID1 Feedforward 2
P10.43	PID1 Feedforward 1 Min	-200.00	200.00	%	0.00	1341	
P10.44	PID1 Feedforward 1 Max	-200.00	200.00	%	100.00	1342	

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 116. PID controller 1—P10, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P10.45 ①②	PID1 Feedforward 2 Source				0	1343	See Par ID 1340
P10.46	PID1 Feedforward 2 Min	-200.00	200.00	%	0.00	1344	
P10.47	PID1 Feedforward 2 Max	-200.00	200.00	%	100.00	1345	
P10.48	PID1 Set Point 1 Comp Enable				0	1352	See Par ID 2462
P10.49	PID1 Set Point 1 Comp Max	-200.00	200.00	%	0.00	1353	
P10.50	PID1 Set Point 2 Comp Enable				0	1354	See Par ID 2462
P10.51	PID1 Set Point 2 Comp Max	-200.00	200.00	%	0.00	1355	
P10.52	PID1 Wake Up Action				0	2466	0 = Below Wake Up Level 1 = Above Wake Up Level 2 = Below Wake Up Level (PID ref.) 3 = Above Wake Up Level (PID ref.)
P10.53	FB PID1 Set Point 1	See Par ID 1298	See Par ID 1300	Varies		2542	
P10.54	FB PID1 Set Point 2	See Par ID 1298	See Par ID 1300	Varies		2544	
P10.55	FB PID1 Feedback 1			%		2550	
P10.56	FB PID1 Feedback 2			%		2551	
P10.57	FB PID1 Feedforward 1			%		2554	
P10.58	FB PID1 Feedforward 2			%		2555	
P10.59	PID1 Sleep Boost level	-9999	9999	Varies	0	2660	
P10.60	PID1 Sleep Boost Max Time	1	300	s	30	2661	
P10.61	PID1 Low Feedback Level	0.0	6000.0	Varies	0.0	2811	
P10.62	PID1 Low Feedback Time	0	3600	s	10	2812	
P10.63 ①	PID1 Low Feedback Protection				0	2813	See Par ID 307
P10.64	PID1 High Feedback Level	0.0	6000.0	Varies	150.0	2814	
P10.65	PID1 High Feedback Time	0	3600	s	5	2815	
P10.66 ①	PID1 High Feedback Protection				0	2816	See Par ID 307
P10.67 ①	PID1 Hysteresis Level	0.0	100.0	Varies	0.0	2817	
P10.68	PID1 Backup Feedback Source				0	2825	0 = Not Used 1 = AI1 2 = AI2 3 = Slot A: AI1 4 = Slot B: AI1

Table 117. PID controller 2—P11.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P11.1	PID2 Control Gain	0.00	200.00	%	100.00	1356	
P11.2	PID2 Control I Time	0.00	600.00	s	1.00	1357	
P11.3	PID2 Control D Time	0.00	100.00	s	0.00	1358	
P11.4 ①	PID2 Process Unit				0	1359	See Par ID 1297
P11.5	PID2 Process Unit Min	-99999.99	See Par ID 1362	Varies	0.00	1360	

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 117. PID controller 2—P11, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P11.6	PID2 Process Unit Max	See Par ID 1360	99999.99	Varies	100.00	1362	
P11.7	PID2 Process Unit Decimal	0	4		2	1364	
P11.8 ①	PID2 Error Inversion				0	1365	See Par ID 181
P11.9	PID2 Dead Band	0.00	99999.99	Varies	0.00	1366	
P11.10	PID2 Dead Band Delay	0.00	320.00	s	0.00	1368	
P11.11	PID2 Keypad Set Point 1	See Par ID 1360	See Par ID 1362	Varies	0.00	1369	
P11.12	PID2 Keypad Set Point 2	See Par ID 1360	See Par ID 1362	Varies	0.00	1371	
P11.13	PID2 Ramp Time	0.00	300.00	s	0.00	1373	
P11.14 ①	PID2 Set Point 1 Source				1	1374	0 = Not Used 1 = PID2 Keypad Set Point 1 2 = PID2 Keypad Set Point 2 3 = AI1 4 = AI2 5 = Slot A: AI1 6 = Slot B: AI1 7 = FB Process Data Input 1 8 = FB Process Data Input 2 9 = FB Process Data Input 3 10 = FB Process Data Input 4 11 = FB Process Data Input 5 12 = FB Process Data Input 6 13 = FB Process Data Input 7 14 = FB Process Data Input 8 15 = PID1 Output 16 = Multi Drive Network 17 = FB PID2 Set Point 1 18 = FB PID2 Set Point 2
P11.15	PID2 Set Point 1 Min	-200.00	200.00	%	0.00	1375	
P11.16	PID2 Set Point 1 Max	-200.00	200.00	%	100.00	1376	
P11.17 ①	PID2 Set Point 1 Sleep Enable				0	1377	See Par ID 2462
P11.18 ①	PID2 Set Point 1 Sleep Unit Sel				0	2398	0 = Output Frequency 1 = Motor Speed 2 = Motor Current 3 = PID2 Feedback
P11.19	PID2 Set Point 1 Sleep Level			Varies	0.00	2454	
P11.20	PID2 Set Point 1 Sleep Delay	0	3000	s	0	1379	
P11.21	PID2 Set Point 1 WakeUp Level	-99999.99	99999.99	Varies	0.00	1380	
P11.22	PID2 Set Point 1 Boost	-2.0	2.0		1.0	1382	
P11.23 ①	PID2 Set Point 2 Source				2	1383	See Par ID 1374
P11.24	PID2 Set Point 2 Min	-200.00	200.00	%	0.00	1384	
P11.25	PID2 Set Point 2 Max	-200.00	200.00	%	100.00	1385	
P11.26 ①	PID2 Set Point 2 Sleep Enable				0	1386	See Par ID 2462
P11.27 ①	PID2 Set Point 2 Sleep Unit Sel				0	2399	See Par ID 2398
P11.28	PID2 Set Point 2 Sleep Level			Varies	0.00	2456	
P11.29	PID2 Set Point 2 Sleep Delay	0	3000	s	0	1388	

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 117. PID controller 2—P11, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P11.30	PID2 Set Point 2 WakeUp Level	-99999.99	99999.99	Varies	0.00	1389	
P11.31	PID2 Set Point 2 Boost	-2.0	2.0		1.0	1391	
P11.32 ①	PID2 Feedback Func				0	1392	See Par ID 1330
P11.33	PID2 Feedback Gain	-1000.0	1000.0	%	100.0	1393	
P11.34 ①	PID2 Feedback 1 Source				2	1394	0 = Not Used 1 = AI1 2 = AI2 3 = Slot A: AI1 4 = Slot B: AI1 5 = FB Process Data Input 1 6 = FB Process Data Input 2 7 = FB Process Data Input 3 8 = FB Process Data Input 4 9 = FB Process Data Input 5 10 = FB Process Data Input 6 11 = FB Process Data Input 7 12 = FB Process Data Input 8 13 = PT100 Temperture 14 = PID1 Output 15 = SlotA PT100 Temp Channel 1 16 = SlotA PT100 Temp Channel 2 17 = SlotA PT100 Temp Channel 3 18 = SlotB PT100 Temp Channel 1 19 = SlotB PT100 Temp Channel 2 20 = SlotB PT100 Temp Channel 3 21 = FB PID2 Feedback 1 22 = FB PID2 Feedback 2
P11.35	PID2 Feedback 1 Min	-200.00	200.00	%	0.00	1395	
P11.36	PID2 Feedback 1 Max	-200.00	200.00	%	100.00	1396	
P11.37 ①	PID2 Feedback 2 Source				0	1397	See Par ID 1394
P11.38	PID2 Feedback 2 Min	-200.00	200.00	%	0.00	1398	
P11.39	PID2 Feedback 2 Max	-200.00	200.00	%	100.00	1399	
P11.40 ①	PID2 Feedforward Func				0	1400	See Par ID 1330
P11.41	PID2 Feedforward Gain	-1000.0	1000.0	%	100.0	1401	
P11.42 ①	PID2 Feedforward 1 Source				0	1402	0 = Not Used 1 = AI1 2 = AI2 3 = Slot A: AI1 4 = Slot B: AI1 5 = FB Process Data Input 1 6 = FB Process Data Input 2 7 = FB Process Data Input 3 8 = FB Process Data Input 4 9 = FB Process Data Input 5 10 = FB Process Data Input 6 11 = FB Process Data Input 7 12 = FB Process Data Input 8 13 = PT100 Temperture 14 = PID1 Output 15 = SlotA PT100 Temp Channel 1

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 117. PID controller 2—P11, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P11.42 ①, continued	PID2 Feedforward 1 Source				0	1402	16 = SlotA PT100 Temp Channel 2 17 = SlotA PT100 Temp Channel 3 18 = SlotB PT100 Temp Channel 1 19 = SlotB PT100 Temp Channel 2 20 = SlotB PT100 Temp Channel 3 21 = FB PID2 Feedforward 1 22 = FB PID2 Feedforward 2
P11.43	PID2 Feedforward 1 Min	-200.00	200.00	%	0.00	1403	
P11.44	PID2 Feedforward 1 Max	-200.00	200.00	%	100.00	1404	
P11.45 ①	PID2 Feedforward 2 Source				0	1405	See Par ID 1402
P11.46	PID2 Feedforward 2 Min	-200.00	200.00	%	0.00	1406	
P11.47	PID2 Feedforward 2 Max	-200.00	200.00	%	100.00	1407	
P11.48	PID2 Set Point1 Comp Enable				0	1414	See Par ID 2462
P11.49	PID2 Set Point1 Comp Max	-200.00	200.00	%	0.00	1415	
P11.50	PID2 Set Point 2 Comp Enable				0	1416	See Par ID 2462
P11.51	PID2 Set Point 2 Comp Max	-200.00	200.00	%	0.00	1417	
P11.52	PID2 Wake Up Action				0	2467	See Par ID 2466
P11.53	FB PID2 Set Point 1	See Par ID 1298	See Par ID 1300	Varies		2546	
P11.54	FB PID2 Set Point 2	See Par ID 1298	See Par ID 1300	Varies		2548	
P11.55	FB PID2 Feedback 1			%		2552	
P11.56	FB PID2 Feedback 2			%		2553	
P11.57	FB PID2 Feedforward 1			%		2556	
P11.58	FB PID2 Feedforward 2			%		2557	
P11.59	PID2 Sleep Boost level	-9999	9999	Varies	0	2662	
P11.60	PID2 Sleep Boost Max Time	1	300	s	30	2663	
P11.61	PID2 Low Feedback Level	0.0	6000.0	Varies	0.0	2818	
P11.62	PID2 Low Feedback Time	0	3600	s	10	2819	
P11.63 ①	PID2 Low Feedback Protection				0	2820	See Par ID 307
P11.64	PID2 High Feedback Level	0.0	6000.0	Varies	150.0	2821	
P11.65	PID2 High Feedback Time	0	3600	s	5	2822	
P11.66 ①	PID2 High Feedback Protection				0	2823	See Par ID 307
P11.67 ①	PID2 Hysteresis Level	0.0	100.0	Varies	0.0	2824	
P11.68	PID2 Backup Feedback Source				0	2826	See Par ID 2825

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 118. Preset speed—P12.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P12.1	Preset Speed 1	0.00	See Par ID 102	Hz	5.00	105	
P12.2	Preset Speed 2	0.00	See Par ID 102	Hz	10.00	106	
P12.3	Preset Speed 3	0.00	See Par ID 102	Hz	15.00	118	
P12.4	Preset Speed 4	0.00	See Par ID 102	Hz	20.00	119	
P12.5	Preset Speed 5	0.00	See Par ID 102	Hz	25.00	120	
P12.6	Preset Speed 6	0.00	See Par ID 102	Hz	30.00	121	
P12.7	Preset Speed 7	0.00	See Par ID 102	Hz	35.00	122	

Table 119. Brake—P14.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P14.1 ①	DC-Brake Current	Drive NomCurrCT*15/100	Drive NomCurrCT*15/10	A	DriveNomCurrCT*1/2	254	
P14.2 ①	Start DC-Brake Time	0.00	600.00	s	0.00	263	
P14.3 ①	Stop DC-Brake Frequency	0.10	10.00	Hz	1.50	262	
P14.4 ①	Stop DC-Brake Time	0.00	600.00	s	0.00	255	
P14.5 ①	Brake Chopper Mode				0	251	0 = Disabled 1 = B(Run) T(Rdy) 2 = External 3 = B(Rdy) T(Rdy) 4 = B(Run) T(No)
P14.6 ①	Flux Brake				0	266	0 = Off 1 = On
P14.7 ①	Flux Brake Current	ActiveMotor NomCurr*1/10	See Par ID 107	A	ActiveMotorNomCurr*1/2	265	

Table 120. Fire mode—P15.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P15.1 ①	Fire Mode Function				0	535	0 = Closing Contact 1 = Opening Contact
P15.2 ①②	Fire Mode Ref Select Function				0	536	0 = Fire Mode Min Frequency 1 = Fire Mode Ref 2 = Fieldbus Ref 3 = AI1 4 = AI2 5 = AI1 + AI2 6 = PID1 Control Output 7 = PID2 Control Output
P15.3	Fire Mode Frequency	See Par ID 101	See Par ID 102	Hz	MotorNomFreqMFG	537	
P15.4	Fire Mode % Speed Ref 1	0.0	100.0	%	75.0	565	
P15.5	Fire Mode % Speed Ref 2	0.0	100.0	%	100.0	564	
P15.6 ①	Smoke Purge Frequency	0.0	100.0	%	50.0	554	
P15.7	Fire Mode Test Enable					2443	See Par ID 2462

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 121. Second motor parameter—P16.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P16.1 ①	Motor Nom Current 2	DriveNomCurrCT*1/10	DriveNomCurrCT*2	A	DriveNomCurrCT	577	
P16.2 ①	Motor Nom Speed 2	300	20000	rpm	SecdMotorNomSpeedMFG	578	
P16.3 ①	Motor PF 2	0.30	1.00		0.85	579	
P16.4 ①	Motor Nom Volt 2	180	690	V	SecdMotorNomVoltMFG	580	
P16.5 ①	Motor Nom Freq 2	8.00	400.00	Hz	SecdMotorNomFreqMFG	581	
P16.6 ①	Stator Resistor 2	0.001	65.535	ohm	0.033	1419	

Bypass

Table 122. Basic setting—P17.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P17.1.1 ①	Bypass Enable				0	1418	See Par ID 2462
P17.1.2 ①	Bypass Start Delay	1	32765	s	5	544	
P17.1.3 ①	Auto Bypass				0	542	See Par ID 2462
P17.1.4 ①	Auto Bypass Delay	0	32765	s	10	543	
P17.1.5 ①	OverCurrent Bypass Enable				0	547	See Par ID 2462
P17.1.6 ①	IGBT Fault Bypas Enable				0	546	See Par ID 2462
P17.1.7 ①	4mA Fault Bypass Enable				0	548	See Par ID 2462
P17.1.8 ①	UnderVoltage Bypass Enable				0	545	See Par ID 2462
P17.1.9 ①	OverVoltage Bypass Enable				0	549	See Par ID 2462
P17.1.10 ①	Motor OverTemp Bypass Enable				0	1698	See Par ID 2462
P17.1.11 ①	UnderLoad Bypass Enable				0	1699	See Par ID 2462
P17.1.12 ①	External Bypass Enable				0	1700	See Par ID 2462
P17.1.13 ①	Charge Switch Fault Bypass Enable				0	1701	See Par ID 2462
P17.1.14 ①	Saturation Trip Fault Bypass Enable				0	1702	See Par ID 2462
P17.1.15 ①	Under Temp Fault Bypass Enable				0	1703	See Par ID 2462
P17.1.16 ①	EEPROM Fault Bypass Enable				0	1704	See Par ID 2462
P17.1.17 ①	Control board EEPROM Fault Bypass Enable				0	1705	See Par ID 2462
P17.1.18 ①	Watchdog Fault Bypass Enable				0	1706	See Par ID 2462
P17.1.19 ①	Fan Cooling Fault Bypass Enable				0	1707	See Par ID 2462
P17.1.20 ①	Keypad Com Fault Bypass Enable				0	1708	See Par ID 2462
P17.1.21 ①	Option Card Fault Bypass Enable				0	1709	See Par ID 2462
P17.1.22 ①	RTC Clock Fault Bypass Enable				0	1710	See Par ID 2462
P17.1.23 ①	Ctrl Board OverTemp Fault Bypass Enable				0	1711	See Par ID 2462

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 122. Basic setting—P17.1, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P17.1.24 ①	Fieldbus Fault Bypass Enable				0	1713	See Par ID 2462
P17.1.25 ①	Op Cont Interlock Fault Bypass Enable				0	2832	See Par ID 2462

Table 123. Redundant drive—P17.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P17.2.1	Redundant Drive Enable				0	2476	See Par ID 2462
P17.2.2 ①	Drive ID	0	5		0	2278	
P17.2.3	Redundant Run Time Enable				0	2477	See Par ID 2462
P17.2.4	Redundant Run Time Reset					2478	See Par ID 2125
P17.2.5	Redundant RunTime Limit	0.00	30000.00	h	0.00	2479	

Pump parameters

Table 124. Basic setting—P18.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.1.1 ①	Multi-pump Mode				0	2279	0 = Disabled 1 = Single Drive Control 2 = Multi Drive Network
P18.1.2 ①	Drive ID	0	5		0	2278	
P18.1.3	PID Bandwidth	0.00	6000.00	Varies	10.00	2458	
P18.1.4 ①	Staging Frequency	See Par ID 101	400.00		50.00	2315	
P18.1.5 ①	De-Staging Frequency	0.00	See Par ID 102		0.00	2316	
P18.1.6	Add/Remove Delay	0	3600	s	10	344	
P18.1.7	Interlock Enable				0	350	See Par ID 2462
P18.1.8 ①	Damper Start				0	483	0 = Normal 1 = Interlock Start 2 = Interlock Tout 3 = Interlock Delay
P18.1.9 ①	Damper Time Out	1	32500	s	5	484	
P18.1.10 ①	Damper Delay	1	32500	s	5	485	
P18.1.11	Derag Cycles	0	10		3	2468	
P18.1.12	Derag at Start/Stop				0	2469	0 = Off 1 = Start 2 = Stop 3 = Start and Stop 4 = Digital Input
P18.1.13	Deragging Run Time	0	3600	s	0	2470	
P18.1.14	Derag Speed	See Par ID 101	See Par ID 102	Hz	5.00	2471	
P18.1.15	Derag Off Delay	1	600	s	10	2472	
P18.1.16 ①	Multi-pump Mode 2				0	2659	See Par ID 2279

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Multi-pump status

Table 125. Operation mode—P18.2.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.2.1.1	MPC Drive1 Operate Mode					2218	0 = Offline 1 = Slave Drive 2 = Master Drive 3 = Redundant Drive
P18.2.1.2	MPC Drive2 Operate Mode					2230	See Par ID 2218
P18.2.1.3	MPC Drive3 Operate Mode					2242	See Par ID 2218
P18.2.1.4	MPC Drive4 Operate Mode					2254	See Par ID 2218
P18.2.1.5	MPC Drive5 Operate Mode					2266	See Par ID 2218

Table 126. Multi-pump status—P18.2.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.2.2.1	MPC Drive1 Status				5	2219	0 = Stopped 1 = Sleep 2 = Regulating 3 = Wait for CMD 4 = Following 5 = Unknown 6 = Master Local Control 7 = Slave Local Control
P18.2.2.2	MPC Drive2 Status				5	2231	See Par ID 2219
P18.2.2.3	MPC Drive3 Status				5	2243	See Par ID 2219
P18.2.2.4	MPC Drive4 Status				5	2255	See Par ID 2219
P18.2.2.5	MPC Drive5 Status				5	2267	See Par ID 2219

Table 127. Network status—P18.2.3.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.2.3.1	MPC Drive1 NetworkStatus					2220	0 = Disconnected 1 = Fault 2 = Local Control 3 = Pump Lost 4 = Need Alternation 5 = No Error
P18.2.3.2	MPC Drive2 NetworkStatus					2232	See Par ID 2220
P18.2.3.3	MPC Drive3 NetworkStatus					2244	See Par ID 2220
P18.2.3.4	MPC Drive4 NetworkStatus					2256	See Par ID 2220
P18.2.3.5	MPC Drive5 NetworkStatus					2268	See Par ID 2220

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Multi-pump measurement

Table 128. Latest fault code—P18.3.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.3.1.1	MPC Drive1 Last Fault Code					2221	
P18.3.1.2	MPC Drive2 Last Fault Code					2233	
P18.3.1.3	MPC Drive3 Last Fault Code					2245	
P18.3.1.4	MPC Drive4 Last Fault Code					2257	
P18.3.1.5	MPC Drive5 Last Fault Code					2269	

Table 129. Output frequency—P18.3.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.3.2.1	MPC Drive1 f-Out			Hz		2222	
P18.3.2.2	MPC Drive2 f-Out			Hz		2234	
P18.3.2.3	MPC Drive3 f-Out			Hz		2246	
P18.3.2.4	MPC Drive4 f-Out			Hz		2258	
P18.3.2.5	MPC Drive5 f-Out			Hz		2270	

Table 130. Motor voltage—P18.3.3.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.3.3.1	MPC Drive1 V-Out			V		2223	
P18.3.3.2	MPC Drive2 V-Out			V		2235	
P18.3.3.3	MPC Drive3 V-Out			V		2247	
P18.3.3.4	MPC Drive4 V-Out			V		2259	
P18.3.3.5	MPC Drive5 V-Out			V		2271	

Table 131. Motor current—P18.3.4.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.3.4.1	MPC Drive1 I-Out			A		2224	
P18.3.4.2	MPC Drive2 I-Out			A		2236	
P18.3.4.3	MPC Drive3 I-Out			A		2248	
P18.3.4.4	MPC Drive4 I-Out			A		2260	
P18.3.4.5	MPC Drive5 I-Out			A		2272	

Table 132. Motor torque—P18.3.5.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.3.5.1	MPC Drive1 M-Out			%		2225	
P18.3.5.2	MPC Drive2 M-Out			%		2237	
P18.3.5.3	MPC Drive3 M-Out			%		2249	
P18.3.5.4	MPC Drive4 M-Out			%		2261	
P18.3.5.5	MPC Drive5 M-Out			%		2273	

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 133. Motor power—P18.3.6.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.3.6.1	MPC Drive1 P-Out			%		2226	
P18.3.6.2	MPC Drive2 P-Out			%		2238	
P18.3.6.3	MPC Drive3 P-Out			%		2250	
P18.3.6.4	MPC Drive4 P-Out			%		2262	
P18.3.6.5	MPC Drive5 P-Out			%		2274	

Table 134. Motor speed—P18.3.7.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.3.7.1	MPC Drive1 n-Out			rpm		2227	
P18.3.7.2	MPC Drive2 n-Out			rpm		2239	
P18.3.7.3	MPC Drive3 n-Out			rpm		2251	
P18.3.7.4	MPC Drive4 n-Out			rpm		2263	
P18.3.7.5	MPC Drive5 n-Out			rpm		2275	

Table 135. Run time—P18.3.8.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.3.8.1	MPC Drive1 t-Run			h		2228	
P18.3.8.2	MPC Drive2 t-Run			h		2240	
P18.3.8.3	MPC Drive3 t-Run			h		2252	
P18.3.8.4	MPC Drive4 t-Run			h		2264	
P18.3.8.5	MPC Drive5 t-Run			h		2276	

Table 136. Multi-pump single drive—P18.4.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.4.1 ①	Number of Pumps	1	5		1	342	
P18.4.2	Include Freq Converter				1	346	See Par ID 2462
P18.4.3	Auto-Change Enable				0	345	See Par ID 2462
P18.4.4	Auto-Change Interval	0.0	3000.0	h	48.0	347	
P18.4.5	Auto-Change Freq Limit	See Par ID 101	See Par ID 102	Hz	25.00	349	
P18.4.6	Auto-Change Pump Limit	0	5		1	348	
P18.4.7 ①	Pipe Fill Aux Pump Select				0	2439	0 = Disabled 1 = Aux Motor 1 2 = Aux Motor 2 3 = Aux Motor 3 4 = Aux Motor 4
P18.4.8 ①	Pipe Fill Aux Pump Run Time	0.0	3600.0	min	0.0	2440	
P18.4.9 ①	Pipe Fill Aux Pump Operation				0	2441	0 = Automatic 1 = Stop
P18.4.10 ①	Pipe Fill Aux Pump Delay	0.0	600.0	min	2.0	2442	

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 137. Multi-pump multi-drive—P18.5.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.5.1 ①	Number of Drives	1	5		1	2449	
P18.5.2 ①	Regulation Source				0	2284	0 = Network Only 1 = PID Controller 1
P18.5.3 ①	Recovery Method				0	2285	See Par ID 2441
P18.5.4 ①	Callback Source				0	2286	0 = No Action 1 = Safety Torque Off
P18.5.5	Add/Remove Drive Selection				0	2311	0 = Drive ID 1 = Run Time
P18.5.6	Run Time Enable				0	2280	See Par ID 2462
P18.5.7	Run Time Limit	0.0	300000.0	h	0.0	2281	
P18.5.8	Run Time Reset				0	2283	0 = No Action 1 = Reset
P18.5.9	Master Drive Mode				0	2473	0 = Follow PID 1 = Fixed Speed 2 = Turn Off
P18.5.10	Master Fixed Speed	See Par ID 101	See Par ID 102	Hz	50.00	2474	
P18.5.11	Master Fixed Speed Delay	0	1000	s	5	2475	

Table 138. Protections—P18.6.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.6.1 ①	Pipe Fill Loss Detection Method				0	2406	0 = Motor Current 1 = Motor Power 2 = Motor Torque
P18.6.2	Pipe Fill Loss Level	0.0	1000.0	Varies	0.0	2407	
P18.6.3	Pipe Fill Loss Time	0	600	s	0	2408	
P18.6.4 ①	Pipe Fill Loss Frequency	0.00	See Par ID 102	Hz	0.00	2409	
P18.6.5 ①	Pipe Fill Loss Response				0	2410	See Par ID 2427
P18.6.6	Pipe Fill Loss Attempts	0	10		1	2411	
P18.6.7	Prime Pump Enable				0	2428	See Par ID 190
P18.6.8	Prime Pump Level	0.00	6000.00	Varies	0.00	2429	
P18.6.9	Prime Pump Frequency	See Par ID 101	See Par ID 102	Hz	0.00	2431	
P18.6.10	Prime Pump Delay Time	0.0	3600.0	min	0.0	2432	
P18.6.11	Prime Pump Loss of Prime Level	0.0	1000.0	Varies	0.0	2433	
P18.6.12	Prime Pump Level 2	0.00	6000.00	Varies	0.00	2434	
P18.6.13	Prime Pump Frequency 2	See Par ID 101	See Par ID 102	Hz	0.00	2436	
P18.6.14	Prime Pump Delay Time 2	0.0	3600.0	min	0.0	2437	
P18.6.15	Prime Pump Loss of Prime Level 2	0.0	1000.0	Varies	0.0	2438	
P18.6.16 ①	Broken Pipe Fault Response				0	1853	See Par ID 307
P18.6.17	Broken Pipe Level	0.0	6000.0	Varies	15.0	1854	
P18.6.18	Broken Pipe Delay	1.0	120.0	s	15.0	1855	
P18.6.19	Broken Pipe Frequency	1.00	See Par ID 102	Hz	25.00	1856	
P18.6.20	Jockey Pump Enable				0	2804	0 = Not Used 1 = PID Sleep 2 = PID Sleep(Level)
P18.6.21	Jockey Start Level	-99999.99	See Par ID 2807	Varies	0.00	2805	

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 138. Protections—P18.6, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.6.22	Jockey Stop Level	See Par ID 2805	99999.99	Varies	0.00	2807	
P18.6.23	Lube Pump Enable				0	2809	See Par ID 2462
P18.6.24	Lube Pump Time	0.0	300.0	s	0.0	2810	

Table 139. Real time clock—P19.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P19.1	Interval 1 On Time				0,0,0	491	
P19.2	Interval 1 Off Time				0,0,0	493	
P19.3	Interval 1 From Day				0	517	0 = Sunday 1 = Monday 2 = Tuesday 3 = Wednesday 4 = Thursday 5 = Friday 6 = Saturday
P19.4	Interval 1 To Day				0	518	See Par ID 517
P19.5	Interval 1 Channel				0	519	0 = Not Used 1 = Time Channel 1 2 = Time Channel 2 3 = Time Channel 3
P19.6	Interval 2 On Time				0,0,0	495	
P19.7	Interval 2 Off Time				0,0,0	497	
P19.8	Interval 2 From Day				0	520	See Par ID 517
P19.9	Interval 2 To Day				0	521	See Par ID 517
P19.10	Interval 2 Channel				0	522	See Par ID 519
P19.11	Interval 3 On Time				0,0,0	499	
P19.12	Interval 3 Off Time				0,0,0	501	
P19.13	Interval 3 From Day				0	523	See Par ID 517
P19.14	Interval 3 To Day				0	524	See Par ID 517
P19.15	Interval 3 Channel				0	525	See Par ID 519
P19.16	Interval 4 On Time				0,0,0	503	
P19.17	Interval 4 Off Time				0,0,0	505	
P19.18	Interval 4 From Day				0	526	See Par ID 517
P19.19	Interval 4 To Day				0	527	See Par ID 517
P19.20	Interval 4 Channel				0	528	See Par ID 519
P19.21	Interval 5 On Time				0,0,0	507	
P19.22	Interval 5 Off Time				0,0,0	509	
P19.23	Interval 5 From Day				0	529	See Par ID 517
P19.24	Interval 5 To Day				0	530	See Par ID 517
P19.25	Interval 5 Channel				0	531	See Par ID 519
P19.26	Timer 1 Duration	0	72000	s	0	511	
P19.27	Timer 1 Channel				0	532	See Par ID 519
P19.28	Timer 2 Duration	0	72000	s	0	513	
P19.29	Timer 2 Channel				0	533	See Par ID 519
P19.30	Timer 3 Duration	0	72000	s	0	515	
P19.31	Timer 3 Channel				0	534	See Par ID 519
P19.32	Interval 1 Setting				0	2487	0 = Weekly 1 = Daily
P19.33	Interval 2 Setting				0	2488	See Par ID 2487
P19.34	Interval 3 Setting				0	2489	See Par ID 2487

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 139. Real time clock—P19, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P19.35	Interval 4 Setting				0	2490	See Par ID 2487
P19.36	Interval 5 Setting				0	2491	See Par ID 2487

Communication

Table 140. FB process data input Sel—P20.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.1.1	FB Process Data Input 1 Sel	0	3000		2541	2533	
P20.1.2	FB Process Data Input 2 Sel	0	See Par ID 2533		2542	2534	
P20.1.3	FB Process Data Input 3 Sel	0	See Par ID 2533		2550	2535	
P20.1.4	FB Process Data Input 4 Sel	0	See Par ID 2533		0	2536	
P20.1.5	FB Process Data Input 5 Sel	0	See Par ID 2533		0	2537	
P20.1.6	FB Process Data Input 6 Sel	0	See Par ID 2533		0	2538	
P20.1.7	FB Process Data Input 7 Sel	0	See Par ID 2533		0	2539	
P20.1.8	FB Process Data Input 8 Sel	0	See Par ID 2533		0	2540	

Table 141. FB process data output Sel—P20.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.2.1	FB Process Data Output 1 Sel				1	1556	
P20.2.2	FB Process Data Output 2 Sel				2	1557	
P20.2.3	FB Process Data Output 3 Sel				3	1558	
P20.2.4	FB Process Data Output 4 Sel				4	1559	
P20.2.5	FB Process Data Output 5 Sel				5	1560	
P20.2.6	FB Process Data Output 6 Sel				6	1561	
P20.2.7	FB Process Data Output 7 Sel				7	1562	
P20.2.8	FB Process Data Output 8 Sel				28	1563	

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 141. FB process data output Sel—P20.2, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.2.9 ②	Standard Status Word Bit0 Function Select				1	2415	0 = Not Used 1 = Ready 2 = Run 3 = Fault 4 = Fault Invert 5 = Warning 6 = Reversed 7 = At Speed 8 = Zero Frequency 9 = Freq Limit 1 Superv 10 = Freq Limit 2 Superv 11 = PID1 Superv 12 = PID2 Superv 13 = OverHeat Fault 14 = OCurrent Fault 15 = OVolt Fault 16 = UVolt Fault Resp 17 = 4mA Ref Fault/Warning 20 = Torq Limit Superv 21 = Ref Limit Superv 22 = Control from I/O 23 = Un-Requested Rotation Direction 24 = Thermistor Fault Output 25 = Fire Mode 26 = In Bypass Mode 27 = Ext Fault/Warning 28 = Remote Control 29 = Jog Speed Select 30 = Motor Therm Protection 31 = FB Digital Input 1 32 = FB Digital Input 2 33 = FB Digital Input 3 34 = FB Digital Input 4 35 = Damper Control 36 = TC1 Status 37 = TC2 Status 38 = TC3 Status 39 = In E-Stop 40 = Power Limit Superv 41 = Temp Limit Superv 42 = Analog Input Superv 43 = Motor 1 Control 44 = Motor 2 Control 45 = Motor 3 Control 46 = Motor 4 Control 47 = Motor 5 Control 49 = PID1 Sleep 50 = PID2 Sleep 51 = Motor Current 1 Supv 52 = Motor Current 2 Supv 53 = Second AI Limit Supv 54 = DC Charge Switch Close 55 = Preheat Active 56 = Cold Weather Active 57 = Prime Pump Active 58 = 2nd Stage Ramp Frequency Active 59 = STO Fault Output 60 = Run Bypass/Drive 61 = Bypass Overload 62 = Bypass Run 63 = Auto Local On COM Fault 64 = FieldBus RTU Fault 65 = FieldBus TCP Fault

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 141. FB process data output Sel—P20.2, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.2.9 ②, continued	Standard Status Word Bit0 Function Select				1	2415	66 = FieldBus MSTP Fault 67 = FieldBus EIP Fault 68 = FieldBus SlotA Fault 69 = FieldBus SlotB Fault 70 = FieldBus SWD Fault 71 = Jockey Pump Active 72 = Lube Pump Active 73 = PID1 Low Feedback 74 = PID1 High Feedback 75 = PID2 Low Feedback 76 = PID2 High Feedback 77 = Master in MPFC 78 = CP Interlock Fault
P20.2.10 ②	Standard Status Word Bit1 Function Select				2	2416	See Par ID 2415
P20.2.11 ②	Standard Status Word Bit2 Function Select				3	2417	See Par ID 2415
P20.2.12 ②	Standard Status Word Bit3 Function Select				4	2418	See Par ID 2415
P20.2.13 ②	Standard Status Word Bit4 Function Select				5	2419	See Par ID 2415
P20.2.14 ②	Standard Status Word Bit5 Function Select				6	2420	See Par ID 2415
P20.2.15 ②	Standard Status Word Bit6 Function Select				7	2421	See Par ID 2415
P20.2.16 ②	Standard Status Word Bit7 Function Select				8	2422	See Par ID 2415

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

RS-485 bus

Table 142. Basic setting—P20.3.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.3.1.1 ①	RS485 Comm Set				0	586	0 = Modbus RTU 1 = BACnet MS/TP 2 = SWD

Table 143. Modbus RTU—P20.3.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.3.2.1 ①	Slave Address	1	247		1	587	
P20.3.2.2 ①	Baud Rate				1	584	0 = 9600 1 = 19200 2 = 38400 3 = 57600 4 = 115200
P20.3.2.3 ①	Parity Type And Stop Bit				2	585	0 = None and 2 stop bits 1 = Odd and 1 stop bit 2 = Even and 1 stop bit 3 = None and 1 stop bit
P20.3.2.4	Modbus RTU Protocol Status					588	0 = Initial 1 = Stopped 2 = Operational 3 = Faulted
P20.3.2.5	Comm Timeout Modbus RTU	0	60000	ms	10000	593	
P20.3.2.6	Modbus RTU Fault Response				0	2516	0 = in Fieldbus Control 1 = in all Control

Table 144. BACnet MS/TP—P20.3.3.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.3.3.1	MSTP Baud Rate				2	594	0 = 9600 1 = 19200 2 = 38400 3 = 76800 4 = 115200
P20.3.3.2	MSTP Device Address	0	127		1	595	
P20.3.3.3	MSTP Instance Number	0	4194302		0	596	
P20.3.3.4	MSTP Comm Timeout	0	60000	ms	10000	598	
P20.3.3.5	MSTP Protocol Status				0	599	0 = Stopped 1 = Operational 2 = Faulted
P20.3.3.6	MSTP Fault Code				0	600	0 = None 1 = Sole Master 2 = Duplicate MAC ID 3 = Baud rate fault
P20.3.3.7	MSTP Fault Response				0	2526	See Par ID 2516
P20.3.3.8 ①	MSTP Max Master	1	127		127	1537	

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 145. Terminal: SWD—P20.3.4.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.3.4.1	Parameter Access				1	2630	0 = Local Control 1 = Fieldbus
P20.3.4.2 ①	Process Data Access				4	2631	0 = Local Control 1 = Fieldbus 2 = Mixed Interface 4 = NET, Local on Fault 5 = Dual Mode
P20.3.4.3	Fault Situation Counter					2632	
P20.3.4.4	Board Status					2609	
P20.3.4.5	Firmware Version					2610	
P20.3.4.6	Protocol Status					2612	0 = Not Configured 1 = Operational 2 = Diagnostics
P20.3.4.7	Operation Mode					2613	0 = PD2x16Bit Profil 1 = 8Bit Profil 2 = 1-0-A Switch
P20.3.4.8	PDP-Telegram Selection				1	2614	1= Standard Telegram
P20.3.4.9	Fault Counter PDP				0	2615	
P20.3.4.10	Fault Situations Max				8,8	2616	
P20.3.4.11	PDP-Profil Number				809	2618	
P20.3.4.12	PDP-Control Word					2619	
P20.3.4.13	PDP-Status Word				64	2620	
P20.3.4.14	PDP-MaxBlockLength				512	2621	
P20.3.4.15	PDP-NoOfMultiparameter				64	2622	
P20.3.4.16	PDP-MaxLatency				0	2623	
P20.3.4.17	PDP-DO Manufacturer					2624	
P20.3.4.18	PDP-DO Device Type					1451	
P20.3.4.19	PDP-DO FW-Interface					2625	
P20.3.4.20	PDP-DO FW-Year					2626	
P20.3.4.21	PDP-DO FW-DayMonth					2627	
P20.3.4.22	PDP-DO NoOfDOs				1	2628	
P20.3.4.23	PDP-DO Subclass				1	2629	

Table 146. EtherNet/IP—P20.4

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.4.1 ①	IP Address Mode				0	1500	0 = Static IP 1 = DHCP with AutoIP
P20.4.2	Active IP Address					1507	
P20.4.3	Active Subnet Mask					1509	
P20.4.4	Active Default Gateway					1511	
P20.4.5	MAC Address					1513	
P20.4.6 ①	Static IP Address				192.168.1.254	1501	
P20.4.7 ①	Static Subnet Mask				255.255.255.0	1503	
P20.4.8 ①	Static Default Gateway				192.168.1.1	1505	
P20.4.9	Ethernet IP Protocol Status					608	0 = Off 1 = Operational 2 = Faulted
P20.4.10	EIP Fault Response				0	2518	See Par ID 2516

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 147. Modbus TCP—P20.5.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.5.1	Connection Limit				5	609	
P20.5.2	Modbus TCP Unit ID				1	610	
P20.5.3	Comm Timeout Modbus TCP	0	60000	ms	10000	611	
P20.5.4	Modbus TCP Protocol Status					612	See Par ID 599
P20.5.5	Modbus TCP Fault Response				0	2517	See Par ID 2516
P20.5.6	Modbus TCP Trusted IP Enable				1	74	See Par ID 2462
P20.5.7	Trusted IP White List				0xC0.0xA8.0x01.0xFF. 0x00.0x00.0x00.0x00. 0x00.0x00.0x00.0x00	68	

Table 148. WebUI—P20.6.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.6.1	WebUI Protocol Status					2915	
P20.6.2	WebUI Fault Response				0	2916	See Par ID 2516
P20.6.3	WebUI Communication Timeout	30000	60000	ms	60000	2919	

Table 149. Protocol Enable—P20.7.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.7.1 ①⑥	Ethernet based protocol select				0	1997	0 = Disabled 1 = Ethernet IP
P20.7.2 ①⑥	Modbus TCP enable				0	1942	0 = Disabled 1 = Ethernet IP
P20.7.3 ①⑥	WebUI Enable				1	2921	See Par ID 2462

Sysytem

Table 150. Basic setting—P21.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P21.1.1	Language				0	340	0 = English 1 = 中文 2 = Deutsch
P21.1.2 ①	Application					142	0 = Standard 1 = Multi-Pump 2 = Multi-PID 3 = Multi-Purpose
P21.1.3 ①	Parameter Sets					619	
P21.1.4	Up To Keypad					620	See Par ID 2118
P21.1.5 ①	Down From Keypad					621	
P21.1.6	Parameter Comparison					623	
P21.1.7	Password	0	9999		0	624	
P21.1.8	Parameter Lock				0	625	
P21.1.9	Multimonitor Set				0	627	See Par ID 2462
P21.1.10	Default Page				2	628	
P21.1.11	Timeout Time	0	65535	s	30	629	
P21.1.12	Contrast Adjust	5	18		12	630	
P21.1.13	Backlight Time	1	65535	min	10	631	

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 150. Basic setting—P21.1, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P21.1.14	Fan Control				1	632	
P21.1.15	Keypad ACK Timeout	200	5000	ms	200	633	
P21.1.16	Keypad Retry Number	1	10		5	634	
P21.1.17	Startup Wizard				0	626	
P21.1.18	Jog Softkey Hidden				0	2412	See Par ID 2462
P21.1.19	Reverse Softkey Hidden				0	2413	See Par ID 2462
P21.1.20	Output Display Unit				45	2424	
P21.1.21	Output Display Unit Min	-60000.00	See Par ID 2425	Varies	0.00	2460	
P21.1.22	Output Display Unit Max	See Par ID 2460	60000.00	Varies	MotorNomFreqMFG	2425	
P21.1.23	Keypad Lock Password	0	9999		0	75	

Table 151. Version info.—P21.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P21.2.1	Keypad Software Version					640	
P21.2.2	Motor Control Software Version					642	
P21.2.3	Application Software Version					644	
P21.2.4	Software Bundle Version					1714	

Table 152. Application info.—P21.3.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P21.3.1	Brake Chopper Status					646	See Par ID 2118
P21.3.2	Brake Resistor Status					647	See Par ID 2118
P21.3.3	Serial Number					648	
P21.3.4	Power Unit Serail Number					1270	
P21.3.5	Control Unit Serial Number					1276	

Table 153. User info.—P21.4.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P21.4.1	Real Time Clock				0.0.0.1:1:13	566	
P21.4.2	Daylight Saving				0	582	
P21.4.3	Total MWh Count			Mwh		601	
P21.4.4	Total Power Day Count					603	
P21.4.5	Total Power Hr Count					606	
P21.4.6	Trip MWh Count			Mwh		604	
P21.4.7	Clear Trip MWh Count					635	See Par ID 2125
P21.4.8	Trip Power Day Count					636	
P21.4.9	Trip Power Hr Count					637	
P21.4.10	Clear Trip Power Count					639	See Par ID 2125

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 154. Operate mode—O.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
O1	Output Frequency			Hz		1	
O2	Freq Reference			Hz		24	
O3	Motor Speed			rpm		2	
O4	Motor Current			A		3	
O5	Motor Torque			%		4	
O6	Motor Power			%		5	
O7	Motor Voltage			V		6	
O8	DC-link Voltage			V		7	
O9	Unit Temperature			Deg. C		8	
O10	Motor Temperature			%		9	
R12	Keypad Reference	See Par ID 101	See Par ID 102	Hz	0.00	141	
R13	PID1 Keypad Set Point 1	See Par ID 1298	See Par ID 1300	Varies	0.00	1307	
R14	PID1 Keypad Set Point 2	See Par ID 1298	See Par ID 1300	Varies	0.00	1309	

Notes: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Chapter 8—Multi-purpose application

Introduction

The Multi-purpose application is designed for a large set of applications with the ability to have advanced motor control systems. It takes the same functions provided in the Standard, Multi-pump and Fan, and Multi-PID applications and adds in some additional control techniques. The application is designed with 2 control places that use 8 digital inputs, 2 analog inputs, 3 relay outputs, 1 digital output, and 2 analog outputs that are programmable. Motor controlwise, it provides the ability to do frequency and speed control and adds Open Loop Speed Control as well as Torque Control. For tuning the V/Hz curve, it has the ability to go out and ID the motor characteristic and enters those specific measurements into its parameters for better control. Drive/motor protections are programmable for desired actions depending on the application. Below is a list of additional features available in addition to the Standard, Multi-pump and Fan, and Multi-PID application features that are available in the Multi-purpose application.

- Motor potentiometer reference control
- External brake control
- Droop function with multiple loads
- Motor identification
- Motor control modes
- I/O Ccntrols
  - "Terminal to Function" (TTF) Programming

    The design behind the programming of the digital inputs in the DG1 drive is to use "Terminal to Function" programming. It is composed of multiple functions that get assigned a digital input to that function, the parameters in the drive are set up with specific functions and by defining the digital input and slot in some cases depending on the what options are available. For use of the drives control board inputs they will be referred to as DigIN:1 through DigIN:8. When additional option cards are used, they will be defined as DigIN:X:IOY:Z. The X indicates the slot that the card is being installed in which will be either A or B, then the IOY determines the type of card it is, which would be IO1 or IO5, and the Z would indicate which input is being used on that available option card.
  - "Function to Terminal" (FTT) Programming

    The design behind the programming of the relay outputs and digital output in the DG1 drive is to use "Function to Terminal" programming. It is composed of a terminal be it a relay output or a digital output that is assigned a parameter. Within that parameter, it has different functions that can be set.

The parameters of the Multi-purpose application are explained on **Page 151** of this manual, "Description of Parameters." The explanations are arranged according to the parameter number.

For the DI function, we use terminal programming method to function (TTF), where there is a fixed input that gets programmed to a list of functions. This allows for multiple inputs to be used for different functions. Connecting a certain input with a certain parameter function is done by give a parameter an appropriate value. The value is formed by the location of the input, either being on the standard control board or an external option board and the slot in which it is located.

Force Open/Force Close selection

The Force Open selection would make the selected function always off. Essentially this is a virtual switch that is always open.

The Force Close selection would make the selected function always on. Essentially this is a virtual switch that is always closed.

These options are assigned to a function if we want to force a state without using a hardware input.

Example:

If we set Run Enable to Force Closed, the drive is always enabled. If we set the same function to Force Open, the drive would never be enabled. If a digital input is to be used to activate this Run Enable, the function should be assigned to a hardware input (see below for DIGIN selections).

DIGIN selection

This allows assignment of a hardware digital input to a function, this is set in a format of DigIN:X where X is one of the 8 digital inputs on the main control board.

Example:

If we set Run Enable to DigIN:6, the drive will be enabled when digital input 6 (terminal 8) is closed, and would not be enabled when digital input 6 (terminal 8) is open.

Option board DigIN selection

This allows assignment of a hardware digital input on an option card to a function, this is set in a format of DigIN: Y:IO1:X where Y is the slot the option card is inserted on the main control board and X is the input on the board and IO1 is the type of option board used.

Example:

If we set Run Enable to DigIN:A:IO5:6, the drive will be enabled when digital input 6 is closed on the IO5 option card which is inserted in Slot A, and would not be enabled when digital input 6 on the option card is open.

Time Channel selection

A Time Channel is a virtual path to link the digital output of a timer function to a digital input function. To utilize this feature a timer or interval would need to be assigned to a time channel 1 through 3, and the input function to be controlled would need to be assigned to the same time channel.

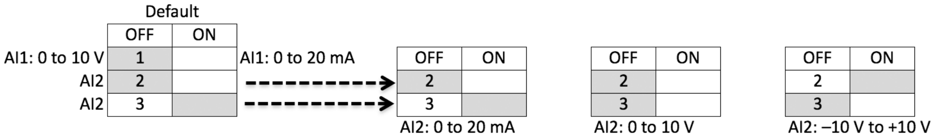
Example:

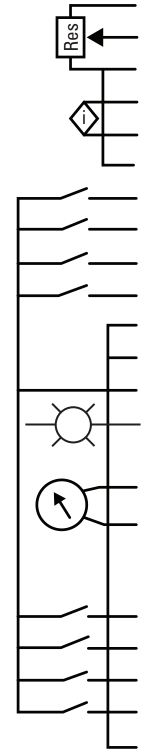
If we set Run Enable to DigIN:TimeChannel1, the drive will be enabled when the timer assigned to Time Channel 1 is active or High, and would not be enabled when the Time Channel is inactive or Low.

Control I/O configuration

- Run 240 Vac and 24 Vdc control wiring in separate conduit
- Communication wire to be shielded

Table 155. Multi-purpose application default I/O configuration.



External wiring	Pin	Signal name	Signal	Default setting	Description
	1	+10 V	Ref. Output Voltage	—	10 Vdc Supply Source
	2	AI1+ ①	Analog Input 1	0–10 V	Voltage Speed Reference (Programmable to 4 mA to 20 mA)
	3	AI1–	Analog Input 1 Ground	—	Analog Input 1 Common (Ground)
	4	AI2+ ①	Analog Input 2	4 mA to 20 mA	Current Speed Reference (Programmable to 0–10 V)
	5	AI2–	Analog Input 2 Ground	—	Analog Input 2 Common (Ground)
	6	GND	I/O Signal Ground	—	I/O Ground for Reference and Control
	7	DIN5	Digital Input 5	Preset Speed B0	Sets frequency output to Preset Speed 1
	8	DIN6	Digital Input 6	Preset Speed B1	Sets frequency output to Preset Speed 2
	9	DIN7	Digital Input 7	Not Used (TI–)	Input forces VFD output to shut off
	10	DIN8	Digital Input 8	Force Remote (TI+)	Input takes VFD from Local to Remote
	11	CMB	DI5 to DI8 Common	Grounded	Allows source input
	12	GND	I/O Signal Ground	—	I/O Ground for Reference and Control
	13	24 V	+24 Vdc Output	—	Control voltage output (100 mA max.)
	14	DO1	Digital Output 1	Ready	Shows the drive is ready to run
	15	24 Vo	+24 Vdc Output	—	Control voltage output (100 mA max.)
	16	GND	I/O Signal Ground	—	I/O Ground for Reference and Control
	17	AO1+	Analog Output 1	Output Frequency	Shows Output frequency to motor 0–60 Hz (4 mA to 20 mA)
	18	AO2+	Analog Output 2	Motor Current	Shows Motor current of motor 0–FLA (4 mA to 20 mA)
	19	24 Vi	+24 Vdc Input	—	External control voltage input
	20	DIN1	Digital Input 1	Run Forward	Input starts drive in forward direction (start enable)
	21	DIN2	Digital Input 2	Run Reverse	Input starts drive in reverse direction (start enable)
	22	DIN3	Digital Input 3	External Fault	Input causes drive to fault
	23	DIN4	Digital Input 4	Fault Reset	Input resets active faults
	24	CMA	DI1 to DI4 Common	Grounded	Allows source input
	25	A/+	RS-485 Signal A	—	Fieldbus Communication (Modbus, BACnet)
	26	B/-	RS-485 Signal B	—	Fieldbus Communication (Modbus, BACnet)
	27	R3NO	Relay 3 Normally Open	At Speed	Relay output 3 shows VFD is at Ref. Frequency
	28	R1NC	Relay 1 Normally Closed	Run	Relay output 1 shows VFD is in a run state
	29	R1CM	Relay 1 Common		
	30	R1NO	Relay 1 Normally Open		
	31	R3CM	Relay 3 Common	At Speed	Relay output 3 shows VFD is at Ref. Frequency
	32	R2NC	Relay 2 Normally Closed	Fault	Relay output 2 shows VFD is in a fault state
	33	R2CM	Relay 2 Common		
	34	R2NO	Relay 2 Normally Open		

Notes: The above wiring demonstrates a SINK configuration. It is important that CMA and CMB are wired to ground (as shown by dashed line). If a SOURCE configuration is desired, wire 24 V to CMA and CMB and close the inputs to ground. When using the +10 V for AI1, it is important to wire AI1—to ground (as shown by dashed line). If using +10 V for AI1 or AI2, terminals 3, 5, and 6 need to be jumpered together.
① AI1+ and AI2+ support 10K potentiometer.

Table 156. Drive communication ports.

Port	Communication
RJ45 Keypad Port	
Upload/Download Parameters	USB to RJ45
Remote Mount Keypad	Ethernet
Upgrade Drive Firmware	USB to RJ45
RJ45 Ethernet Port	
Upload/Download Parameters	Ethernet
Ethernet IP Communications	Ethernet
Modbus TCP Communications	Ethernet
RS-485 Serial Port ①	
Upload/Download Parameters	Two-Wire Twisted Pair
Upgrade Drive Firmware	Two-Wire Twisted Pair
Modbus RTU Communications	Two-Wire Twisted Pair
BACnet MS/TP Communications	Two-Wire Twisted Pair

① Shielded wire recommended.

Multi-purpose application—parameters list

On the next pages you will find the lists of parameters within the respective parameter groups. The parameter descriptions are given on **Page 194**, "Description of Parameters." The descriptions are arranged according to the parameter number.

Column explanations:

Code = Location indication on the keypad; shows the operator the present parameter number
Parameter = Name of parameter
Min = Minimum value of parameter
Max = Maximum value of parameter
Unit = Unit of parameter value; given if available
Default = Value preset by factory
ID = ID number of the parameter

Table 157. Monitor—M.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
M1	Output Frequency			Hz		1	
M2	Freq Reference			Hz		24	
M3	Motor Speed			rpm		2	
M4	Motor Current			A		3	
M5	Motor Torque			%		4	
M6	Motor Power			%		5	
M7	Motor Voltage			V		6	
M8	DC-link Voltage			V		7	
M9	Unit Temperature			Deg. C		8	
M10	Motor Temperature			%		9	
M11	Torque Reference			%		15	
M12	Analog Input 1			Varies		10	
M13	Analog Input 2			Varies		11	
M14	Analog Output 1			Varies		25	
M15	Analog Output 2			Varies		575	
M16	DI1, DI2, DI3					12	
M17	DI4, DI5, DI6					13	
M18	DI7, DI8					576	
M19	DO1,Virtual RO1,Virtual RO2					14	
M20	RO1, RO2, RO3					557	
M21	TC1, TC2, TC3					558	
M22	Interval 1					559	0 = Inactive 1 = Active
M23	Interval 2					560	See Par ID 559
M24	Interval 3					561	See Par ID 559
M25	Interval 4					562	See Par ID 559
M26	Interval 5					563	See Par ID 559
M27	Timer 1			s	0	569	
M28	Timer 2			s	0	571	
M29	Timer 3			s	0	573	
M30	PID1 Set Point			Varies		16	
M31	PID1 Feedback			Varies		18	
M32	PID1 Error Value			Varies		20	
M33	PID1 Output			%		22	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 157. Monitor—M, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
M34	PID1 Status					23	0 = Stopped 1 = Running 2 = Sleep Mode
M35	PID2 Set Point			Varies		32	
M36	PID2 Feedback			Varies		34	
M37	PID2 Error Value			Varies		36	
M38	PID2 Output			%		38	
M39	PID2 Status					39	See Par ID 23
M40	Running Motors					26	
M41	PT100 Temperture			Deg. C	1000.0	27	
M42	Latest Fault Code					28	
M43	RTC Battery Status				0	583	0 = Not Installed 1 = Installed 2 = Change Battery 3 = OverVoltage
M44	Instant Motor Power			kW		1686	
M45	Energy Savings			Varies	0.000	2120	
M46	Control Board DIDO Status					2209	
M47	SlotA DIDO Status					2210	
M48	SlotB DIDO Status					2211	
M49	Application Status Word					29	
M50	Standard Status Word					2414	
M51	Output			Varies		2445	
M52	Reference			Varies		2447	
M53	Total MWh Count			Mwh		601	
M54	Total Power Day Count					603	
M55	Total Power Hr Count					606	
M56	Trip MWh Count			Mwh		604	
M57	Trip Power Day Count					636	
M58	Trip Power Hr Count					637	
M59	Total Run time Count			h		2827	
M60	Numbers Of Start					2830	
M61	Trip Run Time Count			h		2829	
M62	FB Status Word					2101	
M63	FB Ctrol Word					2001	
M64	FB Speed Reference	0.00	200.00	%		2003	
M67	Control board DI status					3214	
M68	SlotA DI status					3248	
M69	SlotB DI status					3249	
M70	Multi-Monitoring				2,1,3,2,1,3,2,1,3	1753	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Parameters

Table 158. Basic parameters—P1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P1.1	Min Frequency	0.00	See Par ID 102	Hz	0.00	101	
P1.2 ①	Max Frequency	See Par ID 101	400.00	Hz	MaxFreqMFG	102	
P1.3	Accel Time 1	0.1	3000.0	s	3.0	103	
P1.4	Decel Time 1	0.1	3000.0	s	3.0	104	
P1.5 ①	Motor Nom Current	DriveNomCurrCT*1/10	DriveNomCurrCT*2	A	DriveNomCurrCT	486	
P1.6 ①	Motor Nom Speed	300	24000	rpm	MotorNomSpeedMFG	489	
P1.7 ①	Motor PF	0.30	1.00		0.85	490	
P1.8 ①	Motor Nom Voltage	180	690	V	MotorNomVoltMFG	487	
P1.9 ①	Motor Nom Frequency	8.00	400.00	Hz	MotorNomFreqMFG	488	
P1.10	Power Up Local Remote Select				0	1685	0 = Hold Last 1 = Local Control 2 = Remote control
P1.11	Remote 1 Control Place				0	135	0 = I/O Terminal Start 1 1 = Fieldbus 2 = I/O Terminal Start 2 3 = Keypad
P1.12	Local Control Place				0	1685	0 = Keypad 1 = I/O Terminal Start 1 2 = I/O Terminal Start 2 3 = Fieldbus
P1.13	Bumpless Enable				0	2462	0 = Disabled 1 = Enabled
P1.14 ①②	Local Reference				6	136	0 = AI1 1 = AI2 2 = Slot A: AI1 3 = Slot B: AI1 4 = AI1 Joystick 5 = AI2 Joystick 6 = Keypad 7 = Fieldbus Ref 8 = Motor Pot 9 = Max Frequency 10 = AI1 + AI2 11 = AI1 - AI2 12 = AI2 - AI1 13 = AI1 * AI2 14 = AI1 or AI2 15 = MIN(AI1,AI2) 16 = MAX(AI1,AI2) 17 = PID1 Control Output 18 = PID2 Control Output
P1.15 ①②	Remote 1 Reference				0	137	See Par ID 136
P1.16 ①	Reverse Enable				1	1679	See Par ID 2462
P1.17	Run Delay Time	0	32500	s	0	2423	
P1.18 ①	HOA Source				0	2465	0 = Disabled 1 = IO Terminal 2 = Keypad
P1.19 ①	Minimum Run Time	0	32500	s	0	1813	
P1.20	Frequency Reference Upper Limit	See Par ID 101	See Par ID 102	Hz	50.00	2840	
P1.21	Frequency Reference Upper Limit Source				0	2841	0 = Not Used 1 = Freq Ref Upper 2 = AI1 3 = AI2
P1.22 ①②	Motor Type Selection				0	1820	0 = Inverter Duty 1 = IPM 2 = SPM

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Analog input

Table 159. Basic setting—P2.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P2.1.1	AI Ref Scale Min Value	0.00	See Par ID 145	Hz	0.00	144	
P2.1.2	AI Ref Scale Max Value	See Par ID 144	400.00	Hz	0.00	145	

Table 160. AI1 settings—P2.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P2.2.1	AI1 Mode				1	222	0 = 0–20 mA 1 = 0–10 V
P2.2.2	AI1 Signal Range				0	175	0 = 0–100%/ 0–20 mA/0–10 V 1 = 20–100%/ 4–20 mA/2–10 V 2 = Customized
P2.2.3	AI1 Custom Min	0.00	See Par ID 177	%	0.00	176	
P2.2.4	AI1 Custom Max	See Par ID 176	100.00	%	100.00	177	
P2.2.5	AI1 Filter Time	0.00	10.00	s	0.10	174	
P2.2.6	AI1 Signal Invert				0	181	0 = Not Inverted 1 = Inverted
P2.2.7	AI1 Joystick Hyst	0.00	20.00	%	0.00	178	
P2.2.8	AI1 Sleep Limit	0.00	100.00	%	0.00	179	
P2.2.9	AI1 Sleep Delay	0.00	320.00	s	0.00	180	
P2.2.10	AI1 Joystick Offset	-50.00	50.00	%	0.00	133	

Table 161. AI2 settings—P2.3.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P2.3.1	AI2 Mode				0	223	0 = 0–20 mA 1 = 0–10 V 2 = –10 to +10 V
P2.3.2	AI2 Signal Range				1	183	0 = 0–100%/0–20 mA/ 0–10 V –10 to 10 V 1 = 20–100%/4–20 mA/ 2–10 V/–6- to 10 V 2 = Customized
P2.3.3	AI2 Custom Min	0.00	See Par ID 185	%	0.00	184	
P2.3.4	AI2 Custom Max	See Par ID 184	100.00	%	100.00	185	
P2.3.5	AI2 Filter Time	0.00	10.00	s	0.10	182	
P2.3.6	AI2 Signal Invert				0	189	See Par ID 181
P2.3.7	AI2 Joystick Hyst	0.00	20.00	%	0.00	186	
P2.3.8	AI2 Sleep Limit	0.00	100.00	%	0.00	187	
P2.3.9	AI2 Sleep Delay	0.00	320.00	s	0.00	188	
P2.3.10	AI2 Joystick Offset	-50.00	50.00	%	0.00	134	

Table 162. Fine adjust—P2.4.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P2.4.1 ①	Fine Tuning Input				0	2484	0 = Not Used 1 = AI1 2 = AI2 3 = Slot A: AI1 4 = Slot B: AI1 5 = Fieldbus
P2.4.2 ①	Fine Tuning Min	0.0	100.0	%	0.0	2485	
P2.4.3 ①	Fine Tuning Max	0.0	100.0	%	0.0	2486	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 163. Digital input—P3.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P3.1 ①	IO Terminal 1 Start Stop Logic				0	143	0 = Forward - Reverse 1 = Start - Reverse 2 = Start - Enable 3 = 3 Wire Control
P3.2 ②⑤	IO Terminal 1 Start Signal 1				2	190	0 = DigIN:NormallyOpen 1 = DigIN:NormallyClose 2 = DigIN: 1 3 = DigIN: 2 4 = DigIN: 3 5 = DigIN: 4 6 = DigIN: 5 7 = DigIN: 6 8 = DigIN: 7 9 = DigIN: 8 10 = DigIN: A: IO1: 1 11 = DigIN: A: IO1: 2 12 = DigIN: A: IO1: 3 13 = DigIN: A: IO5: 1 14 = DigIN: A: IO5: 2 15 = DigIN: A: IO5: 3 16 = DigIN: A: IO5: 4 17 = DigIN: A: IO5: 5 18 = DigIN: A: IO5: 6 19 = DigIN: B: IO1: 1 20 = DigIN: B: IO1: 2 21 = DigIN: B: IO1: 3 22 = DigIN: B: IO5: 1 23 = DigIN: B: IO5: 2 24 = DigIN: B: IO5: 3 25 = DigIN: B: IO5: 4 26 = DigIN: B: IO5: 5 27 = DigIN: B: IO5: 6 28 = Time Channel 1 29 = Time Channel 2 30 = Time Channel 3 31 = RO1 Function 32 = RO2 Function 33 = RO3 Function 34 = Virtual RO1 Function 35 = Virtual RO2 Function
P3.3 ② ⑤	IO Terminal 1 Start Signal 2				3	191	See Par ID 190
P3.4 ①	Thermistor Input Select				0	881	0 = Digital Input 1 = Thermistor Input
P3.5 ②③	Reverse				0	198	See Par ID 190
P3.6 ②③	Ext. Fault 1 NO				4	192	See Par ID 190
P3.7 ②③	Ext. Fault 1 NC				1	193	See Par ID 190
P3.8 ②④	Fault Reset				5	200	See Par ID 190
P3.9 ②③	Run Enable				1	194	See Par ID 190
P3.10 ②③	Preset Speed B0				6	205	See Par ID 190
P3.11 ②③	Preset Speed B1				7	206	See Par ID 190
P3.12 ②③	Preset Speed B2				0	207	See Par ID 190
P3.13 ②③	PID1 Control Enable				1	550	See Par ID 190
P3.14 ②③	PID2 Control Enable				1	553	See Par ID 190
P3.15 ②③	Accel/Decel Time Set				0	195	See Par ID 190
P3.16 ②③	Accel/Decel Prohibit				0	201	See Par ID 190
P3.17 ②④	No Access To Param				0	215	See Par ID 190
P3.18 ②③	Accel Pot Value				0	203	See Par ID 190
P3.19 ②③	Decel Pot Value				0	204	See Par ID 190
P3.20 ②③	Reset Pot Zero				0	216	See Par ID 190
P3.21 ②③	Remote Control				9	196	See Par ID 190

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 163. Digital input—P3, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P3.22 ②③	Local Control				0	197	See Par ID 190
P3.23 ②③	Remote 1/2 Select				0	209	See Par ID 190
P3.24 ②③	Second Motor Para Select				0	217	See Par ID 190
P3.25 ②③	Force Bypass				0	218	See Par ID 190
P3.26 ②③	DC Brake Active				0	202	See Par ID 190
P3.27 ②③	Smoke Mode				0	219	See Par ID 190
P3.28 ②③	Fire Mode				0	220	See Par ID 190
P3.29 ②③	Fire Mode Ref 1/2 Select				0	221	See Par ID 190
P3.30 ②③	PID1 Set Point Select				0	351	See Par ID 190
P3.31 ②③	PID2 Set Point Select				0	352	See Par ID 190
P3.32 ②③	Jog Enable				0	199	See Par ID 190
P3.33 ③	Start Timer 1				0	224	See Par ID 190
P3.34 ③	Start Timer 2				0	225	See Par ID 190
P3.35 ③	Start Timer 3				0	226	See Par ID 190
P3.36 ②③	AI Ref Source Select				0	208	See Par ID 190
P3.37 ②③	Motor Interlock 1				0	210	See Par ID 190
P3.38 ②③	Motor Interlock 2				0	211	See Par ID 190
P3.39 ②③	Motor Interlock 3				0	212	See Par ID 190
P3.40 ②③	Motor Interlock 4				0	213	See Par ID 190
P3.41 ②③	Motor Interlock 5				0	214	See Par ID 190
P3.42 ②③	Ext Fault-AR				1	747	See Par ID 190
P3.43 ②③	Bypass Overload				0	1246	See Par ID 190
P3.44 ②③	Fire Mode Direction Invert				0	2119	See Par ID 190
P3.45 ①	IO Terminal 2 Start Stop Logic				0	2206	See Par ID 143
P3.46 ② ⑤	IO Terminal 2 Start Signal 1				2	2207	See Par ID 190
P3.47 ② ⑤	IO Terminal 2 Start Signal 2				3	2208	See Par ID 190
P3.48 ②③	Ext. Fault 2 NO				0	2293	See Par ID 190
P3.49 ②③	Ext. Fault 2 NC				1	2294	See Par ID 190
P3.50 ②③	Ext. Fault 3 NO				0	2295	See Par ID 190
P3.51 ②③	Ext. Fault 3 NC				1	2296	See Par ID 190
P3.52	Ext. Fault 1 Text				0	2297	0 = External Fault 1 = Vibration Cut out 2 = High Motor temp 3 = Low Pressure 4 = High Pressure 5 = Low Water 6 = Damper Interlock 7 = Run Enable 8 = Freeze Stat Trip 9 = Smoke Detect 10 = Seal Leakage 11 = Rod Breakage 12 = Torque Limit
P3.53	Ext. Fault 2 Text				1	2298	See Par ID 2297
P3.54	Ext. Fault 3 Text				2	2299	See Par ID 2297
P3.55 ②④	Parameter Set1/2 Sel				0	2312	See Par ID 190
P3.56 ②③	Deragging Enable				0	2394	See Par ID 190
P3.57 ②③	HOA On/Off				1	2395	See Par ID 190
P3.58 ③	Multi-pump Mode 1/2 Select				0	2658	See Par ID 190
P3.59 ②③	OP Cont Interlock NO				4	2801	See Par ID 190

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 163. Digital input—P3, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P3.60 ②③	OP Cont Interlock NC				1	2802	See Par ID 190
P3.61 ③	CP Interlock NC				1	2894	See Par ID 190

Table 164. Analog output—P4.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P4.1	AO1 Mode				0	227	See Par ID 222
P4.2 ②	AO1 Function				1	146	0 = Not Used 1 = Output Frequency 2 = Freq Reference 3 = Motor Speed 4 = Motor Current 5 = Motor Torque (0-Nom) 6 = Motor Power 7 = Motor Voltage 8 = DC-Bus Voltage 9 = PID1 Setpoint 10 = PID1 Feedback 1 11 = PID1 Feedback 2 12 = PID1 Control Error Value 13 = PID1 Control Output 14 = PID2 Setpoint 15 = PID2 Feedback 1 16 = PID2 Feedback 2 17 = PID2 Control Error Value 18 = PID2 Control Output 19 = AI1 20 = AI2 21 = Output Freq (-2-+2N) 22 = Motor Torque (-2-+2N) 23 = Motor Power (-2-+2N) 24 = PT100 Temperature 25 = FB Process Data Input 1 26 = FB Process Data Input 2 27 = FB Process Data Input 3 28 = FB Process Data Input 4 29 = FB Process Data Input 5 30 = FB Process Data Input 6 31 = FB Process Data Input 7 32 = FB Process Data Input 8 33 = SlotA PT100 Temp Channel 1 34 = SlotA PT100 Temp Channel 2 35 = SlotA PT100 Temp Channel 3 36 = SlotB PT100 Temp Channel 1 37 = SlotB PT100 Temp Channel 2 38 = SlotB PT100 Temp Channel 3 39 = User Defined Output 40 = Motor Current (-2-+2N)

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 164. Analog output—P4, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P4.3	AO1 Minimum				1	149	0 = 0V / 0 mA 1 = 2V / 4 mA
P4.4	AO1 Filter Time	0.00	10.00	s	1.00	147	
P4.5	AO1 Scale	10	1000	%	100	150	
P4.6	AO1 Inversion				0	148	See Par ID 181
P4.7	AO1 Offset	-100.00	100.00	%	0.00	173	
P4.8	AO2 Mode				0	228	See Par ID 222
P4.9 ②	AO2 Function				4	229	See Par ID 146
P4.10	AO2 Minimum				1	232	See Par ID 149
P4.11	AO2 Filter Time	0.00	10.00	s	1.00	230	
P4.12	AO2 Scale	10	1000	%	100	233	
P4.13	AO2 Inversion				0	231	See Par ID 181
P4.14	AO2 Offset	-100.00	100.00	%	0.00	234	

Table 165. Digital output—P5.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P5.1 ②	DO1 Function				1	151	0 = Not Used 1 = Ready 2 = Run 3 = Fault 4 = Fault Invert 5 = Warning 6 = Reversed 7 = At Speed 8 = Zero Frequency 9 = Freq Limit 1 Superv 10 = Freq Limit 2 Superv 11 = PID1 Superv 12 = PID2 Superv 13 = OverHeat Fault 14 = OCurrent Fault 15 = OVolt Fault 16 = UVolt Fault Resp 17 = 4mA Ref Fault/ Warning 18 = Ext Brake Control 19 = Ext Brake Inverted 20 = Torq Limit Superv 21 = Ref Limit Superv 22 = Control from I/O 23 = Un-Requested Rotation Direction 24 = Thermistor Fault Output 25 = Fire Mode 26 = In Bypass Mode 27 = Ext Fault/Warning 28 = Remote Control 29 = Jog Speed Select 30 = Motor Therm Protection 31 = FB Digital Input 1 32 = FB Digital Input 2 33 = FB Digital Input 3 34 = FB Digital Input 4 35 = Damper Control 36 = TC1 Status 37 = TC2 Status 38 = TC3 Status 39 = In E-Stop 40 = Power Limit Superv

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 165. Digital output—P5, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P5.1 ②, continued	DO1 Function				1	151	41 = Temp Limit Superv 42 = Analog Input Superv 43 = Motor 1 Control 44 = Motor 2 Control 45 = Motor 3 Control 46 = Motor 4 Control 47 = Motor 5 Control 48 = Logic Fulfilled 49 = PID1 Sleep 50 = PID2 Sleep 51 = Motor Current 1 Supv 52 = Motor Current 2 Supv 53 = Second AI Limit Supv 54 = DC Charge Switch Close 55 = Preheat Active 56 = Cold Weather Active 57 = Prime Pump Active 58 = 2nd Stage Ramp Frequency Active 59 = STO Fault Output 60 = Run Bypass/Drive 61 = Bypass Overload 62 = Bypass Run 63 = Auto Local On COM Fault 64 = FieldBus_RTU_Fault 65 = FieldBus_TCP_Fault 66 = FieldBus_MSTP_Fault 67 = FieldBus_EIP_Fault 68 = FieldBus_SlotA_Fault 69 = FieldBus SlotB Fault 70 = FieldBus SWD Fault 71 = Jockey Pump Active 72 = Lube Pump Active 73 = PID1 Low Feedback 74 = PID1 High Feedback 75 = PID2 Low Feedback 76 = PID2 High Feedback 77 = Master in MPFC 78 = CP Interlock Fault
P5.2 ②	RO1 Function				2	152	See Par ID 151
P5.3 ②	RO2 Function				3	153	See Par ID 151
P5.4 ②	RO3 Function				7	538	See Par ID 151
P5.5 ②	Virtual RO1 Function				0	2463	See Par ID 151
P5.6 ②	Virtual RO2 Function				0	2464	See Par ID 151
P5.7 ②	Freq Limit 1 Supv				0	154	0 = No Limit 1 = Low Limit Superv 2 = High Limit Superv 3 = Brake-on Control
P5.8	Freq Limit 1 Supv Val	0.00	See Par ID 102	Hz	0.00	155	
P5.9 ②	Freq Limit 2 Supv				0	157	0 = No Limit 1 = Low Limit Superv 2 = High Limit Superv 3 = Brake-off Control 4 = Brake-on/off Control
P5.10	Freq Limit 2 Supv Val	0.00	See Par ID 102	Hz	0.00	158	
P5.11 ②	Torque Limit Supv				0	159	0 = No Limit 1 = Low Limit Superv 2 = High Limit Superv 3 = Brake-off Control
P5.12 ②	Torque Limit Supv Val	-1000.0	1000.0	%	100.0	160	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 165. Digital output—P5, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P5.13	Ref Limit Supv				0	161	0 = No Limit 1 = Low Limit Superv 2 = High Limit Superv
P5.14	Ref Limit Supv Val	0.00	See Par ID 102	Hz	0.00	162	
P5.15	Ext Brake Off Delay	0.0	100.0	s	0.5	163	
P5.16	Ext Brake On Delay	0.0	100.0	s	1.5	164	
P5.17	Temp Limit Supv				0	165	See Par ID 161
P5.18	Temp Limit Supv Val	-10.0	75.0	Deg. C	40.0	166	
P5.19	Power Limit Supv				0	167	See Par ID 161
P5.20	Power Limit Supv Val	-200.0	200.0	%	0.0	168	
P5.21	AI Supv Select				0	170	0 = AI1 1 = AI2
P5.22	AI Limit Supv				0	171	See Par ID 161
P5.23	AI Limit Supv Val	0.00	100.00	%	0.00	172	
P5.24	PID1 Superv Enable				0	1346	See Par ID 2462
P5.25	PID1 Superv Upper Limit	See Par ID 1298	See Par ID 1300	Varies	0.00	1347	
P5.26	PID1 Superv Lower Limit	See Par ID 1298	See Par ID 1300	Varies	0.00	1349	
P5.27	PID1 Superv Delay	0	3000	s	0	1351	
P5.28	PID2 Superv Enable				0	1408	See Par ID 2462
P5.29	PID2 Superv Upper Limit	See Par ID 1360	See Par ID 1362	Varies	0.00	1409	
P5.30	PID2 Superv Lower Limit	See Par ID 1360	See Par ID 1362	Varies	0.00	1411	
P5.31	PID2 Superv Delay	0	3000	s	0	1413	
P5.32	RO1 On Delay	0.0	320.0	s	0.0	2112	
P5.33	RO1 Off Delay	0.0	320.0	s	0.0	2113	
P5.34	RO2 On Delay	0.0	320.0	s	0.0	2114	
P5.35	RO2 Off Delay	0.0	320.0	s	0.0	2115	
P5.36	RO3 On Delay	0.0	320.0	s	0.0	2116	
P5.37	RO3 Off Delay	0.0	320.0	s	0.0	2117	
P5.38	RO3 Reverse				0	2118	0 = No 1 = Yes
P5.39 ②	Motor Current 1 Supv				0	2189	See Par ID 159
P5.40	Motor Current 1 Supv Value	0.0	DriveNomCurrCT*2	A	DriveNomCurrCT	2190	
P5.41 ②	Motor Current 2 Supv				0	2191	See Par ID 159
P5.42	Motor Current 2 Supv Value	0.0	DriveNomCurrCT*2	A	DriveNomCurrCT	2192	
P5.43	Second AI Supv Select				0	2193	See Par ID 170
P5.44	Second AI Limit Supv				0	2194	See Par ID 161
P5.45	Second AI Limit Supv Val	0.00	100.00	%	0.00	2195	
P5.46	Motor Current 1 Supv Hyst	0.1	1.0	A	0.1	2196	
P5.47	Motor Current 2 Supv Hyst	0.1	1.0	A	0.1	2197	
P5.48	AI Supv Hyst	1.00	10.00	%	1.00	2198	
P5.49	Second AI Supv Hyst	1.00	10.00	%	1.00	2199	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 165. Digital output—P5, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P5.50	Freq Limit 1 Supv Hyst	0.10	1.00	Hz	0.10	2200	
P5.51	Freq Limit 2 Supv Hyst	0.10	1.00	Hz	0.10	2201	
P5.52	Torque Limit Supv Hyst	1.0	5.0	%	1.0	2202	
P5.53	Ref Limit Supv Hyst	0.10	1.00	Hz	0.10	2203	
P5.54	Temp Limit Supv Hyst	1.0	10.0	Deg. C	1.0	2204	
P5.55	Power Limit Supv Hyst	0.1	10.0	%	0.1	2205	
P5.56	Virtual RO1 On Delay	0.0	320.0	s	0.0	2848	
P5.57	Virtual RO1 Off Delay	0.0	320.0	s	0.0	2849	
P5.58	Virtual RO2 On Delay	0.0	320.0	s	0.0	2850	
P5.59	Virtual RO2 Off Delay	0.0	320.0	s	0.0	2851	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 166. Logic function—P6.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P6.1	Logic Function Select				0	751	0 = AND 1 = OR 2 = XOR
P6.2 ②	Logic Operation Input A				0	752	0 = Not Used 1 = Ready 2 = Run 3 = Fault 6 = Reversed 7 = Warning 8 = Zero Frequency 9 = Control from I/O 14 = Run Bypass/Drive 15 = Ext Brake Control 16 = In Bypass Mode 17 = At Speed 18 = Remote Control 19 = Freq Limit 1 Superv 20 = Freq Limit 2 Superv 22 = PID1 Superv 23 = PID2 Superv 24 = OverHeat Fault 28 = 4mA Ref Fault/ Warning 29 = OverCurrent Regular 30 = OverVoltage Regular 31 = UnderVoltage Regular 32 = Torq Limit Superv 33 = Ref Limit Superv 34 = Un-Requested Rotation Direction 35 = Thermal Fault/ Warning 36 = Bypass Enable 37 = Jog Speed Select 38 = Motor Therm Protection 39 = FB Digital Input 1 40 = FB Digital Input 2 41 = FB Digital Input 3 42 = FB Digital Input 4 43 = Damper Control 44 = TC1 Status 45 = TC2 Status 46 = TC3 Status 47 = In E-Stop 48 = Power Limit Superv 49 = Temp Limit Superv 50 = Analog Input Superv 51 = Motor 1 Control 52 = Motor 2 Control 53 = Motor 3 Control 54 = Motor 4 Control 55 = Motor 5 Control 56 = Logic Fulfilled
P6.3 ②	Logic Operation Input B				0	753	See Par ID 752

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 167. Drive control—P7.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P7.1	Remote 2 Control Place				1	138	See Par ID 135
P7.2 ①②	Remote 2 Reference				7	139	See Par ID 136
P7.3	Keypad Reference	See Par ID 101	See Par ID 102	Hz	0.00	141	
P7.4	Keypad Direction				0	116	0 = Forward 1 = Reverse
P7.5	Keypad Stop				1	114	0 = Enabled-Keypad Operation 1 = Always Enabled
P7.6	Jog Reference	0.00	See Par ID 102	Hz	5.00	117	
P7.7	Motor Pot Ramp Time	0.1	2000.0	Hz/s	10.0	156	
P7.8	Motor Pot Ref Reset				0	169	0 = No Reset 1 = Reset: Stop + Power Down 2 = Reset: Power Down
P7.9	Start Mode				0	252	0 = Ramp 1 = Flying Start From Stop Frequency 2 = Flying Start From Max Frequency
P7.10	Stop Mode				1	253	0 = Coasting 1 = Ramp
P7.11	Ramp 1 Shape	0.0	10.0	s	0.0	247	
P7.12	Ramp 2 Shape	0.0	10.0	s	0.0	248	
P7.13	Accel Time 2	0.1	3000.0	s	10.0	249	
P7.14	Decel Time 2	0.1	3000.0	s	10.0	250	
P7.15	Skip F1 Low Limit	0.00	See Par ID 257	Hz	0.00	256	
P7.16	Skip F1 High Limit	See Par ID 256	400.00	Hz	0.00	257	
P7.17	Skip F2 Low Limit	0.00	See Par ID 259	Hz	0.00	258	
P7.18	Skip F2 High Limit	See Par ID 258	400.00	Hz	0.00	259	
P7.19	Skip F3 Low Limit	0.00	See Par ID 261	Hz	0.00	260	
P7.20	Skip F3 High Limit	See Par ID 260	400.00	Hz	0.00	261	
P7.21	Skip Range Ramp Factor	0.1	10.0		1.0	264	
P7.22	Power Loss Function				0	267	0 = Disabled 1 = Decel Mode 2 = Coast Mode
P7.23	Power Loss Time	0.3	5.0	s	2.0	268	
P7.24	Currency				0	2122	0 = $ 1 = £ 2 = € 3 = ¥ 4 = Rs 5 = R$ 6 = Fr 7 = kr
P7.25	Energy Cost			Varies	0.00	2123	
P7.26	Data Type				0	2124	0 = Cumulative 1 = Daily Avg 2 = Weekly Avg 3 = Monthly Avg 4 = Yearly Avg
P7.27	Energy Savings Reset					2125	0 = Not Reset 1 = Reset
P7.28 ①	2nd Stage Ramp Frequency	See Par ID 101	See Par ID 102	Hz	30.00	2444	
P7.29	Change PhaseSequence Motor				0	2515	0 = Change Disable 1 = Change Enable

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 167. Drive Control—P7, continued

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P7.30	Run Remove Stop Mode				0	2667	See Par ID 253

Table 168. Motor control—P8.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P8.1 ①②	Motor Control Mode				0	287	0 = Freq Control 1 = Speed Control 5 = Open Loop Speed Control 6 = Open Loop Torque Control
P8.2 ①	Current Limit	DriveNomCurrCT*1/10	DriveNomCurrCT*2	A	DriveNomCurrVT	107	
P8.3 ①	V/Hz Optimization				0	109	See Par ID 2462
P8.4 ①	V/Hz Ratio				0	108	0 = Linear 1 = Squared 2 = Programmable 3 = Linear + Flux Optimization
P8.5 ①	Field Weakening Point	8.00	400.00	Hz	FieldWeakPointMFG	289	
P8.6 ①	Voltage at FWP	10.00	200.00	%	100.00	290	
P8.7 ①	V/Hz Mid Frequency	0.00	See Par ID 289	Hz	VHzCurveMidFreqMFG	291	
P8.8 ①	V/Hz Mid Voltage	0.00	100.00	%	100.00	292	
P8.9 ①	Zero Frequency Voltage	0.00	40.00	%	0.00	293	
P8.10	Switching Frequency	MinSwitchFreq	MaxSwitchFreq	kHz	DefaultSwitchFreqCT	2522	
P8.11	Sine Filter Enable				0	1665	See Par ID 2462
P8.12 ①	OverVoltage Control				3	294	0 = Disabled 1 = REF + 8Hz 2 = Max Freq 3 = Max Freq + 8Hz
P8.13	Load Drooping	0.00	100.00	%	0.00	298	
P8.14 ②	Identification				0	299	0 = No Action 1 = Identification Only Stator Resistor 2 = Identification with Run 3 = Identification No Run 4 = Identification Only Inertia
P8.15	Neg Frequency Limit	-400.00	See Par ID 1576	Hz	-400.00	1574	
P8.16	Pos Frequency Limit	See Par ID 1574	400.00	Hz	400.00	1576	
P8.17	Frequency Ramp Out FilterTime Constant	0	3000	ms	0	1585	
P8.18	Speed Error Filter Time Constant	0	3000	ms	0	1591	
P8.20	Speed Control Kp0	0.0	1000.0	%		1593	
P8.21	Speed Control Ti0	0.0	3200.0	ms		1594	
P8.24	Speed Control F0	0.00	See Par ID 1598	Hz	5.00	1597	
P8.25	Speed Control F1	See Par ID 1597	See Par ID 289	Hz	10.00	1598	
P8.26	Speed Control Kp1	0.0	1000.0	%		1599	
P8.27	Speed Control Ti1	0.0	3200.0	ms		1600	
P8.29	Motoring Torque Limit	0.0	300.0	%	300.0	1602	
P8.30	Generator Torque Limit	0.0	300.0	%	300.0	1603	
P8.31	Torque Limit Forward	0.0	300.0	%	300.0	1604	
P8.32	Torque Limit Reverse	0.0	300.0	%	300.0	1605	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 168. Motor control—P8, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P8.33	Motoring Power Limit	0.0	300.0	%	300.0	1607	
P8.34	Generator Power Limit	0.0	300.0	%	300.0	1608	
P8.35	Acc Compensation Time Constant	0.0	1000.0	%	0.0	1611	
P8.36	Acc Compensation Filter Time Constant	0	3000	ms	0	1612	
P8.37	Flux Reference	0.0	500.0	%	100.0	1620	
P8.43	Droop Control Filter Time Constant	0	3000	ms	0	1630	
P8.44	Startup Torque Selection				0	1631	0 = Not Used 1 = TorqueMemory 2 = Reserve 3 = StartupTorque FWD/REV
P8.45	Torque Memory Start	-300.0	300.0	%	0.0	1632	
P8.46	Startup Torque Forward	-300.0	300.0	%	0.0	1633	
P8.47	Startup Torque Reverse	-300.0	300.0	%	0.0	1634	
P8.48	Startup Torque Actual			%		1635	
P8.49	Startup Torque Time	0	10000	ms	50	1667	
P8.50 ①	Stator Resistor	0.001	65.535	ohm	0.033	771	
P8.51 ①	Rotor Resistor	0.001	65.535	ohm	0.034	772	
P8.52 ①	Leak Inductance	0.01	655.35	mh	0.12	773	
P8.53 ①	Mutual Inductance	0.1	6553.5	mh	3.4	774	
P8.54 ①	Excitation Current	0.0	DriveNomCurrCT*2	A	0.0	775	
P8.55	Advanced Open Loop Options				24896	58	
P8.56	Torque Stability Gain	0.0	500.0	%	50.0	63	
P8.57	Torque Stability FWP Gain	0.0	500.0	%	50.0	64	
P8.58	Torque Stability Dampening Time	0.0005	1.0000	s	0.0050	62	
P8.59	V/F Stable Kd	0	3000	%	100	1656	
P8.60	V/F Stable Kq	0	3000	%	100	1657	
P8.61 ①	Overmodulation Enable				0	2835	See Par ID 2462
P8.62 ①	Motor Inertia	0.001	65.535		0.038	2837	
P8.63 ①	PM BEMF Voltage	0.0	6553.5	V	0.1	1882	
P8.64 ①	PM q-axis Stator Inductance	0.00	655.35	mh	0.01	1883	
P8.65 ①	PM d-axis Stator Inductance	0.00	655.35	mh	0.01	1884	
P8.66 ①	PM Initial Selection				1	1890	0 = Align 1 = Six Pluse 2 = HFI
P8.67 ①	PM Initial Time	0.0	60.0	s	0.7	1891	
P8.68 ①	PM excited Current	0	200	%	20	1892	
P8.69 ①	PM excited Current Off Frequency	10.00	See Par ID 488	%	20.00	1893	
P8.70	Observer Kp	1	3000	%	100	2901	
P8.71	Slip Compensation Coefficient	0	500	%	100	1664	
P8.72 ①	Pulse Off Frequency	10	35	%	30	1768	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 169. Protections—P9.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P9.1 ①	4mA Input Fault				0	306	0 = No Action 1 = Warning 2 = Warning: Previous Freq 3 = Warning: Preset Freq 4 = Fault 5 = Fault, Coast
P9.2①	4mA Fault Frequency	0.00	See Par ID 102	Hz	0.00	331	
P9.3 ①	External Fault				2	307	0 = No Action 1 = Warning 2 = Fault 3 = Fault, Coast
P9.4 ①	Input Phase Fault				2	332	0 = No Action 1 = Warning 2 = Fault 3 = Fault, Coast 4 = Single Phase Power Limit
P9.5 ①	Uvolt Fault Response				2	330	See Par ID 307
P9.6 ①	Output Phase Fault				2	308	See Par ID 307
P9.7 ①	Ground Fault				2	309	See Par ID 307
P9.8 ①	Motor Thermal Protection				2	310	See Par ID 307
P9.9	Motor Thermal F0 Current	0.0	150.0	%	100.0	311	
P9.11 ①	Stall Protection				0	313	See Par ID 307
P9.12	Stall Current Limit	0.1	ActiveMotor NomCurr*2	A	ActiveMotor NomCurr*13/10	314	
P9.13	Stall Time Limit	1.0	120.0	s	15.0	315	
P9.14	Stall Frequency Limit	1.00	See Par ID 102	Hz	25.00	316	
P9.15 ①	Underload Protection				0	317	See Par ID 307
P9.16	Underload Fnom Torque	10.0	150.0	%	50.0	318	
P9.17	Underload F0 Torque	5.0	150.0	%	10.0	319	
P9.18	Underload Time Limit	2.00	600.00	s	20.00	320	
P9.19 ①	Thermistor Fault Response				2	333	See Par ID 307
P9.20	Line Start Lockout				2	750	0 = Disabled, No Change 1 = Enable, No Change 2 = Disabled, Changed 3 = Enable, Changed
P9.21 ①	Fieldbus Fault Response				2	334	0 = No Action 1 = Warning 2 = Fault 3 = Fault, Coast 4 = Warning, Coast 5 = Warning, Auto Switch To Local 6 = Warning, Auto Switch To Preset Speed 1
P9.22 ①	OPTCard Fault Response				2	335	See Par ID 307
P9.23 ①	Unit Under Temp Prot				2	1564	See Par ID 307
P9.24	AR Wait Time	1.00	300.00	s	1.00	321	
P9.25	AR Trail Time	0.00	600.00	s	30.00	322	
P9.26	AR Start Function				0	323	0 = Flying Start From Stop Frequency 1 = Ramp 2 = Flying Start From Max Frequency
P9.27	Undervoltage Attempts	0	10		1	324	
P9.28	OverVoltage Attempts	0	10		1	325	
P9.29	OverCurrent Attempts	0	3		1	326	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 169. Protections—P9, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P9.30	4mA Fault Attempts	0	10		1	327	
P9.31	Motor Temp Fault Attempts	0	10		1	329	
P9.32	External Fault Attempts	0	10		1	328	
P9.33	Underload Attempts	0	10		1	336	
P9.34 ①	RTC Fault				1	955	See Par ID 307
P9.35 ①	PT100 Fault Response				2	337	See Par ID 307
P9.36 ①	Replace Battery Fault Response				1	1256	See Par ID 307
P9.37 ①	Replace Fan Fault Response				1	1257	See Par ID 307
P9.38 ①	IP Address Confliction Resp				1	1678	See Par ID 307
P9.39	Cold Weather Mode				0	2126	See Par ID 2462
P9.40	Cold Weather Volt. Level	0.0	20.0	%	2.0	2127	
P9.41	Cold Weather Time Out	0	10	min	3	2128	
P9.42	Cold Weather Password					2129	
P9.43	Under Temp Fault Override					2130	See Par ID 2118
P9.44	Ground Fault Limit	0	30	%	15	2158	
P9.45 ①	Keypad Comm Fault Response				2	2157	See Par ID 307
P9.46	Preheat Mode				0	2159	See Par ID 2462

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 169. Protections—P9, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P9.47 ②	Preheat Control Source				31	2160	0 = DigIN:NormallyOpen 1 = DigIN:NormallyClose 2 = DigIN: 1 3 = DigIN: 2 4 = DigIN: 3 5 = DigIN: 4 6 = DigIN: 5 7 = DigIN: 6 8 = DigIN: 7 9 = DigIN: 8 10 = DigIN: A: IO1: 1 11 = DigIN: A: IO1: 2 12 = DigIN: A: IO1: 3 13 = DigIN: A: IO5: 1 14 = DigIN: A: IO5: 2 15 = DigIN: A: IO5: 3 16 = DigIN: A: IO5: 4 17 = DigIN: A: IO5: 5 18 = DigIN: A: IO5: 6 19 = DigIN: B: IO1: 1 20 = DigIN: B: IO1: 2 21 = DigIN: B: IO1: 3 22 = DigIN: B: IO5: 1 23 = DigIN: B: IO5: 2 24 = DigIN: B: IO5: 3 25 = DigIN: B: IO5: 4 26 = DigIN: B: IO5: 5 27 = DigIN: B: IO5: 6 28 = Time Channel 1 29 = Time Channel 2 30 = Time Channel 3 31 = Drive Temperature 32 = SlotA PT100 Temp Channel 1 33 = SlotA PT100 Temp Channel 2 34 = SlotA PT100 Temp Channel 3 35 = SlotA Max PT100 Temp 36 = SlotB PT100 Temp Channel 1 37 = SlotB PT100 Temp Channel 2 38 = SlotB PT100 Temp Channel 3 39 = SlotB Max PT100 Temp 40 = SlotA and SlotB Max PT100 Temp
P9.48	Preheat Enter Temp	-20.0	20.0	Deg. C	10.0	2161	
P9.49	Preheat Quit Temp	-10.0	40.0	Deg. C	20.0	2162	
P9.50	Preheat Output Volt	0.0	20.0	%	2.0	2163	
P9.51 ①	PID Feedback AI Loss Response				0	2401	0 = No Action 1 = Warning 2 = Fault 3 = Warning: Preset Freq 4 = Warning: Analog->Net
P9.52 ①	PID Feedback AI Loss Pre Freq	0.00	400.00	Hz	0.00	2402	
P9.53	PID Feedback AI Loss Pipe Fill Loss Level	0.0	1000.0	Varies	0.0	2403	
P9.54	PID Feedback AI Loss PreFreq Timeout	0	6000	s	0	2404	

Note: ① Parameter value can only be changed after the drive has stopped.
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③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 169. Protections—P9, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P9.55	PID Feedback AI Loss Attempts	0	10		1	2405	
P9.56	STO Fault Response				2	2427	0 = No Action 1 = Warning 2 = Fault
P9.57	Fault Reset Start				0	2483	0 = Follow Run Command 1 = Rising Edge After Fault Reset
P9.58	Warning Operation Mode				1	2657	0 = No Action 1 = Warning, No Store 2 = Warning, Store
P9.59	Fan Protection				2	2664	See Par ID 307
P9.60	Under Voltage Trip Level	DCLinkUnderVolt StopLimit	DCLinkOverVolt StopLimit	V	DCLinkUnderVolt ProtectLimit	2666	
P9.61	OP Cont Interlock Attempts	0	10		1	2803	
P9.62 ①	OP Cont Interlock Protection				2	2831	See Par ID 307
P9.63 ①	CP Interlock Run Protection				2	2895	See Par ID 307
P9.64 ①	CP Interlock Stop Protection				1	2896	0 = No Action 1 = Warning, No Store
P9.65	CP Interlock Attempts	0	10		1	2897	

Table 170. PID controller 1—P10.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P10.1	PID1 Control Gain	0.00	200.00	%	100.00	1294	
P10.2	PID1 Control ITime	0.00	600.00	s	1.00	1295	
P10.3	PID1 Control DTime	0.00	100.00	s	0.00	1296	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 170. PID controller 1—P10, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P10.4 ①, continued	PID1 Process Unit				0	1297	0 = % 1 = 1/min 2 = rpm 3 = ppm 4 = pps 5 = l/s 6 = l/min 7 = l/h 8 = kg/s 9 = kg/min 10 = kg/h 11 = m3/s 12 = m3/min 13 = m3/h 14 = m/s 15 = mbar 16 = bar 17 = Pa 18 = kPa 19 = mVS 20 = kW 21 = Deg. C 22 = GPM 23 = gal/s 24 = gal/min 25 = gal/h 26 = lb/s 27 = lb/min 28 = lb/h 29 = CFM 30 = ft3/s 31 = ft3/min 32 = ft3/h 33 = ft/s 34 = in wg 35 = ft wg 36 = PSI 37 = lb/in2 38 = HP 39 = Deg. F 40 = PA 41 = WC 42 = HG 43 = ft 44 = m
P10.5	PID1 Process Unit Min	-99999.99	See Par ID 1300	Varies	0.00	1298	
P10.6	PID1 Process Unit Max	See Par ID 1298	99999.99	Varies	100.00	1300	
P10.7	PID1 Process Unit Decimal	0	4		2	1302	
P10.8 ①	PID1 Error Inversion				0	1303	See Par ID 181
P10.9	PID1 Dead Band	0.00	99999.99	Varies	0.00	1304	
P10.10	PID1 Dead Band Delay	0.00	320.00	s	0.00	1306	
P10.11	PID1 Keypad Set Point 1	See Par ID 1298	See Par ID 1300	Varies	0.00	1307	
P10.12	PID1 Keypad Set Point 2	See Par ID 1298	See Par ID 1300	Varies	0.00	1309	
P10.13	PID1 Ramp Time	0.00	300.00	s	0.00	1311	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 170. PID controller 1—P10, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P10.14 ①②	PID1 Set Point 1 Source				1	1312	0 = Not Used 1 = PID1 Keypad Set Point 1 2 = PID1 Keypad Set Point 2 3 = AI1 4 = AI2 5 = Slot A: AI1 6 = Slot B: AI1 7 = FB Process Data Input 1 8 = FB Process Data Input 2 9 = FB Process Data Input 3 10 = FB Process Data Input 4 11 = FB Process Data Input 5 12 = FB Process Data Input 6 13 = FB Process Data Input 7 14 = FB Process Data Input 8 15 = PID2 Output 16 = Multi Drive Network 17 = FB PID1 Set Point 1 18 = FB PID1 Set Point 2
P10.15	PID1 Set Point 1 Min	-200.00	200.00	%	0.00	1313	
P10.16	PID1 Set Point 1 Max	-200.00	200.00	%	100.00	1314	
P10.17 ①	PID1 Set Point 1 Sleep Enable				0	1315	See Par ID 2462
P10.18 ①	PID1 Set Point 1 Sleep Unit Sel				0	2396	0 = Output Frequency 1 = Motor Speed 2 = Motor Current 3 = PID1 Feedback
P10.19	PID1 Set Point 1 Sleep Level			Varies	0.00	2450	
P10.20	PID1 Set Point 1 Sleep Delay	0	3000	s	0	1317	
P10.21	PID1 Set Point 1 Wake Up Level	-99999.99	99999.99	Varies	0.00	1318	
P10.22	PID1 Set Point 1 Boost	-2.0	2.0		1.0	1320	
P10.23 ①②	PID1 Set Point 2 Source				2	1321	See Par ID 1312
P10.24	PID1 Set Point 2 Min	-200.00	200.00	%	0.00	1322	
P10.25	PID1 Set Point 2 Max	-200.00	200.00	%	100.00	1323	
P10.26 ①	PID1 Set Point 2 Sleep Enable				0	1324	See Par ID 2462
P10.27 ①	PID1 Set Point 2 Sleep Unit Sel				0	2397	See Par ID 2396
P10.28	PID1 Set Point 2 Sleep Level			Varies	0.00	2452	
P10.29	PID1 Set Point 2 Sleep Delay	0	3000	s	0	1326	
P10.30	PID1 Set Point 2 Wake Up Level	-99999.99	99999.99	Varies	0.00	1327	
P10.31	PID1 Set Point 2 Boost	-2.0	2.0		1.0	1329	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 170. PID controller 1—P10, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P10.32 ①	PID1 Feedback Function				0	1330	0 = Source 1 1 = SQRT(Source 1) 2 = SQRT(Source 1 - Source 2) 3 = SQRT(Source 1) + SQRT(Source 2) 4 = Source 1 + Source 2 5 = Source 1 - Source 2 6 = MIN(Source 1, Source 2) 7 = MAX(Source 1, Source 2) 8 = MEAN(Source1, Source2) 9 = Source1*Source2
P10.33	PID1 Feedback Gain	-1000.0	1000.0	%	100.0	1331	
P10.34 ①②	PID1 Feedback 1 Source				2	1332	0 = Not Used 1 = AI1 2 = AI2 3 = Slot A: AI1 4 = Slot B: AI1 5 = FB Process Data Input 1 6 = FB Process Data Input 2 7 = FB Process Data Input 3 8 = FB Process Data Input 4 9 = FB Process Data Input 5 10 = FB Process Data Input 6 11 = FB Process Data Input 7 12 = FB Process Data Input 8 13 = PT100 Temperture 14 = PID2 Output 15 = SlotA PT100 Temp Channel 1 16 = SlotA PT100 Temp Channel 2 17 = SlotA PT100 Temp Channel 3 18 = SlotB PT100 Temp Channel 1 19 = SlotB PT100 Temp Channel 2 20 = SlotB PT100 Temp Channel 3 21 = FB PID1 Feedback 1 22 = FB PID1 Feedback 2
P10.35	PID1 Feedback 1 Min	-200.00	200.00	%	0.00	1333	
P10.36	PID1 Feedback 1 Max	-200.00	200.00	%	100.00	1334	
P10.37 ①②	PID1 Feedback 2 Source				0	1335	See Par ID 1332
P10.38	PID1 Feedback 2 Min	-200.00	200.00	%	0.00	1336	
P10.39	PID1 Feedback 2 Max	-200.00	200.00	%	100.00	1337	
P10.40 ①	PID1 Feedforward Func				0	1338	See Par ID 1330
P10.41	PID1 Feedforward Gain	-1000.0	1000.0	%	100.0	1339	

Note: ① Parameter value can only be changed after the drive has stopped.
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③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 170. PID controller 1—P10, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P10.42 ①②	PID1 Feedforward 1 Source				0	1340	0 = Not Used 1 = AI1 2 = AI2 3 = Slot A: AI1 4 = Slot B: AI1 5 = FB Process Data Input 1 6 = FB Process Data Input 2 7 = FB Process Data Input 3 8 = FB Process Data Input 4 9 = FB Process Data Input 5 10 = FB Process Data Input 6 11 = FB Process Data Input 7 12 = FB Process Data Input 8 13 = PT100 Temperture 14 = PID2 Output 15 = SlotA PT100 Temp Channel 1 16 = SlotA PT100 Temp Channel 2 17 = SlotA PT100 Temp Channel 3 18 = SlotB PT100 Temp Channel 1 19 = SlotB PT100 Temp Channel 2 20 = SlotB PT100 Temp Channel 3 21 = FB PID1 Feedforward 1 22 = FB PID1 Feedforward 2
P10.43	PID1 Feedforward 1 Min	-200.00	200.00	%	0.00	1341	
P10.44	PID1 Feedforward 1 Max	-200.00	200.00	%	100.00	1342	
P10.45 ①②	PID1 Feedforward 2 Source				0	1343	See Par ID 1340
P10.46	PID1 Feedforward 2 Min	-200.00	200.00	%	0.00	1344	
P10.47	PID1 Feedforward 2 Max	-200.00	200.00	%	100.00	1345	
P10.48	PID1 Set Point 1 Comp Enable				0	1352	See Par ID 2462
P10.49	PID1 Set Point 1 Comp Max	-200.00	200.00	%	0.00	1353	
P10.50	PID1 Set Point 2 Comp Enable				0	1354	See Par ID 2462
P10.51	PID1 Set Point 2 Comp Max	-200.00	200.00	%	0.00	1355	
P10.52	PID1 Wake Up Action				0	2466	0 = Below Wake Up Level 1 = Above Wake Up Level 2 = Below Wake Up Level(PID ref.) 3 = Above Wake Up Level(PID ref.)
P10.53	FB PID1 Set Point 1	See Par ID 1298	See Par ID 1300	Varies		2542	
P10.54	FB PID1 Set Point 2	See Par ID 1298	See Par ID 1300	Varies		2544	
P10.55	FB PID1 Feedback 1			%		2550	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 170. PID controller 1—P10, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P10.56	FB PID1 Feedback 2			%		2551	
P10.57	FB PID1 Feedforward 1			%		2554	
P10.58	FB PID1 Feedforward 2			%		2555	
P10.59	PID1 Sleep Boost level	-9999	9999	Varies	0	2660	
P10.60	PID1 Sleep Boost Max Time	1	300	s	30	2661	
P10.61	PID1 Low Feedback Level	0.0	6000.0	Varies	0.0	2811	
P10.62	PID1 Low Feedback Time	0	3600	s	10	2812	
P10.63 ①	PID1 Low Feedback Protection				0	2813	See Par ID 307
P10.64	PID1 High Feedback Level	0.0	6000.0	Varies	150.0	2814	
P10.65	PID1 High Feedback Time	0	3600	s	5	2815	
P10.66 ①	PID1 High Feedback Protection				0	2816	See Par ID 307
P10.67 ①	PID1 Hysteresis Level	0.0	100.0	Varies	0.0	2817	
P10.68	PID1 Backup Feedback Source				0	2825	0 = Not Used 1 = AI1 2 = AI2 3 = Slot A: AI1 4 = Slot B: AI1

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 171. PID controller 2—P11.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P11.1	PID2 Control Gain	0.00	200.00	%	100.00	1356	
P11.2	PID2 Control I Time	0.00	600.00	s	1.00	1357	
P11.3	PID2 Control D Time	0.00	100.00	s	0.00	1358	
P11.4 ①	PID2 Process Unit				0	1359	See Par ID 1297
P11.5	PID2 Process Unit Min	-99999.99	See Par ID 1362	Varies	0.00	1360	
P11.6	PID2 Process Unit Max	See Par ID 1360	99999.99	Varies	100.00	1362	
P11.7	PID2 Process Unit Decimal	0	4		2	1364	
P11.8 ①	PID2 Error Inversion				0	1365	See Par ID 181
P11.9	PID2 Dead Band	0.00	99999.99	Varies	0.00	1366	
P11.10	PID2 Dead Band Delay	0.00	320.00	s	0.00	1368	
P11.11	PID2 Keypad Set Point 1	See Par ID 1360	See Par ID 1362	Varies	0.00	1369	
P11.12	PID2 Keypad Set Point 2	See Par ID 1360	See Par ID 1362	Varies	0.00	1371	
P11.13	PID2 Ramp Time	0.00	300.00	s	0.00	1373	
P11.14 ①	PID2 Set Point 1 Source				1	1374	0 = Not Used 1 = PID2 Keypad Set Point 1 2 = PID2 Keypad Set Point 2 3 = AI1 4 = AI2 5 = Slot A: AI1 6 = Slot B: AI1 7 = FB Process Data Input 1 8 = FB Process Data Input 2 9 = FB Process Data Input 3 10 = FB Process Data Input 4 11 = FB Process Data Input 5 12 = FB Process Data Input 6 13 = FB Process Data Input 7 14 = FB Process Data Input 8 15 = PID1 Output 16 = Multi Drive Network 17 = FB PID2 Set Point 1 18 = FB PID2 Set Point 2
P11.15	PID2 Set Point 1 Min	-200.00	200.00	%	0.00	1375	
P11.16	PID2 Set Point 1 Max	-200.00	200.00	%	100.00	1376	
P11.17 ①	PID2 Set Point 1 Sleep Enable				0	1377	See Par ID 2462
P11.18 ①	PID2 Set Point 1 Sleep Unit Sel				0	2398	0 = Output Frequency 1 = Motor Speed 2 = Motor Current 3 = PID2 Feedback
P11.19	PID2 Set Point 1 Sleep Level			Varies	0.00	2454	
P11.20	PID2 Set Point 1 Sleep Delay	0	3000	s	0	1379	
P11.21	PID2 Set Point 1 WakeUp Level	-99999.99	99999.99	Varies	0.00	1380	
P11.22	PID2 Set Point 1 Boost	-2.0	2.0		1.0	1382	
P11.23 ①	PID2 Set Point 2 Source				2	1383	See Par ID 1374
P11.24	PID2 Set Point 2 Min	-200.00	200.00	%	0.00	1384	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 171. PID controller 2—P11, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P11.25	PID2 Set Point 2 Max	-200.00	200.00	%	100.00	1385	
P11.26 ①	PID2 Set Point 2 Sleep Enable				0	1386	See Par ID 2462
P11.27 ①	PID2 Set Point 2 Sleep Unit Sel				0	2399	See Par ID 2398
P11.28	PID2 Set Point 2 Sleep Level			Varies	0.00	2456	
P11.29	PID2 Set Point 2 Sleep Delay	0	3000	s	0	1388	
P11.30	PID2 Set Point 2 WakeUp Level	-99999.99	99999.99	Varies	0.00	1389	
P11.31	PID2 Set Point 2 Boost	-2.0	2.0		1.0	1391	
P11.32 ①	PID2 Feedback Func				0	1392	See Par ID 1330
P11.33	PID2 Feedback Gain	-1000.0	1000.0	%	100.0	1393	
P11.34 ①	PID2 Feedback 1 Source				2	1394	0 = Not Used 1 = AI1 2 = AI2 3 = Slot A: AI1 4 = Slot B: AI1 5 = FB Process Data Input 1 6 = FB Process Data Input 2 7 = FB Process Data Input 3 8 = FB Process Data Input 4 9 = FB Process Data Input 5 10 = FB Process Data Input 6 11 = FB Process Data Input 7 12 = FB Process Data Input 8 13 = PT100 Temperture 14 = PID1 Output 15 = SlotA PT100 Temp Channel 1 16 = SlotA PT100 Temp Channel 2 17 = SlotA PT100 Temp Channel 3 18 = SlotB PT100 Temp Channel 1 19 = SlotB PT100 Temp Channel 2 20 = SlotB PT100 Temp Channel 3 21 = FB PID2 Feedback 1 22 = FB PID2 Feedback 2
P11.35	PID2 Feedback 1 Min	-200.00	200.00	%	0.00	1395	
P11.36	PID2 Feedback 1 Max	-200.00	200.00	%	100.00	1396	
P11.37 ①	PID2 Feedback 2 Source				0	1397	See Par ID 1394
P11.38	PID2 Feedback 2 Min	-200.00	200.00	%	0.00	1398	
P11.39	PID2 Feedback 2 Max	-200.00	200.00	%	100.00	1399	
P11.40 ①	PID2 Feedforward Func				0	1400	See Par ID 1330
P11.41	PID2 Feedforward Gain	-1000.0	1000.0	%	100.0	1401	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 171. PID controller 2—P11, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P11.42 ①	PID2 Feedforward 1 Source				0	1402	0 = Not Used 1 = AI1 2 = AI2 3 = Slot A: AI1 4 = Slot B: AI1 5 = FB Process Data Input 1 6 = FB Process Data Input 2 7 = FB Process Data Input 3 8 = FB Process Data Input 4 9 = FB Process Data Input 5 10 = FB Process Data Input 6 11 = FB Process Data Input 7 12 = FB Process Data Input 8 13 = PT100 Temperture 14 = PID1 Output 15 = SlotA PT100 Temp Channel 1 16 = SlotA PT100 Temp Channel 2 17 = SlotA PT100 Temp Channel 3 18 = SlotB PT100 Temp Channel 1 19 = SlotB PT100 Temp Channel 2 20 = SlotB PT100 Temp Channel 3 21 = FB PID2 Feedforward 1 22 = FB PID2 Feedforward 2
P11.43	PID2 Feedforward 1 Min	-200.00	200.00	%	0.00	1403	
P11.44	PID2 Feedforward 1 Max	-200.00	200.00	%	100.00	1404	
P11.45 ①	PID2 Feedforward 2 Source				0	1405	See Par ID 1402
P11.46	PID2 Feedforward 2 Min	-200.00	200.00	%	0.00	1406	
P11.47	PID2 Feedforward 2 Max	-200.00	200.00	%	100.00	1407	
P11.48	PID2 Set Point1 Comp Enable				0	1414	See Par ID 2462
P11.49	PID2 Set Point1 Comp Max	-200.00	200.00	%	0.00	1415	
P11.50	PID2 Set Point 2 Comp Enable				0	1416	See Par ID 2462
P11.51	PID2 Set Point 2 Comp Max	-200.00	200.00	%	0.00	1417	
P11.52	PID2 Wake Up Action				0	2467	See Par ID 2466
P11.53	FB PID2 Set Point 1	See Par ID 1298	See Par ID 1300	Varies		2546	
P11.54	FB PID2 Set Point 2	See Par ID 1298	See Par ID 1300	Varies		2548	
P11.55	FB PID2 Feedback 1			%		2552	
P11.56	FB PID2 Feedback 2			%		2553	
P11.57	FB PID2 Feedforward 1			%		2556	
P11.58	FB PID2 Feedforward 2			%		2557	
P11.59	PID2 Sleep Boost level	-9999	9999	Varies	0	2662	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 171. PID controller 2—P11, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P11.60	PID2 Sleep Boost Max Time	1	300	s	30	2663	
P11.61	PID2 Low Feedback Level	0.0	6000.0	Varies	0.0	2818	
P11.62	PID2 Low Feedback Time	0	3600	s	10	2819	
P11.63 ①	PID2 Low Feedback Protection				0	2820	See Par ID 307
P11.64	PID2 High Feedback Level	0.0	6000.0	Varies	150.0	2821	
P11.65	PID2 High Feedback Time	0	3600	s	5	2822	
P11.66 ①	PID2 High Feedback Protection				0	2823	See Par ID 307
P11.67 ①	PID2 Hysteresis Level	0.0	100.0	Varies	0.0	2824	
P11.68	PID2 Backup Feedback Source				0	2826	See Par ID 2825

Table 172. Preset speed—P12.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P12.1	Preset Speed 1	0.00	See Par ID 102	Hz	5.00	105	
P12.2	Preset Speed 2	0.00	See Par ID 102	Hz	10.00	106	
P12.3	Preset Speed 3	0.00	See Par ID 102	Hz	15.00	118	
P12.4	Preset Speed 4	0.00	See Par ID 102	Hz	20.00	119	
P12.5	Preset Speed 5	0.00	See Par ID 102	Hz	25.00	120	
P12.6	Preset Speed 6	0.00	See Par ID 102	Hz	30.00	121	
P12.7	Preset Speed 7	0.00	See Par ID 102	Hz	35.00	122	

Table 173. Torque control—P13.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P13.1	Torque Limit	0.0	400.0	%	400.0	295	
P13.2	Torque Ref Select				0	303	0 = Not Used 1 = AI1 2 = AI2 3 = Slot A: AI1 4 = Slot B: AI1 5 = AI1 Joystick 6 = AI2 Joystick 7 = Keypad Torque Ref 8 = FB Process Data Input 1 9 = PID1 Control Output 10 = PID2 Control Output 11 = FB Torque Ref
P13.3	Keypad Torque Ref	-300.0	300.0	%	0.0	782	
P13.4	Torque Ref Max	-300.0	300.0	%	100.0	304	
P13.5	Torque Ref Min	-300.0	300.0	%	0.0	305	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 173. Torque control—P13, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P13.6	Speed Limiter Mode				0	1666	0 = NegFreqMax ... PosFreqMax 1 = -|FreqRampOut| ... +|FreqRampOut| 2 = NegFreqMax ... FreqRampout(MIN) 3 = FreqRampOut ... PosFreqMax(MAX) 4 = FreqRampOut ± WindowPos/NegWidth 5 = 0 ... FreqRampOut(pos or neg direction) 6 = FreqRamp ± WindowPos/Neg/PosOff/NegOff
P13.7	Window Pos Width	0.00	50.00	Hz	2.00	1636	
P13.8	Window Neg Width	0.00	50.00	Hz	2.00	1637	
P13.9	Window Pos Off Limit	0.00	See Par ID 1636	Hz	0.00	1638	
P13.10	Window Neg Off Limit	0.00	See Par ID 1637	Hz	0.00	1639	
P13.11	Torque Reference Filter TC	0	32000	ms	0	1640	
P13.12	Pull Out Torque	0.0	1000.0	%	250.0	1606	
P13.13 ①	Stop State Magnetisation Time	0	32000	s	0	1684	
P13.14	FB Torque Ref	-300.0	300.0	%		2541	
P13.15	Torque Control(2) Min Frequency	0.00	See Par ID 102	Hz	3.00	300	
P13.16	Torque Control(2) P-gain	0.00	500.00		0.01	301	
P13.17	Torque Control(2) I-gain	0.1	1000.0		2.0	302	
P13.18	OL Trq Ctrl(6) P-gain	0.00	500.00	%	0.06	60	
P13.19	OL Trq Ctrl(6) I-gain	0.1	1000.0	%	5.0	61	

Table 174. Brake—P14.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P14.1 ①	DC-Brake Current	Drive NomCurrCT*15/100	Drive NomCurrCT*15/10	A	DriveNomCurrCT*1/2	254	
P14.2 ①	Start DC-Brake Time	0.00	600.00	s	0.00	263	
P14.3 ①	Stop DC-Brake Frequency	0.10	10.00	Hz	1.50	262	
P14.4 ①	Stop DC-Brake Time	0.00	600.00	s	0.00	255	
P14.5 ①	Brake Chopper Mode				0	251	0 = Disabled 1 = B(Run) T(Rdy) 2 = External 3 = B(Rdy) T(Rdy) 4 = B(Run) T(No)
P14.6 ①	Flux Brake				0	266	0 = Off 1 = On
P14.7 ①	Flux Brake Current	ActiveMotor NomCurr*1/10	See Par ID 107	A	ActiveMotorNomCurr*1/2	265	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 175. Fire mode—P15.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P15.1 ①	Fire Mode Function				0	535	0 = Closing Contact 1 = Opening Contact
P15.2 ①②	Fire Mode Ref Select Function				0	536	0 = Fire Mode Min Frequency 1 = Fire Mode Ref 2 = Fieldbus Ref 3 = AI1 4 = AI2 5 = AI1 + AI2 6 = PID1 Control Output 7 = PID2 Control Output
P15.3	Fire Mode Frequency	See Par ID 101	See Par ID 102	Hz	MotorNomFreqMFG	537	
P15.4	Fire Mode % Speed Ref 1	0.0	100.0	%	75.0	565	
P15.5	Fire Mode % Speed Ref 2	0.0	100.0	%	100.0	564	
P15.6 ①	Smoke Purge Frequency	0.0	100.0	%	50.0	554	
P15.7	Fire Mode Test Enable					2443	See Par ID 2462

Table 176. Second motor parameter—P16.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P16.1 ①	Motor Nom Current 2	DriveNomCurrCT*1/10	DriveNomCurrCT*2	A	DriveNomCurrCT	577	
P16.2 ①	Motor Nom Speed 2	300	20000	rpm	SecdMotorNomSpeedMFG	578	
P16.3 ①	Motor PF 2	0.30	1.00		0.85	579	
P16.4 ①	Motor Nom Volt 2	180	690	V	SecdMotorNomVoltMFG	580	
P16.5 ①	Motor Nom Freq 2	8.00	400.00	Hz	SecdMotorNomFreqMFG	581	
P16.6 ①	Stator Resistor 2	0.001	65.535	ohm	0.033	1419	
P16.7 ①	Rotor Resistor 2	0.001	65.535	ohm	0.034	1420	
P16.8 ①	Leak Inductance 2	0.01	655.35	mh	0.12	1421	
P16.9 ①	Mutual Inductance 2	0.1	6553.5	mh	3.4	1422	
P16.10 ①	Excitation Current 2	0.0	DriveNomCurrCT*2	A	0.0	1423	
P16.11 ①	Motor Inertia2	0.001	65.535		0.100	2838	
P16.12 ①	Second PM BEMF Voltage	0.0	6553.5	V	0.1	2842	
P16.13 ①	Second PM q-axis Stator Inductance	0.00	655.35	mh	0.01	2843	
P16.14 ①	Second PM d-axis Stator Inductance	0.00	655.35	mh	0.01	2844	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Bypass

Table 177. Basic setting—P17.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P17.1.1 ①	Bypass Enable				0	1418	See Par ID 2462
P17.1.2 ①	Bypass Start Delay	1	32765	s	5	544	
P17.1.3 ①	Auto Bypass				0	542	See Par ID 2462
P17.1.4 ①	Auto Bypass Delay	0	32765	s	10	543	
P17.1.5 ①	OverCurrent Bypass Enable				0	547	See Par ID 2462
P17.1.6 ①	IGBT Fault Bypas Enable				0	546	See Par ID 2462
P17.1.7 ①	4mA Fault Bypass Enable				0	548	See Par ID 2462
P17.1.8 ①	UnderVoltage Bypass Enable				0	545	See Par ID 2462
P17.1.9 ①	OverVoltage Bypass Enable				0	549	See Par ID 2462
P17.1.10 ①	Motor OverTemp Bypass Enable				0	1698	See Par ID 2462
P17.1.11 ①	UnderLoad Bypass Enable				0	1699	See Par ID 2462
P17.1.12 ①	External Bypass Enable				0	1700	See Par ID 2462
P17.1.13 ①	Charge Switch Fault Bypass Enable				0	1701	See Par ID 2462
P17.1.14 ①	Saturation Trip Fault Bypass Enable				0	1702	See Par ID 2462
P17.1.15 ①	Under Temp Fault Bypass Enable				0	1703	See Par ID 2462
P17.1.16 ①	EEPROM Fault Bypass Enable				0	1704	See Par ID 2462
P17.1.17 ①	Control board EEPROM Fault Bypass Enable				0	1705	See Par ID 2462
P17.1.18 ①	Watchdog Fault Bypass Enable				0	1706	See Par ID 2462
P17.1.19 ①	Fan Cooling Fault Bypass Enable				0	1707	See Par ID 2462
P17.1.20 ①	Keypad Com Fault Bypass Enable				0	1708	See Par ID 2462
P17.1.21 ①	Option Card Fault Bypass Enable				0	1709	See Par ID 2462
P17.1.22 ①	RTC Clock Fault Bypass Enable				0	1710	See Par ID 2462
P17.1.23 ①	Ctrl Board OverTemp Fault Bypass Enable				0	1711	See Par ID 2462
P17.1.24 ①	Fieldbus Fault Bypass Enable				0	1713	See Par ID 2462
P17.1.25 ①	Op Cont Interlock Fault Bypass Enable				0	2832	See Par ID 2462

Table 178. Redundant drive—P17.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P17.2.1	Redundant Drive Enable				0	2476	See Par ID 2462
P17.2.2	Drive ID	0	5		0	2278	
P17.2.3	Redundant Run Time Enable				0	2477	See Par ID 2462
P17.2.4	Redundant Run Time Reset					2478	See Par ID 2125
P17.2.5	Redundant RunTime Limit	0.00	300000.00	h	0.00	2479	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Pump parameters

Table 179. Basic setting—P18.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.1.1 ①	Multi-pump Mode				0	2279	0 = Disabled 1 = Single Drive Control 2 = Multi Drive Network
P18.1.2 ①	Drive ID	0	5		0	2278	
P18.1.3	PID Bandwidth	0.00	6000.00	Varies	10.00	2458	
P18.1.4 ①	Staging Frequency	See Par ID 101	400.00		50.00	2315	
P18.1.5 ①	De-Staging Frequency	0.00	See Par ID 102		0.00	2316	
P18.1.6	Add/Remove Delay	0	3600	s	10	344	
P18.1.7	Interlock Enable				0	350	See Par ID 2462
P18.1.8 ①	Damper Start				0	483	0 = Normal 1 = Interlock Start 2 = Interlock Tout 3 = Interlock Delay
P18.1.9 ①	Damper Time Out	1	32500	s	5	484	
P18.1.10 ①	Damper Delay	1	32500	s	5	485	
P18.1.11	Derag Cycles	0	10		3	2468	
P18.1.12	Derag at Start/Stop				0	2469	0 = Off 1 = Start 2 = Stop 3 = Start and Stop 4 = Digital Input
P18.1.13	Deragging Run Time	0	3600	s	0	2470	
P18.1.14	Derag Speed	See Par ID 101	See Par ID 102	Hz	5.00	2471	
P18.1.15	Derag Off Delay	1	600	s	10	2472	
P18.1.16 ①	Multi-pump Mode 2				0	2659	See Par ID 2279

Multi-pump status

Table 180. Operation mode—P18.2.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.2.1.1	MPC Drive1 Operate Mode					2218	0 = Offline 1 = Slave Drive 2 = Master Drive 3 = Redundant Drive
P18.2.1.2	MPC Drive2 Operate Mode					2230	See Par ID 2218
P18.2.1.3	MPC Drive3 Operate Mode					2242	See Par ID 2218
P18.2.1.4	MPC Drive4 Operate Mode					2254	See Par ID 2218
P18.2.1.5	MPC Drive5 Operate Mode					2266	See Par ID 2218

Table 181. Multi-pump status—P18.2.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.2.2.1	MPC Drive1 Status				5	2219	0 = Stopped 1 = Sleep 2 = Regulating 3 = Wait for CMD 4 = Following 5 = Unknown 6 = Master Local Control 7 = Slave Local Control
P18.2.2.2	MPC Drive2 Status				5	2231	See Par ID 2219
P18.2.2.3	MPC Drive3 Status				5	2243	See Par ID 2219
P18.2.2.4	MPC Drive4 Status				5	2255	See Par ID 2219

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 181. Multi-pump status—P18.2.2, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.2.2.5	MPC Drive5 Status				5	2267	See Par ID 2219

Table 182. Network status—P18.2.3.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.2.3.1	MPC Drive1 NetworkStatus					2220	0 = Disconnected 1 = Fault 2 = Local Control 3 = Pump Lost 4 = Need Alternation 5 = No Error
P18.2.3.2	MPC Drive2 NetworkStatus					2232	See Par ID 2220
P18.2.3.3	MPC Drive3 NetworkStatus					2244	See Par ID 2220
P18.2.3.4	MPC Drive4 NetworkStatus					2256	See Par ID 2220
P18.2.3.5	MPC Drive5 NetworkStatus					2268	See Par ID 2220

Multi-pump measurement

Table 183. Latest fault code—P18.3.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.3.1.1	MPC Drive1 Last Fault Code					2221	
P18.3.1.2	MPC Drive2 Last Fault Code					2233	
P18.3.1.3	MPC Drive3 Last Fault Code					2245	
P18.3.1.4	MPC Drive4 Last Fault Code					2257	
P18.3.1.5	MPC Drive5 Last Fault Code					2269	

Table 184. Output frequency—P18.3.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.3.2.1	MPC Drive1 f-Out			Hz		2222	
P18.3.2.2	MPC Drive2 f-Out			Hz		2234	
P18.3.2.3	MPC Drive3 f-Out			Hz		2246	
P18.3.2.4	MPC Drive4 f-Out			Hz		2258	
P18.3.2.5	MPC Drive5 f-Out			Hz		2270	

Table 185. Motor voltage—P18.3.3.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.3.3.1	MPC Drive1 V-Out			V		2223	
P18.3.3.2	MPC Drive2 V-Out			V		2235	
P18.3.3.3	MPC Drive3 V-Out			V		2247	
P18.3.3.4	MPC Drive4 V-Out			V		2259	
P18.3.3.5	MPC Drive5 V-Out			V		2271	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 186. Motor current—P18.3.4.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.3.4.1	MPC Drive1 I-Out			A		2224	
P18.3.4.2	MPC Drive2 I-Out			A		2236	
P18.3.4.3	MPC Drive3 I-Out			A		2248	
P18.3.4.4	MPC Drive4 I-Out			A		2260	
P18.3.4.5	MPC Drive5 I-Out			A		2272	

Table 187. Motor torque—P18.3.5.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.3.5.1	MPC Drive1 M-Out			%		2225	
P18.3.5.2	MPC Drive2 M-Out			%		2237	
P18.3.5.3	MPC Drive3 M-Out			%		2249	
P18.3.5.4	MPC Drive4 M-Out			%		2261	
P18.3.5.5	MPC Drive5 M-Out			%		2273	

Table 188. Motor power—P18.3.6.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.3.6.1	MPC Drive1 P-Out			%		2226	
P18.3.6.2	MPC Drive2 P-Out			%		2238	
P18.3.6.3	MPC Drive3 P-Out			%		2250	
P18.3.6.4	MPC Drive4 P-Out			%		2262	
P18.3.6.5	MPC Drive5 P-Out			%		2274	

Table 189. Motor speed—P18.3.7.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.3.7.1	MPC Drive1 n-Out			rpm		2227	
P18.3.7.2	MPC Drive2 n-Out			rpm		2239	
P18.3.7.3	MPC Drive3 n-Out			rpm		2251	
P18.3.7.4	MPC Drive4 n-Out			rpm		2263	
P18.3.7.5	MPC Drive5 n-Out			rpm		2275	

Table 190. Run time—P18.3.8.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.3.8.1	MPC Drive1 t-Run			h		2228	
P18.3.8.2	MPC Drive2 t-Run			h		2240	
P18.3.8.3	MPC Drive3 t-Run			h		2252	
P18.3.8.4	MPC Drive4 t-Run			h		2264	
P18.3.8.5	MPC Drive5 t-Run			h		2276	

Table 191. Multi-pump single drive—P18.4.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.4.1 ①	Number of Pumps	1	5		1	342	
P18.4.2	Include Freq Converter				1	346	See Par ID 2462
P18.4.3	Auto-Change Enable				0	345	See Par ID 2462
P18.4.4	Auto-Change Interval	0.0	3000.0	h	48.0	347	
P18.4.5	Auto-Change Freq Limit	See Par ID 101	See Par ID 102	Hz	25.00	349	
P18.4.6	Auto-Change Pump Limit	0	5		1	348	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 191. Multi-pump single drive—P18.4, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.4.7 ①	Pipe Fill Aux Pump Select				0	2439	0 = Disabled 1 = Aux Motor 1 2 = Aux Motor 2 3 = Aux Motor 3 4 = Aux Motor 4
P18.4.8 ①	Pipe Fill Aux Pump Run Time	0.0	3600.0	min	0.0	2440	
P18.4.9 ①	Pipe Fill Aux Pump Operation				0	2441	0 = Automatic 1 = Stop
P18.4.10 ①	Pipe Fill Aux Pump Delay	0.0	600.0	min	2.0	2442	

Table 192. Multi-pump multi-drive—P18.5.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.5.1 ①	Number of Drives	1	5		1	2449	
P18.5.2 ①	Regulation Source				0	2284	0 = Network Only 1 = PID Controller 1
P18.5.3 ①	Recovery Method				0	2285	See Par ID 2441
P18.5.4 ①	Callback Source				0	2286	0 = No Action 1 = Safety Torque Off
P18.5.5	Add/Remove Drive Selection				0	2311	0 = Drive ID 1 = Run Time
P18.5.6	Run Time Enable				0	2280	See Par ID 2462
P18.5.7	Run Time Limit	0.0	300000.0	h	0.0	2281	
P18.5.8	Run Time Reset					2283	0 = No Action 1 = Reset
P18.5.9	Master Drive Mode				0	2473	0 = Follow PID 1 = Fixed Speed 2 = Turn Off
P18.5.10	Master Fixed Speed	See Par ID 101	See Par ID 102	Hz	50.00	2474	
P18.5.11	Master Fixed Speed Delay	0	1000	s	5	2475	

Table 193. Protections—P18.6.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.6.1 ①	Pipe Fill Loss Detection Method				0	2406	0 = Motor Current 1 = Motor Power 2 = Motor Torque
P18.6.2	Pipe Fill Loss Level	0.0	1000.0	Varies	0.0	2407	
P18.6.3	Pipe Fill Loss Time	0	600	s	0	2408	
P18.6.4 ①	Pipe Fill Loss Frequency	0.00	See Par ID 102	Hz	0.00	2409	
P18.6.5 ①	Pipe Fill Loss Response				0	2410	See Par ID 2427
P18.6.6	Pipe Fill Loss Attempts	0	10		1	2411	
P18.6.7	Prime Pump Enable				0	2428	See Par ID 190
P18.6.8	Prime Pump Level	0.00	6000.00	Varies	0.00	2429	
P18.6.9	Prime Pump Frequency	See Par ID 101	See Par ID 102	Hz	0.00	2431	
P18.6.10	Prime Pump Delay Time	0.0	3600.0	min	0.0	2432	
P18.6.11	Prime Pump Loss of Prime Level	0.0	1000.0	Varies	0.0	2433	
P18.6.12	Prime Pump Level 2	0.00	6000.00	Varies	0.00	2434	
P18.6.13	Prime Pump Frequency 2	See Par ID 101	See Par ID 102	Hz	0.00	2436	
P18.6.14	Prime Pump Delay Time 2	0.0	3600.0	min	0.0	2437	
P18.6.15	Prime Pump Loss of Prime Level 2	0.0	1000.0	Varies	0.0	2438	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 193. Protections—P18.6, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P18.6.16 ①	Broken Pipe Fault Response				0	1853	See Par ID 307
P18.6.17	Broken Pipe Level	0.0	6000.0	Varies	15.0	1854	
P18.6.18	Broken Pipe Delay	1.0	120.0	s	15.0	1855	
P18.6.19	Broken Pipe Frequency	1.00	See Par ID 102	Hz	25.00	1856	
P18.6.20	Jockey Pump Enable				0	2804	0 = Not Used 1 = PID Sleep 2 = PID Sleep(Level)
P18.6.21	Jockey Start Level	-99999.99	See Par ID 2807	Varies	0.00	2805	
P18.6.22	Jockey Stop Level	See Par ID 2805	99999.99	Varies	0.00	2807	
P18.6.23	Lube Pump Enable				0	2809	See Par ID 2462
P18.6.24	Lube Pump Time	0.0	300.0	s	0.0	2810	

Table 194. Real time clock—P19.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P19.1	Interval 1 On Time				0,0,0	491	
P19.2	Interval 1 Off Time				0,0,0	493	
P19.3	Interval 1 From Day				0	517	0 = Sunday 1 = Monday 2 = Tuesday 3 = Wednesday 4 = Thursday 5 = Friday 6 = Saturday
P19.4	Interval 1 To Day				0	518	See Par ID 517
P19.5	Interval 1 Channel				0	519	0 = Not Used 1 = Time Channel 1 2 = Time Channel 2 3 = Time Channel 3
P19.6	Interval 2 On Time				0,0,0	495	
P19.7	Interval 2 Off Time				0,0,0	497	
P19.8	Interval 2 From Day				0	520	See Par ID 517
P19.9	Interval 2 To Day				0	521	See Par ID 517
P19.10	Interval 2 Channel				0	522	See Par ID 519
P19.11	Interval 3 On Time				0,0,0	499	
P19.12	Interval 3 Off Time				0,0,0	501	
P19.13	Interval 3 From Day				0	523	See Par ID 517
P19.14	Interval 3 To Day				0	524	See Par ID 517
P19.15	Interval 3 Channel				0	525	See Par ID 519
P19.16	Interval 4 On Time				0,0,0	503	
P19.17	Interval 4 Off Time				0,0,0	505	
P19.18	Interval 4 From Day				0	526	See Par ID 517
P19.19	Interval 4 To Day				0	527	See Par ID 517
P19.20	Interval 4 Channel				0	528	See Par ID 519
P19.21	Interval 5 On Time				0,0,0	507	
P19.22	Interval 5 Off Time				0,0,0	509	
P19.23	Interval 5 From Day				0	529	See Par ID 517
P19.24	Interval 5 To Day				0	530	See Par ID 517
P19.25	Interval 5 Channel				0	531	See Par ID 519
P19.26	Timer 1 Duration	0	72000	s	0	511	
P19.27	Timer 1 Channel				0	532	See Par ID 519
P19.28	Timer 2 Duration	0	72000	s	0	513	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 194. Real time clock—P19, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P19.29	Timer 2 Channel				0	533	See Par ID 519
P19.30	Timer 3 Duration	0	72000	s	0	515	
P19.31	Timer 3 Channel				0	534	See Par ID 519
P19.32	Interval 1 Setting				0	2487	0 = Weekly 1 = Daily
P19.33	Interval 2 Setting				0	2488	See Par ID 2487
P19.34	Interval 3 Setting				0	2489	See Par ID 2487
P19.35	Interval 4 Setting				0	2490	See Par ID 2487
P19.36	Interval 5 Setting				0	2491	See Par ID 2487

Communication

Table 195. FB process data input Sel—P20.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.1.1	FB Process Data Input 1 Sel	0	3000		2541	2533	
P20.1.2	FB Process Data Input 2 Sel	0	See Par ID 2533		2542	2534	
P20.1.3	FB Process Data Input 3 Sel	0	See Par ID 2533		2550	2535	
P20.1.4	FB Process Data Input 4 Sel	0	See Par ID 2533		0	2536	
P20.1.5	FB Process Data Input 5 Sel	0	See Par ID 2533		0	2537	
P20.1.6	FB Process Data Input 6 Sel	0	See Par ID 2533		0	2538	
P20.1.7	FB Process Data Input 7 Sel	0	See Par ID 2533		0	2539	
P20.1.8	FB Process Data Input 8 Sel	0	See Par ID 2533		0	2540	

Table 196. FB process data output Sel—P20.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.2.1	FB Process Data Output 1 Sel				1	1556	
P20.2.2	FB Process Data Output 2 Sel				2	1557	
P20.2.3	FB Process Data Output 3 Sel				3	1558	
P20.2.4	FB Process Data Output 4 Sel				4	1559	
P20.2.5	FB Process Data Output 5 Sel				5	1560	
P20.2.6	FB Process Data Output 6 Sel				6	1561	
P20.2.7	FB Process Data Output 7 Sel				7	1562	
P20.2.8	FB Process Data Output 8 Sel				28	1563	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 196. FB process data output Sel—P20.2, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.2.9 ②	Standard Status Word Bit0 Function Select				1	2415	0 = Not Used 1 = Ready 2 = Run 3 = Fault 4 = Fault Invert 5 = Warning 6 = Reversed 7 = At Speed 8 = Zero Frequency 9 = Freq Limit 1 Superv 10 = Freq Limit 2 Superv 11 = PID1 Superv 12 = PID2 Superv 13 = OverHeat Fault 14 = OCurrent Fault 15 = OVolt Fault 16 = UVolt Fault Resp 17 = 4mA Ref Fault/ Warning 18 = Ext Brake Control 19 = Ext Brake Inverted 20 = Torq Limit Superv 21 = Ref Limit Superv 22 = Control from I/O 23 = Un-Requested Rotation Direction 24 = Thermistor Fault Output 25 = Fire Mode 26 = In Bypass Mode 27 = Ext Fault/Warning 28 = Remote Control 29 = Jog Speed Select 30 = Motor Therm Protection 31 = FB Digital Input 1 32 = FB Digital Input 2 33 = FB Digital Input 3 34 = FB Digital Input 4 35 = Damper Control 36 = TC1 Status 37 = TC2 Status 38 = TC3 Status 39 = In E-Stop 40 = Power Limit Superv 41 = Temp Limit Superv 42 = Analog Input Superv 43 = Motor 1 Control 44 = Motor 2 Control 45 = Motor 3 Control 46 = Motor 4 Control 47 = Motor 5 Control 48 = Logic Fulfilled 49 = PID1 Sleep 50 = PID2 Sleep 51 = Motor Current 1 Supv 52 = Motor Current 2 Supv 53 = Second AI Limit Supv 54 = DC Charge Switch Close 55 = Preheat Active 56 = Cold Weather Active 57 = Prime Pump Active 58 = 2nd Stage Ramp Frequency Active 59 = STO Fault Output

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 196. FB process data output Sel—P20.2, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.2.9 ②, continued	Standard Status Word Bit0 Function Select				1	2415	60 = Run Bypass/Drive 61 = Bypass Overload 62 = Bypass Run 63 = Auto Local On COM Fault 64 = FieldBus RTU Fault 65 = FieldBus TCP Fault 66 = FieldBus MSTP Fault 67 = FieldBus EIP Fault 68 = FieldBus SlotA Fault 69 = FieldBus SlotB Fault 70 = FieldBus SWD Fault 71 = Jockey Pump Active 72 = Lube Pump Active 73 = PID1 Low Feedback 74 = PID1 High Feedback 75 = PID2 Low Feedback 76 = PID2 High Feedback 77 = Master in MPFC 78 = CP Interlock Fault
P20.2.10 ②	Standard Status Word Bit1 Function Select				2	2416	See Par ID 2415
P20.2.11 ②	Standard Status Word Bit2 Function Select				3	2417	See Par ID 2415
P20.2.12 ②	Standard Status Word Bit3 Function Select				4	2418	See Par ID 2415
P20.2.13 ②	Standard Status Word Bit4 Function Select				5	2419	See Par ID 2415
P20.2.14 ②	Standard Status Word Bit5 Function Select				6	2420	See Par ID 2415
P20.2.15 ②	Standard Status Word Bit6 Function Select				7	2421	See Par ID 2415
P20.2.16 ②	Standard Status Word Bit7 Function Select				8	2422	See Par ID 2415

RS-485 bus

Table 197. Basic setting—P20.3.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.3.1.1 ①	RS485 Comm Set				0	586	0 = Modbus RTU 1 = BACnet MS/TP 2 = SWD

Table 198. Modbus RTU—P20.3.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.3.2.1 ①	Slave Address	1	247		1	587	
P20.3.2.2 ①	Baud Rate				1	584	0 = 9600 1 = 19200 2 = 38400 3 = 57600 4 = 115200
P20.3.2.3 ①	Parity Type And Stop Bit				2	585	0 = None and 2 stop bits 1 = Odd and 1 stop bit 2 = Even and 1 stop bit 3 = None and 1 stop bit

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 198. Modbus RTU—P20.3.2, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.3.2.4	Modbus RTU Protocol Status					588	0 = Initial 1 = Stopped 2 = Operational 3 = Faulted
P20.3.2.5	Comm Timeout Modbus RTU	0	60000	ms	10000	593	
P20.3.2.6	Modbus RTU Fault Response				0	2516	0 = in Fieldbus Control 1 = in all Control

Table 199. BACnet MS/TP—P20.3.3.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.3.3.1	MSTP Baud Rate				2	594	0 = 9600 1 = 19200 2 = 38400 3 = 76800 4 = 115200
P20.3.3.2	MSTP Device Address	0	127		1	595	
P20.3.3.3	MSTP Instance Number	0	4194302		0	596	
P20.3.3.4	MSTP Comm Timeout	0	60000	ms	10000	598	
P20.3.3.5	MSTP Protocol Status				0	599	0 = Stopped 1 = Operational 2 = Faulted
P20.3.3.6	MSTP Fault Code				0	600	0 = None 1 = Sole Master 2 = Duplicate MAC ID 3 = Baud rate fault
P20.3.3.7	MSTP Fault Response				0	2526	See Par ID 2516
P20.3.3.8 ①	MSTP Max Master	1	127		127	1537	

Table 200. Terminal: SWD—P20.3.4.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.3.4.1	Parameter Access				1	2630	0 = Local Control 1 = Fieldbus
P20.3.4.2 ①	Process Data Access				4	2631	0 = Local Control 1 = Fieldbus 2 = Mixed Interface 4 = NET, Local on Fault 5 = Dual Mode
P20.3.4.3	Fault Situation Counter					2632	
P20.3.4.4	Board Status					2609	
P20.3.4.5	Firmware Version					2610	
P20.3.4.6	Protocol Status					2612	
P20.3.4.7	Operation Mode					2613	
P20.3.4.8	PDP-Telegram Selection				1	2614	
P20.3.4.9	Fault Counter PDP				0	2615	
P20.3.4.10	Fault Situations Max				8,8	2616	
P20.3.4.11	PDP-Profil Number				809	2618	
P20.3.4.12	PDP-Control Word					2619	
P20.3.4.13	PDP-Status Word				64	2620	
P20.3.4.14	PDP-MaxBlockLength				512	2621	
P20.3.4.15	PDP-NoOfMultiparameter				64	2622	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 200. Terminal: SWD—P20.3.4, continued.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.3.4.16	PDP-MaxLatency				0	2623	
P20.3.4.17	PDP-DO Manufacturer					2624	
P20.3.4.18	PDP-DO Device Type					1451	
P20.3.4.19	PDP-DO FW-Interface					2625	
P20.3.4.20	PDP-DO FW-Year					2626	
P20.3.4.21	PDP-DO FW-DayMonth					2627	
P20.3.4.22	PDP-DO NoOfDOs				1	2628	
P20.3.4.23	PDP-DO Subclass				1	2629	

Table 201. EtherNet/IP—P20.4.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.4.1 ①	IP Address Mode				0	1500	
P20.4.2	Active IP Address					1507	
P20.4.3	Active Subnet Mask					1509	
P20.4.4	Active Default Gateway					1511	
P20.4.5	MAC Address					1513	
P20.4.6 ①	Static IP Address				192.168.1.254	1501	
P20.4.7 ①	Static Subnet Mask				255.255.255.0	1503	
P20.4.8 ①	Static Default Gateway				192.168.1.1	1505	
P20.4.9	Ethernet IP Protocol Status					608	
P20.4.10	EIP Fault Response				0	2518	See Par ID 2156

Table 202. Modbus TCP—P20.5.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.5.1	Connection Limit				5	609	
P20.5.2	Modbus TCP Unit ID				1	610	
P20.5.3	Comm Timeout Modbus TCP	0	60000	ms	10000	611	
P20.5.4	Modbus TCP Protocol Status					612	See Par ID 599
P20.5.5	Modbus TCP Fault Response				0	2517	See Par ID 2156
P20.5.6	Modbus TCP Trusted IP Enable				1	74	See Par ID 2462
P20.5.7	Trusted IP White List				0xC0.0xA8.0x01.0xFF.0x00.0x00.0x00.0x00.0x00.0x00.0x00.0x00	68	

Table 203. WebUI—P20.6.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.6.1	WebUI Protocol Status					2915	
P20.6.2	WebUI Fault Response				0	2916	
P20.6.3	WebUI Communication Timeout	30000	60000	ms	60000	2919	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 204. Protocol Enable—P20.7.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P20.7.1 ①⑥	Ethernet based protocol select				0	1997	0 = Disabled 1 = Ethernet IP
P20.7.2 ①⑥	Modbus TCP enable				0	1942	0 = Disabled 1 = Ethernet IP
P20.7.3 ①⑥	WebUI Enable				1	2921	See Par ID 2462

System

Table 205. Basic setting—P21.1.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P21.1.1	Language				0	340	
P21.1.2 ①	Application					142	
P21.1.3 ①	Parameter Sets					619	
P21.1.4	Up To Keypad					620	See Par ID 2118
P21.1.5 ①	Down From Keypad					621	
P21.1.6	Parameter Comparison					623	
P21.1.7	Password	0	9999		0	624	
P21.1.8	Parameter Lock				0	625	
P21.1.9	Multimonitor Set				0	627	See Par ID 2462
P21.1.10	Default Page				2	628	
P21.1.11	Timeout Time	0	65535	s	30	629	
P21.1.12	Contrast Adjust	5	18		12	630	
P21.1.13	Backlight Time	1	65535	min	10	631	
P21.1.14	Fan Control				1	632	
P21.1.15	Keypad ACK Timeout	200	5000	ms	200	633	
P21.1.16	Keypad Retry Number	1	10		5	634	
P21.1.17	Startup Wizard				0	626	
P21.1.18	Jog Softkey Hidden				0	2412	See Par ID 2462
P21.1.19	Reverse Softkey Hidden				0	2413	See Par ID 2462
P21.1.20	Output Display Unit				45	2424	
P21.1.21	Output Display Unit Min	-60000.00	See Par ID 2425	Varies	0.00	2460	
P21.1.22	Output Display Unit Max	See Par ID 2460	60000.00	Varies	MotorNomFreqMFG	2425	
P21.1.23	Keypad Lock Password	0	9999		0	75	

Table 206. Version info.—P21.2.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P21.2.1	Keypad Software Version					640	
P21.2.2	Motor Control Software Version					642	
P21.2.3	Application Software Version					644	
P21.2.4	Software Bundle Version					1714	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Table 207. Application info.—P21.3.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P21.3.1	Brake Chopper Status					646	See Par ID 2118
P21.3.2	Brake Resistor Status					647	See Par ID 2118
P21.3.3	Serial Number					648	
P21.3.4	Power Unit Serail Number					1270	
P21.3.5	Control Unit Serial Number					1276	

Table 208. User info.—P21.4.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
P21.4.1	Real Time Clock				0.0.0.1:1:13	566	
P21.4.2	Daylight Saving				0	582	
P21.4.3	Total MWh Count			Mwh		601	
P21.4.4	Total Power Day Count					603	
P21.4.5	Total Power Hr Count					606	
P21.4.6	Trip MWh Count			Mwh		604	
P21.4.7	Clear Trip MWh Count					635	See Par ID 2125
P21.4.8	Trip Power Day Count					636	
P21.4.9	Trip Power Hr Count					637	
P21.4.10	Clear Trip Power Count					639	See Par ID 2125

Table 209. Operate mode—O.

Code	Parameter	Min.	Max.	Unit	Default	ID	Note
O1	Output Frequency			Hz		1	
O2	Freq Reference			Hz		24	
O3	Motor Speed			rpm		2	
O4	Motor Current			A		3	
O5	Motor Torque			%		4	
O6	Motor Power			%		5	
O7	Motor Voltage			V		6	
O8	DC-link Voltage			V		7	
O9	Unit Temperature			Deg. C		8	
O10	Motor Temperature			%		9	
R11	Keypad Torque Ref	-300.0	300.0	%	0.0	782	
R12	Keypad Reference	See Par ID 101	See Par ID 102	Hz	0.00	141	
R13	PID1 Keypad Set Point 1	See Par ID 1298	See Par ID 1300	Varies	0.00	1307	
R14	PID1 Keypad Set Point 2	See Par ID 1298	See Par ID 1300	Varies	0.00	1309	

Note: ① Parameter value can only be changed after the drive has stopped.
② Parameter value will be set to be default when changing macros.
③ Input function is level sensed.
④ Input function is edge sensed.
⑤ Input function is edge sensed when using StartP/StopP start logic.
⑥ Reset after modification.

Appendix A—Description of parameters

On the following pages you will find the parameter descriptions arranged according to the parameter number.

Some parameter names are followed by a number code indicating the applications in which the parameter is included. See the list of applications below. The parameter numbers under which the parameter appears in different applications are also given.

Application level

1 Standard application
2 Multi-pump and fan application
3 Multi-PID application
4 Multi-purpose application

Modbus ID	Code	Parameters	Application	RO/RW
1	**M1**	**Output Frequency** Output frequency (Hz).	**1, 2, 3, 4**	RO
24	**M2**	**Freq Reference** Reference frequency (Hz).	**1, 2, 3, 4**	RO
2	**M3**	**Motor Speed** Motor output speed (RPM).	**1, 2, 3, 4**	RO
3	**M4**	**Motor Current** Motor output current RMS (Amps).	**1, 2, 3, 4**	RO
4	**M5**	**Motor Torque** Percent motor torque calculated from nameplate values and measured motor current (%).	**1, 2, 3, 4**	RO
5	**M6**	**Motor Power** Percent motor power calculated from nameplate values and measured motor current (%).	**1, 2, 3, 4**	RO
6	**M7**	**Motor Voltage** Output ac motor voltage (Vac).	**1, 2, 3, 4**	RO
7	**M8**	**DC-link Voltage** DC bus voltage (Vdc).	**1, 2, 3, 4**	RO
8	**M9**	**Unit Temperature** Heat sink temperature (deg. C).	**1, 2, 3, 4**	RO
9	**M10**	**Motor Temperature** Motor temperature value calculated from nameplate values and measured motor current (%).	**1, 2, 3, 4**	RO
15	**M11**	**Torque Reference** Torque reference percentage used when in torque control mode.	**4**	RO
10	**M12**	**Analog Input 1** Analog input 1 measured value (Vdc or Amps) selectable with dipswitch.	**1, 2, 3, 4**	RO
11	**M13**	**Analog Input 2** Analog input 2 measured value (Vdc or Amps) selectable with dipswitch.	**1, 2, 3, 4**	RO
25	**M14**	**Analog Output 1** Analog output 1 measured value (Vdc or Amps) selectable with parameter.	**1, 2, 3, 4**	RO
575	**M15**	**Analog Output 2** Analog output 2 measured value (Vdc or Amps) selectable with parameter.	**1, 2, 3, 4**	RO
12	**M16**	**DI1, DI2, DI3** Digital input 1/2/3 status.	**1, 2, 3, 4**	RO
13	**M17**	**DI4, DI5, DI6** Digital input 4/5/6 status.	**1, 2, 3, 4**	RO
576	**M18**	**DI7, DI8** Digital input 7/8 status.	**1, 2, 3, 4**	RO
14	**M19**	**DO1,Virtual RO1,Virtual RO2** Digital output status. The Virtual RO1 and Virtual RO2 status are of internal relays in the control board not for external use.	**1, 2, 3, 4**	RO
557	**M20**	**RO1, RO2, RO3** Relay output 1/2/3 status.	**1, 2, 3, 4**	RO

Modbus ID	Code	Parameters	Application	RO/RW
558	**M21**	**TC1, TC2, TC3** Timer channel status.	**2, 3, 4**	RO
559	**M22**	**Interval 1** Time interval 1 status.	**2, 3, 4**	RO
560	**M23**	**Interval 2** Time interval 2 status.	**2, 3, 4**	RO
561	**M24**	**Interval 3** Time interval 3 status.	**2, 3, 4**	RO
562	**M25**	**Interval 4** Time interval 4 status.	**2, 3, 4**	RO
563	**M26**	**Interval 5** Time interval 5 status.	**2, 3, 4**	RO
569	**M27**	**Timer 1** Timer 1 value in seconds.	**2, 3, 4**	RO
571	**M28**	**Timer 2** Timer 2 value in seconds.	**2, 3, 4**	RO
573	**M29**	**Timer 3** Timer 3 value in seconds.	**2, 3, 4**	RO
16	**M30**	**PID1 Set Point** PID setpoint in process units.	**2, 3, 4**	RO
18	**M31**	**PID1 Feedback** PID feedback level in process units.	**2, 3, 4**	RO
20	**M32**	**PID1 Error Value** PID error in process units.	**2, 3, 4**	RO
22	**M33**	**PID1 Output** PID output (%).	**2, 3, 4**	RO
23	**M34**	**PID1 Status** PID status indication, indicates if drive is stopped, running in PID mode, or in PID sleep mode.	**2, 3, 4**	RO
32	**M35**	**PID2 Set Point** PID setpoint in process units.	**3, 4**	RO
34	**M36**	**PID2 Feedback** PID feedback level in process units.	**3, 4**	RO
36	**M37**	**PID2 Error Value** PID error in process units.	**3, 4**	RO
38	**M38**	**PID2 Output** PID output (%).	**3, 4**	RO
39	**M39**	**PID2 Status** PID status indication, indicates if drive is stopped, running in PID mode, or in PID sleep mode.	**3, 4**	RO
26	**M40**	**Running Motors** Number of auxiliary motors currently running.	**2, 3, 4**	RO
27	**M41**	**PT100 Temperature** PT100 thermistor temperature value in deg. C.	**1, 2, 3, 4**	RO
28	**M42**	**Latest Fault Code** Last active fault code value. See fault codes for the value shown here.	**1, 2, 3, 4**	RO
583	**M43**	**RTC Battery Status** Real time clock battery status.	**1, 2, 3, 4**	RO
1686	**M44**	**Instant Motor Power** Instantaneous motor power (kW).	**1, 2, 3, 4**	RO
2120	**M45**	**Energy Savings** Displays the energy savings of the drive compared to linear V/f curve.	**1, 2, 3, 4**	RO

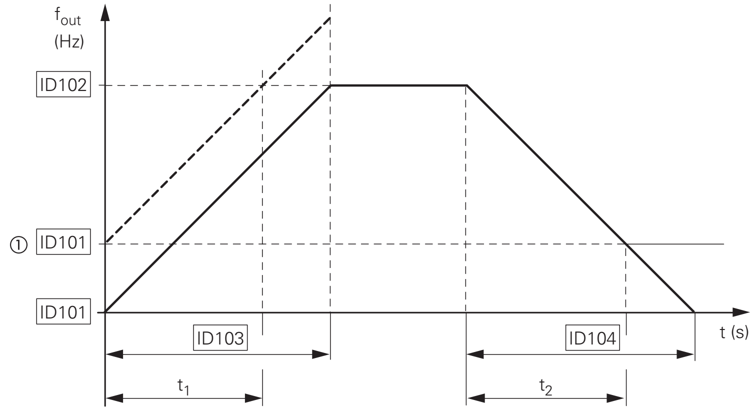
Modbus ID	Code	Parameters	Application	RO/RW
2209	**M46**	**Control Board DIDO Status** Control board digital input and relay output status provides the status of inputs and outputs on the control board. It is looking at DIN1 - Terminal 20, DIN2 - Terminal 21, DIN3 - Terminal 22, DIN4 - Terminal 23, DIN5 - Terminal 7, DIN6 - Terminal 8, DIN7 - Terminal 9, DIN8 - Terminal 10, DO1 - Terminal 14, RO1 - Terminal 28-29, RO2 - Terminal 32-34, RO3 - Terminal 27 and 31. Along with the onboard I/O being monitored, it also provides status info. on if there are boards in the A or B expander board slots. Bit 0 = DIN1 status Bit 1 = DIN2 status Bit 2 = DIN3 status Bit 3 = DIN4 status Bit 4 = DIN5 status Bit 5 = DIN6 status Bit 6 = DIN7 status Bit 7 = DIN8 status Bit 8 = DO1 status Bit 9 = RO1 status Bit 10 = RO2 status Bit 11 = RO3 status Bit 12 = Slot A with board Bit 13 = Slot B with board Bit 14-15 = Not used	**1, 2, 3, 4**	RO
2210	**M47**	**SlotA DIDO Status** SlotA DIDO status will give the input and output status of a board inserted in the A expander board slot. Depending on the board inserted, different bits will become active if the I/O is enabled. Bit 0 = IO1_DIN1 status Bit 1 = IO1_DIN2 status Bit 2 = IO1_DIN3 status Bit 3 = IO1_DO1 status Bit 4 = IO1_DO2 status Bit 5 = IO1_DO3 status Bite 6 = IO3_RO1 status Bit 7 = IO3_RO2 status Bit 8 = IO3_RO3 status Bit 9 = IO5_AC1 status Bit 10 = IO5_AC2 status Bit 11 = IO5_AC3 status Bit 12 = IO5_AC4 status Bit 13 = IO5_AC5 status Bit 14 = IO5_AC6 status Bit 15 = Not used	**1, 2, 3, 4**	RO

Modbus ID	Code	Parameters	Application	RO/RW
2211	**M48**	**SlotB DIDO Status** SlotB DIDO Status will give the input and output status of a board inserted in the B expander board slot. Depending on the board inserted different bits will become active if the I/O is enabled. Bit 0 = IO1_DIN1 Status Bit 1 = IO1_DIN2 Status Bit 2 = IO1_DIN3 Status Bit 3 = IO1_DO1 Status Bit 4 = IO1_DO2 Status Bit 5 = IO1_DO3 Status Bite 6 = IO3_RO1 Status Bit 7 = IO3_RO2 Status Bit 8 = IO3_RO3 Status Bit 9 = IO5_AC1 Status Bit 10 = IO5_AC2 Status Bit 11 = IO5_AC3 Status Bit 12 = IO5_AC4 Status Bit 13 = IO5_AC5 Status Bit 14 = IO5_AC6 Status Bit 15 = Not Used	**1, 2, 3, 4**	RO
29	**M49**	**Application Status Word** Application status word will provide additional status indication of the health of the drive. Bit 0 = MC ready Bit 1 = MC_run Bit 2 = MC_fault Bit 3 = FB_Ref_active Bit 4 = MC_stopping Bit 5 = MC_reverse Bit 6 = MC_Warning/AR-fault Bit 7 = MC_zerospeed Bit 8 = I/O control indicate Bit 9 = Panel control indicator Bit 10 = Panel Fieldbus indicator Bit 11 = MC_DC_brake Bit 12 = RunEnable Bit 13 = Motor regulator status not zero Bit 14 = Ext brake control Bit 15 = Bypass mode	**1, 2, 3, 4**	RO
2414	**M50**	**Standard Status Word** Standard Status Word is defined based of the parameter setting in the Fieldbus process data output (P20.1) group, P20.1.9 through P20.1.16 define the first 8 bits of this status word. The options for these bits are based off the standard relay functions. Bit 0 = P20.1.9 (default = Ready) Bit 1 = P20.1.10 (default = Run) Bit 2 = P20.1.11 (default = Fault) Bit 3 = P20.1.12 (default = Fault invert) Bit 4 = P20.1.13 (default = Warning) Bit 5 = P20.1.14 (default = Reversed) Bit 6 = P20.1.15 (default = At speed) Bit 7 = P20.1.16 (default = Zero frequency) Bit 8 - 15 = Not used	**1, 2, 3, 4**	RO

Modbus ID	Code	Parameters	Application	RO/RW
2445	**M51**	**Output** User defined output value that can be configured with the users desired unit and scale. This value will be displayed in the format selected by P21.1.20 with a scale value from P21.1.22.	**1, 2, 3, 4**	RO
2447	**M52**	**Reference** User defined reference value that can be configured with the users desired unit and scale. This value will be displayed in the format selected by P21.1.20 with a scale value from P21.1.22.	**1, 2, 3, 4**	RO
601	**M53**	**Total MWh Count** Total Megawatt hours of the drive output.	**1, 2, 3, 4**	RO
603	**M54**	**Total Power Day Count** Number of days the drive has been supplied with power.	**1, 2, 3, 4**	RO
606	**M55**	**Total Power Hr Count** Number of hours the drive has been supplied with power.	**1, 2, 3, 4**	RO
604	**M56**	**Trip MWh Count** Megawatts hours of the drive output active since last reset.	**1, 2, 3, 4**	RO
636	**M57**	**Trip Power Day Count** Number of days since the last reset.	**1, 2, 3, 4**	RO
637	**M58**	**Trip Power Hr Count** Number of hours the drive has been running a motor since the last reset.	**1, 2, 3, 4**	RO
2827	**M59**	**Total Run time Count** The total time when drive is running.	**1, 2, 3, 4**	RO
2830	**M60**	**Numbers Of Start** The numbers of drives starts.	**1, 2, 3, 4**	RO
2829	**M61**	**Trip Run Time Count** The run time from last start signal.	**1, 2, 3, 4**	RO
2101	**M62**	**FB Status Word** Fieldbus Status Word is drive status mapped to protocols.	**1, 2, 3, 4**	RO
2001	**M63**	**FB Ctrol Word** Fieldbus control word is protocols control word which mapped to drive.	**1, 2, 3, 4**	RW
2003	**M64**	**FB Speed Reference** Fieldbus frequency reference from protocol.	**1, 2, 3, 4**	RW
1753	**M65**	**Multi-monitoring** Displays any 9 monitoring values in a screen. The values are selectable via the keypad menu. By going to the Multi-monitor page and seeing 3 lines of monitoring values. The Up and Down keys can be used to select the row and then hitting the left arrow key will allow for editing the value then by going up and down.	**1, 2, 3, 4**	RW
3214	**M67**	**Control board DI status** Control board DI Status will give the input status on control board.	**1, 2, 3, 4**	RW
3248	**M68**	**SlotA DI status** Slot DI Status will give the input status of a board insterted in the expander board slot.	**1, 2, 3, 4**	RO
3249	**M69**	**SlotB DI status** Slot DI Status will give the input status of a board insterted in the expander board slot.	**1, 2, 3, 4**	RO
101	**P1.1**	**Min Frequency** Defines the lowest frequency at which the drive will operate. This setting will limit other frequency parameter settings: 1 = Fire mode frequency 2 = Derag 3 = MPFC staging frequency 4 = MPFC master fixed frequency 5 = Prime pump frequency 6 = Prime pump frequency2	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
102	**P1.2**	**Max Frequency** Defines the highest frequency at which the drive will operate. This will limit other frequency parameters: 1 = Keypad reference 3 = Motor potentiome 3 = Jog speed 4 = 2nd stage ramp frequency 5 = Fire mode min. frequency 6 = Derag 7 = MPFC staging frequency 8 = MPFC master fixed frequency 9 = Prime pump frequency 10 = Prime pump frequency2 11 = Preset speed frequency 12 = Frequency limit value 13 = Reference limit value 14 = SpeedControl_fs2 15 = Stall frequency limit 16 = 4mA fault frequency 17 = MPFC de-staging frequency 18 = Pipe fill loss frequency low 19 = Pipe fill loss frequency high 20 = Broken pipe frequency limit)	**1, 2, 3, 4**	RW
103	**P1.3**	**Accel Time 1** Defines the time required for the output frequency to accelerate from zero frequency to maximum frequency (P1.2).	**1, 2, 3, 4**	RW
104	**P1.4**	**Decel Time 1** Defines the time required for the output frequency to decelerate from maximum frequency to zero frequency (P1.2).	**1, 2, 3, 4**	RW

Figure 39. Acceleration and deceleration time.

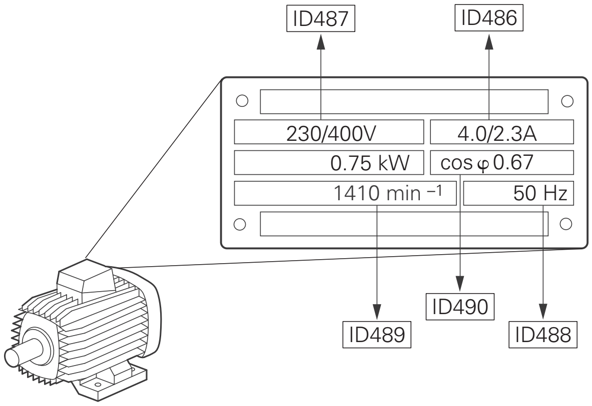


The values for the acceleration time t_1 and the deceleration time t_2 are calculated as follows:

$$t_1 = \frac{(ID102 - ID101) \times ID103}{ID102} \qquad t_2 = \frac{(ID102 - ID101) \times ID104}{ID102}$$

The defined acceleration (ID103) and deceleration times ID104 apply for all changes to the frequency setpoint value.
If the start-release (FWD, REV) is switched off, the output frequency (f_{Out}) is immediately set to zero. The motor runs down uncontrolled.
If a controlled run-down is requested (with value from ID104), stop mode should be set to ramp.

① When setting a minimum output frequency (ID104 greater than 0 Hz), the acceleration and deceleration time of the drive is reduced to t_1 or t_2.

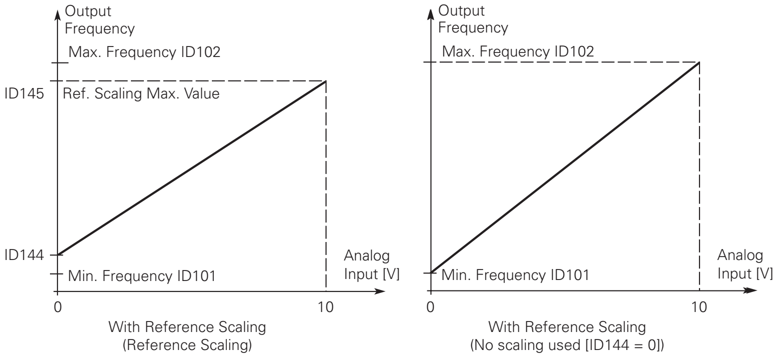
Modbus ID	Code	Parameters	Application	RO/RW
486	**P1.5**	**Motor Nom Current** Motor nameplate rated full load current. This value is found on the rating plate of the motor. **Figure 40. Motor parameters from ratings plate.**  	**1, 2, 3, 4**	RW
489	**P1.6**	**Motor Nom Speed** Motor nameplate rated speed, This value is found on the rating plate of the motor.	**1, 2, 3, 4**	RW
490	**P1.7**	**Motor PF** Motor nameplate rated power factor. This value is found on the rating plate of the motor.	**1, 2, 3, 4**	RW
487	**P1.8**	**Motor Nom Voltage** Motor nameplate rated voltage. This value is found on the rating plate of the motor.	**1, 2, 3, 4**	RW
488	**P1.9**	**Motor Nom Frequency** Motor nameplate rated frequency, This value is found on the rating plate of the motor.	**1, 2, 3, 4**	RW
1685	**P1.10**	**Power Up Local Remote Select** Selects what control place the drive will start at after power is applied. The default setting will hold the last state that the drive was in when powered down. Selecting Local or Remote will cause the drive to start in that mode regardless of last state.	**1, 2, 3, 4**	RW
135	**P1.11**	**Remote 1 Control Place** Defines the signal location for the start command in remote mode. I/O terminals would be from the digital hardwired inputs or keypad for Start/Stop buttons on the drive. Keypad display will indicate what mode is selected.	**1, 2, 3, 4**	RW
1695	**P1.12**	**Local Control Place** Defines the signal location for the start command in local mode. I/O terminals would be from the digital hardwired inputs or keypad for Start/Stop buttons on the drive. Keypad display will indicate what mode is selected.	**1, 2, 3, 4**	RW
2462	**P1.13**	**Bumpless Enable** When switching between Local or Remote control places when enabled the output of the drive will not change to the new reference place until that reference value is adjusted when in the new control place.	**1, 2, 3, 4**	RW
136	**P1.14**	**Local Reference** Defines the signal location for the speed reference in local mode.	**1, 2, 3, 4**	RW
137	**P1.15**	**Remote 1 Reference** Defines the signal location for the speed reference in remote mode.	**1, 2, 3, 4**	RW
1679	**P1.16**	**Reverse Enable** Enables or disables the reverse motor direction.	**1, 2, 3, 4**	RW
2423	**P1.17**	**Run Delay Time** Run Delay time parameter sets the time required for the drive to wait before another run command can be received. During this time the run signal is given it is ignored until the time has expired upon which it will then start, this is true for keypad, I/O, or Fieldbus Control places.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
2465	**P1.18**	**HOA Source** Enables the HOA control function. If enabled it selected the desired location for switching between Hand, Off, and Auto control locations. 0 = Disabled - Off is disable and the standard Loc/Rem is used. 1 = HOA Source: I/O Terminal - Drive is looking for control source selection via I/O terminals. Have to use the HOA On/Off digital input along with Force Hand or Remote to function. 2 = HOA Source: Keypad - Keypad Loc/Rem button will function as the switch between Hand/Off/Auto.	**1, 2, 3, 4**	RW
1813	**P1.19**	**Minimum Run Time** Drive minimum run time.	**1, 2, 3, 4**	RW
2840	**P1.20**	**Frequency Reference Upper Limit** The max. value of frequency reference. It is used to limit the value of frequency reference.	**1, 2, 3, 4**	RW
2841	**P1.21**	**Frequency Reference Upper Limit Source** Frequency reference upper limit source select 0 = Not Used; 1 = Freq Ref upper; 2 = AI1 3 = AL2.	**1, 2, 3, 4**	RW
1820	**P1.22**	**Motor Type Selection** Defines the type of motor connected to the drive, Standard Induction motor, internally mounted permanent magnet, or surface mount permanent magnet. 0 = Inverter duty; 1 = IPM; 2 = SPM.	**4**	RW
144	**P2.1.1**	**AI Ref Scale Min Value** Defines the minimum frequency associated with 0% input from the analog input. Setting AI ref scale min. value and AI ref scale max. value both to zero will cause the analog input to scale to the minimum and maximum frequencies.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
145	**P2.1.2**	**AI Ref Scale Max Value**	**1, 2, 3, 4**	RW

Defines the maximum frequency associated with 100% input from the analog input. Setting AI ref scale min. value and AI ref scale max. value both to zero will cause the analog input to scale to the minimum and maximum frequencies.

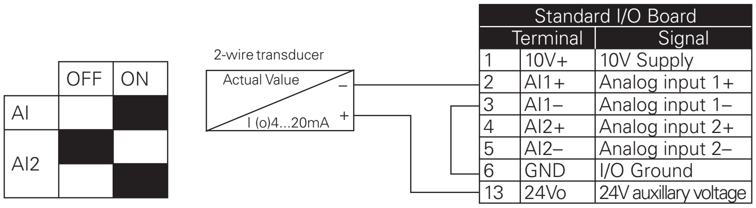
Figure 41. With and without reference scaling.



Modbus ID	Code	Parameters	Application	RO/RW
222	**P2.2.1**	**AI1 Mode**	**1, 2, 3, 4**	RW

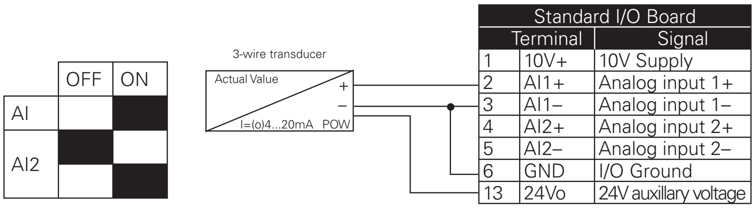
Selects the analog input mode for AI1 terminals 2 and 3 for current or voltage. Also need to set DIP switches on control board, left of the keypad. If using the 10 V supply on terminal 1 of the drive, it will require a ground jumper from terminal 6 to the AI1- input terminal 3 to complete the loop. When doing a current loop with an external supply, the ground jumper is not required.

Figure 42. AI1 2 wire-current.



Standard I/O Board		
Terminal		Signal
1	10V+	10V Supply
2	AI1+	Analog input 1+
3	AI1–	Analog input 1–
4	AI2+	Analog input 2+
5	AI2–	Analog input 2–
6	GND	I/O Ground
13	24Vo	24V auxillary voltage

Figure 43. AI1 3wire-current

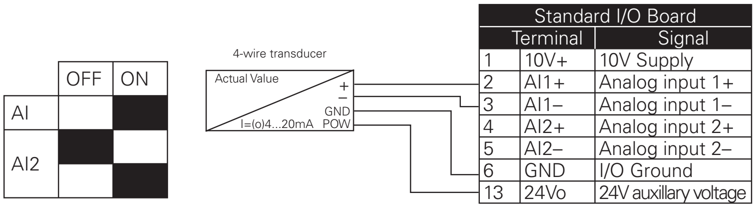


Standard I/O Board		
Terminal		Signal
1	10V+	10V Supply
2	AI1+	Analog input 1+
3	AI1–	Analog input 1–
4	AI2+	Analog input 2+
5	AI2–	Analog input 2–
6	GND	I/O Ground
13	24Vo	24V auxillary voltage

Modbus ID	Code	Parameters	Application	RO/RW
222	**P2.2.1**	**AI1 Mode, continued**	**1, 2, 3, 4**	RW

Selects the analog input mode for AI1 terminals 2 and 3 for current or voltage. Also need to set DIP switches on control board, left of the keypad. If using the 10 V supply on terminal 1 of the drive, it will require a ground jumper from terminal 6 to the AI- input terminal 3 to complete the loop. When doing a current loop with an external supply, the ground jumper is not required.

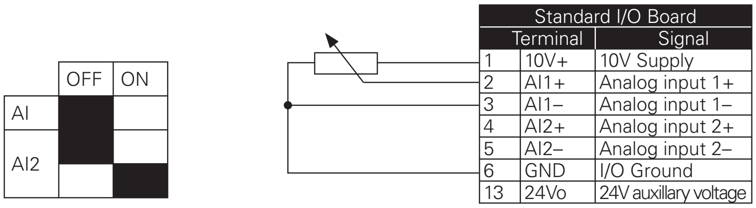
Figure 44. AI1 4 wire-current.



Standard I/O Board		
Terminal		Signal
1	10V+	10V Supply
2	AI1+	Analog input 1+
3	AI1–	Analog input 1–
4	AI2+	Analog input 2+
5	AI2–	Analog input 2–
6	GND	I/O Ground
13	24Vo	24V auxillary voltage

1 = 0-10V - If using the 10V supply on Terminal 1 of the drive, it will require a ground jumper from Terminal 6 to the AI1- input terminal 3 as in Figure 45.

Figure 45. AI1 reference potentiometer 10 V.



Standard I/O Board		
Terminal		Signal
1	10V+	10V Supply
2	AI1+	Analog input 1+
3	AI1–	Analog input 1–
4	AI2+	Analog input 2+
5	AI2–	Analog input 2–
6	GND	I/O Ground
13	24Vo	24V auxillary voltage

Modbus ID	Code	Parameters	Application	RO/RW
175	**P2.2.2**	**AI1 Signal Range**	**1, 2, 3, 4**	RW

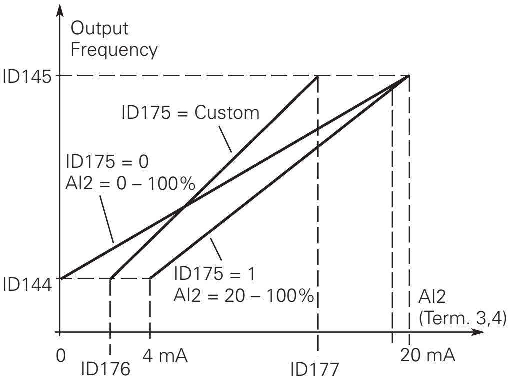
With this parameter, you can select the analog input 1 signal range.

0-100% is equal to 0 to 10 V/ 0-20 mA

20-100% is equal to 2 to 10 V, 4-20 mA.

For selection “Customized,” see “AI1 Custom Min” and ” AI1 Custom Max”. This enables a customized signal range.

Figure 46. Analog input AI scaling.

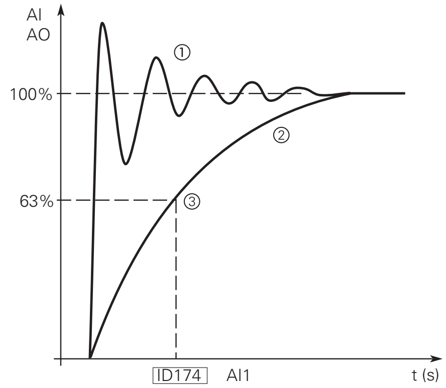


Modbus ID	Code	Parameters	Application	RO/RW
176	**P2.2.3**	**AI1 Custom Min** Defines the minimum percentage for the input range to be associated with AI Ref Min. scale.	**1, 2, 3, 4**	RW
177	**P2.2.4**	**AI1 Custom Max** Defines the maximum percentage for the input range to be associated with AI Ref Max. scale.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
174	**P2.2.5**	**AI1 Filter Time**	**1, 2, 3, 4**	RW

Defines the filter time applied to the analog input signal. Zero equals no filtering.

Figure 47. AI1 signal filtering.



Notes: ① Unfiltered analog signal.
② Filtered analog signal.
③ Filter time constant at 63% of the set value.

181	**P2.2.6**	**AI1 Signal Invert**	**1, 2, 3, 4**	RW

Inverts the reference signal. Maximum reference becomes minimum frequency and minimum reference becomes maximum frequency.

0 = No inversion of analog Vin signal takes place.

1 = Inversion of analog signal takes place.

Figure 48. AI1 - No signal inversion.

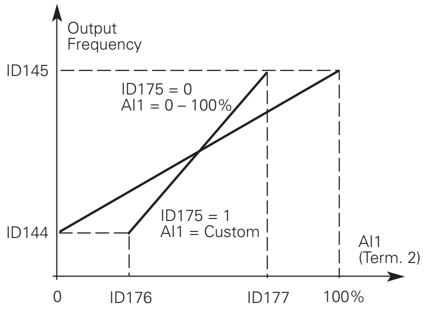
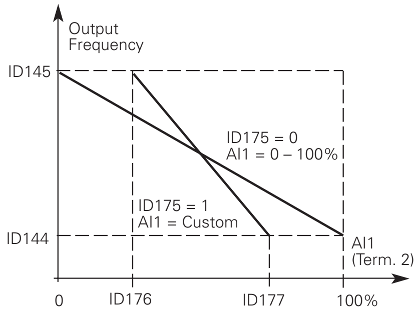


Figure 49. AI1 Signal Inversion

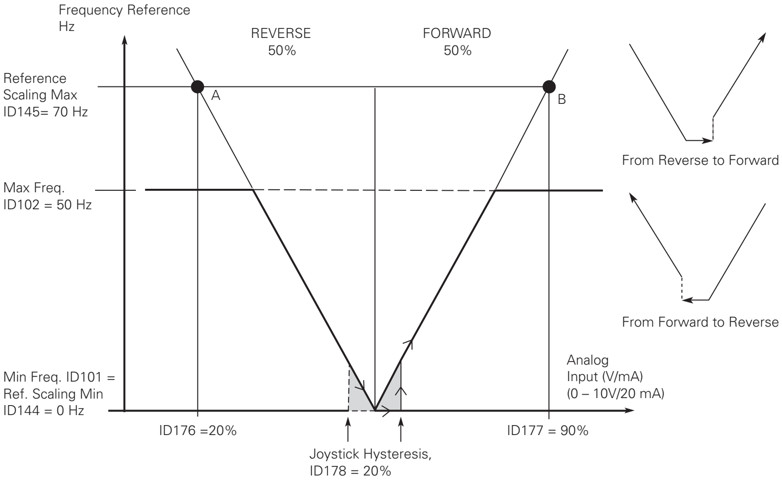


Maximum AI1 signal = minimum set speed.

Minimum AI1 signal = maximum set speed.

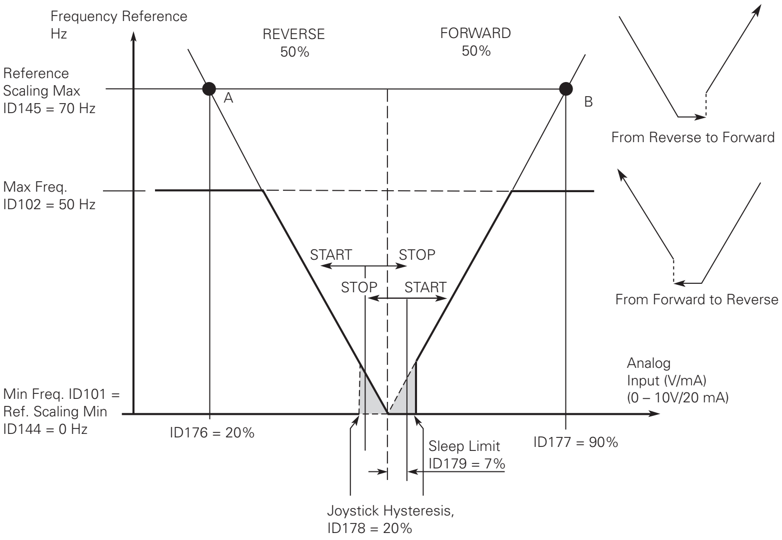
Modbus ID	Code	Parameters	Application	RO/RW
178	P2.2.7	**AI1 Joystick Hyst** Defines the joystick hysteresis between 0 and 20%, when the analog input is within this range the drive will interpret this as a zero speed reference.	1, 2, 3, 4	RW

Figure 50. Example of joystick hysteresis.



Modbus ID	Code	Parameters	Application	RO/RW
179	P2.2.8	**AI1 Sleep Limit** Defines the sleep level of the analog input. If the analog input signal is below this level for a time greater than the Analog Sleep Delay, the drive will transition to a sleep state and restart when the analog input increases above this level.	1, 2, 3, 4	RW

Figure 51. Example of sleep limit function.

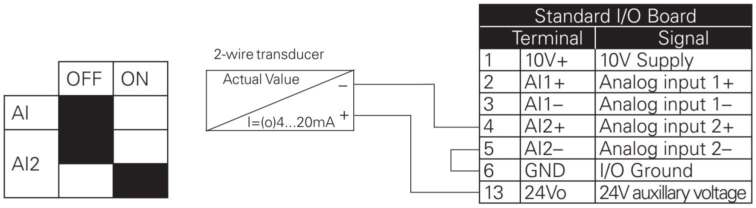


Modbus ID	Code	Parameters	Application	RO/RW
180	P2.2.9	**AI1 Sleep Delay** Defines the delay for the analog input sleep level.	1, 2, 3, 4	RW
133	P2.2.10	**AI1 Joystick Offset** Joysticks zero point by default is the middle of AI range. Joystick offset defines how much the zero point is moved in the forward or reverse from this analog input centerpoint.	1, 2, 3, 4	RW

Modbus ID	Code	Parameters	Application	RO/RW
223	**P2.3.1**	**AI2 Mode**	**1, 2, 3, 4**	RW

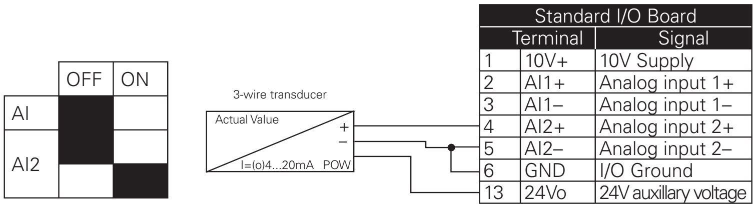
Selects the analog input mode for AI2 terminal 4 and 5. For current or voltage, also need to set DIP switches on control board. If using the 10 V supply on terminal 1 of the drive, it will require a ground jumper from terminal 6 to the AI2- input terminal 5 to complete the loop. When doing a current loop with an external supply the ground jumper is not required.

Figure 52. AI2 2 wire-current.



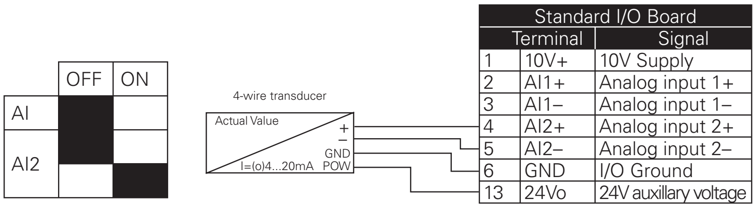
Standard I/O Board		
Terminal		Signal
1	10V+	10V Supply
2	AI1+	Analog input 1+
3	AI1–	Analog input 1–
4	AI2+	Analog input 2+
5	AI2–	Analog input 2–
6	GND	I/O Ground
13	24Vo	24V auxillary voltage

Figure 53. AI2 3 wire-current.



Standard I/O Board		
Terminal		Signal
1	10V+	10V Supply
2	AI1+	Analog input 1+
3	AI1–	Analog input 1–
4	AI2+	Analog input 2+
5	AI2–	Analog input 2–
6	GND	I/O Ground
13	24Vo	24V auxillary voltage

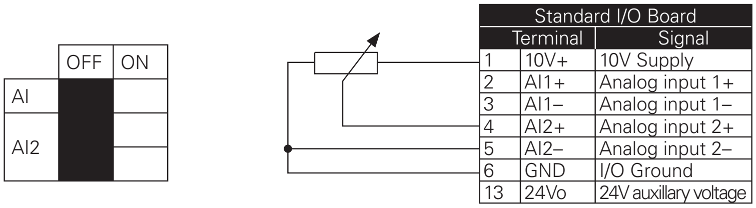
Figure 54. AI2 4 wire-current.



Standard I/O Board		
Terminal		Signal
1	10V+	10V Supply
2	AI1+	Analog input 1+
3	AI1–	Analog input 1–
4	AI2+	Analog input 2+
5	AI2–	Analog input 2–
6	GND	I/O Ground
13	24Vo	24V auxillary voltage

1 = 0-10 V - If using the 10 V supply on terminal 1 of the drive, it will require a ground jumper from terminal 6 to the AI2- input terminal 5 as in Figure 55.

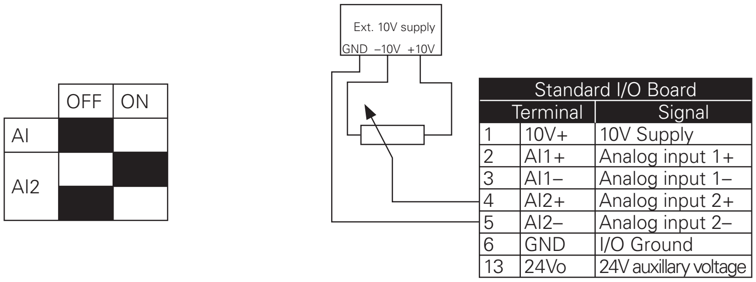
Figure 55. AI2 pot ref.



Standard I/O Board		
Terminal		Signal
1	10V+	10V Supply
2	AI1+	Analog input 1+
3	AI1–	Analog input 1–
4	AI2+	Analog input 2+
5	AI2–	Analog input 2–
6	GND	I/O Ground
13	24Vo	24V auxillary voltage

Modbus ID	Code	Parameters	Application	RO/RW
223	**P2.3.1**	**AI2 Mode, continued** 2 = -10 V to +10 Vdc - Voltage loop with a +10 and a -10 volt differential supply as in Figure 56.	**1, 2, 3, 4**	RW

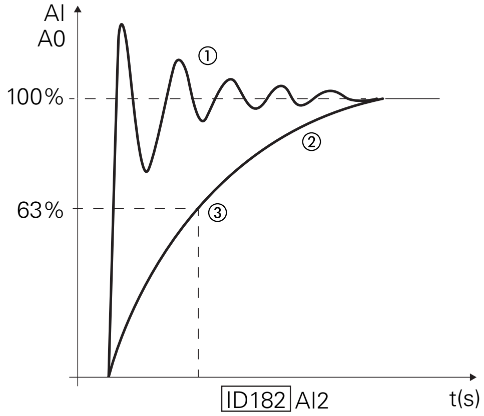
Figure 56. AI2 differential voltage.



Standard I/O Board		
Terminal		Signal
1	10V+	10V Supply
2	AI1+	Analog input 1+
3	AI1–	Analog input 1–
4	AI2+	Analog input 2+
5	AI2–	Analog input 2–
6	GND	I/O Ground
13	24Vo	24V auxillary voltage

Modbus ID	Code	Parameters	Application	RO/RW
183	**P2.3.2**	**AI2 Signal Range** With this parameter you can select the analog input 2 signal range. 0-100% is equal to 0 to 10 V, 0-20 mA, or -10 V to 10 V depending on the selection of AI2 Mode 20-100% is equal to 2 to 10 V, 4-20 mA. For selection “Customized”, see “AI2 Custom Min” (P2.3.3) and “AI2 Custom Max” (P2.3.4). This enables a customized signal range.	**1, 2, 3, 4**	RW
184	**P2.3.3**	**AI2 Custom Min** Defines the minimum percentage for the input range to be associated with AI Ref Min. scale.	**1, 2, 3, 4**	RW
185	**P2.3.4**	**AI2 Custom Max** Defines the maximum percentage for the input range to be associated with AI Ref Max. scale.	**1, 2, 3, 4**	RW
182	**P2.3.5**	**AI2 Filter Time** Defines the filter time applied to the analog input signal, zero equals no filtering.	**1, 2, 3, 4**	RW

Figure 57. AI2 filter time.



Notes: ① Unfiltered analog signal.
② Filtered analog signal.
③ Filter time constant at 63% of the set value.

Modbus ID	Code	Parameters	Application	RO/RW
189	**P2.3.6**	**AI2 Signal Invert**	**1, 2, 3, 4**	RW

Inverts the reference signal. Maximum reference becomes minimum frequency and minimum reference becomes maximum frequency.

0 = No inversion of analog Vin signal takes place.

1 = Inversion of analog signal takes place.

Figure 58. AI2 - No signal inversion.

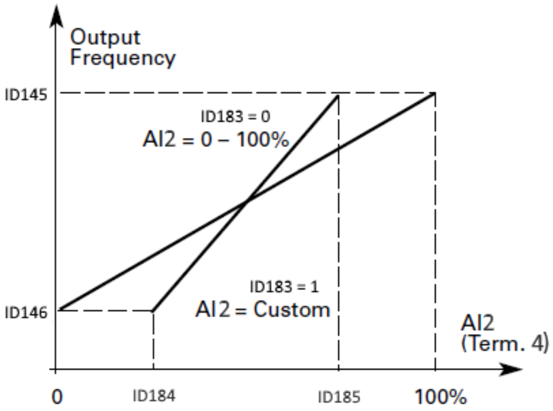
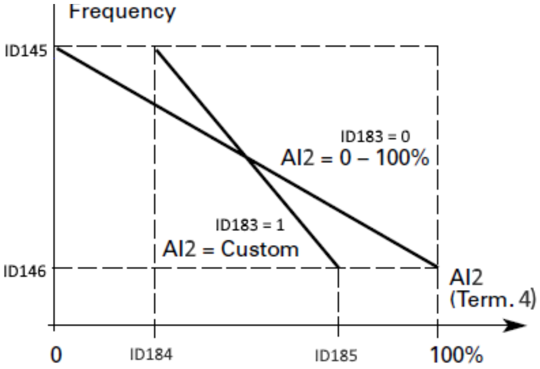


Figure 59. AI2 signal inversion.

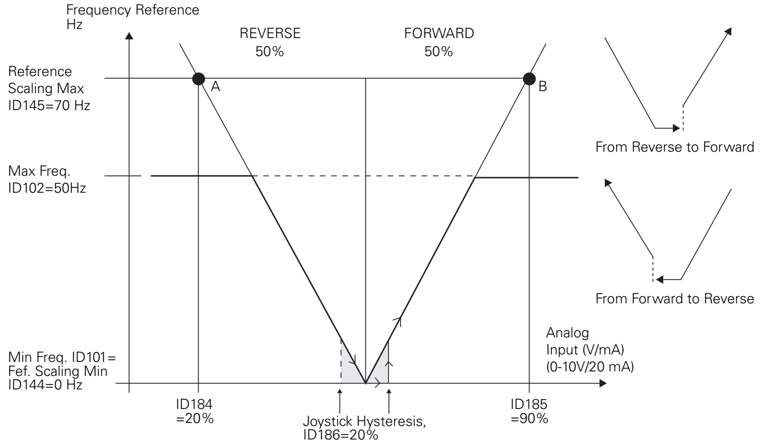


Maximum AI2 signal = minimum set speed.

Minimum AI2 signal = maximum set speed.

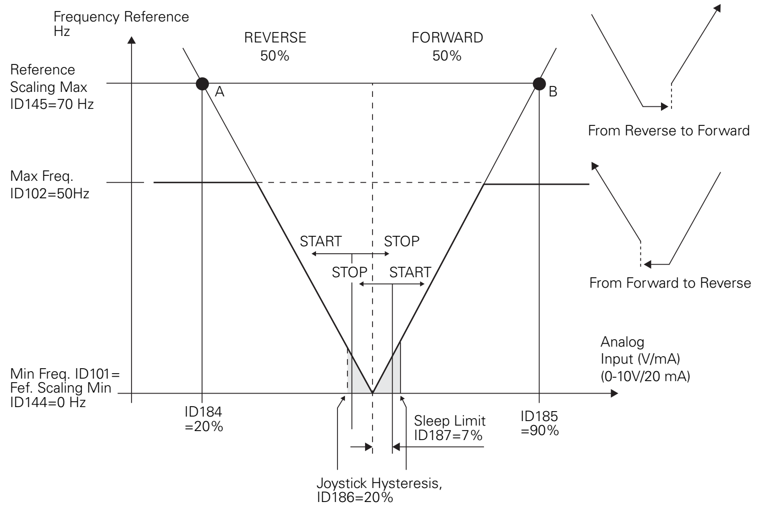
Modbus ID	Code	Parameters	Application	RO/RW
186	**P2.3.7**	**AI2 Joystick Hyst** Defines the joystick hysteresis. When the analog input is within this range the drive will interpret this as a zero speed reference.	**1, 2, 3, 4**	RW

Figure 60. Example of joystick hysteresis.



Modbus ID	Code	Parameters	Application	RO/RW
187	**P2.3.8**	**AI2 Sleep Limit** Defines the sleep level of the analog input, if the analog input signal is below this level for a time greater than the Analog Sleep Delay the drive will transition to a sleep state and restart when the analog input increases above this level.	**1, 2, 3, 4**	RW

Figure 61. Example of sleep limit function.



Modbus ID	Code	Parameters	Application	RO/RW
188	**P2.3.9**	**AI2 Sleep Delay** Defines the delay for the analog input sleep level.	**1, 2, 3, 4**	RW
134	**P2.3.10**	**AI2 Joystick Offset** Joysticks zero point by default is the middle of AI range. Joystick offset defines how much the zero point is moved in the forward or reverse from this analog input centerpoint.	**1, 2, 3, 4**	RW
2484	**P2.4.1**	**Fine Tuning Input** Selects the Analog input used for Fine adjustment tuning of a reference signal. 0 = Not Used 1 = Analog Input 1 2 = Analog Input 2	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
2485	**P2.4.2**	**Fine Tuning Min** Percentage that is subtracted from the main reference when adjust input is at minimum.	**1, 2, 3, 4**	RW
2486	**P2.4.3**	**Fine Tuning Max** Percentage that is added from the main reference when adjust input is at maximum.	**1, 2, 3, 4**	RW
143	**P3.1**	**IO Terminal 1 Start Stop Logic** For the DI function, we use Terminal programming method to function (TTF), you have a fixed input or output for which you define a certain function. 0 = DI closed contact = start forward : DI closed contact = start reverse - This would be considered 2-wire control with either a contact used on the Start FWD or Start REV commands. Contacts Open the motor stops.	**1, 2, 3, 4**	RW

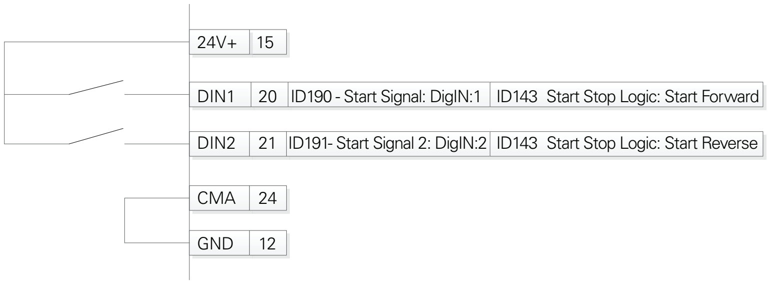
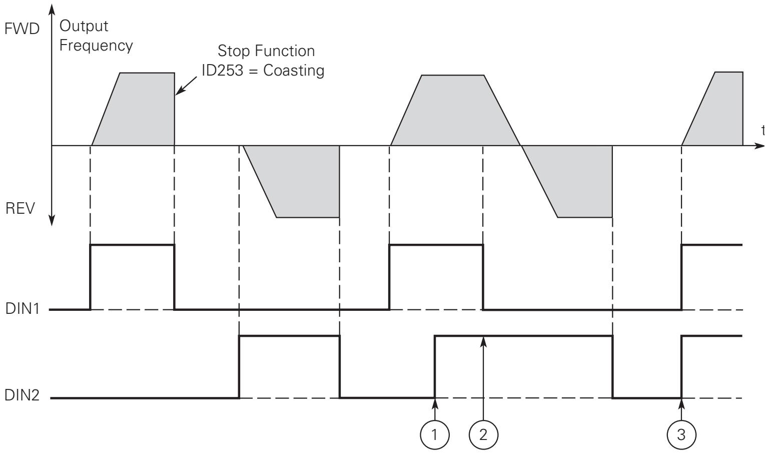


Figure 62. Start forward/start reverse.



Notes: ① The first selected direction has the highest priority.
② When the DIN1 contact opens the direction of rotation starts to change.
③ If Start forward (DIN1) and Start reverse (DIN2) signals are active simultaneously the Start forward signal (DIN1) has priority.

Modbus ID	Code	Parameters	Application	RO/RW
143	**P3.1**	**IO Terminal 1 Start Stop Logic, continued**	**1, 2, 3, 4**	RW

1 = DI closed contact = start /open contact = stop: DI closed contact = reverse / open contact = forward - This would be considered 2-wire control with a contact on start/stop, contact open it stops and direction on 2nd start signal.

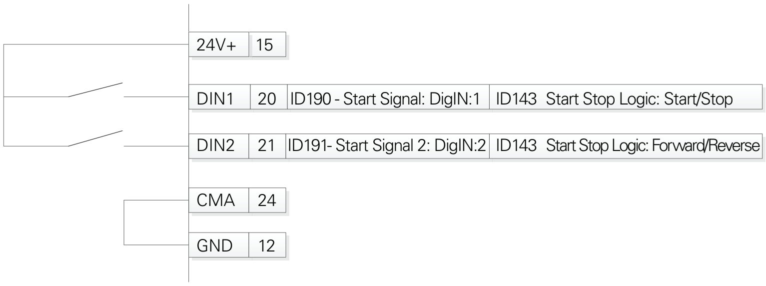
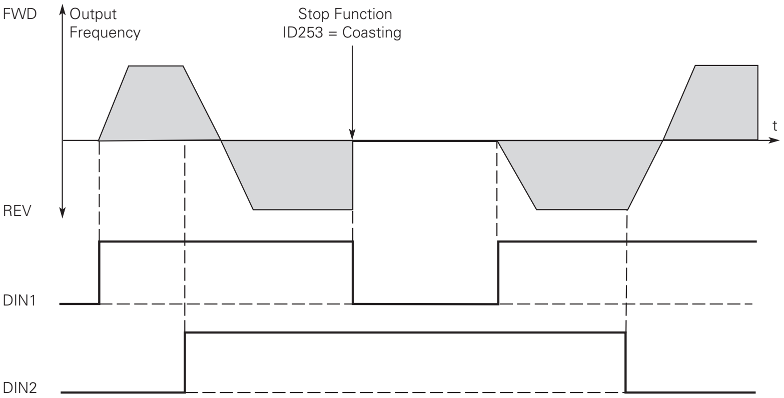
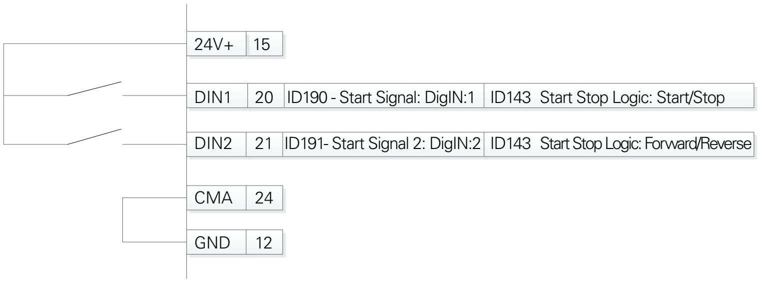


Figure 63. Start, stop, and reverse.



2 = DI closed contact = start / open contact = stop : DI closed contact = start enabled / open contact = start disabled and drive stopped if running motor direction keeps forward - This would be considered 3-wire control with Start signal 2 required to be closed to enable Start on Start signal 1.



Modbus ID	Code	Parameters	Application	RO/RW
143	**P3.1**	**IO Terminal 1 Start Stop Logic, continued** 3 = Three-wire connection (pulse control): DI changes from open to closed = start pulse : DI changes from closed to open = stop pulse DI closed contact = reverse/ open contact = forward - This would be considered 3-wire control with Start Signal 1 being the Start Pulse and Start Signal 2 being the NC Stop.	**1, 2, 3, 4**	RW

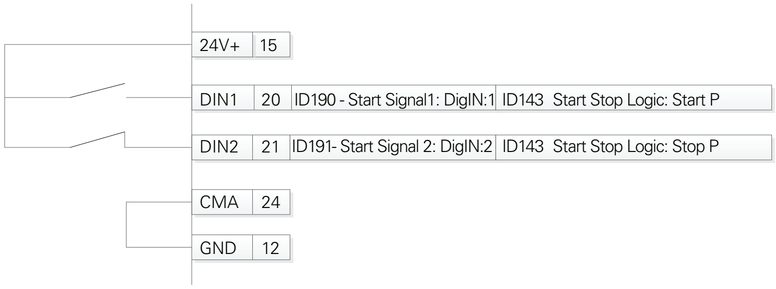
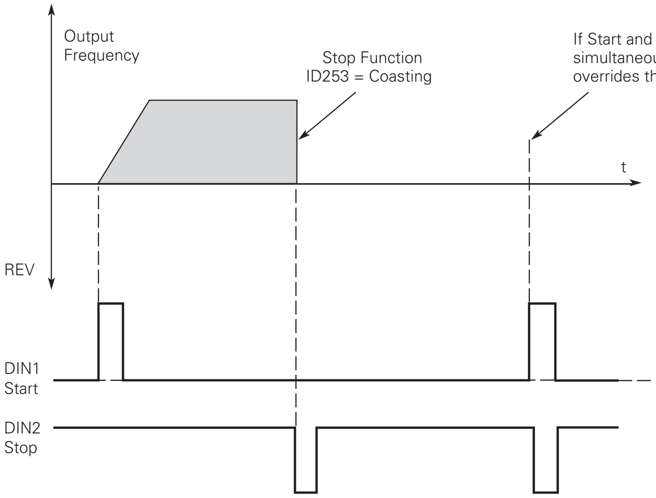


Figure 64. Start pulse/stop pulse.



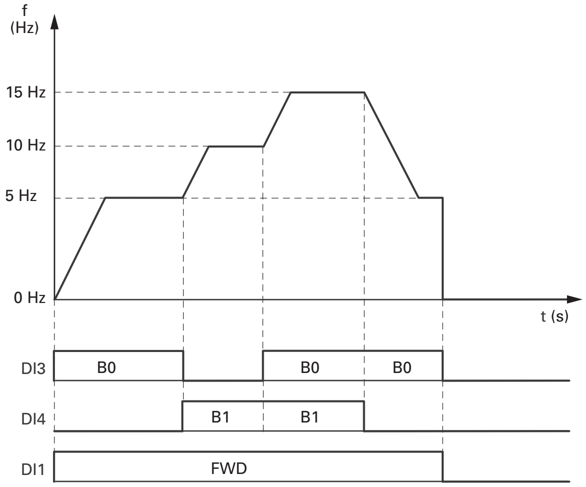
Modbus ID	Code	Parameters	Application	RO/RW
190	**P3.2**	**IO Terminal 1 Start Signal 1** Signal selection 1 for the start/stop logic listed in P3.1. This parameter would correspond to the function listed for DIN1. When the parameter is set to DigIN: 1, it references DIN1 on the control board. Selecting different DIGIN values will assign it to a different input on the control board or option card. When set to Normally Open, this function would be always tied low or 0 when using I/O terminal 1 as the control place. When value is set to Normally Closed, this will cause the function to be always on and activate the output if I/O Terminal 1 is the current control place. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X.	**1, 2, 3, 4**	RW
191	**P3.3**	**IO Terminal 1 Start Signal 2** Signal selection 2 for the start/stop logic listed listed in P3.1. This parameter would correspond to the function listed for DIN2. When the parameter is set to DigIN: 2, it references DIN2 on the control board. Selecting different DIGIN values will assign it to a different input on the control board or option card. When set to Normally Open, this function would be always tied low or 0 when using I/O terminal 1 as the control place. When value is set to Normally Closed, this will cause the function to be always on and activate the output if I/O Terminal 1 is the current control place. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X).	**1, 2, 3, 4**	RW
881	**P3.4**	**Thermistor Input Select** This parameter defines DIN7, and DIN8 is digital input or thermistor input. When this parameter is enabled it switches DIN7 and DIN8 to a thermistor input that triggers at 4.7k ohm.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
198	**P3.5**	**Reverse** Allows for switching the direction of the motor when using 3 wire start/stop logic. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X Contact Open = Forward direction. Contact Close = Reverse direction.	**1, 2, 3, 4**	RW
192	**P3.6**	**Ext. Fault 1 NO** Allows for external input causing drive to fault. This function is defined as NO so the function activates on a closed contact. If this function is assigned to Normally Open, the function is always off so the drive will not fault. When set to Normally Closed, the function will be active and fault all the time. The additional settings allow assigning them to an input to control the function. Different Settings DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. The description on the fault can be changed in P3.52. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact = external fault. Open contact = no external fault.	**1, 2, 3, 4**	RW
193	**P3.7**	**Ext. Fault 1 NC** Allows for external input causing drive to fault. This function is defined as NC so the function activates on a open contact. If this function is assigned to Normally Closed, the function is always on so the drive will not fault. When set to Normally Open, the function will be active and fault all the time. The additional settings allow assigning them to an input to control the function. Different Settings DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. The description on the fault can be changed in P3.52. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact = no external fault. Open contact = external fault.	**1, 2, 3, 4**	RW
200	**P3.8**	**Fault Reset** Allows for external fault reset input. This function is looking for a rising edge to reset a fault. If this function is set for Normally Open, the drive will not do a reset via the control terminals. When set for Normally Closed, the fault condition will always be trying to reset on the rising edge. When it is tied to an input on the control board or option card the function would be set to DIGIN: and the input desired. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. DI change from open contact to closed contact: reset fault.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
194	**P3.9**	**Run Enable** Allows for safety start input that is required along with start command for frequency converter to turn on output. When using this command if the function is set for Normally Open, the drive will see this as a open input and not allow the drive to run due to no Ready. The default state being Normally Closed indicates that the drive is in a Ready condition and will accept the start command. When assigned to one of the DIGIN or Time channels it requires the input to be high to activate output. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact = Start of motor enabled Open contact = Start of motor disabled	**1, 2, 3, 4**	RW
205	**P3.10**	**Preset Speed B0** Preset bit select inputs to select preset speed reference values. Validating 3 digital inputs will allow for 7 preset speeds to be obtained. When switching between inputs it will follow the acceleration and deceleration time. When all the inputs are set to Normally Open none of the preset speeds will be enabled and the output will follow the control place reference command. If the function is set for Normally Closed the drive will follow the preset speed assigned to the inputs enabled. When assigned to one of the DIGIN on the control board or an installed option card it is looking for a high input to enable that preset. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output.	**1, 2, 3, 4**	RW
206	**P3.11**	**Preset Speed B1** Preset bit select inputs to select preset speed reference values. Validating 3 digital inputs will allow for 7 preset speeds to be obtained. When switching between inputs it will follow the acceleration and deceleration time. When all the inputs are set to Normally Open none of the preset speeds will be enabled and the output will follow the control place reference command. If the function is set for Normally Closed the drive will follow the preset speed assigned to the inputs enabled. When assigned to one of the DIGIN on the control board or an installed option card it is looking for a high input to enable that preset. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
207	P3.12	**Preset Speed B2** Preset bit select inputs to select preset speed reference values. Validating 3 digital inputs will allow for 7 preset speeds to be obtained. When switching between inputs it will follow the acceleration and deceleration time. When all the inputs are set to Normally Open none of the preset speeds will be enabled and the output will follow the control place reference command. If the function is set for Normally Closed the drive will follow the preset speed assigned to the inputs enabled. When assigned to one of the DIGIN on the control board or an installed option card it is looking for a high input to enable that preset. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output.	1, 2, 3, 4	RW

Figure 65. Activation of fixed frequencies.



Fixed frequency

Input (Binary)			Fixed frequency
B0	B1	B2	(Factory setting)
X	—	—	Preset Speed 1, ID105 = 5 Hz
—	X	—	Preset Speed 2, ID106 = 10 Hz
X	X	—	Preset Speed 3, ID118 = 15 Hz
—	—	X	Preset Speed 4, ID119 = 20 Hz
X	—	X	Preset Speed 5, ID120 = 25 Hz
—	X	X	Preset Speed 6, ID121 = 30 Hz
X	X	X	Preset Speed 7, ID122 = 35 Hz

Modbus ID	Code	Parameters	Application	RO/RW
550	P3.13	**PID1 Control Enable** Allows for activating PID1 control mode when it is set as a reference place in local reference (P1.1.13) or remote reference (P1.1.14). If the input is not enabled when starting the drive with PID1 Controller set as the reference, the drive outout will not start. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X function allows for having an input turn on without having to hard wire it to the physical relay output. Contact Close: Enables PID 1 control mode.	2, 3, 4	RW
553	P3.14	**PID2 Control Enable** Allows for activating PID2 control mode when it is set as a reference place in local reference (P1.1.13) or remote reference (P1.1.14). If the input is not enabled when starting the drive with PID2 Controller set as the reference the drive output will not start. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Contact Close: Enables PID 2 control mode.	3, 4	RW

Modbus ID	Code	Parameters	Application	RO/RW
195	**P3.15**	**Accel/Decel Time Set** Selects between accel/decel time 1 and accel/decel time 2. When this function is set for Normally Open the Accel/Decel time set will follow time 1 always, when set for Normally Closed it will follow the 2nd Accel/Decel time always. Assigning it to an input will allow for the input to control this. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact = 2nd set of acc/dec time applied. Open contact = 1st set of acc/dec time applied.	**1, 2, 3, 4**	RW
201	**P3.16**	**Accel/Decel Prohibit** Disables the ability to change speed, even if the reference signal changes if this input is enabled the output stays at the value it was at before the input was enabled. When this functions is set for Normally Open the Accel/Decel will be allowed via the desired control source, when is set for Normally Closed the drive will prohibit changing of speed from any control source. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: drive output frequency cannot rise or fall, it keeps on current output.	**1, 2, 3, 4**	RW
215	**P3.17**	**No Access To Param** Locks out the ability to change parameters when this input is enabled, this can be used with the password protection. When this function is set for Normally Open it will allow for changing of parameters, if it is set for Normally Closed it prevents any changes to parameters. If a input is desired to control this DIGIN X can be used. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: all writable parameters cannot be edited.	**1, 2, 3, 4**	RW
203	**P3.18**	**Accel Pot Value** Motor Potentiometer is set for a reference, when this input is enabled it will increase reference value till contact opens. When this function is set for Normally Open it will not cause the Motor Pot reference to increase, when this is set for Normally Closed it will cause the Motor pot reference to increase till it reaches max frequency. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: Potentiometer value keeps on rising.	**4**	RW
204	**P3.19**	**Decel Pot Value** Motor Potentiometer is set for a reference, when this input is enabled it decrease reference value till contact opens. When this function is set for Normally Open it will not cause the Motor Pot reference to decrease, when this is set for Normally Closed it will cause the Motor pot reference to decrease till the min frequency is reached.Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: Potentiometer value keeps on falling.	**4**	RW
216	**P3.20**	**Reset Pot Zero** Sets Motor Potentiometer reference value to zero when using the Motor Potentiometer as a Reference signal when contact closes. When this is set for Normally Open it will not cause the Motor Pot reference to not reset to 0 speed, when this is set for Normally Closed it will cause the Motor pot reference to reset to 0 speed and stay there till the opens. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: Potentiometer value reset to zero.	**4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
196	P3.21	**Remote Control** Selection allows for external control panel to control frequency converters control place. When this function is set for Normally Open the drive will not go into the remote control unless the keypad input is pressed. When set for Normally Closed the drive will always be in the remote location no matter the keypad loc/rem is pressed.Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed Contact: force to remote control.	1, 2, 3, 4	RW
197	P3.22	**Local Control** Selection allows for external control panel to control frequency converters control place. When this function is set for Normally Open the drive will not go into the local control place unless the keypad Loc/Rem button is used. When it is set for Normally Closed it will always be in the local control location no matter if the keypad loc/rem button is pressed. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: force to local control.	1, 2, 3, 4	RW
209	P3.23	**Remote 1/2 Select** Selection allows for switching between Remote control 1 (P1.11 and P1.14) and control 2 (P7.1 and P7.2). This switches control and reference locations. When this function is set for Normally Open, the drive will not go into the Remote 2 control place and will stay in Remote 1. When it is set for Normally Closed, the drive will always be in the Remote 2 Control Place. When a DIGIN is used, it will allow cycling between the two based off high/low state. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: Remote 2 is selected as control source. Open contact: Remote 1 is selected as control.	1, 2, 3, 4	RW
217	P3.24	**Second Motor Para Select** Selection allows for switching between motor parameter set 1(P1 Group) and set 2 (P16 Group). When this function is set for Normally pen the drive will follow the first set of motor parameters and when the input is set for Normally Closed it will used the Second Motor Parameter set. If an input is used the function will follow the logic of the input being high/low. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: the 2nd motor parameters is applied.	2, 3, 4	RW
218	P3.25	**Force Bypass** Selection allows for switching between bypass and drive modes. When this input is enabled the Bypass output contactor is enabled to bypass the drive, when disabled this relay opens. When the input is enabled on the rising edge the bypass output contactor function is enabled in the output functions on the drive. When this fault is set for Normally Open/Normally Closed the drive will not activate the bypass relay output function due to the drive looking for a rising edge trigger. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: switch to bypass. Open contact: switch to drive.	2, 3, 4	RW
202	P3.26	**DC Brake Active** Selection enables DC brake on a closed contact. When enabled, this will cause the drive to inject DC voltage into the motor to assist in bring it to a stop. When this function is set for Normally Open, the drive will not activate the DC brake function. When Normally Closed is used, the drive will always have the DC brake function activated. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: DC brake function is enable.	1, 2, 3, 4	RW

Modbus ID	Code	Parameters	Application	RO/RW
219	P3.27	**Smoke Mode** Selection enables the smoke purge preset speed to be enabled. When this function is set for Normally Open the drive will not activate the Smoke Mode frequency. When Normally Closed is used the drive will always run at the Smoke Purge Frequency. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: drive is in smoke purge mode.	2, 3, 4	RW
220	P3.28	**Fire Mode** Selection enables drive into fire mode where faults will be ignored and preset speeds are given for reference commands to the drive, the reference are selectable in the P15 Group. When this function is set for Normally Open or Normally Closed it will depend on the setting in the Fire Mode parameter group, if the function activates on an open contact and this is set for Normally Open it will always be in the Fire Mode, if Normally Closed is used then the function will always be off. Vise versa will occur if Fire Mode is active on an Closed contact. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: drive is in fire mode. Ignores all the faults. **Note**: When Fire mode is enabled, this causes the drive to ignore all faults except hardware overcurrent, STO, saturation fault. Warranty will be non valid in the case this is enabled and the drive causes issues to the system.	2, 3, 4	RW
221	P3.29	**Fire Mode Ref 1/2 Select** Selection allows for switching between fire mode speed reference 1 (P15.4) and reference 2 (P15.5). When this function is set for Normally Open and the drive is in Fire Mode, it will follow Fire Mode Ref 1. If the function is set for Normally Closed, it will follow Fire Mode Ref 2. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: drive output reference frequency selection 2.	2, 3, 4	RW
351	P3.30	**PID1 Set Point Select** Selection allows for selecting between Setpoint 1 and setpoint 2 when in the PID control mode, depending on the PID Controller you are using this will all for multiple setpoints. When this function is set for Normally Open and the drive is in PID mode, it will use the first PID Set Point Reference. When the function is set for Normally Close the 1st PID Set Point will be active. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: setpoint2 is selected for pid1. Open contact:setpoint1 is selected for pid1.	2, 3, 4	RW
352	P3.31	**PID2 Set Point Select** Selection allows for selecting between Setpoint 1 and setpoint 2 when in the PID control mode, depending on the PID Controller you are using this will all for multiple setpoints. When this function is set for Normally Open and the drive is in PID mode, it will use the first PID Set Point Reference. When the function is set for Normally Close the 2nd PID Set Point will be active. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: setpoint2 is selected for pid1. Open contact:setpoint1 is selected for pid1.	3, 4	RW
199	P3.32	**Jog Enable** Selection enables the jog frequency reference and starts the drive to slowly advance the system. When this function is set for Normally Open the drive will not follow the jog enable speed. If the function is set for Normally Close then the output will be activated and run at the Jog Frequency. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: drive is under jog mode.	1, 2, 3, 4	RW

Modbus ID	Code	Parameters	Application	RO/RW
224	P3.33	**Start Timer 1** Selection enables the timer functions to begin counting. When this function is set for Normally Open the drive will not start the Timer sequence. If the function is set for Normally Close the Timer function will start. When assigned to an input the input active will start the timer.Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: Timer1, Timer2, or Timer3 will be started.	2, 3, 4	RW
225	P3.34	**Start Timer 2** Selection enables the timer functions to begin counting. When this function is set for Normally Open the drive will not start the Timer sequence. If the function is set for Normally Close the Timer function will start. When assigned to an input the input active will start the timer.Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: Timer1, Timer2, or Timer3 will be started.	2, 3, 4	RW
226	P3.35	**Start Timer 3** Selection enables the timer functions to begin counting. When this function is set for Normally Open the drive will not start the Timer sequence. If the function is set for Normally Close the Timer function will start. When assigned to an input the input active will start the timer.Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: Timer1, Timer2, or Timer3 will be started.	2, 3, 4	RW
208	P3.36	**AI Ref Source Select** Selection switches between AI1 and AI2 reference signals that are located on the control board. When this function is set for Normally Open the drive will follow the AI1 input. If the function is set for Normally Close, the AI2 input would then be active. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: AI2 is selected for reference source. Open contact: AI1 is selected for reference source.	1, 2, 3, 4	RW
210	P3.37	**Motor Interlock 1** Selects inputs allowed to verify aux motors are connected to allow them to run, if inputs are disabled drive will see this as a motor not connected an skip over the motor in the booster/auto-change sequence. When this function is set for Normally Open the drive will not see a motor interlock enabled when doing multi-pump and fan. If the function is set for Normally Close the drive will initialize that motors are connected to allow running. These are ideally tied to aux contacts on the output contactor to the motor. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: motor interlock signal activated. Open contact: motor interlock signal unactivated.	2, 3, 4	RW
211	P3.38	**Motor Interlock 2** Selects inputs allowed to verify aux motors are connected to allow them to run, if inputs are disabled drive will see this as a motor not connected an skip over the motor in the booster/auto-change sequence. When this function is set for Normally Open the drive will not see a motor interlock enabled when doing multi-pump and fan. If the function is set for Normally Close the drive will initialize that motors are connected to allow running. These are ideally tied to aux contacts on the output contactor to the motor. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: motor interlock signal activated. Open contact: motor interlock signal unactivated.	2, 3, 4	RW

Modbus ID	Code	Parameters	Application	RO/RW
212	**P3.39**	**Motor Interlock 3** Selects inputs allowed to verify aux motors are connected to allow them to run, if inputs are disabled drive will see this as a motor not connected an skip over the motor in the booster/auto-change sequence. When this function is set for Normally Open the drive will not see a motor interlock enabled when doing multi-pump and fan. If the function is set for Normally Close the drive will initialize that motors are connected to allow running. These are ideally tied to aux contacts on the output contactor to the motor. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: motor interlock signal activated. Open contact: motor interlock signal unactivated.	**2, 3, 4**	RW
213	**P3.40**	**Motor Interlock 4** Selects inputs allowed to verify aux motors are connected to allow them to run, if inputs are disabled drive will see this as a motor not connected an skip over the motor in the booster/auto-change sequence. When this function is set for Normally Open the drive will not see a motor interlock enabled when doing multi-pump and fan. If the function is set for Normally Close the drive will initialize that motors are connected to allow running. These are ideally tied to aux contacts on the output contactor to the motor. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: motor interlock signal activated. Open contact: motor interlock signal unactivated.	**2, 3, 4**	RW
214	**P3.41**	**Motor Interlock 5** Selects inputs allowed to verify aux motors are connected to allow them to run, if inputs are disabled drive will see this as a motor not connected an skip over the motor in the booster/auto-change sequence. When this function is set for Normally Open the drive will not see a motor interlock enabled when doing multi-pump and fan. If the function is set for Normally Close the drive will initialize that motors are connected to allow running. These are ideally tied to aux contacts on the output contactor to the motor. When this function is set for Normally Open the drive will not see a motor interlock enabled when doing multi-pump and fan. If the function is set for Normally Close the drive will initialize that motors are connected to allow running. These are ideally tied to aux contacts on the output contactor to the motor. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: motor interlock signal activated. Open contact: motor interlock signal unactivated.	**2, 3, 4**	RW
747	**P3.42**	**Ext Fault-AR** Function disables the frequency converter from running the motor. Once this function is open the drive will stop on E-stop fault, when input closes drive will return to run with no reset required. If the function is set for Normally Open it will cause the drive to always have this function active. When set to Normally Closed the function will not be active and allow operation of the drive. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. This input will automatically reset once the input is closed. Contact Open: Disables the ability for the motor to Run. Contact Close: Enables the ability for the motor to Run.	**1, 2, 3, 4**	RW
1246	**P3.43**	**Bypass Overload** Function faults frequency converter when using an external overload block, the relay would be fed into this input to fault the drive. When the function is set for Normally Open the drive will not go into the fault state, if it is set for Normally Closed the drive will go into this fault state and stay even if reset is applied. Input needs to be low to allow operation. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. Closed contact: motor is over load in bypass. Use TTF method to realize the above functions.	**2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
2119	**P3.44**	**Fire Mode Direction Invert**	**2, 3, 4**	RW

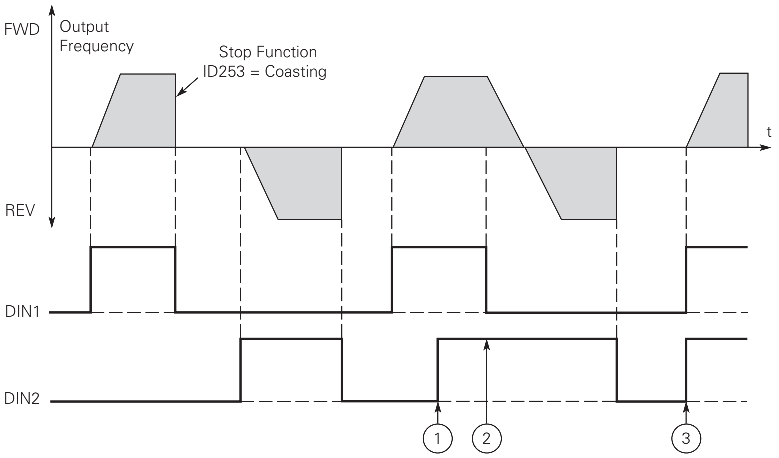
Function allows motor to run in reverse when in fire mode input is enabled. when the function is set for Normally Open and not in Fire mode the drive will run as normal, when the function is set for Normally Closed and the Fire Mode input is enabled the motor will spin in the counter clockwise direction. DigiIN:X indicates on-board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot and DigiIN:B:IOX:X indicates optional board inputs in B slot or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output.

Modbus ID	Code	Parameters	Application	RO/RW
2206	**P3.45**	**IO Terminal 2 Start Stop Logic**	**1, 2, 3, 4**	RW

For the DI function, we use Terminal programming method to function (TTF), you have a fixed input or output for which you define a certain function.

0 = DI closed contact = start forward : DI closed contact = start reverse - This would be considered 2-wire control with either a contact used on the Start FWD or Start REV commands. Contacts Open the motor stops.

Figure 66. Start forward/start reverse.



1 = DI closed contact = start /open contact = stop : DI closed contact = reverse / open contact = forward - This would be considered 2-wire control with a contact on start/stop, contact open it stops and direction on 2nd start signal.

NOTES:

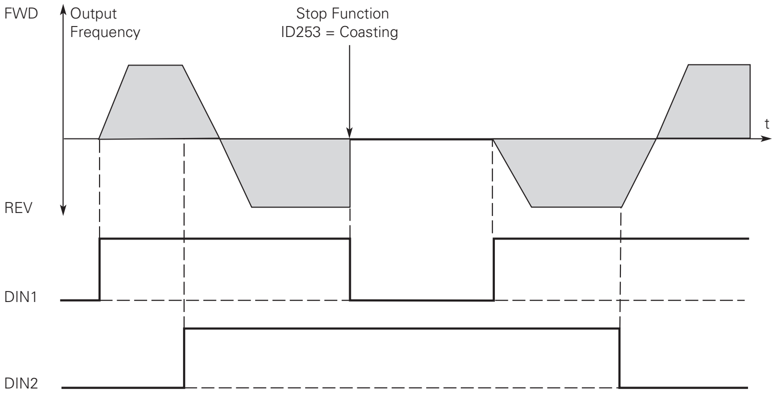
① The first selected direction has the highest priority.

② When the DIN1 contact opens the direction of rotation starts to change.

③ If Start forward (DIN1) and Start reverse (DIN2) signals are active simultaneously the Start forward signal (DIN1) has priority.

Modbus ID	Code	Parameters	Application	RO/RW
2206	**P3.45**	**IO Terminal 2 Start Stop Logic, continued**	**1, 2, 3, 4**	RW

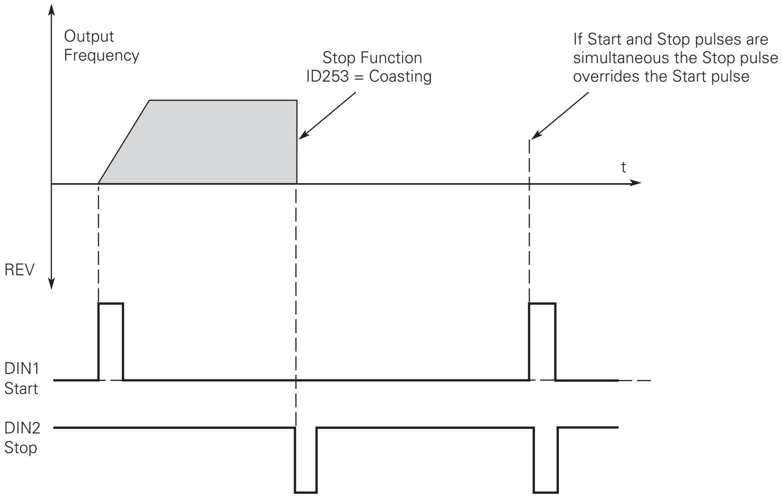
Figure 67. Start, stop, and reverse.



2 = DI closed contact = start / open contact = stop : DI closed contact = start enabled / open contact = start disabled and drive stopped if running motor direction keeps forward - This would be considered 3-wire control with Start signal 2 required to be closed to enable Start on Start signal 1.

3 = Three-wire connection (pulse control): DI changes from open to closed = start pulse: DI changes from closed to open = stop pulse: DI closed contact = reverse/ open contact = forward - This would be considered 3-wire control with Start Signal 1 being the Start Pulse and Start Signal 2 being the NC Stop.

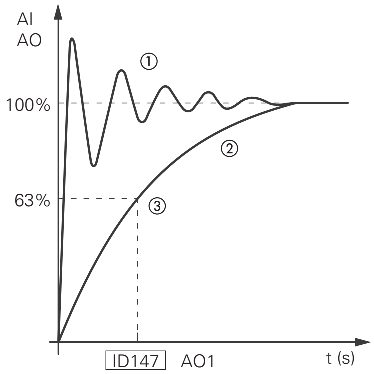
Figure 68. Start pulse/stop pulse.

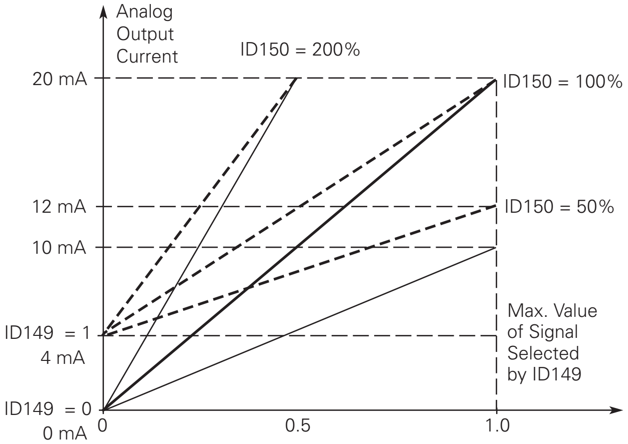
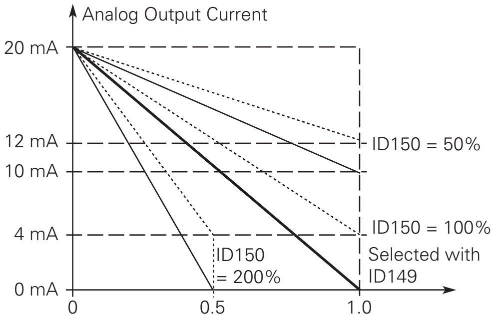


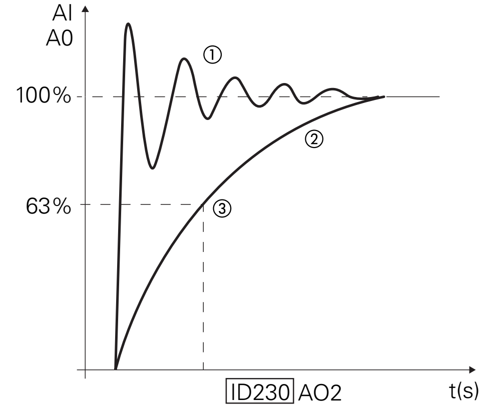
Modbus ID	Code	Parameters	Application	RO/RW
2207	**P3.46**	**IO Terminal 2 Start Signal 1** The 2nd Signal selection 1 for the start/stop logic listed in P3.45. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output.	**1, 2, 3, 4**	RW
2208	**P3.47**	**IO Terminal 2 Start Signal 2** The 2nd Signal selection 2 for the start/stop logic listed in P3.45. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output.	**1, 2, 3, 4**	RW

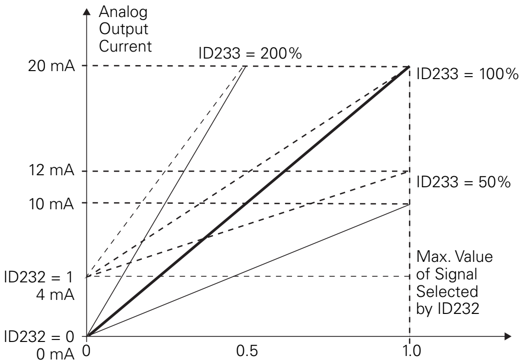
Modbus ID	Code	Parameters	Application	RO/RW
2293	**P3.48**	**Ext. Fault 2 NO** Allows for external input causing drive to fault. This function is defined as NO so the function activates on a closed contact. If this function is assigned to Normally Open - the function is always off so the drive will not fault, when set to Normally Closed the function will be active and fault all the time. The additional settings allow assigning them to an input to control the function.Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. The description on the fault can be changed in P3.53. Closed contact = external fault. Open contact = no external fault.	**1, 2, 3, 4**	RW
2294	**P3.49**	**Ext. Fault 2 NC** Allows for external input causing drive to fault. This function is defined as NC, so the function activates on a open contact. If this function is assigned to Normally Closed - the function is always on so the drive will not fault. When set to Normally Open, the function will be active and fault all the time. The additional settings allow assigning them to an input to control the function. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. The description on the fault can be changed in P3.53. Closed contact = no external fault. Open contact = external fault.	**1, 2, 3, 4**	RW
2295	**P3.50**	**Ext. Fault 3 NO** Allows for external input causing drive to fault. This function is defined as NO so the function activates on a closed contact. If this function is assigned to Normally Open, the function is always off so the drive will not fault. When set to Normally Closed, the function will be active and fault all the time. The additional settings allow assigning them to an input to control the function. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. The description on the fault can be changed in P3.54. Closed contact = external fault. Open contact = no external fault.	**1, 2, 3, 4**	RW
2296	**P3.51**	**Ext. Fault 3 NC** Allows for external input causing drive to fault. This function is defined as NC so the function activates on a open contact. If this function is assigned to Normally Closed, the function is always on so the drive will not fault. When set to Normally Open, the function will be active and fault all the time. The additional settings allow assigning them to an input to control the function. Can be set to DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output. The description on the fault can be changed in P3.54. Closed contact = no external fault. Open contact = external fault.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
2297	**P3.52**	**Ext. Fault 1 Text** Defines the text to be displayed when external Fault 1 NO or NC is triggered. This text will be viewable using a remote keypad, PowerXpert inControl, or the built in webserver. 0 = External fault 1 = Vibration cut out 2 = High motor temp 3 = Low pressure 4 = High pressure 5 = Low water 6 = Damper interlock 7 = Run enable 8 = Freeze stat trip 9 = Smoke detect 10 = Seal leakage 11 = Rod breakage	**1, 2, 3, 4**	RW
2298	**P3.53**	**Ext. Fault 2 Text** Defines the text to be displayed when external Fault 2 NO or NC is triggered. This text will be viewable using a remote keypad, PowerXpert inControl, or the built in webserver. See Par ID 2297.	**1, 2, 3, 4**	RW
2299	**P3.54**	**Ext. Fault 3 Text** Defines the text to be displayed when external Fault 3 NO or NC is triggered. This text will be viewable using a remote keypad, PowerXpert inControl, or the built in webserver. See Par ID 2297.	**1, 2, 3, 4**	RW
2312	**P3.55**	**Parameter Set1/2 Sel** Allows for the drive to select between the stored parameter set1 or set2. This requires saving parameters to the stored sets parameter set (P21.1.3). When the function is set for Normally Open, the drive will use the standard Parameter Set 1 in the keypad. If the function is set for Normally Closed, the drive will follow Parameter Set 2 setting when stored to the keypad. DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output.	**1, 2, 3, 4**	RW
2394	**P3.56**	**Deragging Enable** When Deragging Enable is Enabled it will allow the drive to cycle the motor forward and reverse for 3 cycles, this would be used to remove any jamming on start. If the function is set for Normally Open, the deragging function will not be activated. If the function is set for Normally Closed, then the Derag Function will always be active. Can be set to DigiIN: X indicates on board terminal inputs, DigiIN:A:IOX:X indicates option boards in A slot, DigiIN:B:IOX:X indicates optional board in B slot, or Timer Channel X. RO X function allows for having an input to run on without having to hard wire it to the physical relay output.	**2, 3, 4**	RW
2395	**P3.57**	**HOA On/Off** HOA off control allows for disabling any control signal when the input is the off/open position, when closed drive will follow the desired control signal. If the function is set for Normally Open, this will cause the drive to operate. If the function is set for Normally Closed, then the drive will be in the off location and not allow operation. Can be set to DigiIN: X indicates on board terminal inputs, DigiIN:A:IOX:X indicates option boards in A slot, DigiIN:B:IOX:X indicates optional board in B slot, or Timer Channel X. RO X function allows for having an input to run on without having to hard wire it to the physical relay output.	**1, 2, 3, 4**	RW
2658	**P3.58**	**Multi-pump Mode 1/2 Select** DI function selection parameter. It will select MPFC use parameter MFC mode or MFC mode2. User could switch the pump mode between MFC mode and MFC mode2 by DI.	**2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
2801	**P3.59**	**OP Cont Interlock NO** Allows for Output Contactor Interlock input causing drive to fault if drive in run mode and has a time delay of 250 ms. This function is defined as NO so the function activates on a closed contact. If this function is assigned to Normally Open, the function is always off so the drive will not fault. When set to Normally Closed, the function will be active and fault all the time if run drive. The additional settings allow assigning them to an input to control the function. Different Settings DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output.	**1, 2, 3, 4**	RW
2802	**P3.60**	**OP Cont Interlock NC** Allows for Output Contactor Interlock input causing drive to fault if drive in run mode and has a time delay of 250 ms. This function is defined as NC so the function activates on a open contact. If this function is assigned to Normally Closed, the function is always off so the drive will not fault. When set to Normally Open, the function will be active and fault all the time if run drive. The additional settings allow assigning them to an input to control the function. Different Settings DigiIN:X indicates on board terminal inputs, DigiIN:A:IOX:X indicates optional board inputs in A slot, DigiIN:B:IOX:X indicates optional board inputs in B slot, or Timer Channel X. RO X Function allows for having an input turn on without having to hard wire it to the physical relay output.	**1, 2, 3, 4**	RW
2894	**P3.61**	**CP Interlock NC** CleanPower interlock DI NC select.	**1, 2, 3, 4**	RW
227	**P4.1**	**AO1 Mode** Defines the analog output mode to current or voltage. There are internal relays to perform the switching of the signal between mA or V.	**1, 2, 3, 4**	RW
146	**P4.2**	**AO1 Function** Select the function desired to the terminal AO1 terminal 22.	**1, 2, 3, 4**	RW
149	**P4.3**	**AO1 Minimum** Defines the signal minimum to be either 0 mA or 4 mA (AO1 mode = 0–20 mA); 0 V or 2 V (AO1 mode = 0–10 V). 0 = Set minimum value to 0 V/0 mA. 1 = Set minimum value to 2 V/4 mA.	**1, 2, 3, 4**	RW
147	**P4.4**	**AO1 Filter Time** Defines the filter time applied to the analog output signal. Zero equals no filtering. **Figure 69. Analog output filtering.**  **Notes** ① Unfiltered analog signal. ② Filtered analog signal. ③ Filter time constant at 63% of the set value.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
150	P4.5	**AO1 Scale** Scaling factor for analog output function from 10% to 1000%. In adjusting this value, it will either extend or shrink the scale on the analog signal from 0–10 V/0–20 mA or 2–10 V/4–20 mA. **Figure 70. Analog output scaling.** 	1, 2, 3, 4	RW
148	P4.6	**AO1 Inversion** Inverts the analog output signal, normally 0 V/0 mA/2 V/4 mA = 0% and 10 V/20 mA = 100%, when inverted 0 V/0 mA/2 V/4 mA = 100% and 10 V/20 mA = 0%: Maximum output signal = Minimum set value. Minimum output signal = Maximum set value. **Figure 71. Analog output invert.** 	1, 2, 3, 4	RW
173	P4.7	**AO1 Offset** Add –100.0 to 100.0% to the analog output minimum value to add in an additional offset scale factor.	1, 2, 3, 4	RW
228	P4.8	**AO2 Mode** Selects the analog output mode for AO2 as current or voltage. There are internal relays to perform the switching of the signal between mA or V.	1, 2, 3, 4	RW
229	P4.9	**AO2 Function** Selects the desired function for the AO2 terminal 24.	1, 2, 3, 4	RW
232	P4.10	**AO2 Minimum** Defines the signal minimum to be either 0 mA or 4 mA (AO1 mode = 0–20 mA); 0 V or 2 V (AO1 mode = 0–10 V). 0 = Set minimum value to 0 V/0 mA. 1 = Set minimum value to 2 V/4 mA.	1, 2, 3, 4	RW

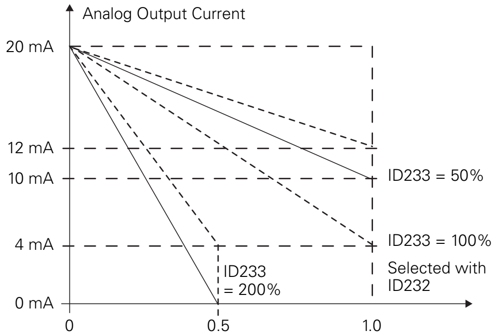
<table>
<tr><th>Modbus ID</th><th>Code</th><th>Parameters</th><th>Application</th><th>RO/RW</th></tr>
<tr><td>230</td><td>P4.11</td><td>AO2 Filter Time
Defines the filtering time for the analog output signal, with a higher number the more filtering time is added on the output signal. Setting this parameter value to 0.00 will deactivate filtering.
Figure 72. AO2 filter time.


Notes: ① Unfiltered analog signal.
② Filtered analog signal.
③ Filter time constant at 63% of the set value.</td><td>1, 2, 3, 4</td><td>RW</td></tr>
<tr><td>233</td><td>P4.12</td><td>AO2 Scale
Scaling factor for analog output function from 10% to 1000%. In adjusting this value, it will either extend or shrink the scale on the analog signal from 0–10 V/0–20 mA or 2–10 V/ 4–20 mA.
Figure 73. Analog output scaling.

</td><td>1, 2, 3, 4</td><td>RW</td></tr>
<tr><td>231</td><td>P4.13</td><td>AO2 Inversion
Inverts the analog output signal, normally 0 V/0 mA/2 V/4 mA = 0% and 10 V/ 20 mA = 100%, when inverted 0 V/0m A/2 V/4 mA = 100% and 10 V/20 mA = 0%:
Maximum output signal = Minimum set value.
Minimum output signal = Maximum set value.</td><td>1, 2, 3, 4</td><td>RW</td></tr>
</table>

Modbus ID	Code	Parameters	Application	RO/RW
234	**P4.14**	**AO2 Offset**	**1, 2, 3, 4**	RW

Add –100.0 to 100.0% to the analog output minimum value to add in an additional offset scale factor.

Figure 74. Analog output invert.

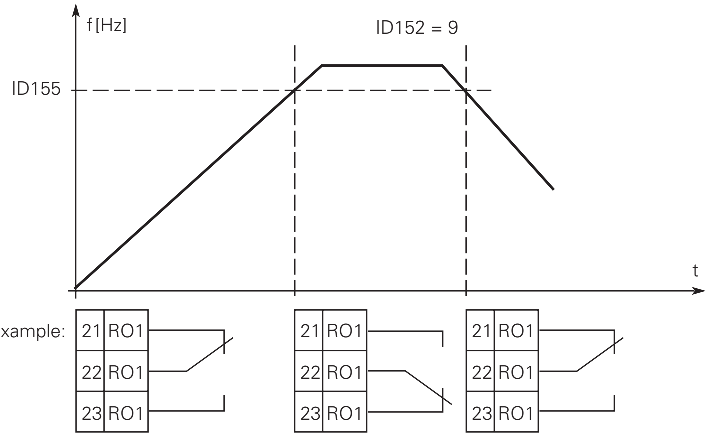


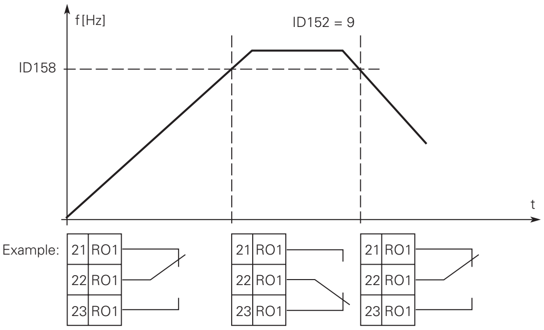
151	**P5.1**	**DO1 Function**	**1, 2, 3, 4**	RW

Setting Value Signal Content

0 = Not used - No Action
1 = Ready - Drive is ready for operation
2 = Run - Drive is running
3 = Fault - Drive is faulted
4 = Fault invert - Drive is not faulted
5 = Warning - Drive has a warning message
6 = Reverse - The Drive is outputing reverse phase rotation
7 = At Speed - The output frequency has reached the set reference
8 = Zero frequency - Drive output is at zero frequency
9 = Frequency limit supervision - Supervision for frequency limit 1 is activated
10 = Frequency limit2 supervision -Supervision for frequency limit2 is activated
11 = pid1 supervision - Supervision for pid1 controller is activated
12 = pid2 supervision - Supervision for pid2 controller is activated
13 = Over heat - Drive over heat fault has occurred
14 = Ocurrent fault - Over current fault has occurred
15 = Ovolt fault - Over volt fault has occurred
16 = Uvolt fault Resp - Under volt warning/fault has occurred
17 = 4 mA fault - 4 mA fault has occurred
18 = External brake - External brake is active
19 = External brake inverted - External brake control inverted
20 = Torque limit supervision - Supervision for torque limit
21 = Reference limit supervision - Supervision for reference limit
22 = Control from IO - I/O is the control place
23 = Unrequired rotation direction - The active direction isn't the same with the reference direction
24 = Thermal fault - Thermistor fault has occurred
25 = Fire mode - Drive is in fire mode
26 = Bypass running - Drive is in bypass mode
27 = External fault - External fault has occurred
28 = Remote control - Remote is the control place
29 = Jog speed - Drive is in jog mode
30 = motor thermal protection - Motor is thermal protected
31 = Fieldbus input1 - Controled by FB control word, look at com manuals.
32 = Fieldbus input2 - Controled by FB control word, look at com manuals.
33 = Fieldbus input3 - Controled by FB control word, look at com manuals.
34 = Fieldbus intpu4 - Controled by FB control word, look at com manuals.

Modbus ID	Code	Parameters	Application	RO/RW
151	**P5.1**	**DO1 Function, continued** Setting Value Signal Content 35 = Damper control - Drive is in damper control 36 = Timer1 status - The status of timer1 37 = Timer2 status - The status of timer2 38 = Timer3 status - The status of timer3 39 = In E-stop - Emergency stop digital input is enabled, drive faulted 40 = Power limit supervision - Supervision for power limit 41 = Temperature limit supervision - Supervision for temperature limit 42 = Analog input supervision - Supervision for analog input 43 = Motor1 control - Motor1 is controlled 44 = Motor2 control - Motor2 is controlled 45 = Motor3 control - Motor3 is controlled 46 = Motor4 control - Motor4 is controlled 47 = Motor5 control - Motor5 is controlled 48 = Logic fulfilled - The status of logic function P6 49 = PID1 sleep - PID1 controller is in sleep mode 50 = PID2 sleep - PID2 controller is in sleep mode 51 = Motor current 1 Supv - Motor current supervision value active 52 = Motor current 2 Supv - Motor current supervision value active 53 = Second AI limit Supv - Analog input supervision active 54 = DC charge switch close - DC bus is charged (230 VAC - 230 VDC, 480 VAC - 380 VDC, 575 VAC - 520 VDC) fault signal is not effected by this output. 55 = Preheat active - Preheat control mode is activated 56 = Cold weather active - Cold weather mode is activated 57 = Prime pump active 58 = 2nd stage ramp frequency active - 2nd stage ramp frequency limit reached 59 = STO fault output - STO fault has occurred 60 = Run bypass/drive - Run indication for drive and bypass. 61 = Bypass overload; 62 = Bypass run; 63 = Auto local On COM fault; 64 = Fieldbus RTU fault; 65 = Fieldbus TCP fault; 66 = Fieldbus MSTP fault; 67 = Fieldbus EIP fault; 68 = Fieldbus SlotA fault; 69 = Fieldbus SlotB fault;+D384 70 = Fieldbus SWD fault; 71 = Jockey pump active; 72 = Lube pump active; 73 = PID1 low feedback; setting in Par ID 2811 PID1 low feedback level, Par ID 2812 PID1 low feedback time 74 = PID1 high feedback; setting in Par ID 2814 PID1 high feedback level, Par ID 2815 PID1 high feedback time 75 = PID2 low feedback; setting in Par ID 2818 PID2 low feedback level, Par ID 2819 PID2 high feedback time 76 = PID2 high feedback; setting in Par ID 2821 PID2 high feedback level, Par ID 2822 PID2 high feedback time P11.64, P11.65 77 = Master in MPFC; 78 = CP interlock fault - CleanPower interlock run fault has occurred)	**1, 2, 3, 4**	RW
152	**P5.2**	**RO1 Function** Defines the Function associated with changing the state of relay output1. See Par ID 151.	**1, 2, 3, 4**	RW
153	**P5.3**	**RO2 Function** Defines the function associated with changing the state of relay output2. See Par ID 151.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
538	**P5.4**	**RO3 Function** Defines the Function associated with changing the state of relay output3. See Par ID 151.	**1, 2, 3, 4**	RW
2463	**P5.5**	**Virtual RO1 Function** Defines the Function associated with changing the state of relay RO1. See Par ID 151.	**1, 2, 3, 4**	RW
2464	**P5.6**	**Virtual RO2 Function** Defines the function associated with changing the state of relay RO2. See Par ID 151.	**1, 2, 3, 4**	RW
154	**P5.7**	**Freq Limit 1 Supv** Selects how the drive's frequency limit supervision controller functions. If the output frequency goes under/over the set limit (P5.8), this function generates a warning message via the digital output DO1 or relay outputs RO1, RO2, or RO3, depending on the settings of P5.1 to P5.2, P5.3, and P5.4. 0 = No supervision 1 = Low limit supervision 2 = High limit supervision 3 = Brake-on control (Application 4 only).	**1, 2, 3, 4**	RW
155	**P5.8**	**Freq Limit 1 Supv Val** Selects the frequency value supervised by the frequency limit supervision function (P5.7). **Figure 75. Supervision function.**  	**1, 2, 3, 4**	RW
157	**P5.9**	**Freq Limit 2 Supv** Selects how the drives frequency limit supervision controller functions. Selects how the drives frequency limit supervision controller functions. If the output frequency goes under/over the set limit (P5.10), this function generates a warning message via the digital output DO1 or relay outputs RO1, RO2, or RO3, depending on the settings of P5.1 to P5.2, P5.3, and P5.4. 0 = No supervision 1 = Low limit supervision 2 = High limit supervision 3 = Brake-on control (Application 4 only) 4 = Brake-on/off control (Application 4 only).	**1, 2, 3, 4**	RW
158	**P5.10**	**Freq Limit 2 Supv Val** Defines the frequency value supervised by the frequency limit supervision function (P5.9).	**1, 2, 3, 4**	RW

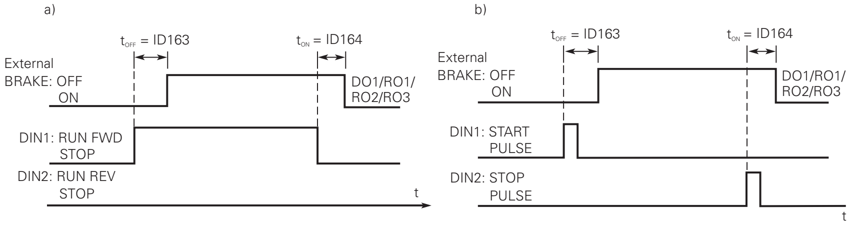
Modbus ID	Code	Parameters	Application	RO/RW
159	**P5.11**	**Torque Limit Supv** Selects how the drives torque limit supervision controller functions. If the output torque goes under/over the set limit (P5.12), this function generates a warning message via the digital output DO1 or via the relay outputs RO1, RO2, or RO3, depending on the settings of P5.1 to P5.2, P5.3, and P5.4. It can also control a mechanical brake to disable once torque is built up with the motor (Torque proofing). 0 = No limit 1 = Low limit supervision 2 = High limit supervision 3 = Brake-off control (Application 4 only). **Figure 76. Supervision function.** 	**1, 2, 3, 4**	RW
160	**P5.12**	**Torque Limit Supv Val** Defines the torque value supervised by the torque limit supervision function (P5.11).	**1, 2, 3, 4**	RW
161	**P5.13**	**Ref Limit Supv** Selects how the drives reference limit supervision controller function. If the drivers reference goes under/over the set limit (P5.14), this function generates a warning message via the digital output DO1 or via the relay outputs RO1, RO2, or RO3, depending on the settings of P5.1 to P5.2, P5.3, and P5.4. 0 = No supervision 1 = Low limit supervision 2 = High limit supervision.	**1, 2, 3, 4**	RW
162	**P5.14**	**Ref Limit Supv Val** Defines the reference frequency value supervised by the reference frequency limit supervision function (P5.13).	**1, 2, 3, 4**	RW
163	**P5.15**	**Ext Brake Off Delay** The function of the external brake can be timed on or time off delay to provide ample time to enable and disable an external brake module. The brake control signal can be programmed via digital output DO1, or via one of the relay outputs RO1, RO2, and RO3. a) Start/Stop logic selection, 0, 1, or 2. b) Start/Stop logic selection, 3.	**4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
164	**P5.16**	**Ext Brake On Delay**	**4**	RW

The function of the external brake can be timed on or time off delay to provide ample time to enable and disable an external brake module.

The brake control signal can be programmed via digital output DO1, or via one of the relay outputs RO1, RO2, and RO3.

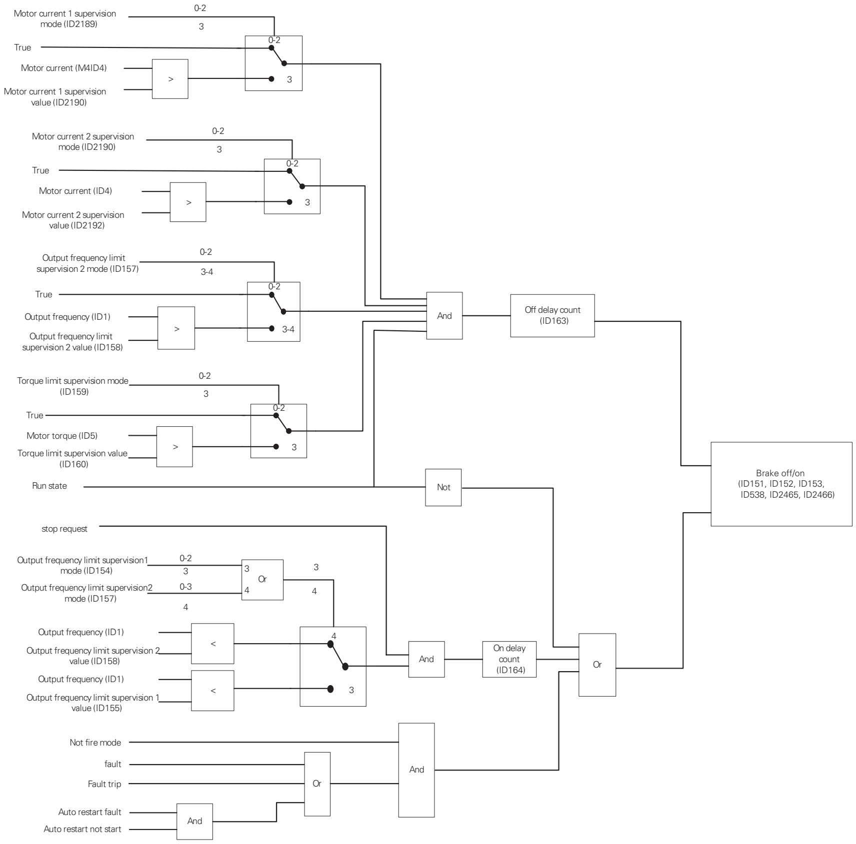
Figure 77. External brake control.



a) Start/Stop logic selection, 0, 1 or 2.

b) Start/Stop logic selection, 3

.When using the brake control, the following table is used to demonstrate the control functions. Brake on delay should be set longer than the ramp time in order to avoid damaging the brake.

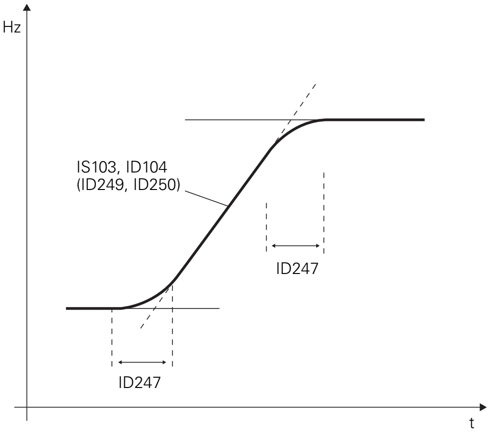
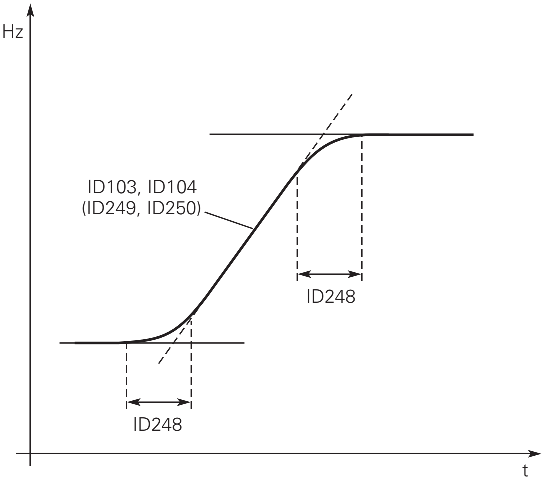


Modbus ID	Code	Parameters	Application	RO/RW
165	**P5.17**	**Temp Limit Supv** Selects how the drives temperature limit supervision controller function. If the temperature of the frequency converter unit falls below or exceeds the set limit (P5.18), this function generates a warning message via the digital output DO1 or via a relay output RO1, RO2, or RO3, depending on the settings of P5.1 to P5.2, P5.3, and P5.4. 0 = No supervision 1 = Low limit supervision 2 = High limit supervision.	**1, 2, 3, 4**	RW
166	**P5.18**	**Temp Limit Supv Val** Defines the drive temperature value supervised by the drive temperature limit supervision function (P5.17).	**1, 2, 3, 4**	RW
167	**P5.19**	**Power Limit Supv** Selects how the drives power limit supervision controller functions. If the calculated power value falls below or exceeds the set limit (P5.20), this function generates a warning message via the digital output DO1 or via a relay output RO1, RO2, or RO3, depending on the settings of P5.1 to P5.2, P5.3, and P5.4. 0 = No supervision 1 = Low limit supervision 2 = High limit supervision.	**1, 2, 3, 4**	RW
168	**P5.20**	**Power Limit Supv Val** Defines the output power value supervised by the power limit supervision function (P5.19).	**1, 2, 3, 4**	RW
170	**P5.21**	**AI Supv Select** Selects analog signal to use for the analog input supervision. 0 = Analog reference from AI. 1 = Analog reference from keypad potentiometer.	**1, 2, 3, 4**	RW
171	**P5.22**	**AI Limit Supv** Selects how the analog input limit supervision controller functions. If the value of the selected analog input goes under/over the set limit (P5.23), this function generates a warning message through the digital output or the relay outputs depending on the settings of P5.1 to P5.2, P5.3, and P5.4. 0 = No supervision 1 = Low limit supervision 2 = High limit supervision.	**1, 2, 3, 4**	RW
172	**P5.23**	**AI Limit Supv Val** Defines the analog reference value supervised by the analog reference limit supervision function (P5.22).	**1, 2, 3, 4**	RW
1346	**P5.24**	**PID1 Superv Enable** Upper and lower limits around the reference are set. When the actual feedback value goes above the upper limit (P5.25) or below the upper limit (P5.26), and lower limit the delay timer will increment. When the actual value is within the allowed area, the delay counter decrements. After the delay time expires, the relay output for PIDsupervision will be activated. It will generate a warning message through the digital output or the relay outputs depending on the settings of P5.1 to P5.2, P5.3, and P5.4. This function is used for process value out of range faults.	**2, 3, 4**	RW
1347	**P5.25**	**PID1 Superv Upper Limit** Defines upper limit for PID feedback value used with the PID supervision controller.	**2, 3, 4**	RW
1349	**P5.26**	**PID1 Superv Lower Limit** Defines lower limit for PID feedback value used with the PID supervision controller.	**2, 3, 4**	RW
1351	**P5.27**	**PID1 Superv Delay** Defines the delay time that the PID feedback value must be out of range before activating the PID supervision output.	**2, 3, 4**	RW
1408	**P5.28**	**PID2 Superv Enable** Upper and lower limits around the reference are set. When the actual value goes above or below these, a counter starts counting up toward the Delay. When the actual value is within the allowed area, the same counter counts down instead. After the delay time it will turn on an relay output value. These can be fed into a digital input for pressure level faults.	**3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
1409	**P5.29**	**PID2 Superv Upper Limit** Upper and lower limits around the reference are set. When the actual value goes above or below these, a counter starts counting up toward the Delay. When the actual value is within the allowed area, the same counter counts down instead. After the delay time it will turn on an relay output value. These can be fed into a digital input for pressure level faults.	**3, 4**	RW
1411	**P5.30**	**PID2 Superv Lower Limit** Upper and lower limits around the reference are set. When the actual value goes above or below these, a counter starts counting up toward the Delay. When the actual value is within the allowed area, the same counter counts down instead. After the delay time it will turn on an relay output value. These can be fed into a digital input for pressure level faults.	**3, 4**	RW
1413	**P5.31**	**PID2 Superv Delay** Upper and lower limits around the reference are set. When the actual value goes above or below these, a counter starts counting up toward the Delay. When the actual value is within the allowed area, the same counter counts down instead. After the delay time it will turn on an relay output value. These can be fed into a digital input for pressure level faults.	**3, 4**	RW
2112	**P5.32**	**RO1 On Delay** Delay time for RO1 relay to turn on after signal received.	**1, 2, 3, 4**	RW
2113	**P5.33**	**RO1 Off Delay** Delay time for RO1 relay to turn off after signal removed.	**1, 2, 3, 4**	RW
2114	**P5.34**	**RO2 On Delay** Delay time for RO2 relay to turn on after signal received.	**1, 2, 3, 4**	RW
2115	**P5.35**	**RO2 Off Delay** Delay time for RO2 relay to turn off after signal removed.	**1, 2, 3, 4**	RW
2116	**P5.36**	**RO3 On Delay** Delay time for RO3 relay to turn on after signal received.	**1, 2, 3, 4**	RW
2117	**P5.37**	**RO3 Off Delay** Delay time for RO3 relay to turn off after signal removed.	**1, 2, 3, 4**	RW
2118	**P5.38**	**RO3 Reverse** Inverts the output function of RO3 to be normally closed. Instead of normally open, on the Form A relay.	**1, 2, 3, 4**	RW
2189	**P5.39**	**Motor Current 1 Supv** Selects how the motor current limit supervision controller functions. If the motor current goes under/over the set limit (P5.40), this function generates a warning message through the digital output or the relay outputs, depending on the settings of P5.1 to P5.2, P5.3, and P5.4. 0 = No supervision 1 = Low limit supervision 2 = High limit supervision 3= Brake Off Control (Application 4 only).	**1, 2, 3, 4**	RW
2190	**P5.40**	**Motor Current 1 Supv Value** Defines the motor current value supervised by the motor current limit supervision function (P5.39).	**1, 2, 3, 4**	RW
2191	**P5.41**	**Motor Current 2 Supv** Selects how the motor current limit supervision controller functions. If the motor current goes under/over the set limit (P5.42), this function generates a warning message through the digital output or the relay outputs, depending on the settings of P5.1 to P5.2, P5.3, and P5.4. 0 = No supervision 1 = Low limit supervision 2 = High limit supervision 3= Brake off control (Application 4 only).	**1, 2, 3, 4**	RW
2192	**P5.42**	**Motor Current 2 Supv Value** Defines the motor current value supervised by the motor current limit supervision function (P5.41).	**1, 2, 3, 4**	RW
2193	**P5.43**	**Second AI Supv Select** Selects analog signal to use for the analog input supervision. 0 = Analog reference from AI. 1 = Analog reference from keypad potentiometer.	**1, 2, 3, 4**	RW

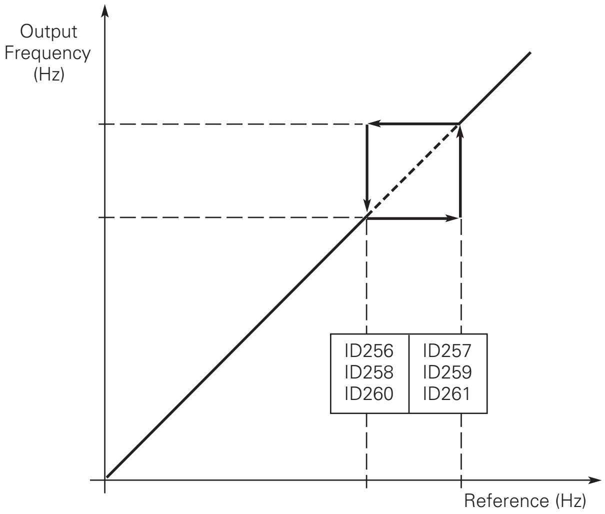
Modbus ID	Code	Parameters	Application	RO/RW
2194	**P5.44**	**Second AI Limit Supv** Selects how the analog input limit supervision controller functions. If the value of the selected analog input goes under/over the set limit (P5.45), this function generates a warning message through the digital output or the relay outputs, depending on the settings of P5.1 to P5.2, P5.3, and P5.4. 0 = No supervision 1 = Low limit supervision 2 = High limit supervision.	**1, 2, 3, 4**	RW
2195	**P5.45**	**Second AI Limit Supv Val** Defines the analog reference value supervised by the analog reference limit supervision function (P5.44).	**1, 2, 3, 4**	RW
2196	**P5.46**	**Motor Current 1 Supv Hyst** This value defines the bandwidth between when the motor current 1 supervision enables and disables.	**1, 2, 3, 4**	RW
2197	**P5.47**	**Motor Current 2 Supv Hyst** This value defines the bandwidth between when the motor current 2 supervision enables and disables.	**1, 2, 3, 4**	RW
2198	**P5.48**	**AI Supv Hyst** This value defines the bandwidth between when the AI supervision enables and disables.	**1, 2, 3, 4**	RW
2199	**P5.49**	**Second AI Supv Hyst** This value selects the bandwidth between when the second AI supervision enables and disables.	**1, 2, 3, 4**	RW
2200	**P5.50**	**Freq Limit 1 Supv Hyst** This value definess the bandwidth between when the output frequency Limit 1 supervision enables and disables.	**1, 2, 3, 4**	RW
2201	**P5.51**	**Freq Limit 2 Supv Hyst** This value defines the bandwidth between when the output frequency Limit 2 supervision enables and disables.	**1, 2, 3, 4**	RW
2202	**P5.52**	**Torque Limit Supv Hyst** This value defines the bandwidth between when the torque limit supervision enables and disables.	**1, 2, 3, 4**	RW
2203	**P5.53**	**Ref Limit Supv Hyst** This value defines the bandwidth between when the reference limit supervision enables and disables.	**1, 2, 3, 4**	RW
2204	**P5.54**	**Temp Limit Supv Hyst** This value defines the bandwidth between when the temp limit supervision enables and disables.	**1, 2, 3, 4**	RW
2205	**P5.55**	**Power Limit Supv Hyst** This value defines the bandwidth between when the power limit supervision enables and disables.	**1, 2, 3, 4**	RW
2848	**P5.56**	**Virtual RO1 On Delay** Delay time for virtual RO1 relay to turn on after signal received.	**1, 2, 3, 4**	RW
2849	**P5.57**	**Virtual RO1 Off Delay** Delay time for virtual RO1 relay to turn off after signal removed.	**1, 2, 3, 4**	RW
2850	**P5.58**	**Virtual RO2 On Delay** Delay time for virtual RO2 relay to turn on after signal received.	**1, 2, 3, 4**	RW
2851	**P5.59**	**Virtual RO2 Off Delay** Delay time for virtual RO2 relay to turn off after signal removed.	**1, 2, 3, 4**	RW
751	**P6.1**	**Logic Function Select** The logic function enables you to link both parameters logic function input (A) and logic function input (B) logically with each other. The value can be AND - indicating both being active then enable the logic, OR - if one or both inputs are active then it will enabled the logic, XOR - if any one of the inputs are active the logic is enabled, if both logic's are the same state it disables the logic. The result (LOG) can then be assigned to the digital outputs DO, RO1, RO2, and RO3. The type of operation is defined in parameter logic function (P6) selection: 0 = AND 1 = OR 2 = XOR	**4**	RW
752	**P6.2**	**Logic Operation Input A** Input A for Logic function calculation defined in P6.1. See P5.1 DO/RO Functions for settings.	**4**	RW

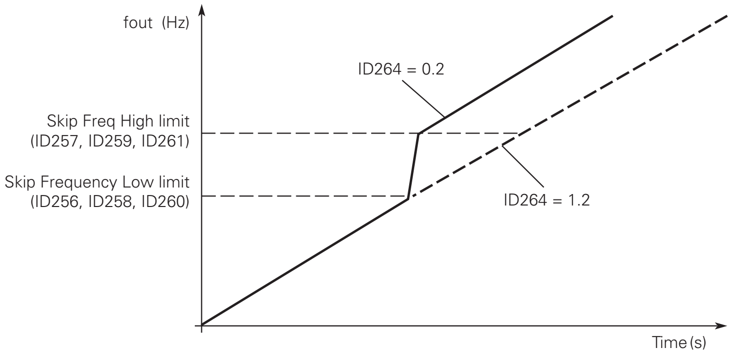
Modbus ID	Code	Parameters	Application	RO/RW
753	**P6.3**	**Logic Operation Input B** Input B for Logic function calculation defined in P6.1. See P5.1 DO/RO Functions for settings.	**4**	RW
138	**P7.1**	**Remote 2 Control Place** Selects where the drive will look for the 2nd start command, I/O terminals would be from≈the Digital hardwired inputs, Fieldbus would be a communication bus. Keypad will indicate what mode is selected. Digital input will select between control place 1 and control place 2.	**1, 2, 3, 4**	RW
139	**P7.2**	**Remote 2 Reference** Selects what frequency reference source to look at when in the Remote 2 control mode.	**1, 2, 3, 4**	RW
141	**P7.3**	**Keypad Reference** Keypad Reference value.	**1, 2, 3, 4**	RW
116	**P7.4**	**Keypad Direction** 0 = Forward: The rotation of the motor is forward or clockwise direction, when the keypad is the active control place. 1 = Reverse: The rotation of the motor is reversed or counter clockwise direction, when the keypad is the active control place.	**1, 2, 3, 4**	RW
114	**P7.5**	**Keypad Stop** 0 = Enabled-Keypad operation - In this mode, the keypad stop will only operate when the control source is set to keypad. 1 = Always Enables - In this mode, the stop button will always stop the drive regardless of control mode.	**1, 2, 3, 4**	RW
117	**P7.6**	**Jog Reference** Defines the jogging speed set point. This speed is selected with the digital input programmed for Jogging speed. When DI is enabled, the drive starts and ramps to this speed. When DI is removed, the drive stops. This parameter's value is automatically limited between minimum and maximum frequency (P1.1.1 and P1.1.2).	**1, 2, 3, 4**	RW
156	**P7.7**	**Motor Pot Ramp Time** Defines the speed of change for the motor potentiometer reference value.	**4**	RW
169	**P7.8**	**Motor Pot Ref Reset** Defines how the motor pot reference signal is handled on shutting down frequency converter output or powering down the frequency converter. 0 = No reset - Reference stays at last setting. 1 = Memory reset in stop and power down - Reference resets to 0 when drive is stopped or the power is cycled to the drive. 2 = Memory reset in power down - Reference resets to 0 when drive is powered down only.	**4**	RW
252	**P7.9**	**Start Mode** 0 = Ramp - The drive starts from 0 Hz and ramps to the frequency reference value. 1 = Flying start from stop frequency - The drive will catch a spinning motor. This setting searches for the current frequency using the last operating frequency as a starting point. 2 = Flying start from max. frequency - The drive will catch a spinning motor. This setting searches for the current frequency using the maximum operating frequency as a starting point.	**1, 2, 3, 4**	RW
253	**P7.10**	**Stop Mode** 0 = Coasting - After a stop command, the motor coasts to a stop uncontrolled by the drive. 1 = Ramp - After the stop command, the speed of the motor is decelerated according to the set deceleration parameters.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
247	**P7.11**	**Ramp 1 Shape** The start and end of the acceleration and deceleration ramps can be smoothed with these parameters. Setting a value of 0.0 gives a linear ramp shape that causes acceleration and deceleration to react immediately to the changes in the reference signal. Setting a value from 0.1 to 10 seconds for this parameter produces an S-shaped acceleration/deceleration at the start and stop of the slope. The acceleration time is determined with P1.3 and P1.4, or P7.13 and P7.14. **Figure 78. Acceleration/deceleration (S-shaped).**  	**1, 2, 3, 4**	RW
248	**P7.12**	**Ramp 2 Shape** The start and end of the acceleration and deceleration ramps can be smoothed with these parameters. Setting a value of 0.0 gives a linear ramp shape that causes acceleration and deceleration to react immediately to the changes in the reference signal. Setting a value from 0.1 to 10 seconds for this parameter produces an S-shaped acceleration/deceleration at the start and stop of the slope. The acceleration time is determined with P1.3 and P1.4, or P7.13 and P7.14. **Figure 79. Acceleration/deceleration (S-shaped).**  	**1, 2, 3, 4**	RW
249	**P7.13**	**Accel Time 2** These values correspond to the time required for the output frequency to accelerate from the zero frequency to the set maximum frequency (P1.2). These parameters provide the possibility to set two different acceleration/deceleration time sets for one application. The active set can be selected with the programmable digital input.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
250	**P7.14**	**Decel Time 2** These values correspond to the time required for the output frequency to decelerate from the set maximum frequency (P1.2) to the zero frequency. These parameters provide the possibility to set two different acceleration/deceleration time sets for one application. The active set can be selected with the programmable digital input.	**1, 2, 3, 4**	RW
256	**P7.15**	**Skip F1 Low Limit** In some systems, it may be necessary to avoid certain frequencies because of mechanical resonance problems. With these parameters, limits are set for the “skip frequency” regions. The frequency converter will skip the set frequency, ramp time will be the same.	**1, 2, 3, 4**	RW
257	**P7.16**	**Skip F1 High Limit** In some systems, it may be necessary to avoid certain frequencies because of mechanical resonance problems. With these parameters, limits are set for the “skip frequency” regions. The frequency converter will skip the set frequency, ramp time will be the same.	**1, 2, 3, 4**	RW
258	**P7.17**	**Skip F2 Low Limit** In some systems, it may be necessary to avoid certain frequencies because of mechanical resonance problems. With these parameters, limits are set for the “skip frequency” regions. The frequency converter will skip the set frequency, ramp time will be the same.	**1, 2, 3, 4**	RW
259	**P7.18**	**Skip F2 High Limit** In some systems, it may be necessary to avoid certain frequencies because of mechanical resonance problems. With these parameters, limits are set for the “skip frequency” regions. The frequency converter will skip the set frequency, ramp time will be the same.	**1, 2, 3, 4**	RW
260	**P7.19**	**Skip F3 Low Limit** In some systems, it may be necessary to avoid certain frequencies because of mechanical resonance problems. With these parameters, limits are set for the “skip frequency” regions. The frequency converter will skip the set frequency, ramp time will be the same.	**1, 2, 3, 4**	RW
261	**P7.20**	**Skip F3 High Limit** In some systems, it may be necessary to avoid certain frequencies because of mechanical resonance problems. With these parameters, limits are set for the “skip frequency” regions. The frequency converter will skip the set frequency, ramp time will be the same.	**1, 2, 3, 4**	RW

Figure 80. Example of skip frequency area setting.



Modbus ID	Code	Parameters	Application	RO/RW
264	**P7.21**	**Skip Range Ramp Factor** Defines the acceleration/deceleration time when the output frequency is between the selected prohibit frequency range limits. The ramping speed (selected acceleration/deceleration time 1 or 2) is multiplied with this factor. e.g., value 0.1 makes the acceleration time 10 times shorter than outside the prohibit frequency range limits. **Figure 81. Ramp speed scaling between skip frequencies.**  	**1, 2, 3, 4**	RW
267	**P7.22**	**Power Loss Function** This enables the drive to reduce output voltage to the motor to keep the drive powered up as long as it can before power is lost. The motor is used as a generator to feed the DC bus. This mode is engaged at the following levels - 230 V - 156.8 Vdc, 480 V - 303 Vdc, and 575 - 426.65 Vdc. 1 = Enable power loss function 0 = Disable power loss function	**1, 2, 3, 4**	RW
268	**P7.23**	**Power Loss Time** Allowable power loss max time before the drive shuts down. If AC input voltage recovers before this time setting, drive shall continue to operate.	**1, 2, 3, 4**	RW
2122	**P7.24**	**Currency** Sets the local currency used for energy savings estimation.	**1, 2, 3, 4**	RW
2123	**P7.25**	**Energy Cost** Sets the local energy cost per kW, used for energy savings estimation.	**1, 2, 3, 4**	RW
2124	**P7.26**	**Data Type** Selects data type to view energy savings. The drive takes four recordings in an hour and then calculates the average based off this parameter. The savings estimation is based on comparing the drives energy usage compared to a across the line starter. 0 = Cumulative 1 = Daily Avg. 2 = Weekly Avg. 3 = Monthly Avg. 4 = Yearly Avg.	**1, 2, 3, 4**	RW
2125	**P7.27**	**Energy Savings Reset** Resets the energy savings value.	**1, 2, 3, 4**	RW
2444	**P7.28**	**2nd Stage Ramp Frequency** When 2nd Stage Ramp Frequency is the frequency level at which the drive will enable the 2nd Stage Ramp Frequency output function. This then can be used for other inputs or devices to signal a frequency level.	**1, 2, 3, 4**	RW
2515	**P7.29**	**Change Phase Sequence Motor** This parameter allows for swapping the motor phase output from u, v, w to u, w, v.	**1, 2, 3, 4**	RW
2667	**P7.30**	**Run Remove Stop Mode** Drive will use this stop mode setting if Run Enable (Par ID 594) signal is removed. Default value should be coast stop.	**1, 2, 3, 4**	RW

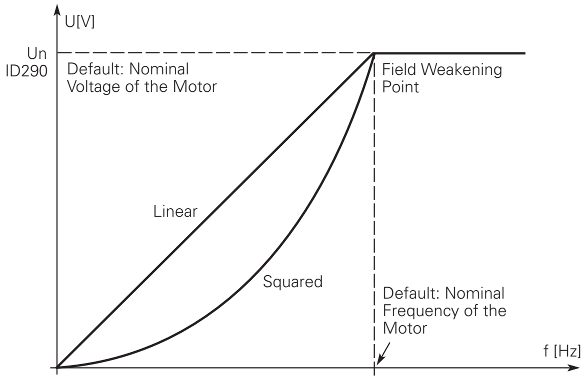
Modbus ID	Code	Parameters	Application	RO/RW
287	**P8.1**	**Motor Control Mode** 0 = Frequency control: Motor is controlled by giving a frequency reference to it. Voltage reference is calculated from scalar U/f ratio according to pre-programmed curve. (Output frequency resolution = 0.01 Hz). The frequency reference can be from I/O terminal, keypad or communication bus. 1 = Speed control: Motor is controlled by giving a frequency reference to it with slip compensation. Voltage reference is calculated from scalar U/f ratio according to pre-programmed curve. (Output frequency resolution = 0.01 Hz). The speed reference can be from I/O terminal, keypad, or communication bus (accuracy ±0.5%). 2 = PM control1 - PM motor control mode 1, used for SPM (surface mounted permanent magnet) and it also can be used for IPM. 3= PM control2 - PM motor control mode 2, used for IPM (internally mounted permanent magnet) and it can not be used for SPM. 5 = Speed control (open loop): Similar to the standard speed control mode, but it internally calculates for the amount of slip feedback from the motor. Requires running a motor identification to perform the calculations. 6 = Torque control (open loop): Motor is controlled based off a torque reference given to the drive and then based on the motor load the drive will maintain that torque level. Requires running a motor identification to perform the calculations. **Note:** Option 0/1 is V/Hz mode, options 2/3/5/6 are vector control modes.	**1, 2, 3, 4**	RW
107	**P8.2**	**Current Limit** This parameter determines the maximum output current allowed from the drive. Once the motor current hits this level, it goes into the current limiter controller and tries to limit the output current.	**1, 2, 3, 4**	RW
109	**P8.3**	**V/Hz Optimization** Automatic torque boost. The voltage to the motor increases automatically, which assists the motor to produce sufficient torque to start and run at low frequencies with high loads. To obtain the required torque, the zero point voltage and midpoint voltage/frequency (in parameter group P8) need to be set, so that the motor can draw enough current at the low frequencies. First set parameter P8.4 to Programmable V/Hz curve (value 2). Increase the zero point voltage P8.9 to get enough current at zero speed. Then set the midpoint voltage P8.8 to 100% and the midpoint frequency P8.7 to value P8.8/100%*P1.9. **Note:** In high torque - low speed applications - it is likely that the motor will overheat. If the motor has to run a prolonged time under these conditions, special attention must be paid to cooling the motor. Use external cooling for the motor if the temperature tends to rise too high. 0 = Disable torque boost function. 1 = Enable torque boost function.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
108	**P8.4**	**V/Hz Ratio**	**1, 2, 3, 4**	RW

0 = Linear - The voltage of the motor changes linearly with the frequency in the constant flux area from 0 Hz to the field weakening point where the nominal voltage is supplied. A linear V/Hz ratio should be used in constant torque applications.

1 = Squared - The voltage of the motor changes following a squared curve with the frequency in the area from 0 Hz to the field weakening point where the nominal voltage is supplied. The motor runs under magnetized below the field weakening point and produces less torque and electromechanical noise. A squared V/Hz ratio can be used in applications where the torque demand of the load is proportional to the square of the speed.

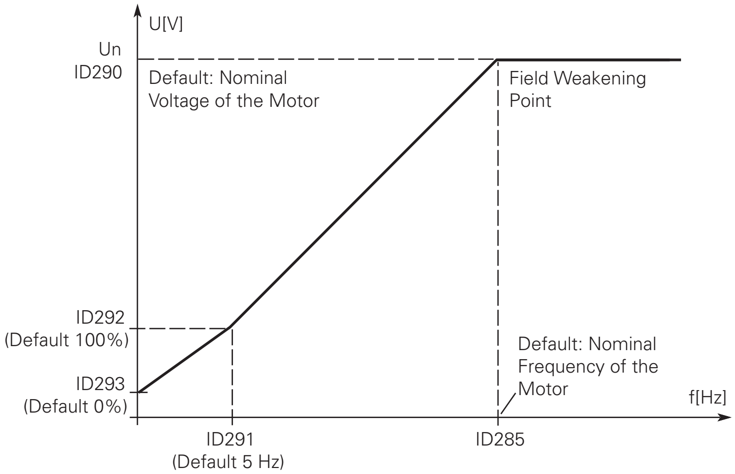
Figure 82. Linear and squared change of motor voltage.



Modbus ID	Code	Parameters	Application	RO/RW
108	**P8.4**	**V/Hz Ratio, continued**	**1, 2, 3, 4**	RW

2 = Programmable V/Hz curve - The V/Hz curve can be programmed with three different points. These points are the 0 frequency voltage, midpoint, and weakening point. A programmable V/Hz curve can be used if the other settings do not satisfy the needs of the application. When running the motor identification, this parameter gets set by default along with the values below for the V/Hz curve along with the resistance information of the motor.

Figure 83. Programmable V/Hz curve.



Manual Motor Tuning - in Multi-purpose App

1. Setting the motor magnetizing current:
   - Run the motor at 2/3 of the motor nominal frequency as the frequency reference.
   - Read the motor current in the Monitor menu or via the InControl PC tool.
   - Set the current as the motor excitation current (P8.54)
2. Set the V/Hz optimization parameter (P8.4) to value 2 “Programmable V/Hz curve”.
3. Run the motor with zero frequency reference and increase the motor zero point voltage (P8.9) until the motor current is approximately same as the motor excitation current. If the Motor is in a low frequency area for only short periods, 65% of the motor nominal current is possible.
4. Set the midpoint voltage (P8.8) to 1.4142*(P8.9) and midpoint frequency (P8.7) to value P8.7/100%*P1.9.
5. If required, activate the speed control or V/Hz optimization (torque boost).
6. If required, activate the speed control and V/Hz optimization (torque boost).

Linear with flux optimization

3 = The drive starts to search for the minimum motor current in order to save energy. This mode is called Active Energy Control which will reduce the voltage and current but still maintain the desired speed.

Modbus ID	Code	Parameters	Application	RO/RW
289	**P8.5**	**Field Weakening Point**	**1, 2, 3, 4**	RW

The field weakening point is the frequency at which the output voltage reaches the set maximum value. This value is usually determined by the motor nameplate value. This function can be used in applications with constant motor load, such as fans, pumps, etc.

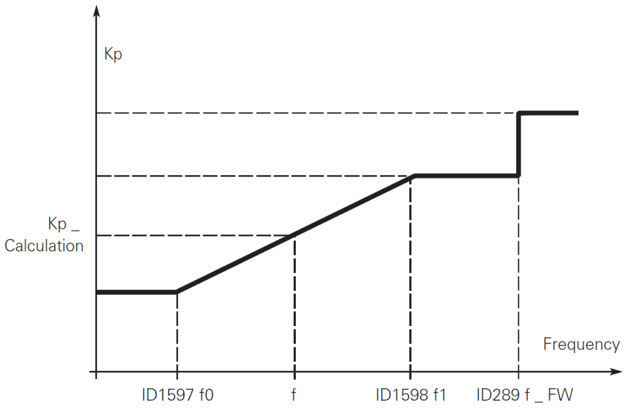
Modbus ID	Code	Parameters	Application	RO/RW
290	**P8.6**	**Voltage at FWP**	**1, 2, 3, 4**	RW

Defines the voltage at the field weakening point. When the output frequency exceeds the field weakening point the voltage will remain constant.

Below the frequency at the field weakening point, the output voltage depends on the setting of the V/Hz curve parameters (see P8.3, P8.4, P8.6, and P8.8).

When the parameters P1.8 and P1.9 (nominal voltage and nominal frequency of the motor) are set, the parameters P8.5 and P8.6 are automatically set to the corresponding values (FWP nominal frequency, voltage 100% = nominal voltage). If you need different values for the field weakening point and the maximum output voltage, change these parameters after setting P1.8 and P1.9.

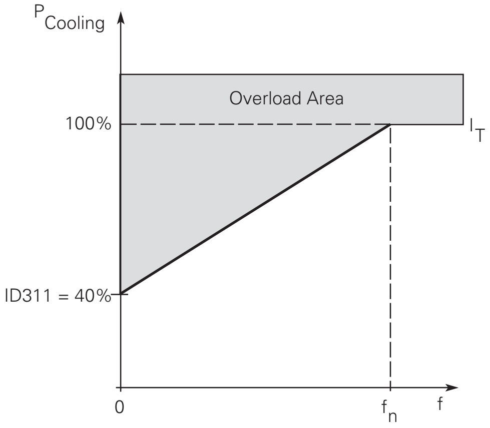
Modbus ID	Code	Parameters	Application	RO/RW
291	**P8.7**	**V/Hz Mid Frequency** If the programmable V/Hz curve has been selected with the P8.4, this parameter defines the midpoint frequency of the curve. This value can be set anywhere between 0 and the field weakening point (P8.5). To either have a different V/Hz ramp or if set to the FWP, it will provide the field weakening point voltage all the way up the curve.	**1, 2, 3, 4**	RW
292	**P8.8**	**V/Hz Mid Voltage** If the programmable V/Hz curve has been selected with the P8.4, this parameter defines the midpoint voltage of the curve. This value can be set anywhere between zero frequency volt and the field weakening point voltage (P8.6).	**1, 2, 3, 4**	RW
293	**P8.9**	**Zero Frequency Voltage** If the programmable V/Hz curve has been selected with the P8.4, this parameter defines the zero frequency voltage of the curve. When putting this value above 0%, additional voltage is given. In some cases, by putting this value too high, it can cause the motor to be oversaturated.	**1, 2, 3, 4**	RW
2522	**P8.10**	**Switching Frequency** This parameter sets the frequency that the PWM wave rides on, higher switching frequency will be cleaner current sine wave, lower switching frequency will be a choppier current sine wave. Motor noise can be minimized using a high switching frequency but the amount of heat dissipation increases. Increasing the switching frequency reduces the capacity of the frequency converter unit. By default, switching frequency may optimize automatically to get better performance and efficiency. If this auto adjustment is not expected, user can disable this feature via setting P8.11 Sine Filter Enable as “enable”. **Note:** See Installation Manual (MN040002EN) for the values listed for the individual frame size switching frequency ranges. It also provides de-rating tables required for sizing.	**1, 2, 3, 4**	RW
1665	**P8.11**	**Sine Filter Enable** This parameter enables the drive to have a fixed switching frequency (Par ID 2522) which is required by sine filters. The drive no longer automatically adjusts the switching frequency based on the unit temperature.	**1, 2, 3, 4**	RW
294	**P8.12**	**OverVoltage Control** The overvoltage control is used to limit the DC link voltage below the preset limit value. If over voltage control is enabled, the drive will control the DC link voltage below the preset limit value by increasing the output frequency to allow the motor to use the energy. 0 = Disable over voltage controller. 1 = The max. controller output frequency is the (ramp frequency +8 Hz). 2 = The max. controller output frequency is the max. frequency. 3 = The max. controller output frequency is the (max frequency + 8 Hz).	**1, 2, 3, 4**	RW
298	**P8.13**	**Load Drooping** The drooping function enables speed drop as a function of load. This parameter sets that amount corresponding to the nominal torque of the motor. This is typically used in sharing of loads with multiple VFD’s.	**4**	RW
299	**P8.14**	**Identification** This parameter enables the drive to make an motor identification cycle of the motor once complete the drive will adjust tuning parameters to improve starting torque and open loop vector control performance. Once set and a run command is given, the operation will be active - then set back to 0 when completed. When a run command is issued, the message on the keypad will indicate ‘Auto tuning’ is being performed. If there is an issue with the motor identification, a fault message will be displayed. Selection 2, 3, 4 is for multi-purpose only. 0 = Not Action. 1 = Identification only stator resistor - Does not spin the motor can be done with load attached. 2 = Identification with run - Motor stator resistor is completed then the motor is run, must be completed with unloaded motor. 3 = Identification no run - Motor is supplied with current and voltage but at zero frequency. 4 = Identification only inertia - Identification for the system inertia only.	**4**	RW
1574	**P8.15**	**Neg Frequency Limit** Frequency limit in the reverse direction in Open Loop Control mode.	**4**	RW
1576	**P8.16**	**Pos Frequency Limit** Frequency limit in the forward direction in Open Loop Control mode.	**4**	RW

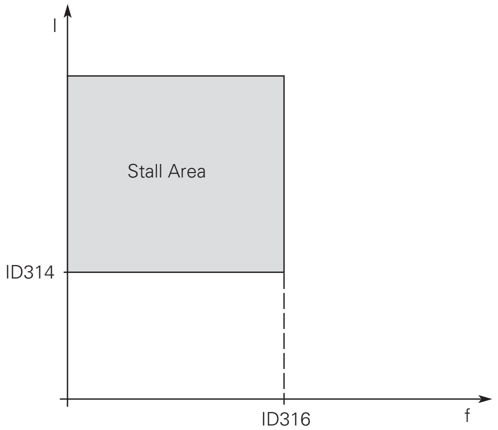
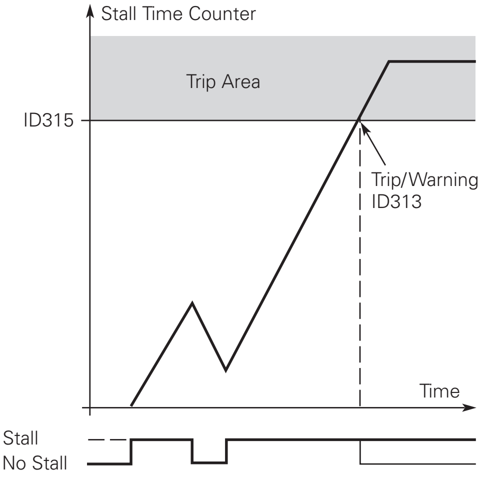
Modbus ID	Code	Parameters	Application	RO/RW
1585	**P8.17**	**Frequency Ramp Out Filter Time Constant** Filter time used when ramping the drive to its stop mode.	**1, 2, 3, 4**	RW
1591	**P8.18**	**Speed Error Filter Time Constant** Filter time constant for speed reference and actual speed error.	**4**	RW
1593	**P8.20**	**Speed Control Kp0** This parameter is the gain for the speed controller in open loop control mode given in % per Hz. Gain value of 100% means that the nominal torque reference is produced at the speed controller output for a frequency error of 1 Hz (see Figure 83 in P8.25).	**4**	RW
1594	**P8.21**	**Speed Control Ti0** Sets the integral time constant for the speed controller.	**4**	RW
1597	**P8.24**	**Speed Control F0** Speed level in Hz below the speed controller gain is equal to the speed control gain below F0 (see Figure 83 in P8.25).	**4**	RW
1598	**P8.25**	**Speed Control F1** The speed level in Hz above the speed controller gain is equal to the speed control gain (P8.20). From the speed defined by the F0 (P8.24) setting to the speed defined by the F1 (P8.25) setting, the speed controller gain changes linearly from the F0 gain to the speed gain Kp (see image below). **Figure 84. Speed control F1.**  	**4**	RW
1599	**P8.26**	**Speed Control Kp1** The relative gain of the speed controller as a percentage of the speed control gain (P8.20). When torque reference or speed control output is less than the value of speed control Ti0 (P8.27) . This parameter is normally used to stabilise the speed controller for a drive system with gear backlash.	**4**	RW
1600	**P8.27**	**Speed Control Ti1** Sets the integral time constant for the speed controller.	**4**	RW
1602	**P8.29**	**Motoring Torque Limit** Torque limit setting in the motoring side.	**4**	RW
1603	**P8.30**	**Generator Torque Limit** Torque limit setting for the generating side.	**4**	RW
1604	**P8.31**	**Torque Limit Forward** Torque limit setting in forward direction.	**4**	RW
1605	**P8.32**	**Torque Limit Reverse** Torque limit setting in reverse direction.	**4**	RW
1607	**P8.33**	**Motoring Power Limit** Motor power limit setting.	**4**	RW
1608	**P8.34**	**Generator Power Limit** Generator power limit setting.	**4**	RW
1611	**P8.35**	**Acc Compensation Time Constant** This value will compensate for the amount of inertia on the motor when starting and stopping. It improves speed response and is defined as acceleration time to nominal speed with nominal torque.	**4**	RW

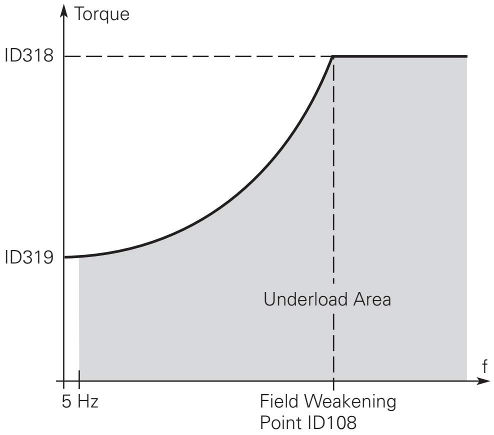
Modbus ID	Code	Parameters	Application	RO/RW
1612	**P8.36**	**Acc Compensation Filter Time Constant** The filter time for the acceleration compensation time constant (P8.35). Used to remove any disturbances in the inertia feedback.	**4**	RW
1620	**P8.37**	**Flux Reference** This parameter defines the amount of flux that is output to the motor, which is valid only in open loop vector control.	**4**	RW
1630	**P8.43**	**Droop Control Filter Time Constant** Filter time when using droop control.	**4**	RW
1631	**P8.44**	**Startup Torque Selection** Voltage across the q-axis stator inductance of the PM motor at the rated motor current and the rated motor frequency displayed in line-to-line rms value. Value is measured when performing Identification.	**4**	RW
1632	**P8.45**	**Torque Memory Start** This starting torque reference comes from the actual torque (P8.48). On start, it will use the measured actual torque value stored to memory and then use that value the next time a start is required.	**4**	RW
1633	**P8.46**	**Startup Torque Forward** Defines the amount of starting torque reference applied on startup in the forward direction when selected in P8.44.	**4**	RW
1634	**P8.47**	**Startup Torque Reverse** Defines the amount of starting torque reference applied on startup in the reverse direction when selected in P8.44.	**4**	RW
1635	**P8.48**	**Startup Torque Actual** Actual starting torque	**4**	RO
1667	**P8.49**	**Startup Torque Time** This time is used to define the amount of time the start torque value assigned in P8.44 will be applied for before the normal torque reference is used.	**4**	RW
771	**P8.50**	**Stator Resistor** Motor stator resistor real value. This value is the stator winding resistance of the windings in the motor. Value is measured when performing Identification (P8.14).	**4**	RW
772	**P8.51**	**Rotor Resistor** Motor rotor resistor real value. This value is the rotor resistance of the motor. Value is measured when performing Identification (P8.14).	**4**	RW
773	**P8.52**	**Leak Inductance** Motor leakage inductance real value. This value is the amount of magnetic inductance that does not link to a winding in the motor. Value is measured when performing Identification (P8.14).	**4**	RW
774	**P8.53**	**Mutual Inductance** Motor mutual inductance real value. This value is the amount of inductance between 2 sets of windings in the motor. Value is measured when performing Identification (P8.14).	**4**	RW
775	**P8.54**	**Excitation Current** Motor no-load current real value. This value is the amount of electrical current required to generate a rotating magnetic field in the motor. Value is measured when performing Identification (P8.14).	**4**	RW

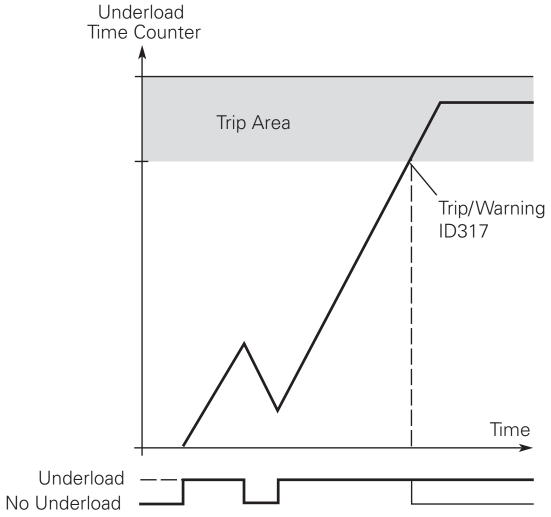
Modbus ID	Code	Parameters	Application	RO/RW
58	**P8.55**	**Advanced Open Loop Options** Advanced option word for sensorless control. B0 = Rs identification enabled at each start; B1 = Online Rs adaptation enabled; B2 = Enable additional stabilizer/regulator/control for id; B3 = Limit frequency polarity; B4 = Reserved; B5 = Reserved; B6 = Reduced load compensation; B7 = Reserved; B8 = Enable voltage-based current limit; B9 = Limit voltage polarity; B10 = Reserved; B11 = Reserved; B12 = Reserved; B13 = Standard start DC brake functionality; B14 = Enable ramp frequency anti-windup; B15 = Reserved.	**4**	RW
63	**P8.56**	**Torque Stability Gain** Frequency-dependent gain of the stabilizer. It changes linearly between zero and the field weakening point frequency so that full gain is at 0 Hz and zero gain is at the field weakening point.	**4**	RW
64	**P8.57**	**Torque Stability FWP Gain** Constant gain of the stabilizer. It is a constant gain at all output frequencies.	**4**	RW
62	**P8.58**	**Torque Stability Dampening Time** Damping time constant of the stabilizer in seconds.	**4**	RW
1656	**P8.59**	**V/F Stable Kd** The compensation coefficient of the d-axis, which is used to suppress oscillation.	**1, 2, 3, 4**	RW
1657	**P8.60**	**V/F Stable Kq** The compensation coefficient of the q-axis, which is used to suppress oscillation.	**1, 2, 3, 4**	RW
2835	**P8.61**	**Over Modulation Enable** Voltage drop of rectifier circuit may impact the required maximum motor output voltage. Enabling the over modulation allows for compensating the rectifier drop and helps increase the output voltage (roughly 0~10%). The side effect of over modulation results in increase in harmonic, impacting the stability, so it should be used per application requirement. Over modulation control is only available for V/Hz control.	**1, 2, 3, 4**	RW
2837	**P8.62**	**Motor Inertia** System rotation inertia real value for speed loop parameter tuning. Value is measured when performing Identification.	**4**	RW
1882	**P8.63**	**PM BEMF Voltage** Back electromotive force (EMF) voltage. Value is measured when performing Identification.	**4**	RW
1883	**P8.64**	**PM Q-axis Stator Inductance** Voltage across the q-axis stator inductance of the PM motor at the rated motor current and the rated motor frequency displayed in line-to-line rms value. Value is measured when performing identification.	**4**	RW
1884	**P8.65**	**PM D-axis Stator Inductance** Voltage across the d-axis stator inductance of the PM motor at the rated motor current and the rated motor frequency displayed in line-to-line rms value. Value is measured when performing identification.	**4**	RW
1890	**P8.66**	**PM Initial Selection** PM initial angle detect method.	**4**	RW
1891	**P8.67**	**PM Initial Time** PM initial angle detect time.	**4**	RW
1892	**P8.68**	**PM Excited Current** PM excited current during the low speed.	**4**	RW
1893	**P8.69**	**PM Excited Current Off frequency** PM excited current cut off frequency.	**4**	RW
2901	**P8.70**	**Observer Kp** Linear gain of the PM/IM observer.	**4**	RW

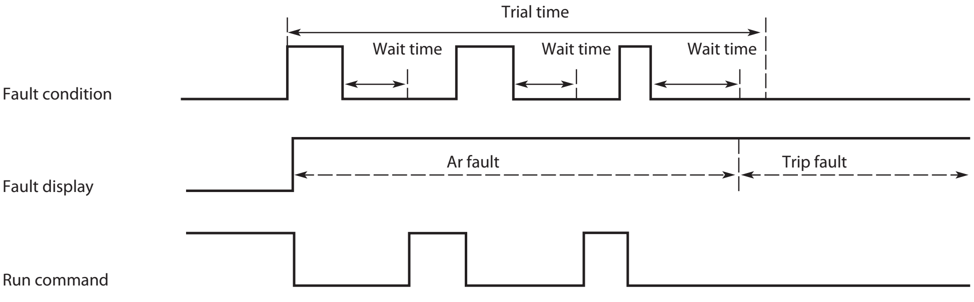
Modbus ID	Code	Parameters	Application	RO/RW
1664	**P8.71**	**Slip Compensation Coefficient** The linear coefficient of the slip compensation frequency, which is valid only in the speed control mode.	**1, 2, 3, 4**	RW
1768	**P8.72**	**Pulse Off Frequency** High frequency injection cutoff frequency. It will active if Motor Control Mode(Par ID 287) select value "PM Control2". PM Control2 requires high frequency pulse signal to inject to motor to support identify rotor position at the lower speed area which is less than Pules off Frequency. Customers do not need to modify this parameter by default.	**4**	RW
306	**P9.1**	**4 mA Input Fault** A warning or a fault action and message is generated if the 4–20 mA reference signal is used and the signal falls below 4 mA for 5 seconds or below 0.5 mA for 0.5 seconds. The information can also be programmed into digital output DO1 or relay outputs RO1 and RO2. 0 = No response. 1 = Warning. 2 = Warning, the frequency from 10 seconds back is set as reference. 3 = Warning, the preset frequency P9.2 is set as reference. 4 = Fault, stop mode after fault according to parameter stop mode (P7.10). 5 = Fault, stop mode after fault always by coasting.	**1, 2, 3, 4**	RW
331	**P9.2**	**4 mA Fault Frequency** When 4 mA fault happens, the output frequency of drive goes to this preset speed when P9.1 = 3.	**1, 2, 3, 4**	RW
307	**P9.3**	**External Fault** A warning or a fault action and message is generated from the external fault signal in the programmable (digital inputs function select external fault DIN3 is defaulted). The status information can also be programmed into digital output relay outputs RO1 and RO2. 0 = No response. 1 = Warning. 2 = Fault, stop mode after fault according to parameter stop mode (P7.10). 3 = Fault, stop mode after fault always by coasting.	**1, 2, 3, 4**	RW
332	**P9.4**	**Input Phase Fault** The input phase supervision ensures that the input phases of the frequency converter have approximately equal current draw. See Par ID 307.	**1, 2, 3, 4**	RW
330	**P9.5**	**Uvolt Fault Response** Frequency converter monitors DC bus voltage. If it drops below set level (via trouble shooting guide for more information on fault level) the drive will respond corresponding to this setting. See Par ID 307.	**1, 2, 3, 4**	RW
308	**P9.6**	**Output Phase Fault** Output phase supervision of the motor ensures that the motor phases have equal currents. If phases are 5% difference from one another, the frequency converter will respond corresponding to this setting. See Par ID 307.	**1, 2, 3, 4**	RW
309	**P9.7**	**Ground Fault** Earth fault protection ensures that the sum of the motor phase currents is zero. There is a current level setting parameter ground fault limit that allows for setting the allowable ground current level based off the total drive current. The over-current protection is always working and protects the frequency converter from earth faults with high currents. Frequency converter will correspond to the the setting below. See Par ID 307.	**1, 2, 3, 4**	RW
310	**P9.8**	**Motor Thermal Protection** If a fault condition is selected, the drive will stop and activate the fault stage based off the % of calculated motor temperature. The calculated motor temp. is based off the install power on values of the drive and monitoring values as the drive is running. Deactivating this protection, (i.e., setting parameter to 0) will reset the thermal stage of the motor to 0%. See Par ID 307.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
311	**P9.9**	**Motor Thermal F0 Current** The current can be set between 0–150.0% x InMotor. This parameter sets the value for thermal current at zero frequency. The default value is set assuming that there is no external fan cooling the motor. If an external fan is used, this parameter can be set to 90% (or even higher). **Note**: The value is set as a percentage of the motor nameplate data, parameter "nominal current of the motor" (P1.5), not the drive's nominal output current. The motor's nominal current is the current that the motor can withstand in direct on-line use without being overheated. If you change the parameter nominal current of motor, this parameter is automatically restored to the default value. Setting this parameter does not affect the maximum output current of the drive which is determined by P1.16 alone. **Figure 85. Motor thermal current it curve.**  	**1, 2, 3, 4**	RW
313	**P9.11**	**Stall Protection** Stall protection is a user defined of over-current protection. It protects the motor from short time overload situations like a stalled shaft. This is customer selectable based off of current level, frequency level and time. 0 = No action. 1 = Warning. 2 = Fault. 3 = Fault, coast.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
314	**P9.12**	**Stall Current Limit** The current can be set to 0.1–InMotor*2. For a stall stage to occur, the current must have exceeded this limit. The software does not allow entering a greater value than InMotor*2. If parameter "nominal motor current" (P1.5) is changed, this parameter is automatically restored to the default value (IL). **Figure 86. Stall characteristics settings.** 	**1, 2, 3, 4**	RW
315	**P9.13**	**Stall Time Limit** This time can be set between 1.0 and 120.0 s. This is the maximum time allowed for a stall stage. The stall time is counted by an internal up/down counter based off the current being above the limit setting. If the stall time counter value goes above this limit the stall protection will cause a trip according to protection parameter P9.11. **Figure 87. Stall time count.** 	**1, 2, 3, 4**	RW
316	**P9.14**	**Stall Frequency Limit** The frequency can be set between 1–fmax (P1.1.2). For a stall state to occur, the output frequency must have remained below this limit, above the current limit for the stall time to occur.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
317	**P9.15**	**Underload Protection** If fault is set as the function. The drive will stop and activate the fault stage based on the parameter conditions and the monitoring status of the motor. If the motor torque drops below the Fnom and F0 torque levels for the time limit, the protection is enabled. Deactivating the protection by setting the parameter to 0 will reset the underload time counter to zero. 0 = No response. 1 = Warning. 2 = Fault, stop mode after fault according to parameter stop mode (P7.10). 3 = Fault, stop mode after fault always by coasting.	**1, 2, 3, 4**	RW
318	**P9.16**	**Underload From Torque** The torque limit can be set between 10.0–150.0 % x TnMotor. This parameter gives the value for the minimum torque allowed when the output frequency is at or above the field weakening point. If you change parameter "nominal motor current" (P1.5), this parameter is automatically restored to the default value. **Figure 88. Setting of minimum load.** 	**1, 2, 3, 4**	RW
319	**P9.17**	**Underload F0 Torque** The torque limit can be set between 5.0–150.0 % x TnMotor. This parameter gives the value for the minimum torque allowed at zero frequency. If you change the value of "nominal motor current" (P1.5), this parameter is automatically restored to the default value.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
320	**P9.18**	**Underload Time Limit** This time can be set between 2.0 and 600.0 s. This is the time allowed for an underload fault state to exist. An internal up/down counter counts the accumulated underload time. If the underload counter value goes above this limit, the protection will cause a trip according to protection parameter (P9.15). If the drive is stopped, the counter is reset to zero. **Figure 89. Underload time counter function.**  	**1, 2, 3, 4**	RW
333	**P9.19**	**Thermistor Fault Response** Setting the parameter to 0 will deactivate the protection. If motor thermistors input is enabled, it requires enabling the fault condition, the thermistor is usually in the winding of the motor or an external sensor. Motor thermal protection can be deactivated. 0 = No response. 1 = Warning. 2 = Fault, stop mode after fault according to parameter stop mode. 3 = Fault, stop mode after fault always by coasting.	**1, 2, 3, 4**	RW
750	**P9.20**	**Line Start Lockout** Determines the response of frequency converter going to a run state cycle with I/O run command is still active as the control place. 0 = Respond to I/O run command when power is applied. If in another control place and switched to I/O control, do not respond. (Run command has to be cycled.) 1 = Do not respond to I/O run command when power is applied. If in another control place and switched to I/O control, do not respond. (Run command has to be cycled.) 2 = Respond to I/O commands when power is applied. If in another control place and switched to I/O control, the drive will respond to a maintained run command. 3 = Do not respond to I/O commands when power is applied. If in another control place and switched to I/O control, the drive will respond to a maintained run command.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
334	P9.21	**Fieldbus Fault Response** This sets the response mode for the Fieldbus fault when a Fieldbus mode is used and communication is lost between the PLC and communication port. Each protocol has another parameter to select in all control or only in Fieldbus control to set fault or warning. 0 = No action 1 = Warning 2 = Fault 3 = Fault, Coast 4 = Warning, Coast 5 = Warning, Auto switch to local 6 = Warning, Auto switch to preset speed 1.	1, 2, 3, 4	RW
335	P9.22	**OPTCard Fault Response** This sets the response mode for a board slot fault caused by a missing or failed option board not communicating to the central processor. 0 = No response 1 = Warning 2 = Fault, stop mode after fault according to parameter stop mode (P7.10) 3 = Fault, stop mode after fault always by coasting.	1, 2, 3, 4	RW
1564	P9.23	**Unit Under Temp Prot** This protection sets the response to a low frequency converter temperature on the heat sink. 0 = No response 1 = Warning 2 = Fault, stop mode after fault according to parameter stop mode (P7.10) 3 = Fault, stop mode after fault always by coasting.	1, 2, 3, 4	RW
321	P9.24	**AR Wait Time** Defines time before drive tries to automatically restart the motor after a specific fault condition has been cleared.	1, 2, 3, 4	RW
322	P9.25	**AR Trail Time** Amount of time after fault set that drive uses the restart attempts to reset the fault and restart the motor. After this time has run out without resetting the alarm, drive will fault. Attempts parameter determines the maximum number of automatic restarts during the trial time set. If the number of faults occurring during the trial time exceeds the attempts values, the fault state becomes active. Otherwise the fault is cleared after the trial time has elapsed. **Figure 90. Auto restart fail (try number >2).**  	1, 2, 3, 4	RW
323	P9.26	**AR Start Function** The parameter defines the start mode upon a auto restart condition. 0 = Flying start from stop frequency. 1 = Start according to parameter Par ID 252 Start Mode. 2 = Flying start from max. frequency.	1, 2, 3, 4	RW

Modbus ID	Code	Parameters	Application	RO/RW
324	P9.27	**Undervoltage Attempts** This parameter determines how many automatic restarts can be made during the trial time set by P9.25 after an under-voltage trip. 0 = No automatic restarts. >0 = Number of automatic restarts after under-voltage fault. The fault is reset and the drive is started automatically after the DC-link voltage has returned to the normal level.	1, 2, 3, 4	RW
325	P9.28	**OverVoltage Attempts** This parameter determines how many automatic restarts can be made during the trial time set by P9.25 after an over-voltage trip. 0 = No automatic restart after overvoltage fault trip. >0 = Number of automatic restarts after overvoltage fault trip. The fault is reset and the drive is started automatically after the DC-link voltage has returned to the normal level.	1, 2, 3, 4	RW
326	P9.29	**OverCurrent Attempts** This parameter determines how many automatic restarts can be made during the trial time set by P9.25 after an overcurrent trip. **Note:** An IGBT temperature fault, saturation fault, and over-current faults are included as part of this fault. 0 = No automatic restart after over-current fault trip. >0 = Number of automatic restarts after an over-current trip, saturation trip, or IGBT temperature fault.	1, 2, 3, 4	RW
327	P9.30	**4 mA Fault Attempts** This parameter determines how many automatic restarts can be made during the trial time set by P9.25 after 4 mA fault trip. 0 = No automatic restart after reference fault trip. >0 = Number of automatic restarts after the analog current signal (4–20 mA) has returned to the normal level (>4 mA).	1, 2, 3, 4	RW
329	P9.31	**Motor Temp Fault Attempts** This parameter determines how many automatic restarts can be made during the trial time set by P9.25 after Motor temp fault trip. 0 = No automatic restart after motor temperature fault trip. >0 = Number of automatic restarts after the motor temperature has returned to its normal level.	1, 2, 3, 4	RW
328	P9.32	**External Fault Attempts** This parameter determines how many automatic restarts can be made during the trial time set by P9.25 after external fault trip. 0 = No automatic restart after external fault trip. >0 = Number of automatic restarts after external fault trip.	1, 2, 3, 4	RW
336	P9.33	**Underload Attempts** This parameter determines how many automatic restarts can be made during the trial time set by P9.25 after underload fault trip. 0 = No automatic restart after an underload fault trip. >0 = Number of automatic restarts after an underload fault trip.	1, 2, 3, 4	RW
955	P9.34	**RTC Fault** RTC (real time clock) fault protection ensures the real time display is correct, the interval and timer function can run normally. 0 = No response. 1 = Warning. 2 = Fault, stop mode after fault according to stop mode. 3 = Fault, stop mode after fault always by coasting.	1, 2, 3, 4	RW

Modbus ID	Code	Parameters	Application	RO/RW
337	**P9.35**	**PT100 Fault Response** PT100 therminstor protection used with motor PT100 thermistors input option board are used to fault frequency conveter if motor has reached the set temperature fault level on the option card. If using PT100 thermistors motor therminal protection can be disabled. 0 = No response. 1 = Warning. 2 = Fault, stop mode after fault according to stop mode. 3 = Fault, stop mode after fault always by coasting.	**1, 2, 3, 4**	RW
1256	**P9.36**	**Replace Battery Fault Response** Sets how the frequency converter responds to a low voltage on the real time clock battery. If the voltage on the battery drops below 2 V, drive will display a warning by default. 0 = No response. 1 = Warning. 2 = Fault, stop mode after fault according to stop mode. 3 = Fault, stop mode after fault always by coasting.	**1, 2, 3, 4**	RW
1257	**P9.37**	**Replace Fan Fault Response** Replace fan fault will show when the fan life is less than 2 months; remind user to replace the fan. The time is based off the power on time of the drive. 0 = No response. 1 = Warning. 2 = Fault, stop mode after fault according to stop mode. 3 = Fault, stop mode after fault always by coasting.	**1, 2, 3, 4**	RW
1678	**P9.38**	**IP Address Confliction Resp** Indicates there is a conflict in the IP address assigned to the drive, typically meaning there are multiple devices with the same IP address assigned. See Par ID 955.	**1, 2, 3, 4**	RW
2126	**P9.39**	**Cold Weather Mode** With this parameter, you are able to enable the cold weather function causing the frequency converter's under temp limit to drop from –10°C to –30°C drive. This then enables a warm-up feature when the frequency converter is between –30°C and –20°C. The motor, when given a run command, will turn on for the cold weather time-out (P9.41) and output the cold weather voltage (P9.40) at 0.5 Hz to allow the motor to warm up. If it does not warm up above –20°C, after that the time frequency converter will fault on under temp fault. If the frequency converter does go above –20°C, output will begin to follow reference.	**1, 2, 3, 4**	RW
2127	**P9.40**	**Cold Weather Volt Level** With this parameter, you are able to select the % of the motor voltage that is output to the motor when in the cold weather warm-up period.	**1, 2, 3, 4**	RW
2128	**P9.41**	**Cold Weather Time Out** With this parameter, you are able to select the time limit that the frequency converter will run in the warmup period.	**1, 2, 3, 4**	RW
2129	**P9.42**	**Cold Weather Password** This password allows access to override the under temperature fault protection. This parameter is seen by pressing the left and right soft keys on the keypad. Password should be set to 62385, this value gets reset on cycle of power.	**1, 2, 3, 4**	RW
2130	**P9.43**	**Under Temp Fault Override** With the password set to the correct value this parameter is enabled and will give the ability to override the under temp fault. This function gets reset when power is cycled.	**1, 2, 3, 4**	RW
2158	**P9.44**	**Ground Fault Limit** Sets the level of the ground fault protection, this protection is based off the amount of leakage current that is seen to ground on the output of the drive.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
2157	**P9.45**	**Keypad Comm Fault Response** This parameter defines the function of the keypad communication response in the case the keypad is removed. 0 = No action. 1 = Warning. 2 = Fault. 3 = Fault, coast.	**1, 2, 3, 4**	RW
2159	**P9.46**	**Preheat Mode** This parameter enables/disables the preheat function where this is used in the case depending on where the temperature is being read from the drive. It will turn on the output to allow current to flow to the motor if the temperature of the drive drops. This is typically used when the motor is not running. 0 = Disable. 1 = Enable.	**1, 2, 3, 4**	RW
2160	**P9.47**	**Preheat Control Source** Selects the source of where the temperature is coming from, either digital input or the drive heat sink temperature, which potentially could be at a different temperature. 0 = DI function. 1 = Drive temperature.	**1, 2, 3, 4**	RW
2161	**P9.48**	**Preheat Enter Temp** Temperature when the preheat is enabled, drive goes into a run state to all the preheat voltage to flow through the motor an create some current.	**1, 2, 3, 4**	RW
2162	**P9.49**	**Preheat Quit Temp** Temperature when the preheat is disabled, drive goes into a stop state if the temperature is above this rating.	**1, 2, 3, 4**	RW
2163	**P9.50**	**Preheat Output Volt** Voltage level output to the motor when the drive is in the preheat operation mode. This is a percentage of the motor nameplate voltage.	**1, 2, 3, 4**	RW
2401	**P9.51**	**PID Feedback AI Loss Response** This parameter defines the function of the PID feedback analog Input loss response, if the AI feedback is lost based off the programed AI feedback. 0 = No action. 1 = Warning 2 = Fault. 3 = Warning: preset frequency (P9.52). 4 = Warning: Analog -> Net.	**2, 3, 4**	RW
2402	**P9.52**	**PID Feedback AI Loss Pre Freq** This parameter defines the frequency the master would run to if a feedback is lost and PID feedback AI loss response (P9.51) was set to option 3.	**2, 3, 4**	RW
2403	**P9.53**	**PID Feedback AI Loss Pipe Fill Loss Level** Detects loss of prime in the pump based off the measured level. If the value drops below this level for the time-out time (P9.54) and below the frequency in pipe fill loss level (P9.53), "loss of prime" occurs.	**2, 3, 4**	RW
2404	**P9.54**	**PID Feedback AI Loss PreFreq Timeout** When response is set to 3 or 4, when the Feedback signal is lost, the drive will run at the frequency set by AI loss pipe fill prefrequency for the time set here. After this time, the drive will fault out on "Feedback Loss". The time is disabled when set to 0 sec.	**2, 3, 4**	RW
2405	**P9.55**	**PID Feedback AI Loss Attempts** This parameter sets the amount of tries it will try to Auto restart the Feedback AI loss fault.	**2, 3, 4**	RW
2427	**P9.56**	**STO Fault Response** STO Fault Response defines the function of how the STO input will be seen on the keypad and how the drive functions to it. 0 = No action - Drive will stop no indication shown, if STO clears drive will run without reset. 1 = Warning - Drive stop and indicate warning/if STO clears drive will run without reset. 2 = Fault - Drive will indicate fault/require reset to start again.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
2483	**P9.57**	**Fault Reset Start** Defines how the drive functions after a fault reset is given if the run command has to be cycled or if still present it will start again. 0 = Follow run command - Follow Start/Stop input after fault reset. 1 = Rising edge after fault reset - Toggle of run input required to start after fault reset.	**1, 2, 3, 4**	RW
2657	**P9.58**	**Warning Operation Mode** Warning store and set rule. User could select save warning log in memory, or even do not pop out by keypad or PC tool.	**1, 2, 3, 4**	RW
2664	**P9.59**	**Fan Protection** Fan protection parameter.	**1, 2, 3, 4**	RW
2666	**P9.60**	**Under Voltage Trip Level** Under voltage trip level.	**1, 2, 3, 4**	RW
2803	**P9.61**	**OP Cont Interlock Attempts** OP cont. interlock attempts.	**1, 2, 3, 4**	RW
2831	**P9.62**	**OP Cont Interlock Protection** OP cont. interlock protection.	**1, 2, 3, 4**	RW
2895	**P9.63**	**CP Interlock Run Protection** CleanPower interlock fault protection parameters only for drive running.	**1, 2, 3, 4**	RW
2896	**P9.64**	**CP Interlock Stop Protection** CleanPower interlock fault protection parameters only for drive stop.	**1, 2, 3, 4**	RW
2897	**P9.65**	**CP Interlock Attempts** CleanPower interlock running fault auto reset try number.	**1, 2, 3, 4**	RW
1294	**P10.1**	**PID1 Control Gain** Defines the gain of the PID Controller. It adjust the slope of the speed increase according to the initial of the load. If this value is set to 100% a change of 10% in the error value causes the controller output to change 10%.	**2, 3, 4**	RW
1295	**P10.2**	**PID1 Control ITime** Defines the integration time of the PID controller. Over the time the integral time contributes to the deviation between the reference and the feedback signal. If this value is set to 1.00 sec., a change of 10% in the error value causes the controller output to change by 10.00%/s. With value set to 0.0, frequency converter operates as PD controller.	**2, 3, 4**	RW
1296	**P10.3**	**PID1 Control DTime** Defines the derivation time of the PID controller. This value will adjust the rate of change on the feedback signal. If this value is set to 1.00 sec., a change of %10 in error value during 1.00 sec. causes the control output to change by %10.00. If value is set to 0.0, frequency converter operates as PI controller.	**2, 3, 4**	RW
1297	**P10.4**	**PID1 Process Unit** Defines the unit type for PID Feedback unit.	**2, 3, 4**	RW
1298	**P10.5**	**PID1 Process Unit Min** Defines the minimum process unit Value	**2, 3, 4**	RW
1300	**P10.6**	**PID1 Process Unit Max** Defines the maximum process unit Value	**2, 3, 4**	RW
1302	**P10.7**	**PID1 Process Unit Decimal** Defines the amount of decimal places in process unit Value	**2, 3, 4**	RW
1303	**P10.8**	**PID1 Error Inversion** Defines the way the process value output reacts to the feedback signal. 0 = Normal - If feedback is less than set-point, PID controller output increases. 1 = Inverted - If feedback is less than set-point, PID controller output decreases.	**2, 3, 4**	RW
1304	**P10.9**	**PID1 Dead Band** PID dead band around set-point in process units. This is the band where no actions occur, to prevent oscillation or repeated activation/deactivation of controller. The PID output is locked if the feedback stays within the dead band area.	**2, 3, 4**	RW
1306	**P10.10**	**PID1 Dead Band Delay** If the PID process value goes out of the dead band area for the desired time delay at that point the controller will re-initialize and try to level out again.	**2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
1307	**P10.11**	**PID1 Keypad Set Point 1** Keypad PID reference value set point 1.	**2, 3, 4**	RW
1309	**P10.12**	**PID1 Keypad Set Point 2** Keypad PID reference value set point 2.	**2, 3, 4**	RW
1311	**P10.13**	**PID1 Ramp Time** Defines the rising and falling ramp times for changes in the process value.	**2, 3, 4**	RW
1312	**P10.14**	**PID1 Set Point 1 Source** Defines source of the set-point value the drive uses this can either be an internal preset value, keypad set-point, analog signal or Fieldbus message.	**2, 3, 4**	RW
1313	**P10.15**	**PID1 Set Point 1 Min** Defines minimum value for the set point 1 source.	**2, 3, 4**	RW
1314	**P10.16**	**PID1 Set Point 1 Max** Defines maximum value for the set point 1 source.	**2, 3, 4**	RW
1315	**P10.17**	**PID1 Sleep Enable When Using Set Point 1** Enable PID set-point sleep mode. This function will disable the output when the frequency drops below, or increase above, depends on application the sleep frequency for the sleep delay time. The output re-engages when feedback rises above the wakeup level.	**2, 3, 4**	RW
2396	**P10.18**	**PID1 Sleep Level Unit When Using Set Point 1** Defines what value would be looked at when drive is going into the sleep mode when the motor is not required to run. 0 = Output frequency. 1 = Motor speed. 2 = Motor current. 3 = PID1 feedback.	**2, 3, 4**	RW
2450	**P10.19**	**PID1 Sleep Level When Using Set Point 1** Defines the level of which the unit value is used to look at to go into the sleep mode. When the unit drops below, or increase above, depend on application this level for the sleep delay time it will put the drive into the sleep mode.	**2, 3, 4**	RW
1317	**P10.20**	**PID1 Sleep Delay When Using Set Point 1** This parameter sets the delay time after the set-point drops below the sleep level for this amount of time and then the drives output will shut off until the wakeup level is met. It is to prevent large fluctuations when going into the sleep function to save motor run time.	**2, 3, 4**	RW
1318	**P10.21**	**PID1 Wakeup Level When Using Set Point 1** Defines the level for the PID feedback value to go above top enable the PID output to be re enabled. This value is based of the % of feedback which can be scaled based off the PID Unit Min/Max values P10.5 and P10.6.	**2, 3, 4**	RW
1320	**P10.22**	**PID1 Set Point 1 Boost** The set-point can be boosted via a multiplier value.	**2, 3, 4**	RW
1321	**P10.23**	**PID1 Set Point 2 Source** Defines source of the set-point value the drive uses. This can either be an internal preset value, keypad set-point, analog signal, or Fieldbus message.	**2, 3, 4**	RW
1322	**P10.24**	**PID1 Set Point 2 Min** Defines minimum value for the set point 2 source.	**2, 3, 4**	RW
1323	**P10.25**	**PID1 Set Point 2 Max** Defines maximum value for the set point 2 source.	**2, 3, 4**	RW
1324	**P10.26**	**PID1 Sleep Enable When Using Set Point 2** Enable PID set-point sleep mode. This function will disable the output when the frequency drops below, or increase above, depend on application of the sleep frequency for the sleep delay time. The output re-engages when feedback rises above the wakeup level.	**2, 3, 4**	RW
2397	**P10.27**	**PID1 Sleep Level Unit When Using Set Point 2** Defines what value would be looked at when drive is going into the sleep mode when the motor is not required to run. 0 = Output frequency. 1 = Motor speed. 2 = Motor current. 3 = PID1 feedback.	**2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
2452	**P10.28**	**PID1 Sleep Level When Using Set Point 2** Defines the level of which the unit value is used to look at to go into the sleep mode. When the unit drops below or increase above depend on application this level for the sleep delay time it will put the drive into the sleep mode.	**2, 3, 4**	RW
1326	**P10.29**	**PID1 Sleep Delay When Using Set Point 2** This parameter sets the delay time after the set-point drops below the sleep level for this amount of time and then the drives output will shut off till the wakeup level is met. It is to prevent large fluctuations when going into the sleep function to save motor run time.	**2, 3, 4**	RW
1327	**P10.30**	**PID1 Wakeup Level when Using Set Point 2** Defines the level for the PID feedback value to go above top enable the PID output to be re enabled. This value is based of the % of feedback which can be scaled based off the PID Unit Min/Max values P10.5 and P10.6.	**2, 3, 4**	RW
1329	**P10.31**	**PID1 Set Point 2 Boost** The set-point can be boosted via a multiplier value.	**2, 3, 4**	RW
1330	**P10.32**	**PID1 Feedback Function** Choose a single signal used as feedback, this parameter allows for doing math functions with 2 sources.	**2, 3, 4**	RW
1331	**P10.33**	**PID1 Feedback Gain** Define gain associated with feedback signal from the measuring device.	**2, 3, 4**	RW
1332	**P10.34**	**PID1 Feedback 1 Source** Define where feedback signal is being fed into the drive, via analog or Fieldbus data value.	**2, 3, 4**	RW
1333	**P10.35**	**PID1 Feedback 1 Min** Minimum unit value for the feedback signal.	**2, 3, 4**	RW
1334	**P10.36**	**PID1 Feedback 1 Max** Maximum unit value for the feedback signal.	**2, 3, 4**	RW
1335	**P10.37**	**PID1 Feedback 2 Source** Define where feedback signal is being fed into the drive, via analog, or Fieldbus data value.	**2, 3, 4**	RW
1336	**P10.38**	**PID1 Feedback 2 Min** Minimum unit value for the feedback signal.	**2, 3, 4**	RW
1337	**P10.39**	**PID1 Feedback 2 Max** Maximum unit value for the feedback signal.	**2, 3, 4**	RW
1338	**P10.40**	**PID1 Feedforward Func** Choose a single signal used as feed forward command. This is used to account for major disturbances that the processor does not see via the feedback.	**2, 3, 4**	RW
1339	**P10.41**	**PID1 Feedforward Gain** Define feed forward gain control level.	**2, 3, 4**	RW
1340	**P10.42**	**PID1 Feedforward 1 Source** Define where feed forward signal is fed from, this can either be an analog signal or Fieldbus process value.	**2, 3, 4**	RW
1341	**P10.43**	**PID1 Feedforward 1 Min** Define feed forward minimum value setting.	**2, 3, 4**	RW
1342	**P10.44**	**PID1 Feedforward 1 Max** Define feed forward maximum unit value setting.	**2, 3, 4**	RW
1343	**P10.45**	**PID1 Feedforward 2 Source** Define where feed forward signal is fed from, this can either be an analog signal or Fieldbus process value.	**2, 3, 4**	RW
1344	**P10.46**	**PID1 Feedforward 2 Min** Define feed forward minimum value setting.	**2, 3, 4**	RW
1345	**P10.47**	**PID1 Feedforward 2 Max** Define feed forward maximum unit value setting.	**2, 3, 4**	RW
1352	**P10.48**	**PID1 Set Point 1 Comp Enable** Enables pressure loss compensation for set-point 1 signal value.	**2, 3, 4**	RW
1353	**P10.49**	**PID1 Set Point 1 Comp Max** Value added proportionally to the frequency, set-point compensation = comp max * (output freq–min freq)/(max freq–min freq). Refer P10.51 for procedure for setting up PID application.	**2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
1354	P10.50	**PID1 Set Point 2 Comp Enable** Enables pressure loss compensation for set-point 2 signal value.	2, 3, 4	RW
1355	P10.51	**PID1 Set Point 2 Comp Max** Value added proportionally to the frequency, set-point compensation = comp max * (output freq–min freq)/(max freq–min freq).	2, 3, 4	RW

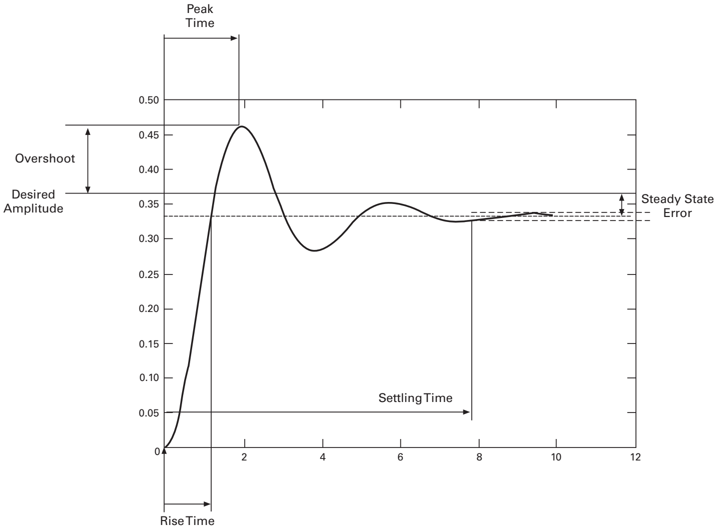
Procedure for setting up PID application.

Initially set PID gain (P10.1) to 0.0% and set the PID I time (P10.2) to 20 sec. Start the frequency converter and verify if the set-point is reached quickly while maintaining stable operation of the system. If not, increase the PID gain (P10.1) until the drive speed oscillates constantly. After this occurs, reduce the PID gain (P10.1) slightly to reduce the oscillation. From here, take the value found for PID gain (P10.1) to 0.5 times that value and reduce the PID I time (P10.2) until the feedback signal oscillates again. Increase the PID I time (P10.2) until the oscillation stops, with that value take it times 1.2 and use that value for the PID I time (P10.2). If signal noise is seen at high frequency, increase the filter time values to filter the signal. If further tuning is required, refer to the Figure 91 table showing what is effected.

Figure 91. Setting up PID application.

Response	Rise time	Overshoot	Settling time	Steady state error
Increase PID Gain	Decrease Rise	Increases Overshoot	Not Affected	Decreases Error
Increase PID1 Time	Decrease Rise	Increases Overshoot	Increases Setting	Eliminates Error
Increase PID0 Time	Not Affected	Decreases Overshoot	Decreases Setting	Not Affected

Rise Time - The time required for the output to rise 90% of the desired level for the first time.
Overshoot - The difference between the peak level and the steady state level.
Setting Time - Time required for the system to converge to its steady state.
Steady State Error - The difference between the steady state level and the desired output level.



Modbus ID	Code	Parameters	Application	RO/RW
2466	P10.52	**PID1 Wakeup Action** This parameter defines the wakeup function action. 0 = Wakeup when below wakeup level P10.21/P10.30. 1 = Wakeup when above wakeup level P10.21/P10.30. 2 = Wake up when below wakeup level % set in P10.21/P10.30 from PID set-point. 3 = Wakeup when above wakeup level %from PID set-point set in P10.21/P10.30.	2, 3, 4	RW
2542	P10.53	**FB PID1 Set Point 1** PID set-point 1 value from Fieldbus.	2, 3, 4	RW
2544	P10.54	**FB PID1 Set Point 2** PID set-point 2 value from Fieldbus.	2, 3, 4	RW
2550	P10.55	**FB PID1 Feedback 1** PID feedback 1 value from Fieldbus.	2, 3, 4	RW

Modbus ID	Code	Parameters	Application	RO/RW
2551	**P10.56**	**FB PID1 Feedback 2** PID reference value feedback 2 from Fieldbus.	**2, 3, 4**	RW
2554	**P10.57**	**FB PID1 Feedforward 1** PID reference value feed forward 1 from Fieldbus.	**2, 3, 4**	RW
2555	**P10.58**	**FB PID1 Feedforward 2** PID reference value feed forward 2 from Fieldbus.	**2, 3, 4**	RW
2660	**P10.59**	**PID1 Sleep Boost level** Defines unit value of which automatic increase of PID regulation set point before entering sleep state.	**2, 3, 4**	RW
2661	**P10.60**	**PID1 Sleep Boost Max Time** Sleep boost max. time defines sleep set point boost active time if the actual value does not reach the incremented set point (normal set point + sleep boost level).	**2, 3, 4**	RW
2811	**P10.61**	**PID1 Low Feedback Level** Defines the level at which a low feedback warning or fault will occur. Low feedback detection is enabled when low feedback level is more than 0 and the run command is present.	**2, 3, 4**	RW
2812	**P10.62**	**PID1 Low Feedback Time** Defines the delay time after which a low feedback warning or fault will occur.	**2, 3, 4**	RW
2813	**P10.63**	**PID1 Low Feedback Protection** Defines the drive response to a low feedback condition. There are four options, default value is 0. 0 = No action. 1 = Warning. 2 = Fault. 3 = Fault, coast.	**2, 3, 4**	RW
2814	**P10.64**	**PID1 High Feedback Level** Defines the level at which a high feedback warning or fault will occur. High feedback detection is enabled when the high feedback level is more than 0 and run command is present.	**2, 3, 4**	RW
2815	**P10.65**	**PID1 High Feedback Time** Defines the delay time after which a high feedback warning or fault will occur.	**2, 3, 4**	RW
2816	**P10.66**	**PID1 High Feedback Protection** Defines the drive response to a high feedback condition. There are four options, default value is 0. 0 = No action. 1 = Warning. 2 = Fault. 4 = Fault, coast.	**2, 3, 4**	RW
2817	**P10.67**	**PID1 Hysteresis Level** Defines the hysteresis level used for low and high feedback level detection.	**2, 3, 4**	RW
2825	**P10.68**	**PID1 Backup Feedback Source** Defines the hysteresis level used for low and high feedback level detection.	**2, 3, 4**	RW
1356	**P11.1**	**PID2 Control Gain** Defines the gain of the PID controller. It adjust the slope of the speed increase according to the initial of the load. If this value is set to 100%, a change of 10% in the error value causes the controller output to change 10%.	**3, 4**	RW
1357	**P11.2**	**PID2 Control I Time** Defines the integration time of the PID controller. Over the time the integral time contributes to the deviation between the reference and the feedback signal. If this value is set to 1.00 sec., a change of 10% in the error value causes the controller output to change by 10.00%/s. With value set to 0.0, frequency converter operates as PD controller.	**3, 4**	RW
1358	**P11.3**	**PID2 Control D Time** Defines the derivation time of the PID controller. This value will adjust the rate of change on the feedback signal. If this value is set to 1.00 sec., a change of 10% in error value during 1.00 sec. causes the control output to change by 10.00%. If value is set to 0.0, frequency converter operates as PI controller.	**3, 4**	RW
1359	**P11.4**	**PID2 Process Unit** Defines the unit type for PID feedback unit.	**3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
1360	**P11.5**	**PID2 Process Unit Min** Defines the minimum process unit value.	**3, 4**	RW
1362	**P11.6**	**PID2 Process Unit Max** Defines the maximum process unit value.	**3, 4**	RW
1364	**P11.7**	**PID2 Process Unit Decimal** Defines the amount of decimal places in process unit value.	**3, 4**	RW
1365	**P11.8**	**PID2 Error Inversion** Defines the way the process value output reacts to the feedback signal. 0 = Normal, If feedback is less than set-point, PID controller output increases. 1 = Inverted, If feedback is less than set-point, PID controller output decreases.	**3, 4**	RW
1366	**P11.9**	**PID2 Dead Band** PID dead band around set-point in process units. This is the band where no actions occur, to prevent oscillation or repeated activation/deactivation of controller. The PID output is locked if the feedback stays within the dead band area.	**3, 4**	RW
1368	**P11.10**	**PID2 Dead Band Delay** If the PID process value goes out of the dead band area for the desired time delay at that point the controller will re-initialize and try to level out again.	**3, 4**	RW
1369	**P11.11**	**PID2 Keypad Set Point 1** Keypad PID reference value set point 1.	**3, 4**	RW
1371	**P11.12**	**PID2 Keypad Set Point 2** Keypad PID reference value set point 2.	**3, 4**	RW
1373	**P11.13**	**PID2 Ramp Time** Defines the rising and falling ramp times for changes in the process value.	**3, 4**	RW
1374	**P11.14**	**PID2 Set Point 1 Source** Defines source of the set point value the drive uses this can either be an internal preset value, keypad set point, analog signal or Fieldbus message.	**3, 4**	RW
1375	**P11.15**	**PID2 Set Point 1 Min** Defines minimum value for the set-point 1 source.	**3, 4**	RW
1376	**P11.16**	**PID2 Set Point 1 Max** Defines maximum value for the set-point 1 source.	**3, 4**	RW
1377	**P11.17**	**PID2 Sleep Enable When Using Set Point 1** Enable PID set-point sleep mode. This function will disable the output when the frequency drops below, or increase above, depend on application the sleep frequency for the sleep delay time. The output re-engages when feedback rises above the wakeup level.	**3, 4**	RW
2398	**P11.18**	**PID2 Sleep Level Unit When Using Set Point 1** PID2 set-point 1 sleep unit defines what value would be looked at when drive is going into the sleep mode when the motor is not required to run. 0 = Output frequency 1 = Motor speed 2 = Motor current 3 = PID1 feedback	**3, 4**	RW
2454	**P11.19**	**PID2 Set Point When Using Set Point 1** Defines the level of which the unit value is used to look at to go into the sleep mode. When the unit drops below this level for the sleep delay time, it will put the drive into the sleep mode.	**3, 4**	RW
1379	**P11.20**	**PID2 Sleep Delay When Using Set Point 1** This parameter sets the delay time after the set-point drops below the sleep level for this amount of time and then the drives output will shut off till the wakeup level is met. It is to prevent large fluctuations when going into the sleep function to save motor run time.	**3, 4**	RW
1380	**P11.21**	**PID2 Wake Up Level When Using Set Point 1** Defines the level for the PID feedback value to go above top enable the PID output to be re enabled. This value is based of the % of feedback which can be scaled based off the PID unit Min/Max values.	**3, 4**	RW
1382	**P11.22**	**PID2 Set Point 1 Boost** The set-point can be boosted via a multiplier value.	**3, 4**	RW

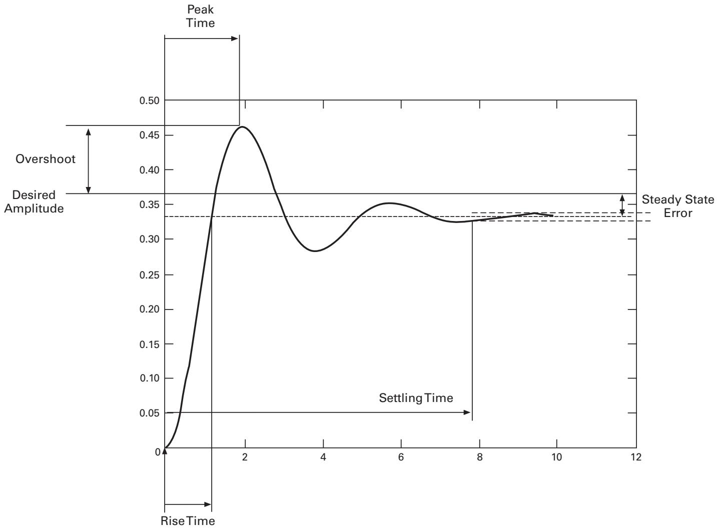
Modbus ID	Code	Parameters	Application	RO/RW
1383	**P11.23**	**PID2 Set Point 2 Source** Defines source of the set-point value the drive uses this can either be an internal preset value, keypad set-point, analog signal or Fieldbus message.	**3, 4**	RW
1384	**P11.24**	**PID2 Set Point 2 Min** Defines minimum value for the set-point 2 source.	**3, 4**	RW
1385	**P11.25**	**PID2 Set Point 2 Max** Defines maximum value for the set-point 2 source.	**3, 4**	RW
1386	**P11.26**	**PID2 Sleep Enable When Using Set Point 2** Enable PID set-point sleep mode. This function will disable the output when the frequency drops below, or increase above, depend on application the sleep frequency for the sleep delay time. The output re-engages when feedback rises above the wakeup level.	**3, 4**	RW
2399	**P11.27**	**PID2 Sleep Level Unit When Using Set Point 2** Defines what value would be looked at when drive is going into the sleep mode when the motor is not required to run. 0 = Output frequency 1 = Motor speed 2 = Motor current 3 = PID1 feedback	**3, 4**	RW
2456	**P11.28**	**PID2 Sleep Level When Using Set Point 2** Defines the level of which the unit value is used to look at to go into the sleep mode. When the unit drops below this level for the sleep delay time, it will put the drive into the sleep mode.	**3, 4**	RW
1388	**P11.29**	**PID2 Sleep Delay When Using Set Point 2** This parameter sets the delay time after the set-point drops below the sleep level for this amount of time and then the drives output will shut off till the wakeup level is met. It is to prevent large fluctuations when going into the sleep function to save motor run time.	**3, 4**	RW
1389	**P11.30**	**PID2 Wakeup Level when Using Set Point 2** Defines the level for the PID feedback value to go above to enable the PID output to be re-enabled. This value is based of the % of feedback which can be scaled based off the PID unit Min/Max values.	**3, 4**	RW
1391	**P11.31**	**PID2 Set Point 2 Boost** The set-point can be boosted via a multiplier value.	**3, 4**	RW
1392	**P11.32**	**PID2 Feedback Func** Choose a single signal used as feedback, this parameter allows for doing math functions with 2 sources.	**3, 4**	RW
1393	**P11.33**	**PID2 Feedback Gain** Define gain associated with feedback signal from the measuring device.	**3, 4**	RW
1394	**P11.34**	**PID2 Feedback 1 Source** Define where feedback signal is being fed into the drive, via analog or Fieldbus data value.	**3, 4**	RW
1395	**P11.35**	**PID2 Feedback 1 Min** Minimum unit value for the feedback signal.	**3, 4**	RW
1396	**P11.36**	**PID2 Feedback 1 Max** Maximum unit value for the feedback signal.	**3, 4**	RW
1397	**P11.37**	**PID2 Feedback 2 Source** Define where feedback signal is being fed into the drive, via analog or Fieldbus data value.	**3, 4**	RW
1398	**P11.38**	**PID2 Feedback 2 Min** Minimum unit value for the feedback signal.	**3, 4**	RW
1399	**P11.39**	**PID2 Feedback 2 Max** Maximum unit value for the feedback signal.	**3, 4**	RW
1400	**P11.40**	**PID2 Feedforward Func** Choose a single signal used as feed forward command. This is used to account for major disturbances that the processor does not see via the feedback.	**3, 4**	RW
1401	**P11.41**	**PID2 Feedforward Gain** Define feed forward gain control level.	**3, 4**	RW
1402	**P11.42**	**PID2 Feedforward 1 Source** Define from where feed forward signal is fed. This can either be an analog signal or Fieldbus process value.	**3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
1403	**P11.43**	**PID2 Feedforward 1 Min** Define feed forward minimum value setting.	**3, 4**	RW
1404	**P11.44**	**PID2 Feedforward 1 Max** Define feed forward maximum unit value setting.	**3, 4**	RW
1405	**P11.45**	**PID2 Feedforward 2 Source** Define from where feed forward signal is fed. This can either be an analog signal or Fieldbus process value.	**3, 4**	RW
1406	**P11.46**	**PID2 Feedforward 2 Min** Define feed forward minimum value setting.	**3, 4**	RW
1407	**P11.47**	**PID2 Feedforward 2 Max** Define feed forward maximum unit Value setting.	**3, 4**	RW
1414	**P11.48**	**PID2 Set Point1 Comp Enable** Enables pressure loss compensation for set-point 1 signal value.	**3, 4**	RW
1415	**P11.49**	**PID2 Set Point1 Comp Max** Value added proportionally to the frequency, set-point compensation = comp max * (output freq–min freq)/(max freq–min freq). Refer P11.51 for procedure for setting up PID application.	**3, 4**	RW
1416	**P11.50**	**PID2 Set Point 2 Comp Enable** Enables pressure loss compensation for set-point 2 signal value.	**3, 4**	RW
1417	**P11.51**	**PID2 Set Point 2 Comp Max** Value added proportionally to the frequency, set-point compensation = comp max * (output freq–min freq)/(max freq–min freq). **Procedure for setting up PID application.** Initially set PID gain (P11.1) to 0.0% and set the PID I time (P11.2) to 20 sec. Start the frequency converter and verify if the set-point is reached quickly while maintaining stable operation of the system. If not, increase the PID gain (P11.1) until the drive speed oscillates constantly. After this occurs, reduce the PID gain (P11.1) slightly to reduce the oscillation. From here, take the value found for PID gain (P11.1) to 0.5 times that value and reduce the PID I time (P11.2) until the feedback signal oscillates again. Increase the PID I time (P11.2) until the oscillation stops, with that value take it times 1.2 and use that value for the PID I time (P11.2). If signal noise is seen at high frequency, increase the filter time values to filter the signal. If further tuning is required, refer to the table showing what is effected.	**3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
2467	**P11.52**	**PID2 Wakeup Action** This parameter defines the wakeup function action. 0 - Wakeup when below wakeup level P11.21/P11.30. 1 - Wakeup when above wakeup level P11.21/P11.30. 2 - Wakeup when below wakeup level % set in P11.21/P11.30 from PID set-point. 3 - Wakeup when above wakeup level % set in P11.21/P11.30 from PID set-point.	**3, 4**	RW

Response	Rise time	Overshoot	Settling time	Steady state error
Increase PID Gain	Decrease Rise	Increases Overshoot	Not Affected	Decreases Error
Increase PID1 Time	Decrease Rise	Increases Overshoot	Increases Setting	Eliminates Error
Increase PID0 Time	Not Affected	Decreases Overshoot	Decreases Setting	Not Affected

Rise time—the time required for the output to rise 90% of the desired level for the first time.
Overshoot—the difference between the peak level and the steady state level. Setting time—time required for the system to converge to its steady state.
Steady state error—the difference between the steady state level and the desired output level.



Modbus ID	Code	Parameters	Application	RO/RW
2546	**P11.53**	**FB PID2 Set Point 1** PID set-point 1 value from Fieldbus.	**3, 4**	RW
2548	**P11.54**	**FB PID2 Set Point 2** PID setpoint 2 value from Fieldbus.	**3, 4**	RW
2552	**P11.55**	**FB PID2 Feedback 1** PID feedback 1 value from Fieldbus.	**3, 4**	RW
2553	**P11.56**	**FB PID2 Feedback 2** PID reference value feedback 2 from Fieldbus.	**3, 4**	RW
2556	**P11.57**	**FB PID2 Feedforward 1** PID reference value feed forward 1 from Fieldbus.	**3, 4**	RW
2557	**P11.58**	**FB PID2 Feedforward 2** PID reference value feed forward 2 from Fieldbus.	**3, 4**	RW
2662	**P11.59**	**PID2 Sleep Boost level** Defines unit value of which automatic increase of PID regulation set point before entering sleep state.	**3, 4**	RW
2663	**P11.60**	**PID2 Sleep Boost Max Time** Sleep boost max. time defines sleep set point boost active time if the actual value does not reach the incremented set point (normal set point + sleep boost level).	**3, 4**	RW
2818	**P11.61**	**PID2 Low Feedback Level** Defines the level at which a low feedback warning or fault will occur. Low feedback detection is enabled when low feedback level is more than 0 and run command is present.	**3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
2819	**P11.62**	**PID2 Low Feedback Time** Defines the delay time after which a low feedback warning or fault will occur.	**3, 4**	RW
2820	**P11.63**	**PID2 Low Feedback Protection** Defines the drive response to a low feedback condition. There are four options, default value is 0. 0 = No action. 1 = Warning. 2 = Fault. 3 = Fault, coast.	**3, 4**	RW
2821	**P11.64**	**PID2 High Feedback Level** Defines the level at which a high feedback warning or fault will occur. High feedback detection is enabled when the high feedback level is more than 0 and run command is present.	**3, 4**	RW
2822	**P11.65**	**PID2 High Feedback Time** Defines the delay time after which a high feedback warning or fault will occur.	**3, 4**	RW
2823	**P11.66**	**PID2 High Feedback Protection** Defines the drive response to a high feedback condition. There are four options, default value is 0. 0 = No action. 1 = Warning. 2 = Fault. 4 = Fault, coast.	**3, 4**	RW
2824	**P11.67**	**PID2 Hysteresis Level** Defines the hysteresis level used for low and high feedback level detection.	**3, 4**	RW
2826	**P11.68**	**PID2 Backup Feedback Source** PID backup feedback source selection has five options, default value is 0. 0 = Not used 1 = AI1. 2 = AI2. 3 = Slot A: AI1. 4 = Slot B: AI1.	**3, 4**	RW
105	**P12.1**	**Preset Speed 1** Preset speed is selected with digital inputs using a binary input. Parameter values are automatically limited between the minimum and maximum frequencies (P1.1, P1.2).	**1, 2, 3, 4**	RW
106	**P12.2**	**Preset Speed 2** Preset speed is selected with digital inputs using a binary input. Parameter values are automatically limited between the minimum and maximum frequencies (P1.1, P1.2).	**1, 2, 3, 4**	RW
118	**P12.3**	**Preset Speed 3** Preset speed is selected with digital inputs using a Binary input. Parameter values are automatically limited between the minimum and maximum frequencies (P1.1, P1.2).	**1, 2, 3, 4**	RW
119	**P12.4**	**Preset Speed 4** Preset speed is selected with digital inputs using a Binary input. Parameter values are automatically limited between the minimum and maximum frequencies (P1.1, P1.2).	**1, 2, 3, 4**	RW
120	**P12.5**	**Preset Speed 5** Preset speed is selected with digital inputs using a Binary input. Parameter values are automatically limited between the minimum and maximum frequencies (P1.1, P1.2).	**1, 2, 3, 4**	RW
121	**P12.6**	**Preset Speed 6** Preset speed is selected with digital inputs using a Binary input. Parameter values are automatically limited between the minimum and maximum frequencies (P1.1, P1.2).	**1, 2, 3, 4**	RW
122	**P12.7**	**Preset Speed 7** Preset speed is selected with digital inputs using a Binary input. Parameter values are automatically limited between the minimum and maximum frequencies (P1.1, P1.2).	**1, 2, 3, 4**	RW
295	**P13.1**	**Torque Limit** With this parameter you can set the torque limit control limit between 0.0–400.0% when in open loop torque control.	**4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
303	P13.2	**Torque Ref Select** Defines the source for torque reference. 0 = Not used. 1 = AI1. 2 = AI2. 3 = SlotA:AI1. 4 = SlotB:AI1. 5 = AI1 joystick. 6 = AI2 joystick. 7 = Keypad torque Ref. 8 = Fieldbus Ref.	4	RW
782	P13.3	**Keypad Torque Ref** Keypad torque speed reference.	4	RW
304	P13.4	**Torque Ref Max** Scales the minimum and maximum level for the torque ref to be between –300.0 to 300.0%.	4	RW
305	P13.5	**Torque Ref Min** Scales the minimum and maximum level for the torque ref to be between –300.0 to 300.0%.	4	RW
1666	P13.6	**Speed Limiter Mode** Defines the speed limit control which the frequency converter operatues in the open loop torque control mode. 0 = NegFreqMax…PosFreqMax. 1 = -|FreqRampOut|…+|FreqRampOut|. 2 = NegFreqMax…FreqRampout(MIN). 3 = FreqRampOut..PosFreqMax(MAX). 4 = FreqRampOut+-WindowPos/NegWidth. 5 = 0…FreqRampOUt(pos or neg direction). 6 = FreqRamp+-WindowPos/Neg/PosOff/NegOff.	4	RW
1636	P13.7	**Window Pos Width** Frequency in positive direction when drive goes into speed control from torque control mode. This references back to P13.6 setting for the frequency max. set-point option 4 or 6.	4	RW
1637	P13.8	**Window Neg Width** Frequency in negative direction when drive goes into speed control from torque control mode. This references back to P13.6 setting for the frequency max. set-point option 4 or 6.	4	RW
1638	P13.9	**Window Pos Off Limit** Frequency in positive direction when drive comes out of speed control from torque control mode. This references back to P13.6 setting for the frequency max. set-point option 6.	4	RW
1639	P13.10	**Window Neg Off Limit** Frequency in negative direction when drive comes out of speed control from torque control mode. This references back to P13.6 setting for the frequency max. set-point option 6.	4	RW
1640	P13.11	**Torque Reference Filter TC** Torque reference filter time.	4	RW
1606	P13.12	**Pull Out Torque** Start up torque level in percentage.	4	RW
1684	P13.13	**Stop State Magnetization Time** Engine stop-magnetization time at the stop in the open-loop torque control mode.	4	RW
2541	P13.14	**FB Torque Ref** Torque reference from Fieldbus.	4	RW
300	P13.15	**Torque Control(2) Min Frequency** Minimum operating frequency of the open loop torque control in Hz.	4	RW
301	P13.16	**Torque Control(2) P-gain** P-gain of the open loop torque controller. Kp = 1.0 will cause 1 Hz in the output frequency when the error is 1 % of motor nominal torque.	4	RW
302	P13.17	**Torque Control(2) I-gain** I-gain of the open-loop torque controller. Ki = 1.0 will cause integration to reach 1 Hz in 1 second when the error is 1 % of motor nominal torque.	4	RW

Modbus ID	Code	Parameters	Application	RO/RW
60	**P13.18**	**OL Trq Ctrl(6) P-gain** P-gain of Iq limit controller. Kp = 1.0 will cause 1 Hz in the output frequency when the error is 1 % of motor nominal current.	**4**	RW
61	**P13.19**	**OL Trq Ctrl(6) I-gain** I-gain of Iq limit controller. Ki = 1.0 will cause integration to reach 1 Hz in 1 second when the error is 1 % of motor nominal current.	**4**	RW
254	**P14.1**	**DC-Brake Current** Defines the current level injected into the motor during DC-braking.	**1, 2, 3, 4**	RW
263	**P14.2**	**Start DC-Brake Time** This parameter defines the time the drive injects DC braking current before starting to ramp. This can be used to stop motors that are potentially spinning before a run command is given, before ramping to reference level. This is to stop motors that are potentially spinning before a run command is given.	**1, 2, 3, 4**	RW
262	**P14.3**	**Stop DC-Brake Frequency** During a ramp to stop this parameter defines the output frequency to be below to begin DC-braking.	**1, 2, 3, 4**	RW
255	**P14.4**	**Stop DC-Brake Time** Determines the length of DC braking while stopping. 0.00 = DC-brake is not used. >0.0 = The amount of time DC-braking will occur after falling below the stop DC brake frequency.	**1, 2, 3, 4**	RW

Figure 92. DC-braking time when stop mode = coasting.

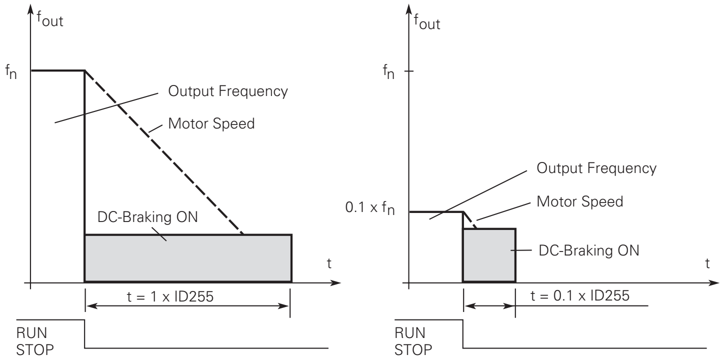
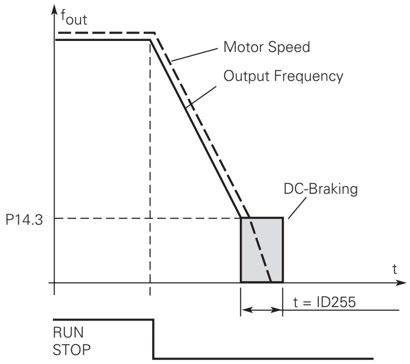


Figure 93. DC-braking time when stop mode = ramp.

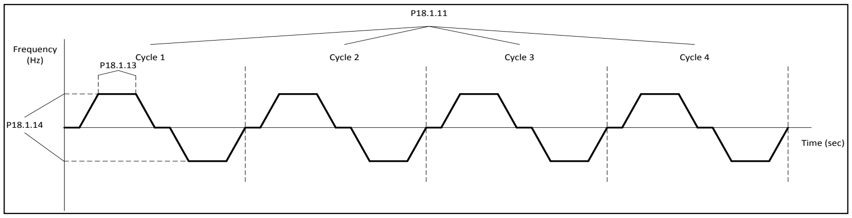


Modbus ID	Code	Parameters	Application	RO/RW
251	P14.5	**Brake Chopper Mode** When the frequency converter is decelerating the motor, the inertia of the motor and the load is fed into an external brake resistor. This enables the frequency converter to decelerate the load with a torque equal to that of acceleration (provided that the correct brake resistor has been selected). 0 = No brake chopper used. 1 = Brake chopper in use and tested when running. Can be tested also in READY state. 2 = External brake chopper (no testing). 3 = Used and tested in READY state and when running. 4 = Used when running (no testing).	1, 2, 3, 4	RW
266	P14.6	**Flux Brake** while stopping the output frequency is reduced and the flux in the motor is increased, which in turn increases the motor's capability to brake. Unlike DC braking, the motor speed remains controlled during braking. The flux braking can be set ON or OFF. 0 = Flux braking OFF 1 = Flux braking ON **Note:** Flux braking converts the energy into heat in the motor, and should be used carefully to avoid motor damage flux braking is a useful form of braking for motors ≤15 kW.	1, 2, 3, 4	RW
265	P14.7	**Flux Brake Current** Defines the flux braking current value output when flux brake is enabled.	1, 2, 3, 4	RW
535	P15.1	**Fire Mode Function** This parameter determines whether the fire mode function is determined by a contact closure or contact opening on the desired digital input function (P3.28) select fire mode. 0 = Closing contact initiates fire mode function. 1 = Opening contact initiates fire mode function. **Note:** when fire mode is enabled, this causes the drive to ignore any fault and run till its death. Warranty will be non-valid in the case this is enabled and the drive causes issues to the system.	2, 3, 4	RW
536	P15.2	**Fire Mode Ref Select Function** This parameter allows for setting the reference location for when the fire mode is enabled. 0 = Fire mode min. frequency (P15.3) 1 = Fire mode ref. - Follows P15.4 and P15.5 with the use of an digital input to select 2 = Fieldbus ref. - Reference from Fieldbus process in 3 = AI1 - Analog input 1 4 = AI2 - Analog input 2 5 = AI1 + AI2 - Analog input 1 added to analog input 2 6 = PID1 control output 7 = PID2 control output	2, 3, 4	RW
537	P15.3	**Fire Mode Frequency** This parameter sets the minimum output frequency for fire mode. This can be used as a selection for reference command.	2, 3, 4	RW
565	P15.4	**Fire Mode % Speed Ref 1** This parameter sets the drive operating percentage based off the 0% being min. frequency and 100% being max. frequency (P1.2) for fire mode reference 1.	2, 3, 4	RW
564	P15.5	**Fire Mode % Speed Ref 2** This parameter sets the drive operating percentage based off the 0% being min. frequency and 100% being max. frequency (P1.2) for fire mode reference 2.	2, 3, 4	RW
554	P15.6	**Smoke Purge Frequency** Frequency setting for smoke purge. Preset speed used for a digital input selection. The percentage is based off the 0% being min. frequency (P1.1) and 100% being max. frequency (P1.2).	2, 3, 4	RW
2443	P15.7	**Fire Mode Test Enable** This parameter allows for testing the fire mode feature. With the parameter set to enable and fire mode input enabled, the drive will run at the fire mode speed desired but all faults are enabled.	2, 3, 4	RW
577	P16.1	**Motor Nom Current 2** The second motor set name plate current. Selected based off of a digital input.	2, 3, 4	RW

Modbus ID	Code	Parameters	Application	RO/RW
578	**P16.2**	**Motor Nom Speed 2** The second motor set name plate RPM. Selected based off of a digital input.	**2, 3, 4**	RW
579	**P16.3**	**Motor PF 2** The second motor set name plate power factor. Selected based off of a digital input.	**2, 3, 4**	RW
580	**P16.4**	**Motor Nom Volt 2** The second motor set name plate voltage. Selected based off of a digital input.	**2, 3, 4**	RW
581	**P16.5**	**Motor Nom Freq 2** The second motor set name plate frequency. Selected based off of a digital input.	**2, 3, 4**	RW
1419	**P16.6**	**Stator Resistor 2** The second set of motor stator resistor real values for 2nd motor set.	**2, 3, 4**	RW
1420	**P16.7**	**Rotor Resistor 2** The second set of motor rotor resistor real values for 2nd motor set.	**4**	RW
1421	**P16.8**	**Leak Inductance 2** The second set of motor leakage inductance real values for 2nd motor set.	**4**	RW
1422	**P16.9**	**Mutual Inductance 2** The second set of motor mutual inductance real values for 2nd motor set.	**4**	RW
1423	**P16.10**	**Excitation Current 2** The second set of motor no-load current real values for 2nd motor set.	**4**	RW
2838	**P16.11**	**Motor Inertia2** Motor Inertia2.	**4**	RW
2842	**P16.12**	**Second PM BEMF Voltage** Second PM BEMF voltage.	**4**	RW
2843	**P16.13**	**Second PM Q-axis Stator Inductance** Second PM q-axis stator inductance.	**4**	RW
2844	**P16.14**	**Second PM D-axis Stator Inductance** Second PM d-axis stator inductance.	**4**	RW
1418	**P17.1.1**	**Bypass Enable** This parameter identifies whether enter into bypass mode is enabled. Once enabled, the “Bypass” soft key on keypad will show to start bypass.	**2, 3, 4**	RW
544	**P17.1.2**	**Bypass Start Delay** This parameter specifies the time delay between when the bypass dignal is applied via I/O, Fieldbus, or keypad, to when the motor starts and once bypass is removed the time to switch back to drive.	**2, 3, 4**	RW
542	**P17.1.3**	**Auto Bypass** This parameter specifies whether an automatic switch to bypass will occur based on overvoltage fault condition. It is enabled based off a specific fault condition of Auto bypass through Undervoltage Fault Auto bypass parameters below. 0 = Auto bypass disabled. 1 = Auto bypass enabled.	**2, 3, 4**	RW
543	**P17.1.4**	**Auto Bypass Delay** This parameter specifies the time delay before an automatic switch to bypass, as determined by over-voltage fault auto bypass through under-voltage fault auto bypass parameters, will occur.	**2, 3, 4**	RW
547	**P17.1.5**	**OverCurrent Bypass Enable** This parameter specifies whether an automatic switch to bypass will occur after the overcurrent fault auto-restart tries have been exceeded. 0 = Auto bypass on overcurrent fault tries exceeded disabled, bypass once fault happens. 1 = Auto bypass on overcurrent fault tries exceeded enabled, bypass after tries exceed.	**2, 3, 4**	RW
546	**P17.1.6**	**IGBT Fault Bypass Enable** This parameter specifies whether an automatic switch to bypass will occur after the IGBT fault auto-restart tries have been exceeded. 0 = Auto bypass on IGBT fault tries exceeded disabled. 1 = Auto bypass on IGBT fault tries exceeded enabled.	**2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
548	**P17.1.7**	**4 mA Fault Bypass Enable** This parameter specifies whether an automatic switch to bypass will occur after the loss of reference fault and auto-restart tries have been exceeded. 0 = Auto bypass on loss of reference fault tries exceeded disabled. 1 = Auto bypass on loss of reference fault tries exceeded enabled. **Note:** 4 mA (reference Fault Auto Bypass) must be set to 4 or 5 (Fault).	**2, 3, 4**	RW
545	**P17.1.8**	**UnderVoltage Bypass Enable** This parameter specifies whether an automatic switch to bypass will occur after the undervoltage fault auto-restart tries have been exceeded. 0 = Auto bypass on undervoltage fault tries exceeded disabled. 1 = Auto bypass on undervoltage fault tries exceeded enabled.	**2, 3, 4**	RW
549	**P17.1.9**	**OverVoltage Bypass Enable** This parameter specifies whether an automatic switch to bypass will occur after the overvoltage fault auto-restart tries have been exceeded. 0 = Auto bypass on overvoltage fault tries exceeded disabled. 1 = Auto bypass on overvoltage fault tries exceeded enabled.	**2, 3, 4**	RW
1698	**P17.1.10**	**Motor OverTemp Bypass Enable** Motor over-temp bypass enable.	**2, 3, 4**	RW
1699	**P17.1.11**	**UnderLoad Bypass Enable** Under-load bypass enable.	**2, 3, 4**	RW
1700	**P17.1.12**	**External Bypass Enable** External bypass enable.	**2, 3, 4**	RW
1701	**P17.1.13**	**Charge Switch Fault Bypass Enable** Charge switch fault bypass enable.	**2, 3, 4**	RW
1702	**P17.1.14**	**Saturation Trip Fault Bypass Enable** Saturation trip fault bypass enable.	**2, 3, 4**	RW
1703	**P17.1.15**	**Under Temp Fault Bypass Enable** Under temp fault bypass enable.	**2, 3, 4**	RW
1704	**P17.1.16**	**EEPROM Fault Bypass Enable** EEPROM fault bypass enable.	**2, 3, 4**	RW
1705	**P17.1.17**	**Control Board EEPROM Fault Bypass Enable** Control board EEPROM fault bypass enable.	**2, 3, 4**	RW
1706	**P17.1.18**	**Watchdog Fault Bypass Enable** Watchdog fault bypass enable.	**2, 3, 4**	RW
1707	**P17.1.19**	**Fan Cooling Fault Bypass Enable** Fan cooling fault bypass enable.	**2, 3, 4**	RW
1708	**P17.1.20**	**Keypad Com Fault Bypass Enable** Keypad com. fault bypass enable.	**2, 3, 4**	RW
1709	**P17.1.21**	**Option Card Fault Bypass Enable** Option card fault bypass enable.	**2, 3, 4**	RW
1710	**P17.1.22**	**RTC Clock Fault Bypass Enable** RTC clock fault bypass enable.	**2, 3, 4**	RW
1711	**P17.1.23**	**Ctrl Board OverTemp Fault Bypass Enable** Ctrl. board over-temp fault bypass enable	**2, 3, 4**	RW
1713	**P17.1.24**	**Fieldbus Fault Bypass Enable** Fieldbus fault bypass enable.	**2, 3, 4**	RW
2832	**P17.1.25**	**Op Cont Interlock Fault Bypass Enable** Op cont. interlock fault bypass enable.	**2, 3, 4**	RW
2476	**P17.2.1**	**Redundant Drive Enable** This parameter will allow for enabling the redundant drive setup were multiple drives can be connected via modbus communications to start if the main drive fails or runtime settings below expires.	**2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
2278	**P17.2.2**	**Drive ID** This parameter defines the drive address when using multi-drive pump mode. Based off this ID, the drive enables in the desired sequence and can be monitored at this drive ID value in the monitor screen.	**2, 3, 4**	RW
2477	**P17.2.3**	**Redundant Run Time Enable** This parameter enables the run time limit on the redundant drive so that drives will be cycled based off the run time limit value.	**2, 3, 4**	RW
2478	**P17.2.4**	**Redundant Run Time Reset** This parameter will reset the redundant drive run timer value.	**2, 3, 4**	RW
2479	**P17.2.5**	**Redundant RunTime Limit** Sets the time limit for the run time of one drive when enabled for the redundant drive scheme.	**2, 3, 4**	RW
2279	**P18.1.1**	**Multi-pump Mode** Determines the number of drives being used in the multi-pump configuration. 0 = Single drive - Single drive for main motor, contractors used on other motors. 1 = Multi-drive - Multi-follower sequence with multiple drives.	**2, 3, 4**	RW
2278	**P18.1.2**	**Drive ID** This parameter defines the drive address when using multi-drive pump mode. Based off this ID, the drive enables in the desired sequence and can be monitored at this drive ID value in the monitor screen.	**2, 3, 4**	RW
2458	**P18.1.3**	**PID Bandwidth** Percentage based off the set-point above and below which defines when the aux. motor will come online or offline.	**2, 3, 4**	RW
2315	**P18.1.4**	**Staging Frequency** Output frequency is above stagging frequency and PID error is out of PID bandwidth. Motor should add to system.	**2, 3, 4**	RW
2316	**P18.1.5**	**De-Staging Frequency** Output frequency is below de-stagging frequency and PID error is out of PID bandwidth. Motor should remove from system.	**2, 3, 4**	RW
344	**P18.1.6**	**Add/Remove Delay** With feedback outside the bandwidth, this time must pass before motors/pumps are added or removed from the system.	**2, 3, 4**	RW
350	**P18.1.7**	**Interlock Enable** This parameter enables the drive to look at the digital input interlocks to tell which motor is available for running or if they were brought offline.	**2, 3, 4**	RW
483	**P18.1.8**	**Damper Start** This parameter determines the function of the damper. 0 = Start - Standard start. 1 = Interlocked start - To use this, a relay output, RO1/RO2, needs to be programmed for selections 29 “Damper Control,” and a digital input function must be programmed for selection “RunEnable”. The relay output is used to energize an element of the driven system, such as a damper, seal water solenoid, or a pre-lube pump. Upon a return acknowledgement contact closure to the programmed digital input, the frequency converter will start. 2 = Interlock time start - This functions the same as the interlocked start, except that if the return acknowledgement contact is not received within the interlock timeout, a “prevent-up start” fault is displayed in keypad and the start sequence will need to be restarted. 3 = Delay start - This start is similar to the interlocked start, except that a return contact is not used. After the “delay time” following the relay output closure, the frequency converter starts.	**2, 3, 4**	RW
484	**P18.1.9**	**Damper Time Out** The time out time used for an interlocked time start, after which the start sequence must be restarted if no acknowledgment contact is received.	**2, 3, 4**	RW
485	**P18.1.10**	**Damper Delay** The delay time following a delay start, after which the frequency converter will be started.	**2, 3, 4**	RW
2468	**P18.1.11**	**Derag Cycles** This parameter defines the number of cycles in the forward/reverse direction for removing any debris in system.	**2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
2469	**P18.1.12**	**Derag at Start/Stop** Defines how the Derag function will become activated; start, stop, both, or based off the digital input.	**2, 3, 4**	RW
2470	**P18.1.13**	**Deragging Run Time** Defines the length of time the drive will run at the Derag speed in the forward and reverse direction.	**2, 3, 4**	RW
2471	**P18.1.14**	**Derag Speed** Defines the frequency the drive will run at in the forward/reverse direction when in the Derag mode.  	**2, 3, 4**	RW
2472	**P18.1.15**	**Derag Off Delay** Defines the length of time the drive will run the Derag function when enabled at stop.	**2, 3, 4**	RW
2659	**P18.1.16**	**Multi-pump Mode 2** Determines the number of drives being used in the multi-pump configuration. 0 = Single drive - Single drive for main motor, contractors used on other motors. 1 = Multi-drive - Multi-follower sequence with multiple drives.	**2, 3, 4**	RW
2218	**P18.2.1.1**	**MPC Drive1 Operate Mode** Provides the operating mode of drive 1 while using multi-pump mode. 0 = Offline 1 = Slave drive 2 = Master drive 3 = Redundant drive.	**2, 3, 4**	RO
2230	**P18.2.1.2**	**MPC Drive2 Operate Mode** Provides the operating mode of drive 2 while using multi-pump mode. See Par ID 2218.	**2, 3, 4**	RO
2242	**P18.2.1.3**	**MPC Drive3 Operate Mode** Provides the operating mode of drive 3 while using multi-pump mode. See Par ID 2218.	**2, 3, 4**	RO
2254	**P18.2.1.4**	**MPC Drive4 Operate Mode** Provides the operating mode of drive 4 while using multi-pump mode. See Par ID 2218.	**2, 3, 4**	RO
2266	**P18.2.1.5**	**MPC Drive5 Operate Mode** Provides the operating mode of drive 5 while using multi-pump mode. See Par ID 2218.	**2, 3, 4**	RO
2219	**P18.2.2.1**	**MPC Drive1 Status** Provides the run status of drive 1 while using the multi-pump mode. 0 = Stopped 1 = Sleep 2 = Regulating 3 = Wait for CMD 4 = Following 5 = Unknown 6 = Local control 7 = Local control.	**2, 3, 4**	RO
2231	**P18.2.2.2**	**MPC Drive2 Status** Provides the run status of drive 2 while using the multi-pump mode. See Par ID 2219.	**2, 3, 4**	RO

Modbus ID	Code	Parameters	Application	RO/RW
2243	**P18.2.2.3**	**MPC Drive3 Status** Provides the run status of drive 3 while using the multi-pump mode. See Par ID 2219.	**2, 3, 4**	RO
2255	**P18.2.2.4**	**MPC Drive4 Status** Provides the run status of drive 4 while using the multi-pump mode. See Par ID 2219.	**2, 3, 4**	RO
2267	**P18.2.2.5**	**MPC Drive5 Status** Provides the run status of drive 5 while using the multi-pump mode. See Par ID 2219.	**2, 3, 4**	RO
2220	**P18.2.3.1**	**MPC Drive1 Network Status** Provides the network status of drive 1 while using the multi-pump mode. 0 = Disconnected 1 = Fault 2 = Local control 3 = Pump lost 4 = Need alternation 5 = No error.	**2, 3, 4**	RO
2232	**P18.2.3.2**	**MPC Drive2 Network Status** Provides the network status of drive 2 while using the multi-pump mode. See Par ID 2220.	**2, 3, 4**	RO
2244	**P18.2.3.3**	**MPC Drive3 Network Status** Provides the network status of drive 3 while using the multi-pump mode. See Par ID 2220.	**2, 3, 4**	RO
2256	**P18.2.3.4**	**MPC Drive4 Network Status** Provides the network status of drive 4 while using the multi-pump mode. See Par ID 2220.	**2, 3, 4**	RO
2268	**P18.2.3.5**	**MPC Drive5 Network Status** Provides the network status of drive 5 while using the multi-pump mode. See Par ID 2220.	**2, 3, 4**	RO
2221	**P18.3.1.1**	**MPC Drive1 Last Fault Code** Provides the latest fault code of drive 1 while using the multi-pump mode.	**2, 3, 4**	RO
2233	**P18.3.1.2**	**MPC Drive2 Last Fault Code** Provides the latest fault code of drive 2 while using the multi-pump mode.	**2, 3, 4**	RO
2245	**P18.3.1.3**	**MPC Drive3 Last Fault Code** Provides the latest fault code of drive 3 while using the multi-pump mode.	**2, 3, 4**	RO
2257	**P18.3.1.4**	**MPC Drive4 Last Fault Code** Provides the latest fault code of drive 4 while using the multi-pump mode.	**2, 3, 4**	RO
2269	**P18.3.1.5**	**MPC Drive5 Last Fault Code** Provides the latest fault code of drive 5 while using the multi-pump mode.	**2, 3, 4**	RO
2222	**P18.3.2.1**	**MPC Drive1 F-Out** Provides the output frequency (Hz) of drive 1 while using the multi-pump mode.	**2, 3, 4**	RO
2234	**P18.3.2.2**	**MPC Drive2 F-Out** Provides the output frequency (Hz) of drive 2 while using the multi-pump mode.	**2, 3, 4**	RO
2246	**P18.3.2.3**	**MPC Drive3 F-Out** Provides the output frequency (Hz) of drive 3 while using the multi-pump mode.	**2, 3, 4**	RO
2258	**P18.3.2.4**	**MPC Drive4 F-Out** Provides the output frequency (Hz) of drive 4 while using the multi-pump mode.	**2, 3, 4**	RO
2270	**P18.3.2.5**	**MPC Drive5 F-Out** Provides the output frequency (Hz) of drive 5 while using the multi-pump mode.	**2, 3, 4**	RO
2223	**P18.3.3.1**	**MPC Drive1 V-Out** Provides the motor voltage (Vac) of drive 1 while using the multi-pump mode.	**2, 3, 4**	RO
2235	**P18.3.3.2**	**MPC Drive2 V-Out** Provides the motor voltage (Vac) of drive 2 while using the multi-pump mode.	**2, 3, 4**	RO

Modbus ID	Code	Parameters	Application	RO/RW
2247	**P18.3.3.3**	**MPC Drive3 V-Out** Provides the motor voltage (Vac) of drive 3 while using the multi-pump mode.	**2, 3, 4**	RO
2259	**P18.3.3.4**	**MPC Drive4 V-Out** Provides the motor voltage (Vac) of drive 4 while using the multi-pump mode.	**2, 3, 4**	RO
2271	**P18.3.3.5**	**MPC Drive5 V-Out** Provides the motor voltage (Vac) of drive 5 while using the multi-pump mode.	**2, 3, 4**	RO
2224	**P18.3.4.1**	**MPC Drive1 I-Out** Provides the motor current (Amps) of drive 1 while using the multi-pump mode.	**2, 3, 4**	RO
2236	**P18.3.4.2**	**MPC Drive2 I-Out** Provides the motor current (Amps) of drive 2 while using the multi-pump mode.	**2, 3, 4**	RO
2248	**P18.3.4.3**	**MPC Drive3 I-Out** Provides the motor current (Amps) of drive 3 while using the multi-pump mode.	**2, 3, 4**	RO
2260	**P18.3.4.4**	**MPC Drive4 I-Out** Provides the motor current (Amps) of drive 4 while using the multi-pump mode.	**2, 3, 4**	RO
2272	**P18.3.4.5**	**MPC Drive5 I-Out** Provides the motor current (Amps) of drive 5 while using the multi-pump mode.	**2, 3, 4**	RO
2225	**P18.3.5.1**	**MPC Drive1 M-Out** Provides the motor torque (%) of drive 1 while using the multi-pump mode.	**2, 3, 4**	RO
2237	**P18.3.5.2**	**MPC Drive2 M-Out** Provides the motor torque (%) of drive 2 while using the multi-pump mode.	**2, 3, 4**	RO
2249	**P18.3.5.3**	**MPC Drive3 M-Out** Provides the motor torque (%) of drive 3 while using the multi-pump mode.	**2, 3, 4**	RO
2261	**P18.3.5.4**	**MPC Drive4 M-Out** Provides the motor torque (%) of drive 4 while using the multi-pump mode.	**2, 3, 4**	RO
2273	**P18.3.5.5**	**MPC Drive5 M-Out** Provides the motor torque (%) of drive 5 while using the multi-pump mode.	**2, 3, 4**	RO
2226	**P18.3.6.1**	**MPC Drive1 P-Out** Provides the motor power (%) of drive 1 while using the multi-pump mode.	**2, 3, 4**	RO
2238	**P18.3.6.2**	**MPC Drive2 P-Out** Provides the motor power (%) of drive 2 while using the multi-pump mode.	**2, 3, 4**	RO
2250	**P18.3.6.3**	**MPC Drive3 P-Out** Provides the motor power (%) of drive 3 while using the multi-pump mode.	**2, 3, 4**	RO
2262	**P18.3.6.4**	**MPC Drive4 P-Out** Provides the motor power (%) of drive 4 while using the multi-pump mode.	**2, 3, 4**	RO
2274	**P18.3.6.5**	**MPC Drive5 P-Out** Provides the motor power (%) of drive 5 while using the multi-pump mode.	**2, 3, 4**	RO
2227	**P18.3.7.1**	**MPC Drive1 N-Out** Provides the motor speed (RPM) of drive 1 while using the multi-pump mode.	**2, 3, 4**	RO
2239	**P18.3.7.2**	**MPC Drive2 N-Out** Provides the motor speed (RPM) of drive 2 while using the multi-pump mode.	**2, 3, 4**	RO
2251	**P18.3.7.3**	**MPC Drive3 N-Out** Provides the motor speed (RPM) of drive 3 while using the multi-pump mode.	**2, 3, 4**	RO
2263	**P18.3.7.4**	**MPC Drive4 N-Out** Provides the motor speed (RPM) of drive 4 while using the multi-pump mode.	**2, 3, 4**	RO
2275	**P18.3.7.5**	**MPC Drive5 N-Out** Provides the motor speed (RPM) of drive 5 while using the multi-pump mode.	**2, 3, 4**	RO
2228	**P18.3.8.1**	**MPC Drive1 T-Run** Provides the motor run time of drive 1 while using the multi-pump mode.	**2, 3, 4**	RO
2240	**P18.3.8.2**	**MPC Drive2 T-Run** Provides the motor run time of drive 2 while using the multi-pump mode.	**2, 3, 4**	RO
2252	**P18.3.8.3**	**MPC Drive3 T-Run** Provides the motor run time of drive 3 while using the multi-pump mode.	**2, 3, 4**	RO
2264	**P18.3.8.4**	**MPC Drive4 T-Run** Provides the motor run time of drive 4 while using the multi-pump mode.	**2, 3, 4**	RO

Modbus ID	Code	Parameters	Application	RO/RW
2276	**P18.3.8.5**	**MPC Drive5 T-Run** Provides the motor run time of drive 5 while using the multi-pump mode.	**2, 3, 4**	RO
342	**P18.4.1**	**Number of Pumps** Total number of auxiliary motors/pumps to be used with the multi-pump system. When in single drive mode, this functions as the amount of motors on a single drive. When in multi drive mode, this functions as the most drives active at one time.	**2, 3, 4**	RW
346	**P18.4.2**	**Include Freq Converter** When enable this tells the drive if the motor/pump connected to frequency converter is included in the auto change sequence when using auxiliary contacts. Not available in multi-drive mode.	**2, 3, 4**	RW
345	**P18.4.3**	**Auto-Change Enable** Auto-change will rotate the starting order/priority of the motors in the system to get equal run time on all the motors. Not available in multi-drive mode.	**2, 3, 4**	RW
347	**P18.4.4**	**Auto-Change Interval** Defines how often to rotate starting order of motors/pumps. Not available in multi-drive mode.	**2, 3, 4**	RW
349	**P18.4.5**	**Auto-Change Freq Limit** An auto-change is done when the auto-change interval has elapsed and the drive is running below auto-change frequency limit. Not available in multi-drive mode.	**2, 3, 4**	RW
348	**P18.4.6**	**Auto-Change Pump Limit** An auto-change is done when the auto-change interval has elapsed and the number of running aux. motors is less than auto-change motor limit. Not available in multi-drive mode.	**2, 3, 4**	RW
2439	**P18.4.7**	**Pipe Fill Aux Pump Select** Pipe fill aux. pump select.	**2, 3, 4**	RW
2440	**P18.4.8**	**Pipe Fill Aux Pump Run Time** Pipe fill aux. pump run time.	**2, 3, 4**	RW
2441	**P18.4.9**	**Pipe Fill Aux Pump Operation** Pipe fill aux. pump operation.	**2, 3, 4**	RW
2442	**P18.4.10**	**Pipe Fill Aux Pump Delay** Pipe fill aux. pump delay.	**2, 3, 4**	RW
2449	**P18.5.1**	**Number of Drives** This defines the number of drives active when doing the multi-drive pump and fan scheme. By default, there will be always 1 drive active at 1 time by setting value to above 1 it allows to bring in additional drives to maintain the system.	**2, 3, 4**	RW
2284	**P18.5.2**	**Regulation Source** Defines drives which have master ability. If 0 is selected, drive only works as slave. If 1 is selected, drive could work as master. More than 1 drive could have master ability in system. Drives which have been connected with both start/stop signal and PID feedback can be set up as PID controller, otherwise, only could be set to network only. 0 = Network only. 1 = PID controller.	**2, 3, 4**	RW
2285	**P18.5.3**	**Recovery Method** The parameter is for the slave drive. When multi-drive system loses master, the slave drive can continue to run if it is set to “Automatic”. However, the slave drive will stop immediately if it is set to “Stop”. 0 = Automatic. 1 = Stop.	**2, 3, 4**	RW
2286	**P18.5.4**	**Callback Source** Slave parameters which will update to master. Sometimes some information needs to be callback from slave to master and affect whole system. If slave drive has a callback source as STO, when it suffers STO fault, the master drive will answer this callback and shutdown whole system. 0 = No action. 1 = Safety torque Off.	**2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
2311	**P18.5.5**	**Add/Remove Drive Selection** In default, MPFC system will add/remove pump according to their drive ID, from small to large; and the order can also depend on each slave drive's running time: add the drive has shortest running time and remove the drive has longest running time first. 0 = Drive ID. 1 = Run time.	**2, 3, 4**	RW
2280	**P18.5.6**	**Run Time Enable** The run time counter will start counting only if this parameter is enabled. 0 = Disable. 1 = Enable.	**2, 3, 4**	RW
2281	**P18.5.7**	**Run Time Limit** If drive run time is over this limit, its network status will be "Need Alternation". Limit equals 0 means run time counter disabled.	**2, 3, 4**	RW
2283	**P18.5.8**	**Run Time Reset** One-time parameter, set to be 1 will clear run time counter. 0 = No action 1 = Reset.	**2, 3, 4**	RW
2473	**P18.5.9**	**Master Drive Mode** Defines how the master drive will maintain the frequency control when slaves are brought in; follow PI, fixed speed, or turn itself off. 0 = Follow PID 1 = Fixed speed 2 = Turn off.	**2, 3, 4**	RW
2474	**P18.5.10**	**Master Fixed Speed** Defines the fixed speed frequency when the master drive mode is set for fixed speed control when slaves are brought in.	**2, 3, 4**	RW
2475	**P18.5.11**	**Master Fixed Speed Delay** Defines the delay time before the master drive begins running at the fixed speed or turns off if the master mode is set for fixed speed or turn off.	**2, 3, 4**	RW
2406	**P18.6.1**	**Pipe Fill Loss Detection Method** Defines the value for looking at a loss of prime. 0 = Motor current. 1 = Motor power (%). 2 = Motor torque (%).	**2, 3, 4**	RW
2407	**P18.6.2**	**Pipe Fill Loss Level** Selects the level at which to look at a condition of loss of prime. When the measured value defined in the Detection Method drops below this level for the Prime Loss Time and is above the Prime Loss Frequency level, the drive will respond based off the parameter "pipe fill loss response".	**2, 3, 4**	RW
2408	**P18.6.3**	**Pipe Fill Loss Time** Defines the delay time before a "Loss of Prime" condition will occur based of the detection method and prime loss level.	**2, 3, 4**	RW
2409	**P18.6.4**	**Pipe Fill Loss Frequency** Defines the frequency point at which the drive needs to be above to enabled the "Loss of Prime" feature. When set to 0 Hz, protection is disabled.	**2, 3, 4**	RW
2410	**P18.6.5**	**Pipe Fill Loss Response** Defines the response method when a "Loss of Prime" condition occurs. 0 = No action 1 = Warning, No sStore 2 = Warning, Store.	**2, 3, 4**	RW
2411	**P18.6.6**	**Pipe Fill Loss Attempts** Defines the amount of attempts to auto restart the drive on an "Prime Loss" condition.	**2, 3, 4**	RW
2428	**P18.6.7**	**Prime Pump Enable** This will enable or disabled the pre-charge function to allow for pre-filling a system before going into PID control mode. See Par ID 190.	**2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
2429	P18.6.8	**Prime Pump Level** This defines the level at which the Pre-Charge function will drop out. If the feedback level rises above this set level, Pre-charge function will be deactivated. If the level is not reached, it will switch after the delay time.	2, 3, 4	RW
2431	P18.6.9	**Prime Pump Frequency** Frequency at which the pre-charge function will operate when enabled.	2, 3, 4	RW
2432	P18.6.10	**Prime Pump Delay Time** This is the time that the drive will run the Pre-charge function on start up. When set to "0 Hz", this function is not enabled.	2, 3, 4	RW
2433	P18.6.11	**Prime Pump Loss of Prime Level** Selects the limit to indicate a loss of prime in pump. If the measured current drops below the determined value for the value assigned in the Prime Loss of Time setting, the drive will display a Pre-charge Loss of Prime.	2, 3, 4	RW
2434	P18.6.12	**Prime Pump Level 2** This defines the level set at which the Pre-charge function will drop out. If the feedback level rises above this set level, the Pre-charge function will be deactivated. If the set level is not reached after the set delay time, the drive will switch out of pre-charge function.	2, 3, 4	RW
2436	P18.6.13	**Prime Pump Frequency 2** Frequency at which the pre-charge level 2 will operate at when enabled.	2, 3, 4	RW
2437	P18.6.14	**Prime Pump Delay Time 2** This is the time that the drive will run at the 2nd level pre-charge function level. When set to 0 Hz, this function is not enabled.	2, 3, 4	RW
2438	P18.6.15	**Prime Pump Loss of Prime Level 2** Selects the limit to indicate a loss of prime in pump. If the measured current drops below the determined value for the value assigned in the prime loss of time setting, the drive will display a pre-charge loss of prime.	2, 3, 4	RW
1853	P18.6.16	**Broken Pipe Fault Response** Broken pipe fault response parameter. 0 = No action. 1 = Warning. 2 = Fault. 3 = Fault, coast.	2, 3, 4	RW
1854	P18.6.17	**Broken Pipe Level** Broken pipe level which compares with PI feedback.	2, 3, 4	RW
1855	P18.6.18	**Broken Pipe Delay** Broken pipe fault delay time which is used in pipe fill analysis of conditions.	2, 3, 4	RW
1856	P18.6.19	**Broken Pipe Frequency** Broke pipe frequency which compares with output frequency.	2, 3, 4	RW
2804	P18.6.20	**Jockey Pump Enable** Parameter "Jockey Enable" specifies which drive shall use jockey function. There are three options, default value is 0. 0 = Not used. 1 = PID sleep, jockey pump will start when PID sleep is active and stopped when PID wakes up. 2 = PID sleep (level), jockey pump will start when PID sleep is active and PID feedback value goes below the level defined by parameter "Jockey Start Level". Jockey pump will be stopped when the feedback value exceeds the level defined by parameter "Jockey Stop Level" or PID wakes up.	2, 3, 4	RW
2805	P18.6.21	**Jockey Start Level** Jockey Start level parameter is defined by the start level when PID sleep is active and the "Jockey Enable" is selected "PID Sleep (level)".	2, 3, 4	RW
2807	P18.6.22	**Jockey Stop Level** Jockey Stop level parameter is defined the stop level when PID sleep is active and the "Jockey Enable" is selected "PID Sleep (level)" Jockey Stop level.	2, 3, 4	RW

Modbus ID	Code	Parameters	Application	RO/RW
2809	**P18.6.23**	**Lube Pump Enable** Lube Pump Enable parameter is used to enable/disable lube pump function. There are two options, one is "Enabled", another is "Disabled", default is "Disabled". 0 = Disabled. 1 = Enabled.	**2, 3, 4**	RW
2810	**P18.6.24**	**Lube Pump Time** Defines the amount of time to delay the drive output and to activate the digital output before the drive is allowed to run. If this parameter is set to 0, it will disable the function.	**2, 3, 4**	RW
491	**P19.1**	**Interval 1 On Time** On time for interval function. It uses 24-hour format. Use to specify a time of day for a desired function to be disabled.	**2, 3, 4**	RW
493	**P19.2**	**Interval 1 Off Time** Off time for interval function. It uses 24-hour format. Use to specify a time of day for a desired function to be disabled.	**2, 3, 4**	RW
517	**P19.3**	**Interval 1 From Day** On day of week for Interval function. 0 = Sunday 1 = Monday 2 = Tuesday 3 = Wednesday 4 = Thursday 5 = Friday 6 = Saturday	**2, 3, 4**	RW
518	**P19.4**	**Interval 1 To Day** On day of week for Interval function. 0 = Sunday 1 = Monday 2 = Tuesday 3 = Wednesday 4 = Thursday 5 = Friday 6 = Saturday	**2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
519	**P19.5**	**Interval 1 Channel** Select affected time channel to store the interval time. 0 = Not used. 1 = Time channel 1. 2 = Time channel 2. 3 = Time channel 3.	**2, 3, 4**	RW
495	**P19.6**	**Interval 2 On Time** On time for interval function. It uses 24-hour format. Use to specify a time of day for a desired function to be disabled.	**2, 3, 4**	RW
497	**P19.7**	**Interval 2 Off Time** Off time for interval function. It uses 24-hour format. Use to specify a time of day for a desired function to be disabled.	**2, 3, 4**	RW
520	**P19.8**	**Interval 2 From Day** On day of week for interval function. 0 = Sunday 1 = Monday 2 = Tuesday 3 = Wednesday 4 = Thursday 5 = Friday 6 = Saturday	**2, 3, 4**	RW
521	**P19.9**	**Interval 2 To Day** On day of week for Interval function. 0 = Sunday 1 = Monday 2 = Tuesday 3 = Wednesday 4 = Thursday 5 = Friday 6 = Saturday	**2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
522	**P19.10**	**Interval 2 Channel** Select affected time channel to store the time interval. 0 = Not used 1 = Time channel 1. 2 = Time channel 2. 3 = Time channel 3.	**2, 3, 4**	RW
499	**P19.11**	**Interval 3 On Time** On time for interval function. It uses 24-hour format. Use to specify a time of day for a desired function to be disabled.	**2, 3, 4**	RW
501	**P19.12**	**Interval 3 Off Time** Off time for interval function. It uses 24-hour format. Use to specify a time of day for a desired function to be disabled.	**2, 3, 4**	RW
523	**P19.13**	**Interval 3 From Day** On day of week for Interval function. 0 = Sunday 1 = Monday 2 = Tuesday 3 = Wednesday 4 = Thursday 5 = Friday 6 = Saturday	**2, 3, 4**	RW
524	**P19.14**	**Interval 3 To Day** On day of week for Interval function. 0 = Sunday 1 = Monday 2 = Tuesday 3 = Wednesday 4 = Thursday 5 = Friday 6 = Saturday	**2, 3, 4**	RW
525	**P19.15**	**Interval 3 Channel** Select affected time channel to store the interval time. 0 = Not used. 1 = Time channel 1. 2 = Time channel 2. 3 = Time channel 3.	**2, 3, 4**	RW
503	**P19.16**	**Interval 4 On Time** On time for interval function. It uses 24-hour format. Use to specify a time of day for a desired function to be disabled.	**2, 3, 4**	RW
505	**P19.17**	**Interval 4 Off Time** Off time for interval function. It uses 24-hour format. Use to specify a time of day for a desired function to be disabled.	**2, 3, 4**	RW
526	**P19.18**	**Interval 4 From Day** On day of week for Interval function. 0 = Sunday 1 = Monday 2 = Tuesday 3 = Wednesday 4 = Thursday 5 = Friday 6 = Saturday	**2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
527	**P19.19**	**Interval 4 To Day** On day of week for Interval function. 0 = Sunday 1 = Monday 2 = Tuesday 3 = Wednesday 4 = Thursday 5 = Friday 6 = Saturday	**2, 3, 4**	RW
528	**P19.20**	**Interval 4 Channel** Select affected time channel to store the interval time. 0 = Not used. 1 = Time channel 1. 2 = Time channel 2. 3 = Time channel 3.	**2, 3, 4**	RW
507	**P19.21**	**Interval 5 On Time** On time for interval function. It uses 24-hour format. Use to specify a time of day for a desired function to be disabled.	**2, 3, 4**	RW
509	**P19.22**	**Interval 5 Off Time** Off time for interval function. It uses 24-hour format. Use to specify a time of day for a desired function to be disabled.	**2, 3, 4**	RW
529	**P19.23**	**Interval 5 From Day** On day of week for Interval function. 0 = Sunday 1 = Monday 2 = Tuesday 3 = Wednesday 4 = Thursday 5 = Friday 6 = Saturday	**2, 3, 4**	RW
530	**P19.24**	**Interval 5 To Day** On day of week for Interval function. 0 = Sunday 1 = Monday 2 = Tuesday 3 = Wednesday 4 = Thursday 5 = Friday 6 = Saturday	**2, 3, 4**	RW
531	**P19.25**	**Interval 5 Channel** Select affected time channel to store the interval time. 0 = Not used. 1 = Time channel 1. 2 = Time channel 2. 3 = Time channel 3.	**2, 3, 4**	RW
511	**P19.26**	**Timer 1 Duration** The timer will run when activated (activated by DI).	**2, 3, 4**	RW
532	**P19.27**	**Timer 1 Channel** Select affected time channel. 0 = Not used. 1 = Time channel 1. 2 = Time channel 2. 3 = Time channel 3.	**2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
513	**P19.28**	**Timer 2 Duration** The timer will run when activated (activated by DI).	**2, 3, 4**	RW
533	**P19.29**	**Timer 2 Channel** Select affected time channel. 0 = Not used. 1 = Time channel 1. 2 = Time channel 2. 3 = Time channel 3.	**2, 3, 4**	RW
515	**P19.30**	**Timer 3 Duration** The timer will run when activated (activated by DI).	**2, 3, 4**	RW
534	**P19.31**	**Timer 3 Channel** Select affected time channel. 0 = Not used. 1 = Time channel 1. 2 = Time channel 2. 3 = Time channel 3.	**2, 3, 4**	RW
2487	**P19.32**	**Interval 1 Setting** Defines the interval time setting for interval 1; to be weekly or daily. 0 = Weekly - Would setup the timer for the week long. 1 = Daily - Would setup the timer for the defined day.	**2, 3, 4**	RW
2488	**P19.33**	**Interval 2 Setting** Defines the interval time setting for interval 1; to be weekly or daily. See Par ID 2487.	**2, 3, 4**	RW
2489	**P19.34**	**Interval 3 Setting** Defines the interval time setting for interval 1; to be weekly or daily. See Par ID 2487.	**2, 3, 4**	RW
2490	**P19.35**	**Interval 4 Setting** Defines the interval time setting for interval 1; to be weekly or daily. See Par ID 2487.	**2, 3, 4**	RW
2491	**P19.36**	**Interval 5 Setting** Defines the interval time setting for interval 1; to be weekly or daily. See Par ID 2487.	**2, 3, 4**	RW
2533	**P20.1.1**	**FB Process Data Input 1 Sel** Fieldbus Data Input selects the parameter/monitor IDs which can be assigned to these registers and then read over the desired Fieldbus Network Word for Process Data. Any drive parameter with an ID can be read over these values. Default Values for Process Data Input are: Process Data In Select 1 - FB torque reference = 2541. Process Data In Select 2 - FB PID 1 set point1 = 2542. Process Data In Select 3 - FB PID 1 feedback1 = 2550. Process Data In Select 4 - No default selection. Process Data In Select 5 - No default selection. Process Data In Select 6 - No default selection. Process Data In Select 7 - No default selection. Process Data In Select 8 - No default selection. See Communication Manual MN040010EN for more details.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
2534	**P20.1.2**	**FB Process Data Input 2 Sel** Fieldbus Data Input selects the parameter/monitor IDs which can be assigned to these registers and then read over the desired Fieldbus Network Word for Process Data. Any drive parameter with an ID can be read over these values. Default values for Process Data Input are: Process Data In Select 1 - FB torque reference = 2541. Process Data In Select 2 - FB PID 1 set point1 = 2542. Process Data In Select 3 - FB PID 1 feedback1 = 2550. Process Data In Select 4 - No default selection. Process Data In Select 5 - No default selection. Process Data In Select 6 - No default selection. Process Data In Select 7 - No default selection. Process Data In Select 8 - No default selection.	**1, 2, 3, 4**	RW
2535	**P20.1.3**	**FB Process Data Input 3 Sel** Fieldbus Data Input selects the parameter/monitor IDs which can be assigned to these registers and then read over the desired Fieldbus Network Word for Process Data. Any drive parameter with an ID can be read over these values. Default values for process data input are: Process Data In Select 1 - FB torque reference = 2541. Process Data In Select 2 - FB PID 1 set point1 = 2542. Process Data In Select 3 - FB PID 1 feedback1 = 2550. Process Data In Select 4 - No default selection. Process Data In Select 5 - No default selection. Process Data In Select 6 - No default selection. Process Data In Select 7 - No default selection. Process Data In Select 8 - No default selection.	**1, 2, 3, 4**	RW
2536	**P20.1.4**	**FB Process Data Input 4 Sel** Fieldbus Data Input selects the parameter/monitor IDs which can be assigned to these registers and then read over the desired Fieldbus Network Word for Process Data. Any drive parameter with an ID can be read over these values. Default values for process data input are: Process Data In Select 1 - FB torque reference = 2541. Process Data In Select 2 - FB PID 1 set point1 = 2542. Process Data In Select 3 - FB PID 1 feedback1 = 2550. Process Data In Select 4 - No default selection. Process Data In Select 5 - No default selection. Process Data In Select 6 - No default selection. Process Data In Select 7 - No default selection. Process Data In Select 8 - No default selection.	**1, 2, 3, 4**	RW
2537	**P20.1.5**	**FB Process Data Input 5 Sel** Fieldbus Data Input selects the parameter/monitor IDs which can be assigned to these registers and then read over the desired Fieldbus Network Word for Process Data. Any drive parameter with an ID can be read over these values. Default values for process data input are: Process Data In Select 1 - FB torque reference = 2541. Process Data In Select 2 - FB PID 1 set point1 = 2542. Process Data In Select 3 - FB PID 1 feedback1 = 2550. Process Data In Select 4 - No default selection. Process Data In Select 5 - No default selection. Process Data In Select 6 - No default selection. Process Data In Select 7 - No default selection. Process Data In Select 8 - No default selection.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
2538	**P20.1.6**	**FB Process Data Input 6 Sel** Fieldbus Data Input selects the parameter/monitor IDs which can be assigned to these registers and then read over the desired Fieldbus Network Word for Process Data. Any drive parameter with an ID can be read over these values. Default values for process data input are: Process Data In Select 1 - FB torque reference = 2541. Process Data In Select 2 - FB PID 1 set point1 = 2542. Process Data In Select 3 - FB PID 1 feedback1 = 2550. Process Data In Select 4 - No default selection. Process Data In Select 5 - No default selection. Process Data In Select 6 - No default selection. Process Data In Select 7 - No default selection. Process Data In Select 8 - No default selection..	**1, 2, 3, 4**	RW
2539	**P20.1.7**	**FB Process Data Input 7 Sel** Fieldbus Data Input selects the parameter/monitor IDs which can be assigned to these registers and then read over the desired Fieldbus Network Word for Process Data. Any drive parameter with an ID can be read over these values. Default values for process data input are: Process Data In Select 1 - FB torque reference = 2541. Process Data In Select 2 - FB PID 1 set point1 = 2542. Process Data In Select 3 - FB PID 1 feedback1 = 2550. Process Data In Select 4 - No default selection. Process Data In Select 5 - No default selection. Process Data In Select 6 - No default selection. Process Data In Select 7 - No default selection. Process Data In Select 8 - No default selection.	**1, 2, 3, 4**	RW
2540	**P20.1.8**	**FB Process Data Input 8 Sel** Fieldbus Data Input selects the parameter/monitor IDs which can be assigned to these registers and then read over the desired Fieldbus Network Word for Process Data. Any drive parameter with an ID can be read over these values. Default values for process data input are: Process Data In Select 1 - FB torque reference = 2541. Process Data In Select 2 - FB PID 1 set point1 = 2542. Process Data In Select 3 - FB PID 1 feedback1 = 2550. Process Data In Select 4 - No default selection. Process Data In Select 5 - No default selection. Process Data In Select 6 - No default selection. Process Data In Select 7 - No default selection. Process Data In Select 8 - No default selection.	**1, 2, 3, 4**	RW
1556	**P20.2.1**	**FB Process Data Output 1 Sel** With the Fieldbus data output selections, parameter/monitor ids can be assigned to these registers and then read over the desired Fieldbus network word for process data. Any drive parameter with an ID can be read over these values. Default values for process data out in Fieldbus. See Par ID 2533.	**1, 2, 3, 4**	RW
1557	**P20.2.2**	**FB Process Data Output 2 Sel** With the Fieldbus data output selections, parameter/monitor ids can be assigned to these registers and then read over the desired Fieldbus network word for process data. Any drive parameter with an ID can be read over these values. Default values for process data out in Fieldbus. See Par ID 2533.	**1, 2, 3, 4**	RW
1558	**P20.2.3**	**FB Process Data Output 3 Sel** With the Fieldbus data output selections, parameter/monitor ids can be assigned to these registers and then read over the desired Fieldbus network word for process data. Any drive parameter with an ID can be read over these values. Default values for process data Out in Fieldbus. See Par ID 2533.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
1559	**P20.2.4**	**FB Process Data Output 4 Sel** With the Fieldbus data output selections, parameter/monitor ids can be assigned to these registers and then read over the desired Fieldbus network word for process data. Any drive parameter with an ID can be read over these values. Default values for process data out in Fieldbus. See Par ID 2533.	**1, 2, 3, 4**	RW
1560	**P20.2.5**	**FB Process Data Output 5 Sel** With the Fieldbus data output selections, parameter/monitor ids can be assigned to these registers and then read over the desired Fieldbus network word for process data. Any drive parameter with an ID can be read over these values. Default values for process data out in Fieldbus. See Par ID 2533.	**1, 2, 3, 4**	RW
1561	**P20.2.6**	**FB Process Data Output 6 Sel** With the Fieldbus data output selections, parameter/monitor ids can be assigned to these registers and then read over the desired Fieldbus network word for process data. Any drive parameter with an ID can be read over these values. Default values for process data out in Fieldbus. See Par ID 2533.	**1, 2, 3, 4**	RW
1562	**P20.2.7**	**FB Process Data Output 7 Sel** With the Fieldbus data output selections, parameter/monitor ids can be assigned to these registers and then read over the desired Fieldbus network word for process data. Any drive parameter with an ID can be read over these values. Default values for process data out in Fieldbus. See Par ID 2533.	**1, 2, 3, 4**	RW
1563	**P20.2.8**	**FB Process Data Output 8 Sel** With the Fieldbus data output selections, parameter/monitor ids can be assigned to these registers and then read over the desired Fieldbus network word for process data. Any drive parameter with an ID can be read over these values. Default values for process data out in Fieldbus. See Par ID 2533.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
2415	**P20.2.9**	**Standard Status Word Bit0 Function Selec** This parameter allows for setting one of the DO/RO functions to a status word that then can be read over the communication standard status word. This also can be viewed in the keypad monitor value M50. 0 = Not Used 1 = Ready 2 = Run 3 = Fault 4 = Fault invert 5 = Warning 6 = Reversed 7 = At speed 8 = Zero fequency 9 = Freq limit 1 Superv 10 = Freq limit 2 Superv 11 = PID1 Superv 12 = PID2 Superv 13 = Over-heat fault 14 = Over-current regular 15 = Over-voltage regular 16 = Under-voltage regular 17 = 4 mA Ref fault/warning 18 = Ext brake control 19 = Ext brake inverted 20 = Torq limit Superv 21 = Ref limit Superv 22 = Control from I/O 23 = Un-requested rotation direction 24 = Thermistor fault output 25 = Fire mode 26 = In bypass mode 27 = Ext fault/warning 28 = Remote control 29 = Jog speed select 30 = Motor therm. protection 31 = FB digital Input 1 32 = FB digital Input 2 33 = FB digital Input 3	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
2415	**P20.2.9**	**Standard Status Word Bit0 Function Select, continued** 34 = FB digital Input 4 35 = Damper control 36 = TC1 status 37 = TC2 status 38 = TC3 status 39 = In E-stop 40 = Power limit Superv 41 = Temp limit Superv 42 = Analog input Superv 43 = Motor 1 control 44 = Motor 2 control 45 = Motor 3 control 46 = Motor 4 control 47 = Motor 5 control 48 = Logic fulfilled 49 = PID1 sleep 50 = PID2 sleep 51 = Motor current 1 Supv 52 = Motor current 2 Supv 53 = Second AI limit Supv 54 = DC charge switch close 55 = Preheat active 56 = Cold weather active 57 = Prime pump active 58 = 2nd stage ramp frequency active 59 = STO fault output 60 = Run bypass/drive 61 = Bypass overload 62 = Bypass run 63 = Auto local on COM fault 64 = Fieldbus RTU fault 65 = Fieldbus TCP fault 66 = Fieldbus MSTP fault 67 = Fieldbus EIP fault 68 = Fieldbus SlotA fault 69 = Fieldbus SlotB fault 70 = Fieldbus SWD fault 71 = Jockey pump active 72 = Lube pump active 73 = PID1 low feedback 74 = PID1 high feedback 75 = PID2 low feedback 76 = PID2 high feedback 77 = Master in MPFC 78 = CP interlock fault.	**1, 2, 3, 4**	RW
2416	**P20.2.10**	**Standard Status Word Bit1 Function Select** This parameter allows for setting one of the DO/RO functions to a status word that then can be read over the communication standard status word. This also can be viewed in the keypad monitor value M50. See Par ID 2415	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
2417	P20.2.11	**Standard Status Word Bit2 Function Select** This parameter allows for setting one of the DO/RO functions to a status word that then can be read over the communication standard status word. This also can be viewed in the keypad monitor value M50. See Par ID 2415	1, 2, 3, 4	RW
2418	P20.2.12	**Standard Status Word Bit3 Function Select** This parameter allows for setting one of the DO/RO functions to a status word that then can be read over the communication standard status word. This also can be viewed in the keypad monitor value M50. See Par ID 2415	1, 2, 3, 4	RW
2419	P20.2.13	**Standard Status Word Bit4 Function Select** This parameter allows for setting one of the DO/RO functions to a status word that then can be read over the communication standard status word. This also can be viewed in the keypad monitor value M50. See Par ID 2415	1, 2, 3, 4	RW
2420	P20.2.14	**Standard Status Word Bit5 Function Select** This parameter allows for setting one of the DO/RO functions to a status word that then can be read over the communication standard status word. This also can be viewed in the keypad monitor value M50. See Par ID 2415	1, 2, 3, 4	RW
2421	P20.2.15	**Standard Status Word Bit6 Function Select** This parameter allows for setting one of the DO/RO functions to a status word that then can be read over the communication standard status word. This also can be viewed in the keypad monitor value M50. See Par ID 2415	1, 2, 3, 4	RW
2422	P20.2.16	**Standard Status Word Bit7 Function Select** This parameter allows for setting one of the DO/RO functions to a status word that then can be read over the communication standard status word. This also can be viewed in the keypad monitor value M50. See Par ID 2415	1, 2, 3, 4	RW
586	P20.3.1.1	**RS485 Comm Set** This parameter defines the communication protocol for RS-485. 0 = Modbus RTU. 1 = BACnet MS/TP. 2 = SWD.	1, 2, 3, 4	RW
587	P20.3.2.1	**Slave Address** This parameter defines the slave address for RS-485 communication.	1, 2, 3, 4	RW
584	P20.3.2.2	**Baud Rate** This parameter defines communication speed for RS-485 communication. 0 = 9600 1 = 19200 2 = 38400 3 = 57600 4 = 115200.	1, 2, 3, 4	RW
585	P20.3.2.3	**Parity Type And Stop Bit** This parameter defines parity type for RS-485 communication. 0 = None and 2 stop bits 1 = Odd and 1 stop bit 2 = Even and 1 stop bit 3 = None and 1 stop bit.	1, 2, 3, 4	RW

Modbus ID	Code	Parameters	Application	RO/RW
588	**P20.3.2.4**	**Modbus RTU Protocol Status** This parameter shows the protocol status for RS-485 communication. 0 = Initial. 1 = Stopped. 2 = Operational. 3 = Faulted.	**1, 2, 3, 4**	RO
593	**P20.3.2.5**	**Comm Timeout Modbus RTU** Selects the time to wait before a communication fault occurs over Modbus RTU if a message is not received.	**1, 2, 3, 4**	RW
2516	**P20.3.2.6**	**Modbus RTU Fault Response** Defines the Fieldbus fault condition for Modbus RTU communication. 0 = Only in Fieldbus control mode - When Fieldbus is the control place and Fieldbus fault is active drive will fault on loss of coms., if not in Fieldbus control place will not fault. 1 = In all control modes - No matter the control place setting if communication is lost Fieldbus fault response will occur.	**1, 2, 3, 4**	RW
594	**P20.3.3.1**	**MSTP Baud Rate** This parameter defines communication speed for RS-485 communication.	**1, 2, 3, 4**	RW
595	**P20.3.3.2**	**MSTP Device Address** Defines the device address of the drive on the Bacnet MSTP network.	**1, 2, 3, 4**	RW
596	**P20.3.3.3**	**MSTP Instance Number** Defines the instance number of the drive on the Bacnet MSTP network.	**1, 2, 3, 4**	RW
598	**P20.3.3.4**	**MSTP Comm Timeout** Selects the time to waits before a communication fault occurs over Bacnet MSTP if a message is not received.	**1, 2, 3, 4**	RW
599	**P20.3.3.5**	**MSTP Protocol Status** This parameter shows the protocol status for Bacnet MSTP communication. 0 = Stopped. 1 = Operational. 2 = Faulted.	**1, 2, 3, 4**	RO
600	**P20.3.3.6**	**MSTP Fault Code** This parameter shows the protocol status for Bacnet MSTP communication. 0 = None. 1 = Sole master. 2 = Duplicate MAC ID. 3 = Baud rate fault.	**1, 2, 3, 4**	RO
2526	**P20.3.3.7**	**MSTP Fault Response** Defines the Fieldbus fault condition for Bacnet MSTP communicaiton. 0 = Only in Fieldbus control mode - When Fieldbus is the control place and Fieldbus fault is active drive will fault on loss of communications, if not in Fieldbus control place will not fault. 1 = In all control modes - No matter the control place setting if communication is lost Fieldbus fault response will occur.	**1, 2, 3, 4**	RW
1537	**P20.3.3.8**	**MSTP Max Master** MSTP Max Master.	**1, 2, 3, 4**	RW
2630	**P20.3.4.1**	**Parameter Access** PNU927 which specifies the operation priority of parameters for Acyclic communication: 0 = No permission to read/write on Acyclic channel. 1 = Acyclic read/write are allowed on ProfiBus.	**1, 2, 3, 4**	RW
2631	**P20.3.4.2**	**Process Data Access** PNU928 which specifies the control priority of the device for Cyclic communication: 0 = Local control. 1 = Fieldbus. 2 = Mixed interface. 4 = Local on fault. 5 = Dual mode.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
2632	**P20.3.4.3**	**Fault Situation Counter** PNU952 which specifies the Fault situation counter. Only write of 0 is allowed, then whole fault buffer (actual fault situation and all other fault situations) and the fault message counter (parameter 944) are erased.	**1, 2, 3, 4**	RW
2609	**P20.3.4.4**	**Board Status** Status of the board: B0-DCOM Comm. fault. B1-Board HW fault. B2-IO1 24 Volt overload fault. B3-Profibus Comm. fault / CANopen comm. fault / ProfiNet Comm. fault. B4-Fieldbus fault.	**1, 2, 3, 4**	RO
2610	**20.3.4.5**	**Firmware Version** This parameter provides the firmware version of the SWD.	**1, 2, 3, 4**	RO
2612	**P20.3.4.6**	**Protocol Status** This parameter specifies the protocol status for SWD card: 0 = Not configured. 1 = Operational. 2 = Diagnostics.	**1, 2, 3, 4**	RO
2613	**P20.3.4.7**	**Operation Mode** This parameter specifies the operation mode of SWD card. 0 = PD2x16Bit Profil. 1 = 8 Bit Profil. 2 = 1-0-A switch.	**1, 2, 3, 4**	RO
2614	**P20.3.4.8**	**PDP-Telegram Selection** PNU922 which specifies the telegram selection for application class.	**1, 2, 3, 4**	RO
2615	**P20.3.4.9**	**Fault Counter PDP** PNU944 which specifies the fault message counter in fault buffer.	**1, 2, 3, 4**	RO
2616	**P20.3.4.10**	**Fault Situations Max** PNU950 which specifies the scaling of the fault buffer.	**1, 2, 3, 4**	RO
2618	**P20.3.4.11**	**PDP-Profil Number** PNU965 which specifies the profile and version.	**1, 2, 3, 4**	RO
2619	**P20.3.4.12**	**PDP-Control Word** PNU967 which specifies the control word received from PLC.	**1, 2, 3, 4**	RO
2620	**P20.3.4.13**	**PDP-Status Word** PNU968 which specifies the status word sent to PLC.	**1, 2, 3, 4**	RO
2621	**P20.3.4.14**	**PDP-Max Block Length** PNU974.0 which specifies the maximum block length in byte, for the parameter request and response block, which is supported by the parameter manager.	**1, 2, 3, 4**	RO
2622	**P20.3.4.15**	**PDP-No Of Multi-parameter** PNU974.1 which specifies the max. number of parameter requests per multi-parameter request: 0 = Reserved. 1 = The parameter manager does not support multi-parameter access service.	**1, 2, 3, 4**	RO
2623	**P20.3.4.16**	**PDP-Max Latency** PNU974.2 which specifies the maximum latency time for the processing of a parameter request (time between request and response without time consumed on the communication line for a worst case scenario). The latency time is calculated by multiplication of the value in this subindex with 10 ms.	**1, 2, 3, 4**	RO
2624	**P20.3.4.17**	**PDP-DO Manufacturer** PNU975.0 which specifies the manufacturer code.	**1, 2, 3, 4**	RO
1451	**P20.3.4.18**	**PDP-DO Device Type** PNU975.1 which specifies the manufacturer product code.	**1, 2, 3, 4**	RO
2625	**P20.3.4.19**	**PDP-DO FW-Interface** PNU975.2 which specifies the product firmware version.	**1, 2, 3, 4**	RO

Modbus ID	Code	Parameters	Application	RO/RW
2626	**P20.3.4.20**	**PDP-DO FW-Year** PNU975.3 which specifies the firmware version year.	**1, 2, 3, 4**	RO
2627	**P20.3.4.21**	**PDP-DO FW-Day Month** PNU975.4 which specifies the firmware version DD MM.	**1, 2, 3, 4**	RO
2628	**P20.3.4.22**	**PDP-DO NoOfDOs** PNU975.5 which specifies the PROFIdrive DO type class: Bit:0 = Axis type implementation.	**1, 2, 3, 4**	RO
2629	**P20.3.4.23**	**PDP-DO Subclass** PNU975.6 which specifies the PROFIdrive DO sub class 1: Bit:0 = Application Class 1 supported.	**1, 2, 3, 4**	RO
1500	**P20.4.1**	**IP Address Mode** This parameter defined the IP address configuration mode for EIP/Modbus TCP. 0 = Static IP. 1 = DHCP with AutoIP.	**1, 2, 3, 4**	RW
1507	**P20.4.2**	**Active IP Address** Reads the current active IP address.	**1, 2, 3, 4**	RO
1509	**P20.4.3**	**Active Subnet Mask** Reads the current active Subnet mask.	**1, 2, 3, 4**	RO
1511	**P20.4.4**	**Active Default Gateway** Reads the current active default gateway.	**1, 2, 3, 4**	RO
1513	**P20.4.5**	**MAC Address** Reads the current MAC address.	**1, 2, 3, 4**	RO
1501	**P20.4.6**	**Static IP Address** Defines the static IP address.	**1, 2, 3, 4**	RW
1503	**P20.4.7**	**Static Subnet Mask** Defines the static Subnet mask.	**1, 2, 3, 4**	RW
1505	**P20.4.8**	**Static Default Gateway** Defines the static default gateway.	**1, 2, 3, 4**	RW
608	**P20.4.9**	**Ethernet IP Protocol Status** Indicates if ethernet protocol is active or not. 0 = Off. 1 = Operational. 2 = Faulted.	**1, 2, 3, 4**	RO
2518	**P20.4.10**	**EIP Fault Response** Defines the Fieldbus fault condition for ethernet IP communication. 0 = Only in Fieldbus control mode - When Fieldbus is the control place and Fieldbus fault is active, the drive will fault on loss of communications. If not in Fieldbus control, place will not fault. 1 = In all control modes - No matter the control place setting, if communication is lost, Fieldbus fault response will occur.	**1, 2, 3, 4**	RW
609	**P20.5.1**	**Connection Limit** Maximum number of connections allowed to the drive.	**1, 2, 3, 4**	RO
610	**P20.5.2**	**Modbus TCP Unit ID** Unit identifier unit value for Modbus TCP.	**1, 2, 3, 4**	RW
611	**P20.5.3**	**Comm Timeout Modbus TCP** Selects the time it waits before a communication fault occurs over Ethernet.	**1, 2, 3, 4**	RW
612	**P20.5.4**	**Modbus TCP Protocol Status** This parameter shows the protocol status for Modbus TCP communication. 0 = Stopped. 1 = Operational. 2 = Faulted.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
2517	**P20.5.5**	**Modbus TCP Fault Response** Defines the Fieldbus fault condition for Modbus TCP communication. 0 = Only in Fieldbus control mode - When Fieldbus is the control place and Fieldbus fault is active, the drive will fault on loss of communications. If not in Fieldbus control, place will not fault. 1 = In all control modes - No matter the control place setting, if communication is lost, Fieldbus fault response will occur.	**1, 2, 3, 4**	RW
74	**P20.5.6**	**Modbus TCP Trusted IP Enable** Defines the IP addresses in the whitelist, a setting of 192.168.1.255 enables all connections on the local subnet.	**1, 2, 3, 4**	RW
608	**P20.5.7**	**Trusted IP White List** Enables IP whitelisting. Devices not in the whitelist will not be able to establish communications with the drive.	**1, 2, 3, 4**	RW
2915	**P20.6.1**	**WebUI Protocol Status** This parameter shows the protocol status for webserver communication. 0 = Off. 1 = Operational. 2 = Faulted.	**1, 2, 3, 4**	RO
2916	**P20.6.2**	**WebUI Fault Response** Defines the Fieldbus fault condition for webserver communication. 0 = Only in Fieldbus control mode - When Fieldbus is the control place and Fieldbus fault is active, drive will fault on loss of communications, if not in Fieldbus control place will not fault. 1 = In all control modes - No matter the control place setting, if communication is lost Fieldbus fault response will occur.	**1, 2, 3, 4**	RW
2919	**P20.6.3**	**WebUI Communication Timeout** Selects the time it waits before a communication fault occurs over the webserver.	**1, 2, 3, 4**	RW
1997	**P20.7.1**	**Ethernet based protocol select** Selects the active communication protocol on the Ethernet I/P port. 0 = Disabled. 1 = Ethernet IP.	**1, 2, 3, 4**	RW
1942	**P20.7.2**	**Modbus TCP enable** Enables Modbus TCP communications. Must be enabled to connect to Power Xpert inControl.	**1, 2, 3, 4**	RW
2921	**P20.7.3**	**WebUI Enable** Enables web server configuration and monitoring page.	**1, 2, 3, 4**	RW
340	**P21.1.1**	**Language** This parameter offers the ability to control the frequency converter through the keypad in the language of your choice. It allows the user to select one of three different languages including English. English is set as default. The user will need to do a firmware update via FUT (firmware update tool) to load any other of the two languages within the available languages. Block 0 - selected language at firmware update. Block 1 - select language at firmware update Pre-Load from factory 0 = English 1 = 中文 2 = Deutsch	**1, 2, 3, 4**	RW
142	**P21.1.2**	**Application** Use this parameter to set the active application marco to use.	**1, 2, 3, 4**	RW
619	**P21.1.3**	**Parameter Sets** This parameter allows you to reload the factory default parameter values, and to store and load two customized parameter sets. 0 = No. 1 = Load factory default parameters. 2 = Reload set 1. 3 = Reload set 2. 4 = Store parameter set1. 5 = Store parameter set2. 6 = Reset. 7 = Reload defaults VM.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
620	**P21.1.4**	**Up to Keypad** This function uploads all existing parameter groups to the keypad. 0 = No . 1 = Yes (all parameters).	**1, 2, 3, 4**	RW
621	**P21.1.5**	**Down from Keypad** This function downloads one or all parameter groups from the keypad to the drive. 0 = No. 1 = Yes (all parameters).	**1, 2, 3, 4**	RW
623	**P21.1.6**	**Param Comparison** Use this parameter to initiate a parameter comparison function. You can compare the actual parameter values to the values of your customized parameter sets and those loaded to the control keypad. The actual parameter values are first compared to those of the customized parameter set1. If no differences are detected, a "0" is displayed on the lowermost line of the keypad. If any of the parameter values differ from those of the set1 parameters, the number of the deviations is displayed together. By pressing the right arrow button once again, you will see both the actual value and the value it was compared to. In this display, the value on the description line (in the middle) is the default value, and the one on the value line (lowermost line) is the edited value. You can also edit the actual value by pushing the right arrow button. Actual values can also be compared to set2, factory settings and keypad set values.	**1, 2, 3, 4**	RW
624	**P21.1.7**	**Password** The application selection can be protected against unauthorized changes with the password function. When the password function is enabled, the user will be prompted to enter a password before application changes, parameter value changes, or password changes. By default, the password function is not in use. If you want to activate the password, change the value of this parameter to any number between 1 and 9999. To deactivate the password, reset the parameter value to 0.	**1, 2, 3, 4**	RW
625	**P21.1.8**	**Parameter Lock** Use this parameter to prevent user from changing parameters. User has to come to the parameter to allow changing. When the parameter lock is activated, the text *locked* will appear on the display if you try to edit a parameter value. **Note:** This function does not prevent unauthorized editing of parameter values.	**1, 2, 3, 4**	RW
627	**P21.1.9**	**Multi-monitor Set** Use this parameter lock in the values set for the mult-monitor page and not allow changing unless re-enabled.	**1, 2, 3, 4**	RW
628	**P21.1.10**	**Default Page** This parameter sets the view to which the display automatically moves as the time-out time expires or when the keypad power is switched on. If the default page value is 0, the function is not activated, i.e., the last displayed page remains on the keypad display.	**1, 2, 3, 4**	RW
629	**P21.1.11**	**Time-out Time** Use this parameter to set the time after which the keypad display returns to the default page, if no keypad keys are pressed. **Note**: If the default page value is 0, the Time-out time setting has no effect.	**1, 2, 3, 4**	RW
630	**P21.1.12**	**Contrast Adjust** If the remote keypad display is not clear, you can adjust the keypad contrast with this parameter.	**1, 2, 3, 4**	RW
631	**P21.1.13**	**Backlight Time** Use this parameter to set the time to illuminate the display.	**1, 2, 3, 4**	RW
632	**P21.1.14**	**Fan Control** This function allows you to control the drive cooling fan. You can set the fan to run: 0 = Continuous-fan runs continuously. 1 = Temperature - Based on the temperature of the unit. The fan is switched on automatically when the heat sink temperature reaches 60°C. The fan receives a stop command when the heat sink temperature falls to 55°C. The fan runs for about a minute after receiving the stop command or switching on the power, as well as after changing the value from "Continuous" to "Temperature." 2 = Run follow - After power up, the fan is stopped until the run command is given and then fan runs continuously. This is mainly made for common DC-bus systems to prevent cooling fans to load charging resistors on power up moment.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
633	**P21.1.15**	**Keypad ACK Time-out** This function allows the user to change the timeout of the keypad acknowledgement time. This is the communication performed between the control module and the keypad. This would be adjusted when using long communication cables between drive and a keypad to delay message time outs. **Example:** • Transfer delay between the frequency converter and the PC = 600 ms. • The value of HMI acknowledge time-out is set to 1200 ms (2 x 600, sending delay + receiving delay). • The corresponding setting shall be entered in the [Misc]-part of the file. It must also be considered that intervals shorter than the HMI acknowledge time-out time cannot be used in frequency converter drive monitoring.	**1, 2, 3, 4**	RW
634	**P21.1.16**	**Keypad Retry Number** With this parameter, you can set the number of times the drive will try to receive acknowledgement when it has not been received within the acknowledgement time (HMI acknowledge time-out) or if the received acknowledgement is faulty.	**1, 2, 3, 4**	RW
626	**P21.1.17**	**Startup Wizard** The Startup Wizard facilitates commissioning the drive. If selected Enable, the Startup Wizard prompts operator for application desired and then advances parameters through the start-up parameter list/ Application Mini wizard in keypad. After completion, it allows the user to go to the Main menu or default page and this parameter is set to Disabled. The Startup Wizard is always enabled for the initial power up of the drive. By setting this parameter to Disable without going through the Startup Wizard, it will not cause it to be active on Start up. If user goes into Start Up Wizard after completion or defaults drive the Startup Wizard will be Enabled. 0 = Enabled. 1 = Disabled.	**1, 2, 3, 4**	RW
2412	**P21.1.18**	**Jog Soft Key Hidden** Use this parameter to hide the jog function from the soft key buttons. 0 = Disable. 1 = Enable.	**1, 2, 3, 4**	RW
2413	**P21.1.19**	**Reverse Soft Key Hidden** Use this parameter to hide the reverse function from the soft key buttons. 0 = Disable. 1 = Enable.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
2424	**P21.1.20**	**Output Display Unit** Allows for changing the monitor value to a desired unit that will reflect the application. From there with process unit it will allow setting a min./max. limit for the value to display desired output. 0, PERCENTAGE, %; 1 = 1/min; 2 = rpm; 3 = ppm; 4 = pps; 5 = l/s; 6 = l/min; 7 = l/h; 8 = kg/s; 9 = kg/min; 10 = kg/h; 11 = m3/s; 12 = m3/min; 13 = m3/h; 14 = m/s; 15 = mbar; 16 = bar; 17 = Pa; 18 = kPa; 19 = mVS; 20 = kW; 21 = Deg. C; 22 = GPM; 23 = gal/s; 24 = gal/min; 25 = gal/h; 26 = lb/s; 27 = lb/min; 28 = lb/h; 29 = CFM; 30 = ft3/s; 31 = ft3/min; 32 = ft3/h; 33 = ft/s; 34 = in wg; 35 = ft wg; 36 = PSI; 37 = lb/in2; 38 = HP; 39 = Deg. F; 40 = PA; 41 = WC; 42 = HG; 43 = ft; 44 = m; 45 = Hz; 46 = strokes/min	**1, 2, 3, 4**	RW
2460	**P21.1.21**	**Output Display Unit Min.** Use this parameter to set the minimum scaled value when changing the display unit to a value other than the default Hz.	**1, 2, 3, 4**	RW
2425	**P21.1.22**	**Output Display Unit Max.** Use this parameter to set the maximum scaled value when changing the display unit to a value other than the default Hz.	**1, 2, 3, 4**	RW
75	**P21.1.23**	**Keypad Lock Password** The keypad can be protected against unauthorized changes with the keypad lock function after no keys have been pressed for 5 minutes. When the password function is enabled, the user will be prompted to enter a password before keypad display parameter or response to key press except up/down/left/right. By default, the password function is not in use. If you want to activate the password, change the value of this parameter to any number between 1 and 9999. To deactivate the password, reset the parameter value to 0.	**1, 2, 3, 4**	RW

Modbus ID	Code	Parameters	Application	RO/RW
640	P21.2.1	**Keypad Software Version** Keypad Firmware Version.	1, 2, 3, 4	RO
642	P21.2.2	**Motor Control Software Version** DSP/motor control software version.	1, 2, 3, 4	RO
644	P21.2.3	**Application Software Version** MCU/application software version.	1, 2, 3, 4	RO
1714	P21.2.4	**Software Bundle Version** Software bundle version.	1, 2, 3, 4	RO
646	P21.3.1	**Brake Chopper** When the frequency converter is decelerating the motor, the inertia of the motor and the load is fed into an external brake resistor. This enables the frequency converter to decelerate the load with a torque equal to that of acceleration (provided that the correct brake resistor has been selected). 0 = No brake chopper used. 1 = Brake chopper in use and tested when running. Can be tested also in READY state. 2 = External brake chopper (no testing). 3 = Used and tested in READY state and when running. 4 = Used when running (no testing).	1, 2, 3, 4	RO
647	P21.3.2	**Brake Resistor** The hardware information - Indication of the brake resistor status being connected or disconnected.	1, 2, 3, 4	RO
648	P21.3.3	**Serial Number** Serial number of the drive.	1, 2, 3, 4	RO
1270	P21.3.4	**Power Unit Serial Number** Power unit serial number.	1, 2, 3, 4	RO
1276	P21.3.5	**Control Unit Serial Number** Control board serial number.	1, 2, 3, 4	RO
566	P21.4.1	**Real Time Clock** This parameter provides the ability to see and adjust the time clock settings in the drive. Formatted in MM.DD.YY, HH:MM:SS.	1, 2, 3, 4	RW
582	P21.4.2	**Daylight Saving** Daylight saving rule. 0 = Off 1 = EU 2 = US 3 = Russia	1, 2, 3, 4	RW
601	P21.4.3	**Total MWh count** Total megawatt hours of the drive output.	1, 2, 3, 4	RO
603	P21.4.4	**Total Power Day Count** Total time power is on, days count (not re-settable).	1, 2, 3, 4	RO
606	P21.4.5	**Total Power Hr Count** Total time power is on, hours count (not re-settable).	1, 2, 3, 4	RO
604	P21.4.6	**Trip MWh Count** Energy consumption MWh meter (re-settable).	1, 2, 3, 4	RW
635	P21.4.7	**Clear Trip MWh Count** Resets megawatts hours counter and clears energy meter in the menu.	1, 2, 3, 4	RW
636	P21.4.8	**Trip Power Day Count** Time power is on, days count (re-settable).	1, 2, 3, 4	RW
637	P21.4.9	**Trip Power Hr Count** Number of hours the drive has been running a motor since the last reset.	1, 2, 3, 4	RW
639	P21.4.10	**Clear Trip Power Count** This parameter will reset the trip power on day and hour count.	1, 2, 3, 4	RW

Appendix B—Fault log

Under this menu, you can find Active faults, History faults and Fault codes.

Table 210. Active faults.

Menu	Function	Note
Active Faults	When a fault/faults appear(s), the display with the name and fault time of the fault will be pop. Press DETAIL to see the fault data. The Active Faults submenu shows the list of faults. Select the fault and push DETAIL to see the fault data.	The fault remains active until it is cleared with the Reset button (push for 2s) or with a reset signal from the I/O terminal or Fieldbus. The memory of active faults can store the maximum of 10 faults in the order of appearance.

Table 211. History faults.

Menu	Function	Note
History Faults	10 latest faults are stored in the Fault history, Select the fault and push DETAIL to see the fault data.	The history fault will be stored until it is cleared with the OK button (push for 5s). The memory of active faults can store the maximum of 10 faults in the order of appearance.

Fault codes and descriptions

Configurable 1 = The fault type of this fault is configurable, fault type can be configured as
0 = No Action; 1 = Warning; 2 = Fault; 3= Fault, Coast

Fault code	Fault name	Fault type	Default fault type	CIP Code	PROFI Code	Possible cause	Remedy
1	Over Current	Fault		0x2310	8976	AC drive has detected too high a current (>4*IH) in the motor cable: • Sudden heavy load increase • Short circuit in motor cables • Unsuitable motor	• Check loading • Check motor • Check cables and connections • Make identification run • Check ramp times
2	Over Voltage	Fault		0x3210	12816	The DC-link voltage has exceeded the limits defined: • Too short a deceleration time • Brake chopper is disabled • High overvoltage spikes in supply • Start/Stop sequence too fast	• Make deceleration time longer • Use brake chopper or brake resistor (available as options) • Activate overvoltage controller • Check input voltage
3	Earth Fault	Configurable	Fault	0x2330	9008	Current measurement has detected that the sum of motor phase current is not zero: • Insulation failure in cables or motor	Check motor cables and motor
5	Charging Switch	Fault		0xA000	12849	The charging switch is open, when the START command has been given: • Faulty operation • Component failure	• Reset the fault and restart • Should the fault re-occur, contact the distributor near to you
6	Emergency Stop (Ext. Fault-AR)	Fault		0xA001	21121	• Emergency signal from DI is inactive.	• Close input signal from DI.
7	Saturation Trip	Fault		0xA002	29040	Short circuit in motor cables. • IGBT module is damaged.	Check cables and connections. Reset the fault and restart. Verify that EMC screw is installed. Should the fault re-occur, contact the distributor near to you.
9	UnderVoltage	Configurable	Fault	0x3220	12576	DC link voltage is under the voltage limits defined: • Most probable cause: Too low a supply voltage • AC drive internal fault • Defect input fuse • External charge switch not closed **Note**: This fault is activated only if the drive is in Run state.	In case of temporary supply voltage break reset the fault and restart the AC drive Check the supply voltage. If it is adequate, an internal failure has occurred. Contact the distributor near you
10	Input Phase Superv	Configurable	Fault	0xA004	8528	Input line phase is missing	Check supply voltage, fuses and cable
11	Output Phase Superv	Configurable	Fault	0xA005	9040	Current measurement has detected that there is no current in one motor phase	Check motor cable and motor

Fault code	Fault name	Fault type	Default fault type	CIP Code	PROFI Code	Possible cause	Remedy
12	Brake Chopper Superv	Fault		0x7110	28944	• No brake resistor installed • Brake resistor is broken • Brake chopper failure	Check brake resistor and cabling. If these are OK, the chopper is faulty. Contact the distributor near you
13	Drive UnderTemp	Configurable	Warning	0x4320	16928	Too low temperature measured in power unit's heat sink or board. Heat sink temperature is under –10°C.	
14	Drive OverTemp	Fault		0x4310	16912	Too high temperature measured in power unit's heat sink or board. Heat sink temperature is over 90°C.	• Check the correct amount and flow of cooling air • Check the heat sink for dust • Check the ambient temperature • Make sure that the switching frequency is not too high in relation to ambient temperature and motor load
15	Motor Stalled	Configurable	No Action	0x7121	28963	Motor is stalled.	Check motor and load
16	Motor Over Temp	Configurable	No Action	0x4210	17168	Motor is too hot, based on either the drive's estimate or on temperature feedback.	Decrease motor load. If no motor overload exists, check the temperature model parameters
17	Motor Under Load	Configurable	No Action	29	28979	Condition defined by parameter P9.15~P9.17 have been valid longer than the time defined by P9.18.	Check load
18	IP Address Conflict	Configurable	Warning	0xA006	30070	IP setting issue.	Check settings for IP address, verify no duplicates are on the network.
19	Power Board EEPROM Fault	Fault		0xA007	21795	Power board EEPROM fault, memory lost in EEPROM.	Cycle power to drive. Try updating software, if issue continues contact Distributor near you.
20	FRAM Fault	Fault		0xA008	21777	FRAM data error in FRAM memory.	Cycle power to drive. Try updating software, if issue continues contact a Distributor near you.
21	S-Flash Fault	Warning		0xA009	21796	Serial flash error, serial flash memory failed.	Cycle power to drive. Try updating software, if issue continues contact a Distributor near you.
22	Speed Deviation	Fault		0xA05C	21522	Estimated speed is greater than 115% of maximum frequency. Or current loop is oscillating.	Check motor parameters and run identification. Adjust the Observer Kp.
25	MCU WatchDog Fault	Fault		0x6010	24848	Watchdog register overflows in MCU.	Cycle power to drive. Try updating software, if issue continues contact a Distributor near you.
26	Start-up Prevent	Fault		0xA00A	35585	The time when Interlock signal activates is over setting time.	Stop drive and resend start command.
29	Thermistor Fault	Configurable	Fault	0x7300	28978	Option board or control board thermistor resistor lager than 4.7K	Thermistor open or short, over temperature
32	Fan Cooling	Fault		0xA00B	28689	Fan is damaged or stalled.	Check fan and fan connected wires, verify 24 Vdc is supplied to fan.
36	Compatibility Fault	Fault		0xA061	24849	The control board isn't match with the power board.	Cycle power to drive. Try updating software, if issue continues contact a Distributor near you.
37	Device Change	Warning		0xA00C	35360	Power board or option card change.	Alarm will reset
38	Device Added	Warning		0xA00D	35361	Power board or option board added.	Device is ready for use Old parameter settings will be used
39	Device Removed	Fault		0xA00E	35362	Optional board removed from slot, or power board removed from control board.	Device no longer available in drive.
40	Device Unknown	Fault		0xA00F	35363		"Check EEPROM connection. Check board connection on slot A/B Power cycle to drive."
41	IGBT Over Temp	Fault		66	16913	IGBT temperature is too high.	• Check output loading • Check motor size • Decrease switching frequency
44	Internal COM Not Synchronized	Warning		0xA043	22020	The MCU is unable to execute the given code in the time allowed. The MCU is operating at a clock frequency that is too low.	Contact a Distributor near you.

Fault code	Fault name	Fault type	Default fault type	CIP Code	PROFI Code	Possible cause	Remedy
45	Power Part Not Connected	Warning		0xA044	12611	The electrical connection between the two control units has been disconnected.	Verify that the interconnect cable between the two control units has been securely connected at each end. Check the interconnect cable between the two control units for open circuits.
46	Overload Device	Fault		0xA045	21604	The power of the drive is too high.	Decrease the load. Examine the dimensions of drive. Examine if it is too small for the load.
47	Current Class Changed	Fault		0xA046	21601	The current class has changed from unconfigured to configured.	Contact a Distributor near you.
48	Other Fault Power Part	Fault		0xA047	21602	A fault has occurred that has not been mapped to the MCU.	Contact a Distributor near you.
49	Power Part Not Configured	Fault		0xA048	21603	The drive has not been configured at the factory.	Contact a Distributor near you.
50	AI < 4 mA (4 to 20 mA)	Configurable	No Action	0xA011	29520	Loss in analog input signal, dropped below 4 mA.	Verify analog input current reference value on either AI1 or AI2, check cabling.
51	External Fault	Configurable	Fault	0x9000	36864	Digital input is activated for external fault input. • The real time isn't normal	Check digital input settings and verify input level, could be an external device causing fault.
52	Keypad Comm. Fault	Configurable	Fault	0xA012	21264	The connection between the control keypad and frequency converter is broken.	Check keypad connection and possible keypad cable. Check the local reference is keypad reference or the local control place is keypad, and the keypad communication fault protection is not "NO action".
54	Option Card Fault	Configurable	Fault	0xA013	35073	Defective option card or option card slot.	Check right option card and option card slot connections. Check board status on keypad for exact cause of fault. Contact distributor nearest you.
55	Real Time Clock fault	Configurable	Warning	0xA015	35344	• Communication between MCU and RTC chip is not normal. • The power of RTC chip is not normal. • The real time is not normal.	Check the RTC chip, power cycle to drive. If issue continues, contact distributor near you.
56	PT100 Fault	Configurable	Fault	0xA016	29536	Temperature is beyond the limit of sensing capacity of PT100.	PT100 short, open or over temperature, check PT100 temperature probe.
57	Motor ID fault	Fault		0xA017	29072	The Motor parameters Identification running was not completed successfully.	Check motor size. Verify the input and output wiring is connected properly.
58	Current Measure Fault	Fault		0x2100	9217	Current measurement is out of range.	Restart the drive again. Should the fault re-occur, contact the distributor near to you.
60	Control Board OverTemp	Fault		0x4300	16914	Control board is over +85 degrees or under –30 degrees.	Check NTC resistor. Check control board temperature.
61	Internal Control Supply	Fault		0x5112	20737	+24V port voltage is over 27V or under 17V.	Check voltage range of +24V on terminals 12 to 13. If voltage is out of range contact distributor near you.
63	Current Unbalance	Fault	Fault	0xA052	9056	Frame 8 only: current unbalanced between power units.	Check the motor cables and connections. Check the output filters (dV/dt, sine). Reset the fault and restart the drive. If the fault recurs, contact your local/nearest service center or distributor. Please, report carefully all the used software, application and all options.
64	Replace Battery	Configurable	Warning	0xA019	35345	RTC Battery voltage is too low.	Check the RTC battery voltage, contact distributor near you for replacement battery.
65	Replace Fan	Configurable	Warning	0xA01A	28688	Fan life is less than 2 months.	Check the fan, clean out any contamination, contact distributor near you for replacement fan.
66	Safe Torque Off	Fault		0xA01B	21665	STO Triggered, STO input is open.	Reset STO Trigger and verify wiring. Reset fault after input is enabled.

Appendix B—Fault log

Fault code	Fault name	Fault type	Default fault type	CIP Code	PROFI Code	Possible cause	Remedy
67	Current Limit Control	Warning		0x2200	8977	The output current has reached the current limit value.	Check the load. Set the acceleration time longer.
68	Over Voltage Control	Warning		0x3310	12817	The DC link voltage has reached its voltage limit value.	Check the input voltage. Set the acceleration/deceleration time longer.
69	System Fault	Fault		0xA01C	21009	Thermistor spi communication error.	Check thermistor chip.
70	System Fault	Fault		0xA01D	22018	MCU send wrong parameters to DSP.	Restart the drive again. Should the fault re-occur, contact the distributor near to you.
71	System Fault	Fault		0xA01E	22019	MCU and DSP communication error.	Restart the drive again. Should the fault re-occur, contact the distributor near to you.
72	Power Board EEPROM Fault	Fault				Power board EEPROM fault, memory lost in EEPROM when initial drive (for FR7 and FR8 only).	Cycle power to drive. Try updating software, if issue continues contact Distributor near you.
73	FRAM Fault	Fault				FRAM chip is broken (for FR7 and FR8 only).	Contact Distributor near you.
74	FRAM Fault	Fault				CRC check fault when access FRAM data (for FR7 and FR8 only).	Try recovery factory default setting if issue continues contact Distributor near you.
75	Power Board EEPROM Fault	Fault				EEPROM chipor I2c circuit is broken (for FR7 and FR8 only).	Contact Distributor near you.
76	Power Board EEPROM Fault	Fault				CRC check fault when access EEPROM data (for FR7 and FR8 only).	Try recovery factory default setting if issue continues contact Distributor near you.
77	S-Flash Fault	Warning				External serial flash chip is broken (for FR7 and FR8 only).	Contact Distributor near you.
80	Fieldbus Fault	Configurable	Fault			Loss of communication with BACnet MSTP, and the fieldbus reference is the remote reference OR the fieldbus control place is the remote control place.	Check BACnet MSTP communication wiring. Verify drive parameter are set correctly. Check master programming to verify proper addressing.
82	Bypass Overload	Fault		0xA025	28980	Over load when motor is in bypass mode	Check motor connection situation.
83	Fieldbus Fault	Configurable	Fault	0xA026	30064	Loss of communication with Modbus RTU, and the fieldbus reference is the remote reference OR the fieldbus control place is the remote control place.	Check RS-485 communication wiring. Verify drive parameter are set correctly. Check master programming to verify proper addressing.
84	Fieldbus Fault	Configurable	Fault	0xA027	30065	Loss of communication with Modbus TCP, and the fieldbus reference is the remote reference OR the fieldbus control place is the remote control place.	Check Ethernet communication wiring. Verify drive parameter are set correctly. Check master programming to verify proper addressing.
85	Fieldbus Fault	Configurable	Fault	0xA028	30066	Loss of communication with BACnet, and the fieldbus reference is the remote reference OR the fieldbus control place is the remote control place, and the fault protection is not “NO action”.	Check RS-485 communication wiring. Verify drive parameter are set correctly. Check BACnet master configuration programming to verify proper addressing.
86	Fieldbus Fault	Configurable	Fault	0x8100	30067	Loss of communication with EtherNet/IP, and the fieldbus reference is the remote reference OR the fieldbus control place is the remote control place, and the fault protection is not “NO action”.	Check Ethernet communication wiring. Verify drive parameter are set correctly. Check EIP master configuration programming to verify proper addressing.
87	Fieldbus Fault	Configurable	Fault	0xA029	30068	Loss of communication with Profibus/Canopen/Devicenet master on Slot A, and the fieldbus reference is the remote reference OR the fieldbus control place is the remote control place, and the fault protection is not “NO action”.	Check Profibus/Canopen/Devicenet communication wiring. Verify drive parameter are set correctly. Check Profibus/Canopen/Devicenet master configuration programming to verify proper addressing.

Fault code	Fault name	Fault type	Default fault type	CIP Code	PROFI Code	Possible cause	Remedy
88	Fieldbus Fault	Configurable	Fault	0xA02A	30069	Loss of communication with Profibus/Canopen/ Devicenet master on Slot B, and the fieldbus reference is the remote reference OR the fieldbus control place is the remote control place, and the fault protection is not "NO action".	Check Profibus/Canopen/Devicenet communication wiring. Verify drive parameter are set correctly. Check Profibus/Canopen/Devicenet master configuration programming to verify proper addressing.
89	Under Voltage Stop	Fault		0xA02B	12580	The DC link voltage has reached the Drive under voltage stop limit value.	Check the input voltage.
90	Drive Under Temp	Warning/ Fault		0x3221	16928	• Cold weather mode is not enabled, and unit temperature is less than -10 degree • Cold weather mode is enabled and Under Temp Fault Override is not set, unit temperature is less than -30 degree • Cold weather mode is enabled and Under Temp Fault Override is not set, unit temperature is -20~ -30 degree. The temp <-20 degree when cold weather start time out	If unit temp -20 ~ -10 degree, start motor in cold weather mode. If unit temp <-20 degree, Warm up unit above -20 deg C for proper operation using cold weather mode. If still < -20 degree when cold weather mode time out, try higher output voltage in cold weather mode.
91	Option Card Fault	Configurable	Fault	0xA02C	30103	External supply on the DeviceNet communication connector is not present.	Check voltage and wiring of power supply of the DeviceNet communication.
92	External Fault 2	Configurable	Fault	0xA02D	36865	Digital input is activated for external fault input.	Check digital input settings and verify input level, could be an external device causing fault.
93	External Fault 3	Configurable	Fault	0xA02E	36866	Digital input is activated for external fault input.	Check digital input settings and verify input level, could be an external device causing fault.
94	Pump Lost	Fault		0xA02F	58881	• In single drive control mode of MPFC, include FC, interlock enable, and all interlock signals lost. • In single drive control mode of MPFC, not include FC, interlock enable, and interlock 1 lost. • In multi drive network mode of MPFC, interlock enable, and interlock 1 lost.	Check digital inputs for interlock.
95	Need Alteration	Warning		0xA030	58882	In multi drive network mode of MPFC, run time counter enable and is over limit.	Need to do motor maintenance and then reset run time counter to clear the warning.
97	Pipe Fill Loss	Configurable	No action	0xA031	35587	• If prime pump is disabled, the pipe fill detection value (motor current, motor power or motor torque) is less than pipe fill loss setting level. • If prime pump is enabled and the drive in the prime pump level1 phase, the pipe fill detection value (motor current, motor power or motor torque) is less than prime pump level1 value. • If prime pump is enabled and the drive in the prime pump level2 phase, the pipe fill detection value(motor current, motor power or motor torque) is less than prime pump level2 value. • If PID feedback AI is lost and the feedback AI loss protection is warning: Preset Freq, the pipe fill detection value (motor current, motor power or motor torque) is less than pipe fill loss setting level of PID feedback AI loss.	Check the motor current/power/torque of drive.
98	PID Feedback AI Loss	Configurable	No action	0xA032	33283	The feedback function has relationship with feedback 1/2 and the feedback 1/2 source has relationship with AI, the AI signal range is 1 (20-100%/2-10 V/4-20 mA), the AI value is out of range (AI mode: 0~20 mA, AI < 4 mA or AI > 20 mA, AI mode: 0~10 V, AI < 2 V or AI > 10 V) of PID1 feedback.	Check the AI of PID1 feedback, the AI value whether is out of range or not, the AI range shall be 2~10 V (AI mode is 0~10 V) or 4~20 mA(AI mode is 0~20 mA).

Fault code	Fault name	Fault type	Default fault type	CIP Code	PROFI Code	Possible cause	Remedy
99	PID Feedback AI Loss	Configurable	No action	0xA033	33284	The feedback function has relationship with feedback 1/2 and the feedback 1/2 source has relationship with AI, the AI signal range is 1 (20-100%/2-10 V/4-20 mA), the AI value is out of range (AI mode: 0~20 mA, AI < 4 mA or AI > 20 mA, AI mode: 0~10 V, AI < 2 V or AI > 10V) of PID2 feedback.	Check the AI of PID2 feedback, the AI value whether is out of range or not, the AI range shall be 2~10 V (AI mode is 0~10 V) or 4~20 mA (AI mode is 0~ 20 mA).
100	Fieldbus Fault	Configurable	Fault	0xA034	30002	Smart Wire BUS fieldbus fault.	Check Smart Wire DT communication for loss of connectivity.
101	Option Card Fault	Configurable		0xA035	35120	SMDT board hardware fault.	Check Smart Wire DT card for healthy operation.
102	External Fault	Configurable	Fault	0xA036	36871	External fault from SWD.	Check Smart Wire DT card for external fault configuration.
103	Drive Over Temp Warning	Warning		0xA037	16912	Drive is 10 degrees away from trip point of 90 deg C.	Check the drive degree.
104	Compatibility Fault	Warning		0xA038	22529	DSP firmware is not compatible with MCB firmware.	Check the DSP firmware revision.
105	Compatibility Fault	Warning		0xA039	22532	Keypad firmware is not compatible with MCB firmware.	Check the keypad firmware revision.
106	Compatibility Fault	Warning		0xA03A	22785	IO1 card firmware is not compatible with MCB firmware	Check the IO1 card firmware revision
107	Compatibility Fault	Warning		0xA03B	22786	IO2 card firmware is not compatible with MCB firmware	Check the IO2 card firmware revision
108	Compatibility Fault	Warning		0xA03C	22784	IO3 card firmware is not compatible with MCB firmware	Check the IO3 card firmware revision
109	Compatibility Fault	Warning		0xA03D	22787	IO4 card firmware is not compatible with MCB firmware	Check the IO4 card firmware revision
110	Compatibility Fault	Warning		0xA03E	22788	IO5 card firmware is not compatible with MCB firmware	Check the IO5 card firmware revision
111	Compatibility Fault	Warning		0xA03F	22792	Profibus card firmware is not compatible with MCB firmware	Check the Profibus card firmware revision
112	Compatibility Fault	Warning		0xA040	22806	DeviceNet card firmware is not compatible with MCB firmware	Check the DeviceNet card firmware revision
113	Compatibility Fault	Warning		0xA041	22789	CANOpen card firmware is not compatible with MCB firmware	Check the CANOpen firmware revision
114	Compatibility Fault	Warning		0xA042	22791	SWD card firmware is not compatible with MCB firmware	Check the SWD card firmware revision
115	Fieldbus Fault			0xA049	30067	FieldBus EIP idle fault	Check EtherNet IP master programming to verify proper addressing and ensure Idle communication bit is not set.
118	Reset the fault and restart the drive.	Configurable	No Action	0xA048	35590	PID feedback is less than broken pipe level and the drive output frequency is more than broke pipe frequency for delay time.	
120	If the fault recurs, contact your local/ nearest service center or distributor. Please, report carefully all the used software, application and all options.	MCU	No Action	0xA043	22792	PID1 Low feedback function is active and pid feedback is low than set value.	
121	PID1 High Feedback	Configurable	No Action	0xA044	33286	PID1 high feedback function is active and pid feedback is high than set value.	
122	PID2 Low Feedback	Configurable	No Action	0xA045	33287	PID2 low feedback function is active and pid feedback is low than set value.	
123	PID2 High Feedback	Configurable	No Action	0xA046	33288	PID2 high feedback function is active and pid feedback is high than set value.	
124	OP Cont Interlock Fault	Configurable	Fault	0xA047	22796	OP Cont Interlock function is active.	
133	Fieldbus Fault	Configurable	Fault	0xA050	33120	FieldBus Web UI fault	Check the web connection with RJ45 connector. Verify drive parameters are set correctly. Check the Web UI tool to know if there is proper request going to drive or not.

Fault code	Fault name	Fault type	Default fault type	CIP Code	PROFI Code	Possible cause	Remedy
134	Bumpless Transfer Fail	Warning	warning	0xA053	21123	There is fault currently. There is no start command from new control place after transition.	Check whether there is fault currently. Check whether there is no start command from new control place after transition.
135	CP Interlock Fault Run	Configurable	Fault	0xA054	13569	CP interlock input open and drive in run status.	Check CP interlock input.
136	CP Interlock Fault Stop	Configurable	Warning	0xA055	13570	CP interlock input open and drive in stop status.	Check CP interlock input.

Appendix C—PowerXL Recommended secure hardening guidelines

Introduction

This section “secure configuration” or “hardening” guidelines provide information to the users to securely deploy and maintain this product to adequately minimize the cybersecurity risks to their system.

Eaton is committed to minimizing the Cybersecurity risk in its products and deploys cybersecurity best practices and latest cybersecurity technologies in its products and solutions; making them more secure, reliable and competitive for our customers. Eaton also offers Cybersecurity Best Practices whitepapers to its customers that can be referenced at www.eaton.com/cybersecurity

PowerXL - SECURE CONFIGURATION GUIDELINES

Category	Description
Asset identification and Inventory	Keeping track of all the devices in the system is a pre-requisite for effective management of Cybersecurity of a system. Ensure you maintain an inventory of all the components in your system in a manner in which you uniquely identify each component. To facilitate this PowerXL Series VFD supports the following identifying information - manufacturer, type, serial number, f/w version number, and location. Customers/users can read following information from product label • Model Number • Serial Number • Device Name Information specific to communication protocols is available form parameter menu as below • IP Address Mode • Active IP Address • MAC Address See application manual for these parameter locations.

Restrict Physical access	Industrial Control Protocols don’t offer cryptographic protections at protocol level leaving them exposed to Cybersecurity risk. Physical security is an important layer of defense in such cases. PowerXL Series VFD is designed with the consideration that it would be deployed and operated in a physically secure location.
	• Eaton suggests that physical access to cabinets and/or enclosures containing PowerXL Series VFD and the associated system should be restricted, monitored and logged at all times.
	• Physical access to the communication lines should be restricted to prevent any attempts of wiretapping, sabotage. It’s a best practice to use metal conduits for the communication lines running between one cabinet to another cabinet.
	• Attacker with unauthorized physical access to the device could cause serious disruption of the device functionality. A combination of physical access controls to the location should be used, such as locks, card readers, and/or guards etc.
	• PowerXL Series VFD supports the following physical access ports,
	  • RJ45 connector for removable keypad as well as Modbus RTU communications
	  • RJ45 for EtherNet IP/Modbus TCP communications
	  • Terminal block for Modbus RTU and other Digital IOs
	Eaton suggests access to above physical ports need to be restricted.

Category	**Description**
Restrict Logical access to PowerXL Series Drive	It is extremely important to securely configure the logical access mechanisms provided in PowerXL Series VFD to safeguard the device from unauthorized access. PowerXL Series VFD provides various types of administrative, operational, configuration privilege levels. Eaton recommends that the available access control mechanisms be used properly to ensure that access to the system is restricted to legitimate users only. And, such users are restricted to only the privilege levels necessary to complete their job roles/functions. Eaton recommends below best practices to be followed to ensure adequate cybersecurity of the setup/system • Default credentials are changed upon first login. PowerXL Series VFD should not be commissioned for production with Default credentials, it's a serious Cybersecurity flaw as the default credentials are published in the manuals. Restrict administrative privileges - Threat actors are increasingly focused on gaining control of legitimate credentials, especially those associated with highly privileged accounts. Limit privileges to only those needed for a user's duties. Make sure that the password used in the device is only available to authorized users like Configuring Engineers and not shared among all operational users. • Perform periodic account maintenance to make sure that password is changed whenever there is personnel change. • Change passwords and other system access credentials as appropriate • PowerXL Series VFD is provided with data/access protection mechanism on keypad, follow below steps to utilize it PowerXL Series VFD provides four levels of data protection for users to ensure the security: 1. Lock parameters on keypad. User can lock the parameters through DI or disable change, in which way all the parameters cannot be edited. 2. Lock parameters while motor running. Motor control parameters can only be modified when motor is in stop mode. In which way to enhance the motor security. The parameters are listed in the application manual. 3. Through Power Xpert inControl tool, facility to hide parameters on keypad is available. User can hide the parameters he/she thinks are significant for himself/herself. Such as IP address and so on. 4. Password on keypad. • 0000 means no password, which is the default. • Password range is 0001 ~ 9999. • With password, user can monitor parameters value but need enter password if he/she wants to edit parameters. • User needs to re-enter the password if there is no key operation in 1 min after enter the password. • User needs to enter the old password if he/she wants to change to a new one.
Restrict Network Access	PowerXL Series VFD provides network access to facilitate communication with other devices in the systems and configuration. But this capability could open up a big security hole if it's not configured securely. Eaton recommends segmentation of networks into logical enclaves and restrict the communication to host-to-host paths. This helps protect sensitive information and critical services and limits damage from network perimeter breaches. At a minimum, a utility Industrial Control Systems network should be segmented into a three-tiered architecture (as recommended by NIST SP800-82[R3]) for better security control. Deploy adequate network protection devices like Firewalls, Intrusion Detection / Protection devices, Below are the protocols and their port details available on PowerXL Series VFD. Use below information for configuring the firewalls. PowerXL Series VFD provides below communication protocols – • EtherNet IP protocols on RJ45 connector – enabled by default on port 44818 and 2222 • Modbus TCP protocol on RJ45 connector – enabled by default on port 502 • Modbus RTU on RS485 physical layer – enabled by default • BACnet MS/TP on RS485 physical layer – disabled by default, when this is enabled, Modbus RTU is disabled. All the protocols have dedicated menu structure, and details are described in User's Manual for how to activate or configure them. • Eaton has published detailed information about various Network level protection strategies in Eaton Cybersecurity Considerations for Electrical Distribution Systems [R1].

Category	Description
Logging and Event Management	**Best Practices** • PowerXL Series VFD provides parameters change log and fault log functions for user, to help diagnose the drive 1. Parameters change log: • PowerXL Series VFD will log the parameter information in FRAM when the parameter changes. The max number of 66 items can be logged. New log will rewrite the old one. User cannot clear this fault information. 2. Fault log: • PowerXL Series VFD will log the drive information in FRAM when fault occurs. The max number of 10 items can be logged. New log will rewrite the old one. User can clear the history fault by pressing OK key more than 5 Sec. • PowerXL Series VFD will log the fault information in FRAM when fault occurs. The max number of 50 items can be logged. New log will rewrite the old one. User cannot clear this fault information.
Secure Maintenance	**Best Practices** **Apply Firmware updates and patches regularly** Due to rapidly increasing Cyber Threats in Industrial Control Systems, Eaton implements a comprehensive patch and update process for its products. Users are encouraged to maintain a consistent process to promptly monitor for fresh firmware updates and apply the update whenever required. • The latest firmware can be acquired from the www.eaton.com/drives website. There will be separate link for PowerXL Series VFD FR0 to FR6 and PowerXL Series VFD FR7 & FR8 • Users can also sign up on our website to get emails when new material is released to the site if desired. • Using the PC Tool or verifying on the keypad the current version of firmware can be verified. • For additional information or technical support on Eaton's Variable frequency drive products contact us at TRCDrives@eaton.com or by phone at 800-386-2273 for US customers. For European customers contact us at AfterSalesEGBonn@eaton.com or by phone at +49 (0) 228602-3640 Eaton also has a robust vulnerability response process. In the event of any security vulnerability getting discovered in its products, Eaton patches the vulnerability and releases information bulletin through its cybersecurity website - http://www.eaton.com/cybersecurity and patches through www.eaton.com/drives.

References

[R1] Cybersecurity Considerations for Electrical Distribution Systems (WP152002EN):

http://www.eaton.com/ecm/groups/public/@pub/@eaton/@corp/documents/content/pct_1603172.pdf

[R2] Cybersecurity Best Practices Checklist Reminder (WP910003EN):

http://www.cooperindustries.com/content/dam/public/powersystems/resources/library/1100_EAS/WP910003EN.pdf

Notes:

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Powering Business Worldwide

EATON

Powering Business Worldwide

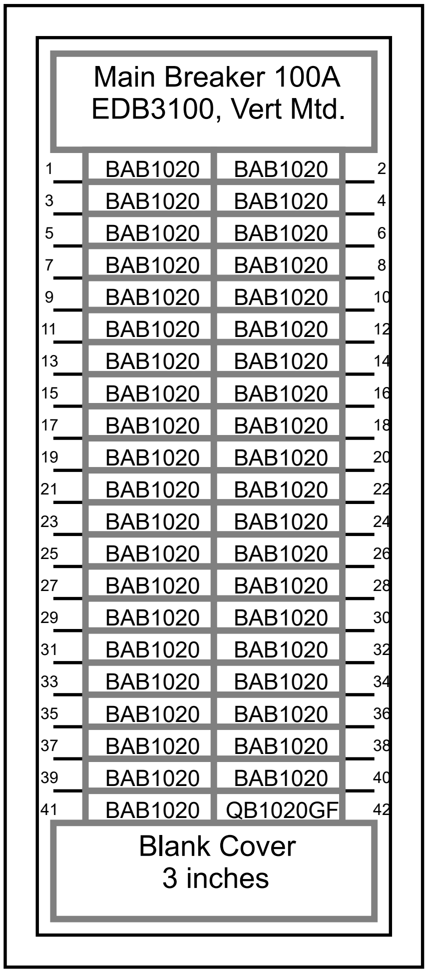
Panelboards

Powering Business Worldwide

Section Table of Contents
Panelboards

Powering Business Worldwide

Drawings



Main Breaker 100A
EDB3100, Vert Mtd.

1	BAB1020	BAB1020	2
3	BAB1020	BAB1020	4
5	BAB1020	BAB1020	6
7	BAB1020	BAB1020	8
9	BAB1020	BAB1020	10
11	BAB1020	BAB1020	12
13	BAB1020	BAB1020	14
15	BAB1020	BAB1020	16
17	BAB1020	BAB1020	18
19	BAB1020	BAB1020	20
21	BAB1020	BAB1020	22
23	BAB1020	BAB1020	24
25	BAB1020	BAB1020	26
27	BAB1020	BAB1020	28
29	BAB1020	BAB1020	30
31	BAB1020	BAB1020	32
33	BAB1020	BAB1020	34
35	BAB1020	BAB1020	36
37	BAB1020	BAB1020	38
39	BAB1020	BAB1020	40
41	BAB1020	QB1020GF	42

Blank Cover
3 inches

General Information **(Section 1 of 1)**

Service Voltage:	208Y/120V 3Ph 4W	**Enclosure:**	Type 12
Bus Rating & Type:	225A Copper	**Neutral Rating:**	225A
Ground Bar:	Std. Bolted Aluminum, Al or Cu cable		
S.C. Rating:	10k A.I.C. Fully Rated		

Main Device Type:	Main Breaker - Top Cable Entry
Main Terminals:	Mechanical - (1) #4-4/0 (Cu/Al)
Neutral Terminals:	Mechanical - (1) #6-300 kcmil (Cu/Al)
Box Catalog No.:	LWPQ2048
Trim:	Standard Trim (Includes Trim)
	Surface Mounted
Box Dimensions:	48.00" [1219.2mm]H x 20.00" [508.0mm]W x 6.5" [165.1mm]D
Min. Gutter Size:	Top = 5.5" [139.7mm] Bottom = 5.5" [139.7mm] Left = 6.0" [152.4mm] Right = 6.0" [152.4mm]

Panel ID Nameplate:		**(1) 4LP1**
Type:	Plastic, adhesive-backed	**(2) 208Y/120V 3Ph 4W**
Color:	White with Black Letters	**(3)**
UL		*****Non-Interchangeable Main Device*****

Trim Lock: T-Handle Lock Assembly
Circuit Directory: Plastic Sleeve with Card
Painted Box:ANSI 61
Main Circuit Breaker Trip Type: Thermal-Magnetic.
Seismic Label (IBC/CBC Seismic Qualified).
Heat Loss - Watts (Est.) = 109
Weight - lbs (Est.) = 150
Wire shall be based on the ampacity of 75°C rated conductors unless otherwise indicated.

Device Modifications:

Ref #	**Description**

Branch Devices

Qty	**Poles**	**Trip**	**Frame**	**Amps**	**kAIC**
41	1	20	BAB	100	10
1	1	20	QB-GF	100	10

Main Devices

Qty	**Poles**	**Trip**	**Frame**	**Amps**	**kAIC**
1	3	100	EDB	225	10

Notes:

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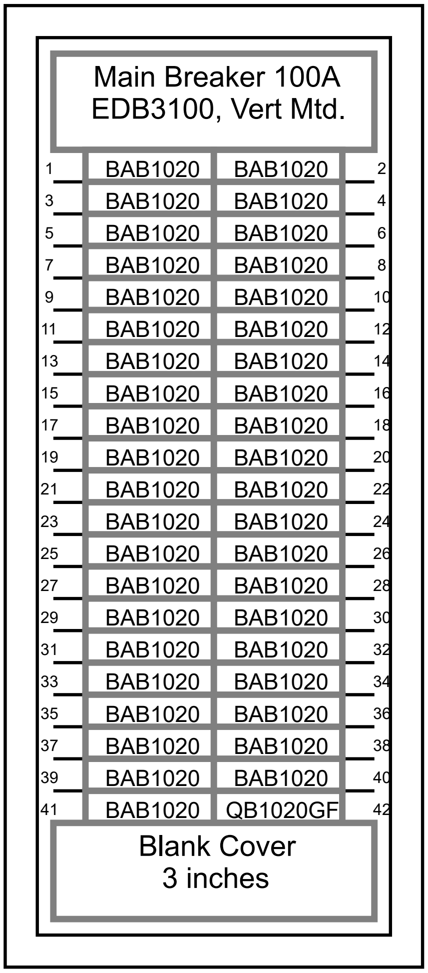
PREPARED BY: SCOTT ARNOLD	DATE: 12/21/2023	**Eaton**	
APPROVED BY:	DATE:	JOB NAME: Taunton WWTF PH2 DESIGNATION: 4LP1	
VERSION: 1.0.0.55		TYPE: PRL1a	DRAWING TYPE: Final
NEG-ALT Number: D7580427X2K2-R001	REVISION: 0	DWG SIZE: A	G.O.: LBS0031682
ITEM: 024I	SHEET: 1 of 1		



General Information **(Section 1 of 1)**

Service Voltage:	208Y/120V 3Ph 4W	**Enclosure:**	Type 12
Bus Rating & Type:	225A Copper	**Neutral Rating:**	225A
Ground Bar:	Std. Bolted Aluminum, Al or Cu cable		
S.C. Rating:	10k A.I.C. Fully Rated		

Main Device Type:	Main Breaker - Top Cable Entry
Main Terminals:	Mechanical - (1) #4-4/0 (Cu/Al)
Neutral Terminals:	Mechanical - (1) #6-300 kcmil (Cu/Al)
Box Catalog No.:	LWPQ2048
Trim:	Standard Trim (Includes Trim) Surface Mounted
Box Dimensions:	48.00" [1219.2mm]H x 20.00" [508.0mm]W x 6.5" [165.1mm]D
Min. Gutter Size:	Top = 5.5" [139.7mm] Bottom = 5.5" [139.7mm] Left = 6.0" [152.4mm] Right = 6.0" [152.4mm]

Panel ID Nameplate:		**(1) 4LP2**
Type:	Plastic, adhesive-backed	**(2) 208Y/120V 3Ph 4W**
Color:	White with Black Letters	**(3)**

UL *****Non-Interchangeable Main Device*****

Trim Lock: T-Handle Lock Assembly
Circuit Directory: Plastic Sleeve with Card
Painted Box:ANSI 61
Main Circuit Breaker Trip Type: Thermal-Magnetic.
Seismic Label (IBC/CBC Seismic Qualified).
Heat Loss - Watts (Est.) = 109
Weight - lbs (Est.) = 150
Wire shall be based on the ampacity of 75°C rated conductors unless otherwise indicated.

Device Modifications:

Ref #	**Description**

Notes:

Branch Devices

Qty	**Poles**	**Trip**	**Frame**	**Amps**	**kAIC**
41	1	20	BAB	100	10
1	1	20	QB-GF	100	10

Main Devices

Qty	**Poles**	**Trip**	**Frame**	**Amps**	**kAIC**
1	3	100	EDB	225	10

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PREPARED BY SCOTT ARNOLD	DATE 12/21/2023	**Eaton**		
APPROVED BY	DATE	JOB NAME DESIGNATION	Taunton WWTF PH2 4LP2	
VERSION 1.0.0.55		TYPE PRL1a	DRAWING TYPE Final	
NEG-ALT Number D7580427X2K2-R001	REVISION 0	DWG SIZE A	G.O. LBS0031682	ITEM 025I
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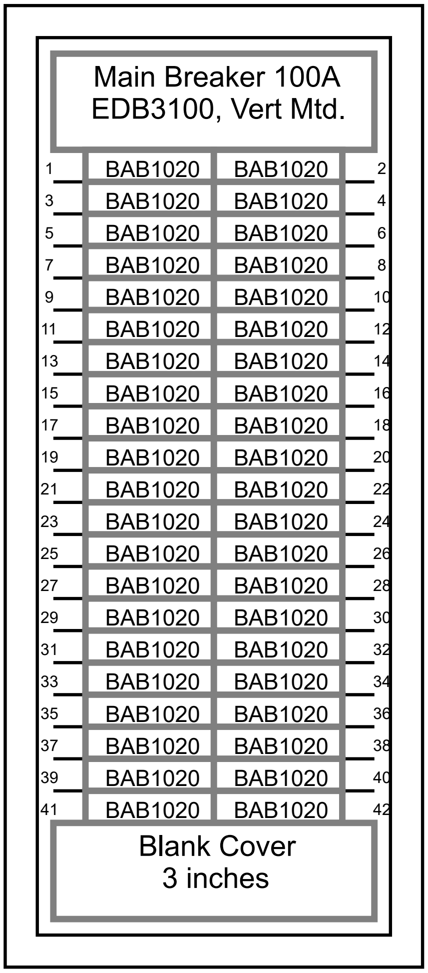


Main Breaker 100A
EDB3100, Vert Mtd.

1	BAB1020	BAB1020	2
3	BAB1020	BAB1020	4
5	BAB1020	BAB1020	6
7	BAB1020	BAB1020	8
9	BAB1020	BAB1020	10
11	BAB1020	BAB1020	12
13	BAB1020	BAB1020	14
15	BAB1020	BAB1020	16
17	BAB1020	BAB1020	18
19	BAB1020	BAB1020	20
21	BAB1020	BAB1020	22
23	BAB1020	BAB1020	24
25	BAB1020	BAB1020	26
27	BAB1020	BAB1020	28
29	BAB1020	BAB1020	30
31	BAB1020	BAB1020	32
33	BAB1020	BAB1020	34
35	BAB1020	BAB1020	36
37	BAB1020	BAB1020	38
39	BAB1020	BAB1020	40
41	BAB1020	BAB1020	42

Blank Cover
3 inches

General Information **(Section 1 of 1)**

Service Voltage:	208Y/120V 3Ph 4W	**Enclosure:**	Type 12
Bus Rating & Type:	225A Copper	**Neutral Rating:**	225A
Ground Bar:	Std. Bolted Aluminum, Al or Cu cable		
S.C. Rating:	10k A.I.C. Fully Rated		

Main Device Type:	Main Breaker - Top Cable Entry
Main Terminals:	Mechanical - (1) #4-4/0 (Cu/Al)
Neutral Terminals:	Mechanical - (1) #6-300 kcmil (Cu/Al)
Box Catalog No.:	LWPQ2048
Trim:	Standard Trim (Includes Trim)
	Surface Mounted
Box Dimensions:	48.00" [1219.2mm]H x 20.00" [508.0mm]W x 6.5" [165.1mm]D
Min. Gutter Size:	Top = 5.5" [139.7mm] Bottom = 5.5" [139.7mm] Left = 6.0" [152.4mm] Right = 6.0" [152.4mm]

Panel ID Nameplate:		**(1) 9LP2**
Type:	Plastic, adhesive-backed	**(2) 208Y/120V 3Ph 4W**
Color:	White with Black Letters	**(3)**
UL		*****Non-Interchangeable Main Device*****

Trim Lock: T-Handle Lock Assembly
Circuit Directory: Plastic Sleeve with Card
Painted Box:ANSI 61
Main Circuit Breaker Trip Type: Thermal-Magnetic.
Seismic Label (IBC/CBC Seismic Qualified).
Heat Loss - Watts (Est.) = 109
Weight - lbs (Est.) = 150
Wire shall be based on the ampacity of 75°C rated conductors unless otherwise indicated.

Device Modifications:

Ref #	**Description**

Notes:

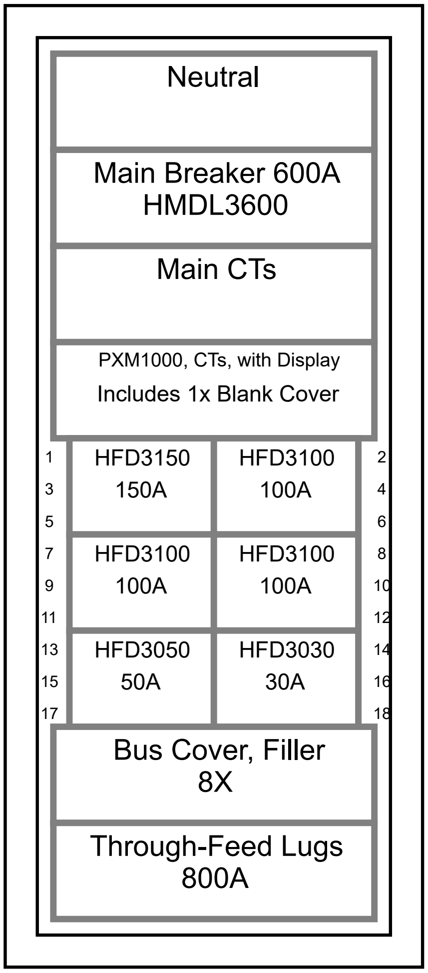
Branch Devices

Qty	**Poles**	**Trip**	**Frame**	**Amps**	**kAIC**
42	1	20	BAB	100	10

Main Devices

Qty	**Poles**	**Trip**	**Frame**	**Amps**	**kAIC**
1	3	100	EDB	225	10

PREPARED BY SCOTT ARNOLD	DATE 12/21/2023	**Eaton**	
APPROVED BY	DATE	JOB NAME Taunton WWTF PH2 DESIGNATION 9LP2	
VERSION 1.0.0.55		TYPE PRL1a	DRAWING TYPE Final
NEG-ALT Number D7580427X2K2-R001	REVISION 0	DWG SIZE A	G.O. LBS0031682
ITEM 026I	SHEET 1 of 1		



General Information

(Section 1 of 1)

Service Voltage:	480Y/277V 3Ph 4W	**Enclosure:**	Type 12
Bus Rating & Type:	800A Copper	**Neutral Rating:**	800A
Ground Bar:	Std. Bolted Aluminum, Al or Cu cable		
S.C. Rating:	65k A.I.C. Fully Rated		

Main Device Type:	Main Breaker - Top Cable Entry
Main Terminals:	Mechanical - (3) 3/0-400 kcmil (Cu/Al)
Neutral Terminals:	Mechanical - (3) #2-500 kcmil (Cu/Al)
Through-Feed Lugs:	Mechanical - (3) #2-500 kcmil (Cu/Al)
Box Catalog No.:	DPC3690
Trim:	Complete Enclosure (Includes Trim) Surface Mounted
Box Dimensions:	90.00" [2286.0mm]H x 36.00" [914.4mm]W x 12.85" [326.4mm]D
Min. Gutter Size:	Top = 10.625" [269.9mm] Bottom = 10.625" [269.9mm] Left = 6" [152.4mm] Right = 8" [203.2mm]

Panel ID Nameplate:		**(1) 4DP1 S1**
Type:	Plastic, adhesive-backed	**(2) 480Y/277V 3Ph 4W**
Color:	White with Black Letters	**(3)**

UL

Trim Lock: T-Handle Lock Assembly
Circuit Directory: Plastic Sleeve with Card
Density Rated Bus
Painted Box:ANSI 61
Main Circuit Breaker Trip Type: 310+ LSI.
Comm. Option, RS-485 plus BACnet/IP and Modbus TCP with Web/HTTP Push
Seismic Label (IBC/CBC Seismic Qualified).
Heat Loss - Watts (Est.) = 368
Wire shall be based on the ampacity of 75°C rated conductors unless otherwise indicated.

Device Modifications:

Ref #	**Description**

Branch Devices

Qty	**Poles**	**Trip**	**Frame**	**Amps**	**kAIC**
3	3	100	HFD	100	65
1	3	50	HFD	100	65
1	3	150	HFD	225	65
1	3	30	HFD	100	65

Main Devices

Qty	**Poles**	**Trip**	**Frame**	**Amps**	**kAIC**
1	3	600	HMDL	800	65

Notes:

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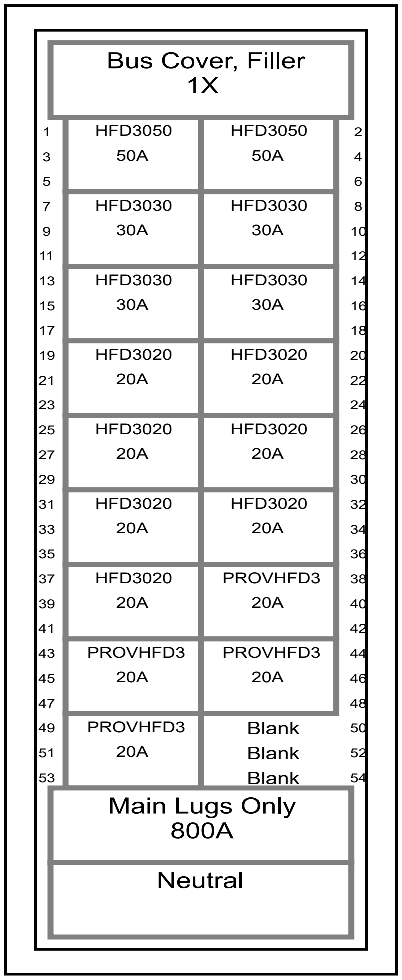
PREPARED BY STEVEN A CARUSO	DATE 12/21/2023	**Eaton**		
APPROVED BY	DATE	JOB NAME DESIGNATION	Taunton WWTF PH2 4DP1 S1	
VERSION 1.0.0.55		TYPE PRL4	DRAWING TYPE Final	
NEG-ALT Number D7580427X2K2-R001	REVISION 0	DWG SIZE A	G.O. LBS0031682	ITEM 027I
				SHEET 1 of 2

Pow-R-Line4 Device Specifications

Ckt #s	Nameplate	Device	Trip	Terminal	Modifications
Main		HMDL3600	600	(3) 3/0-400 kcmil (Cu/Al)	310+LSI Adj. Trip Unit, M Frame
1,3,5		HFD3150	150	(1) #4-4/0 (Cu/Al)	
2,4,6		HFD3100	100	(1) #14-1/0 (Cu/Al)	
7,9,11		HFD3100	100	(1) #14-1/0 (Cu/Al)	
8,10,12		HFD3100	100	(1) #14-1/0 (Cu/Al)	
13,15,17		HFD3050	50	(1) #14-1/0 (Cu/Al)	
14,16,18		HFD3030	30	(1) #14-1/0 (Cu/Al)	
Subfeed		800A-TF-LUGS		(3) #2-500 kcmil (Cu/Al)	

PREPARED BY: STEVEN A CARUSO	DATE: 12/21/2023	**Eaton**	
APPROVED BY	DATE	JOB NAME: Taunton WWTF PH2 DESIGNATION: 4DP1 S1	
VERSION: 1.0.0.55		TYPE: PRL4	DRAWING TYPE: Final
NEG-ALT Number: D7580427X2K2-R001	REVISION: 0	DWG SIZE: A	G.O.: LBS0031682
ITEM: 027I	SHEET: 2 of 2		



Bus Cover, Filler 1X

Circuits	Left	Right	Circuits
1 3 5	HFD3050 50A	HFD3050 50A	2 4 6
7 9 11	HFD3030 30A	HFD3030 30A	8 10 12
13 15 17	HFD3030 30A	HFD3030 30A	14 16 18
19 21 23	HFD3020 20A	HFD3020 20A	20 22 24
25 27 29	HFD3020 20A	HFD3020 20A	26 28 30
31 33 35	HFD3020 20A	HFD3020 20A	32 34 36
37 39 41	HFD3020 20A	PROVHFD3 20A	38 40 42
43 45 47	PROVHFD3 20A	PROVHFD3 20A	44 46 48
49 51 53	PROVHFD3 20A	Blank Blank Blank	50 52 54

Main Lugs Only 800A

Neutral

General Information **(Section 1 of 1)**

Service Voltage: 480Y/277V 3Ph 4W
Enclosure: Type 12
Bus Rating & Type: 800A Copper
Neutral Rating: 800A
Ground Bar: Std. Bolted Aluminum, Al or Cu cable
S.C. Rating: 65k A.I.C. Fully Rated

Main Device Type: Main Lugs Only - Bottom Cable Entry
Main Terminals: Mechanical - (3) #2-500 kcmil (Cu/Al)
Neutral Terminals: Mechanical - (3) #2-500 kcmil (Cu/Al)
Box Catalog No.: DPC2473
Trim: Complete Enclosure (Includes Trim)

Surface Mounted

Box Dimensions: 73.50" [1866.9mm]H x 24.00" [609.6mm]W x 12.85" [326.4mm]D
Min. Gutter Size: Top = 10.625" [269.9mm] Bottom = 10.625" [269.9mm]
Left = 5" [127.0mm] Right = 5" [127.0mm]

Panel ID Nameplate: **(1) 4DP1 S2**
Type: Plastic, adhesive-backed **(2) 480Y/277V 3Ph 4W**
Color: White with Black Letters **(3)**

UL

Trim Lock: T-Handle Lock Assembly
Circuit Directory: Plastic Sleeve with Card
Density Rated Bus
Painted Box:ANSI 61
Seismic Label (IBC/CBC Seismic Qualified).
Heat Loss - Watts (Est.) = 305
Verify neutral terminal provisions and quantity of branch devices.
Wire shall be based on the ampacity of 75°C rated conductors unless otherwise indicated.

Device Modifications:

Ref #	**Description**

Notes:

Branch Devices

Qty	**Poles**	**Trip**	**Frame**	**Amps**	**kAIC**
7	3	20	HFD	100	65
2	3	50	HFD	100	65
4	3		PROVHFD3		
4	3	30	HFD	100	65

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	APPROVED BY	DATE	JOB NAME Taunton WWTF PH2 DESIGNATION 4DP1 S2	
	VERSION 1.0.0.55		TYPE PRL4	DRAWING TYPE Final
NEG-ALT Number D7580427X2K2-R001	REVISION 0	DWG SIZE A	G.O. LBS0031682	ITEM 028I SHEET 1 of 3

Pow-R-Line4 Device Specifications

Ckt #s	Nameplate	Device	Trip	Terminal	Modifications
1,3,5		HFD3050	50	(1) #14-1/0 (Cu/Al)	
2,4,6		HFD3050	50	(1) #14-1/0 (Cu/Al)	
7,9,11		HFD3030	30	(1) #14-1/0 (Cu/Al)	
8,10,12		HFD3030	30	(1) #14-1/0 (Cu/Al)	
13,15,17		HFD3030	30	(1) #14-1/0 (Cu/Al)	
14,16,18		HFD3030	30	(1) #14-1/0 (Cu/Al)	
19,21,23		HFD3020	20	(1) #14-1/0 (Cu/Al)	
20,22,24		HFD3020	20	(1) #14-1/0 (Cu/Al)	
25,27,29		HFD3020	20	(1) #14-1/0 (Cu/Al)	
26,28,30		HFD3020	20	(1) #14-1/0 (Cu/Al)	
31,33,35		HFD3020	20	(1) #14-1/0 (Cu/Al)	
32,34,36		HFD3020	20	(1) #14-1/0 (Cu/Al)	
37,39,41		HFD3020	20	(1) #14-1/0 (Cu/Al)	
38,40,42		PROVHFD3	20	None Available	

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	APPROVED BY	DATE	JOB NAME DESIGNATION	Taunton WWTF PH2 4DP1 S2	
	VERSION 1.0.0.55		TYPE PRL4	DRAWING TYPE Final	
NEG-ALT Number D7580427X2K2-R001	REVISION 0	DWG SIZE A	G.O. LBS0031682	ITEM 028I	SHEET 2 of 3

Pow-R-Line4 Device Specifications

Ckt #s	Nameplate	Device	Trip	Terminal	Modifications
43,45,47		PROVHFD3	20	None Available	
44,46,48		PROVHFD3	20	None Available	
49,51,53		PROVHFD3	20	None Available	
Main		800A-MLO		(3) #2-500 kcmil (Cu/Al)	

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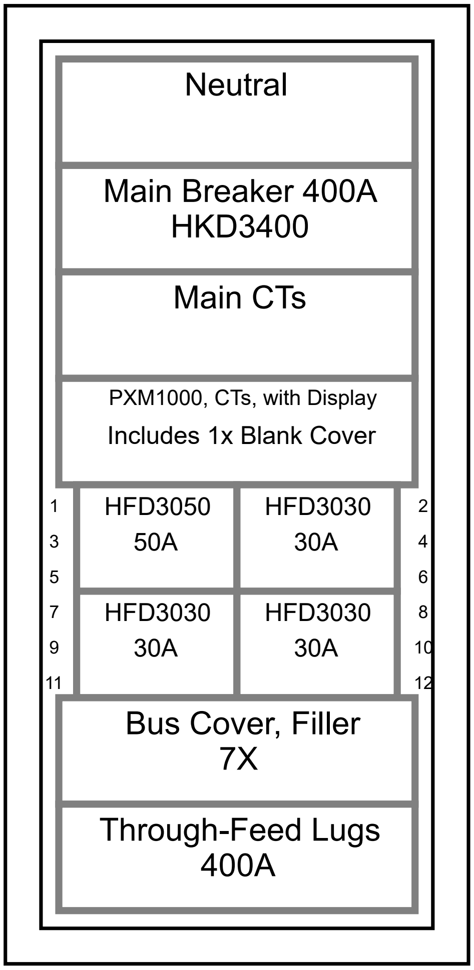
NEG-ALT Number D7580427X2K2-R001	REVISION 0	DWG SIZE A	G.O. LBS0031682	ITEM 028I
				SHEET 3 of 3



General Information

(Section 1 of 1)

Service Voltage: 480Y/277V 3Ph 4W
Enclosure: Type 12
Bus Rating & Type: 400A Copper
Neutral Rating: 400A
Ground Bar: Std. Bolted Aluminum, Al or Cu cable
S.C. Rating: 65k A.I.C. Fully Rated

Main Device Type: Main Breaker - Top Cable Entry
Main Terminals: Mechanical - (1) 500-750 kcmil (Cu/Al)
Neutral Terminals: Mechanical - (2) 3/0-750 kcmil (Cu/Al)
Through-Feed Lugs: Mechanical - (2) #4-500 kcmil (Cu/Al)
Box Catalog No.: DPC3690
Trim: Complete Enclosure (Includes Trim)

Surface Mounted

Box Dimensions: 90.00" [2286.0mm]H x 36.00" [914.4mm]W x 12.85" [326.4mm]D
Min. Gutter Size: Top = 10.625" [269.9mm] Bottom = 10.625" [269.9mm]
Left = 6" [152.4mm] Right = 8" [203.2mm]

Panel ID Nameplate: **(1) 4DP2 S1**
Type: Plastic, adhesive-backed **(2) 480Y/277V 3Ph 4W**
Color: White with Black Letters **(3)**

UL

Trim Lock: T-Handle Lock Assembly
Circuit Directory: Plastic Sleeve with Card
Density Rated Bus
Painted Box:ANSI 61
Main Circuit Breaker Trip Type: 310+ LSI.
Comm. Option, RS-485 plus BACnet/IP and Modbus TCP with Web/HTTP Push
Seismic Label (IBC/CBC Seismic Qualified).
Heat Loss - Watts (Est.) = 146
Wire shall be based on the ampacity of 75°C rated conductors unless otherwise indicated.

Device Modifications:

Ref #	**Description**

Notes:

Branch Devices

Qty	**Poles**	**Trip**	**Frame**	**Amps**	**kAIC**
1	3	50	HFD	100	65
3	3	30	HFD	100	65

Main Devices

Qty	**Poles**	**Trip**	**Frame**	**Amps**	**kAIC**
1	3	400	HKD	400	65

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	VERSION 1.0.0.55		TYPE PRL4	DRAWING TYPE Final
NEG-ALT Number D7580427X2K2-R001	REVISION 0	DWG SIZE A	G.O. LBS0031682	ITEM 029I

SHEET
1 of 2

Pow-R-Line4 Device Specifications

Ckt #s	Nameplate	Device	Trip	Terminal	Modifications
Main		HKD3400	400	(1) 500-750 kcmil (Cu/Al)	310+LSI Adj. Trip Unit, K Frame Optional Terminals, Mech., (1) 500-750 kcmil (Cu/Al)
1,3,5		HFD3050	50	(1) #14-1/0 (Cu/Al)	
2,4,6		HFD3030	30	(1) #14-1/0 (Cu/Al)	
7,9,11		HFD3030	30	(1) #14-1/0 (Cu/Al)	
8,10,12		HFD3030	30	(1) #14-1/0 (Cu/Al)	
Subfeed		400A-TF-LUGS		(2) #4-500 kcmil (Cu/Al)	

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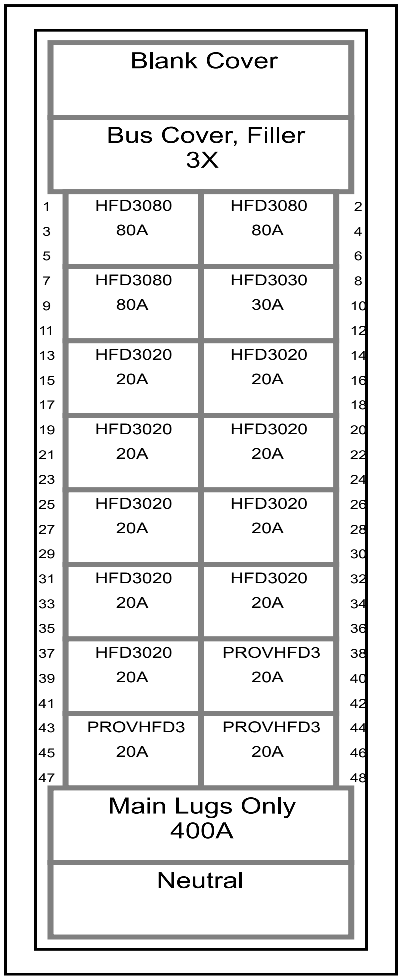
	VERSION 1.0.0.55		TYPE PRL4	DRAWING TYPE Final
NEG-ALT Number D7580427X2K2-R001	REVISION 0	DWG SIZE A	G.O. LBS0031682	ITEM 029I
				SHEET 2 of 2



General Information **(Section 1 of 1)**

Service Voltage:	480Y/277V 3Ph 4W	**Enclosure:**	Type 12
Bus Rating & Type:	400A Copper	**Neutral Rating:**	400A
Ground Bar:	Std. Bolted Aluminum, Al or Cu cable		
S.C. Rating:	65k A.I.C. Fully Rated		

Main Device Type:	Main Lugs Only - Bottom Cable Entry
Main Terminals:	Mechanical - (2) 3/0-750 kcmil (Cu/Al)
Neutral Terminals:	Mechanical - (2) 3/0-750 kcmil (Cu/Al)
Box Catalog No.:	DPC2490
Trim:	Complete Enclosure (Includes Trim) Surface Mounted
Box Dimensions:	90.00" [2286.0mm]H x 24.00" [609.6mm]W x 12.85" [326.4mm]D
Min. Gutter Size:	Top = 10.625" [269.9mm] Bottom = 10.625" [269.9mm] Left = 5" [127.0mm] Right = 5" [127.0mm]

Panel ID Nameplate:		**(1) 4DP2 S2**
Type:	Plastic, adhesive-backed	**(2) 480Y/277V 3Ph 4W**
Color:	White with Black Letters	**(3)**

UL

Trim Lock: T-Handle Lock Assembly
Circuit Directory: Plastic Sleeve with Card
Density Rated Bus
Painted Box:ANSI 61
Material may ship short or be substituted based on availability at the time of manufacturing.
Seismic Label (IBC/CBC Seismic Qualified).
Heat Loss - Watts (Est.) = 146
Wire shall be based on the ampacity of 75°C rated conductors unless otherwise indicated.

Device Modifications:

Ref #	**Description**

Notes:

Branch Devices

Qty	**Poles**	**Trip**	**Frame**	**Amps**	**kAIC**
9	3	20	HFD	100	65
3	3	80	HFD	100	65
3	3		PROVHFD3		
1	3	30	HFD	100	65

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	APPROVED BY	DATE	JOB NAME DESIGNATION	Taunton WWTF PH2 4DP2 S2
	VERSION 1.0.0.56		TYPE PRL4	DRAWING TYPE Final
NEG-ALT Number D7580427X2K2-R001	REVISION 0	DWG SIZE A	G.O. LBS0031682	ITEM 030I

SHEET
1 of 3

Pow-R-Line4 Device Specifications

Ckt #s	Nameplate	Device	Trip	Terminal	Modifications
1,3,5		HFD3080	80	(1) #14-1/0 (Cu/Al)	
2,4,6		HFD3080	80	(1) #14-1/0 (Cu/Al)	
7,9,11		HFD3080	80	(1) #14-1/0 (Cu/Al)	
8,10,12		HFD3030	30	(1) #14-1/0 (Cu/Al)	
13,15,17		HFD3020	20	(1) #14-1/0 (Cu/Al)	
14,16,18		HFD3020	20	(1) #14-1/0 (Cu/Al)	
19,21,23		HFD3020	20	(1) #14-1/0 (Cu/Al)	
20,22,24		HFD3020	20	(1) #14-1/0 (Cu/Al)	
25,27,29		HFD3020	20	(1) #14-1/0 (Cu/Al)	
26,28,30		HFD3020	20	(1) #14-1/0 (Cu/Al)	
31,33,35		HFD3020	20	(1) #14-1/0 (Cu/Al)	
32,34,36		HFD3020	20	(1) #14-1/0 (Cu/Al)	
37,39,41		HFD3020	20	(1) #14-1/0 (Cu/Al)	
38,40,42		PROVHFD3	20	None Available	

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	VERSION 1.0.0.56		TYPE PRL4	DRAWING TYPE Final
NEG-ALT Number D7580427X2K2-R001	REVISION 0	DWG SIZE A	G.O. LBS0031682	ITEM 030I

SHEET
2 of 3

Pow-R-Line4 Device Specifications

Ckt #s	Nameplate	Device	Trip	Terminal	Modifications
43,45,47		PROVHFD3	20	None Available	
44,46,48		PROVHFD3	20	None Available	
Main		400A-MLO		(2) 3/0-750 kcmil (Cu/Al)	

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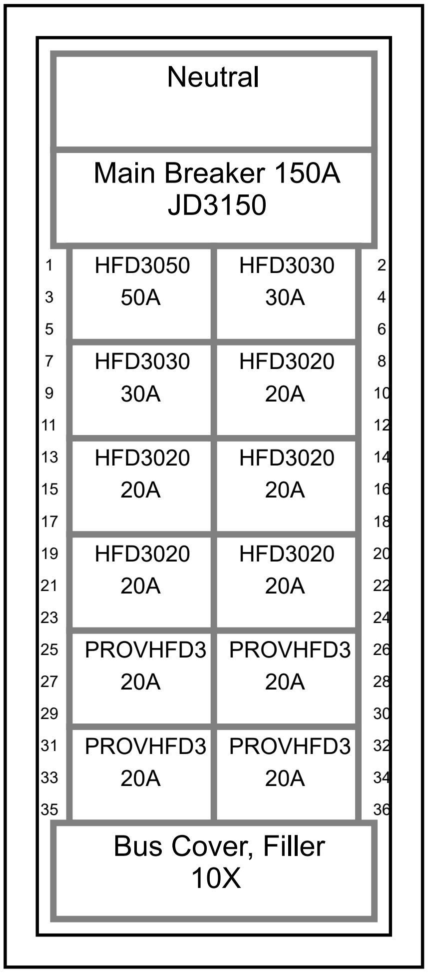
NEG-ALT Number D7580427X2K2-R001	REVISION 0	DWG SIZE A	G.O. LBS0031682	ITEM 030I	SHEET 3 of 3



General Information **(Section 1 of 1)**

Service Voltage:	480Y/277V 3Ph 4W	**Enclosure:**	Type 12
Bus Rating & Type:	250A Copper	**Neutral Rating:**	250A
Ground Bar:	Std. Bolted Aluminum, Al or Cu cable		
S.C. Rating:	35k A.I.C. Fully Rated		

Main Device Type:	Main Breaker - Top Cable Entry
Main Terminals:	Mechanical - (1) #4-350 kcmil (Cu/Al)
Neutral Terminals:	Mechanical - (1) #4-500 kcmil (Cu/Al)
Box Catalog No.:	DPC2473
Trim:	Complete Enclosure (Includes Trim) Surface Mounted
Box Dimensions:	73.50" [1866.9mm]H x 24.00" [609.6mm]W x 12.85" [326.4mm]D
Min. Gutter Size:	Top = 10.625" [269.9mm] Bottom = 10.625" [269.9mm] Left = 5" [127.0mm] Right = 5" [127.0mm]

Panel ID Nameplate:		**(1) 9DP1**
Type:	Plastic, adhesive-backed	**(2) 480Y/277V 3Ph 4W**
Color:	White with Black Letters	**(3)**

UL

Trim Lock: T-Handle Lock Assembly
Circuit Directory: Plastic Sleeve with Card
Density Rated Bus
Painted Box:ANSI 61
Main Circuit Breaker Trip Type: Thermal-Magnetic.
Seismic Label (IBC/CBC Seismic Qualified).
Heat Loss - Watts (Est.) =
Wire shall be based on the ampacity of 75°C rated conductors unless otherwise indicated.

Device Modifications:

Ref #	**Description**

Notes:

Branch Devices

Qty	**Poles**	**Trip**	**Frame**	**Amps**	**kAIC**
5	3	20	HFD	100	35
1	3	50	HFD	100	35
2	3	30	HFD	100	35
4	3		PROVHFD3		

Main Devices

Qty	**Poles**	**Trip**	**Frame**	**Amps**	**kAIC**
1	3	150	JD	250	35

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PREPARED BY SCOTT ARNOLD	DATE 12/21/2023	**Eaton**			
APPROVED BY	DATE	JOB NAME	Taunton WWTF PH2		
		DESIGNATION	9DP1		
VERSION 1.0.0.55		TYPE PRL4		DRAWING TYPE Final	
NEG-ALT Number D7580427X2K2-R001	REVISION 0	DWG SIZE A	G.O. LBS0031682	ITEM 031I	SHEET 1 of 2

Pow-R-Line4 Device Specifications

Ckt #s	Nameplate	Device	Trip	Terminal	Modifications
Main		JD3150	150	(1) #4-350 kcmil (Cu/Al)	
1,3,5		HFD3050	50	(1) #14-1/0 (Cu/Al)	
2,4,6		HFD3030	30	(1) #14-1/0 (Cu/Al)	
7,9,11		HFD3030	30	(1) #14-1/0 (Cu/Al)	
8,10,12		HFD3020	20	(1) #14-1/0 (Cu/Al)	
13,15,17		HFD3020	20	(1) #14-1/0 (Cu/Al)	
14,16,18		HFD3020	20	(1) #14-1/0 (Cu/Al)	
19,21,23		HFD3020	20	(1) #14-1/0 (Cu/Al)	
20,22,24		HFD3020	20	(1) #14-1/0 (Cu/Al)	
25,27,29		PROVHFD3	20	None Available	
26,28,30		PROVHFD3	20	None Available	
31,33,35		PROVHFD3	20	None Available	
32,34,36		PROVHFD3	20	None Available	

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	VERSION 1.0.0.55		TYPE PRL4	DRAWING TYPE Final	
NEG-ALT Number D7580427X2K2-R001	REVISION 0	DWG SIZE A	G.O. LBS0031682	ITEM 031I	SHEET 2 of 2

Powering Business Worldwide

Instruction Data

ANSI/NEMA PB 1.1-2013

General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less

Published by

National Electrical Manufacturers Association
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Approved: September 11, 2013

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(ANSI Accredited Standards Committee)

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TABLE OF CONTENTS

Figures

Foreword

This publication is a guide of practical information containing instructions for the proper installation, operation, and maintenance of panelboards rated 600 volts or less.

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency regarding installation, operation, or maintenance.

It is recommended that work described in this set of instructions be performed only by qualified personnel familiar with the construction and operation of panelboards and that such work be performed only after reading this complete set of instructions. For specific information not covered by these instructions, you are urged to contact the manufacturer of the panelboard directly.

In the preparation of this standards publication input of users and other interested parties has been sought and evaluated. Inquiries, comments, and proposed or recommended revisions should be submitted to the concerned NEMA product section by contacting the following: These recommendations will be reviewed periodically and updated as necessary.

Senior Technical Director, Operations
National Electrical Manufacturers Association
1300 North 17th Street, Suite 900
Rosslyn, Virginia 22209

Publication PB 1.1- 2013 revises and supersedes PB 1.1-2007.

This standards publication was developed by the Panelboard and Distribution Board Product Group of the LVDE Section. Product Group approval of the standard does not necessarily imply that all Product Group members voted for its approval or participated in its development. At the time it was approved, the Product Group was composed of the following members:

Eaton Corporation.—Pittsburgh, PA
GE Industrial Solutions—Plainville, CT
Hubbell, Inc.—Orange, CT
Milbank Manufacturing Company—Kansas City, MO
Penn Panel & Box Company—Collingdale, PA
Reliance Controls Corporation—Racine, WI
Siemens Industry, Inc.—Norcross, GA
Schneider Electric —Palatine, IL

Section 1
SCOPE

This publication covers single panelboards or groups of panel units suitable for assembly in the form of single panelboards, including buses, and with or without switches or automatic overload protective devices (fuses or circuit breakers), or both. These units are used in the distribution of electricity at 600 volts and less with:

1600—ampere mains or less
1200—ampere branch circuits or less

Specifically excluded are live-front panelboards, panelboards employing cast enclosures for special service conditions, and panelboards designed primarily for residential and light commercial service equipment.

Section 2
REFERENCES

National Fire Protection Association (NFPA)
Batterymarch Park
Quincy, MA 02269

NFPA 70	*National Electrical Code®*
NFPA 70E	*Standard for Electrical Safety in the Workplace*

National Electrical Manufacturers Association (NEMA)
1300 North 17th Street, Suite 900
Rosslyn, Virginia 22209

AB 4	*Guidelines for Inspection and Preventative Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications*
PB 2.2	*Application Guide for Ground Fault Protective Devices for Equipment*
	Guidelines for Handling Water Damaged Electrical Products

Section 3
GENERAL

WARNING—HAZARDOUS VOLTAGES IN ELECTRICAL EQUIPMENT CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. UNLESS OTHERWISE SPECIFIED, INSPECTION AND MAINTENANCE SHOULD ONLY BE PERFORMED ON PANELBOARDS AND EQUIPMENT TO WHICH POWER HAS BEEN TURNED OFF, DISCONNECTED AND ELECTRICALLY ISOLATED SO THAT NO ACCIDENTAL CONTACT CAN BE MADE WITH ENERGIZED PARTS. FOLLOW ALL MANUFACTURER'S WARNINGS AND INSTRUCTIONS.

Safety-related work practices, as described in NFPA 70E, should be followed at all times.
All requirements of the *National Electrical Code*® NFPA 70 should be followed.

CAUTION—HYDROCARBON SPRAY PROPELLANTS AND HYDROCARBON BASED SPRAYS OR COMPOUNDS WILL CAUSE DEGRADATION OF CERTAIN PLASTICS. CONTACT THE PANELBOARD MANUFACTURER BEFORE USING THESE PRODUCTS TO CLEAN, DRY, OR LUBRICATE COMPONENTS DURING INSTALLATION OR MAINTENANCE.

3.1 SUCCESSFUL OPERATION OF PANELBOARDS

The successful operation of panelboards is dependent upon proper installation, operation, and maintenance. Neglecting fundamental installation and maintenance requirements may lead to personal injury, death, or damage to electrical equipment or other property.

3.2 QUALIFIED PERSONNEL

Installation, operation, and maintenance of panelboards should be conducted only by qualified personnel.

3.3 DEFINITION OF QUALIFIED PERSONNEL

For purposes of these guidelines, a qualified person is one who is familiar with the installation, construction, and operation of the equipment and the hazards involved. In addition, the person is:

3.3.1 Requirements

Knowledgeable of the requirements of the *National Electrical Code*® and of all other applicable codes, laws, and standards.

3.3.2 Established Safety Practices

Trained and authorized to test, energize, clear, ground, tag, and lockout circuits and equipment in accordance with established safety practices.

3.3.3 Protective Equipment

Trained in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, and flash resistant clothing in accordance with established safety practices.

3.3.4 First Aid

Trained in rendering first aid.

3.4 SUITABLE RATINGS

Verify that all equipment being installed has ratings suitable for the installation.

Section 4
INSTALLATION OF PANELBOARD CABINETS (BOXES)

4.1 INSTALLATION INSTRUCTIONS

Installation of the cabinet in a neat and workmanlike manner. Follow the manufacturer's installation instructions.

4.2 LOCATION IN BUILDING

Locate the cabinet so that it is readily accessible and not exposed to physical damage.

4.3 FLAMMABLE MATERIAL

Locate the cabinet well away from flammable material.

4.4 UNUSUAL SERVICE CONDITIONS

Do not locate the cabinet where it will be exposed to ambient temperatures above 40°C (104°F), corrosive or explosive fumes, dust, vapors, dripping or standing water, abnormal vibration, mechanical shock, high humidity, tilting, or unusual operating conditions, unless the cabinet/panelboard combination has been designed and so identified by the manufacturer for these conditions.

4.5 INDOOR DAMP LOCATIONS

Locate or shield the cabinet so as to prevent moisture and water from entering and accumulating therein. Mount the cabinet so that there is at least 1/4 inch of air space between the cabinet and the wall or other supporting surface.

4.6 WET LOCATIONS

Cabinets should be specifically approved for wet locations. Mount the cabinet so that there is at least 1/4 inch of air space between the cabinet and the wall or other supporting surface.

4.7 CLEARANCE FROM CEILING

Do not locate the cabinet against a non-fireproof ceiling; allow a space of 3 feet between the ceiling and cabinet unless an adequate fireproof shield is provided.

4.8 SPACE AROUND THE CABINET

When selecting a location, provide sufficient access and working space around the cabinet (see Section 110.26 of the *National Electrical Code*®). The width of the working space in front of the panelboard should be at least 30 inches, or the width of the cabinet, whichever is greater, and this space should not be used as storage. The working space should have adequate lighting and a minimum head room of 6 feet 6 inches.

4.9 MOUNTING OF CABINET

The cabinet should be reliably secured to the mounting surface. Do not depend on wooden plugs driven into holes in masonry, concrete, plaster, or similar materials. (See Section 110.13 of the *National Electrical Code*®.)

4.10 FLUSH MOUNTING IN WALL

In walls of concrete, tile, or other noncombustible material, install the cabinet so that its front edge will not set back more than 1/4 inch from the finished surface. In walls of wood or other combustible material, cabinets should be flush with or project beyond the finished surface. (See Section 312.3 of the *National Electrical Code®*.)

4.11 UNUSED OPENINGS IN CABINET

Effectively close unused openings in the cabinet to provide protection which is substantially equivalent to that afforded by the wall of the cabinet.

4.12 GROUNDING OF PANELBOARD CABINETS

Ground the cabinet as specified in Article 250 of the *National Electrical Code®*. When the cabinet contains service equipment, it is necessary to bond the cabinet to the grounded (neutral) service conductor.

Section 5
INSTALLATION OF CONDUIT AND CONDUCTORS

5.1 CONDUITS INSTALLATION

Conduits should be installed so as to prevent moisture or water from entering and accumulating within the enclosure. Provision should be made to protect conductors from abrasion in accordance with Article 312 of the *National Electrical Code®*.

5.2 KNOCKOUTS REMOVAL

Knockouts should be removed as follows:

IMPORTANT—Remove knockouts, ONE AT A TIME, alternating INWARD and OUTWARD.

5.2.1 First Step—Remove Center Knockout

Remove center knockout INWARD.

5.2.1.1 Screwdriver Blade

Place screwdriver blade against point farthest from tie and strike INWARD (Figure 1). Bend back and forth to break tie.

5.2.2 Next Step—Remove Rings

Remove rings ONE AT A TIME without straining remaining rings.

5.2.2.1 Pry First Ring

Pry first ring OUTWARD with screwdriver midway between ties, using pliers flat against box under screwdriver (Figure 2). Bend ring sections OUTWARD with pliers, then back and forth to break ties (Figure 5-3).

5.2.2.2 Second Ring

Remove second ring INWARD by striking screwdriver (with blade against point midway between ties) then breaking ring sections inward and back and forth to break ties.

5.3 *NATIONAL ELECTRICAL CODE®*, ARTICLE 300

Refer to the *National Electrical Code®*, Article 300 for proper wiring methods. See 6.7 for making proper connections.

5.4 CONDUCTOR LENGTH

Keep conductor length to a minimum within the wiring gutter. Excessive conductor length will result in additional heating and may result in overheating. However, conductors should be long enough to reach the terminal location in a manner that avoids strain on the terminal.

5.5 EXERCISE CARE

Exercise care to maintain the largest practical bending radius of conductors; otherwise the insulation may be damaged and terminal connections may become loosened. Deflection of conductors shall comply with *NEC®* Section 312.6.

5.6 *NATIONAL ELECTRICAL CODE®*, SECTION 725.136

Refer to the *National Electrical Code®*, Section 725.136 for the separation requirements for conductors of Class 2 and Class 3 remote-control, signaling and power-limited circuits.

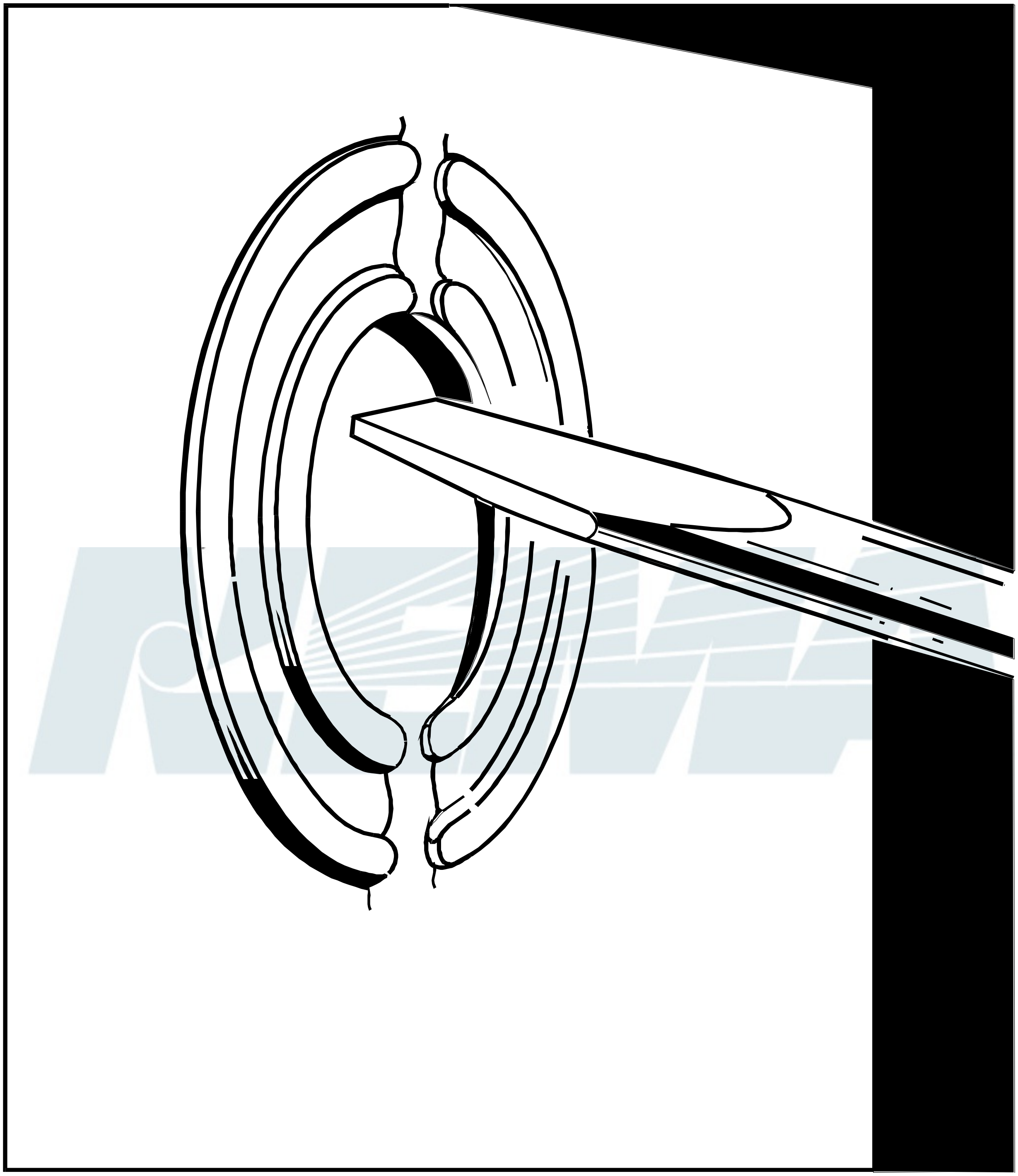

Figure 5–1
KNOCKOUT REMOVAL—STEP 1

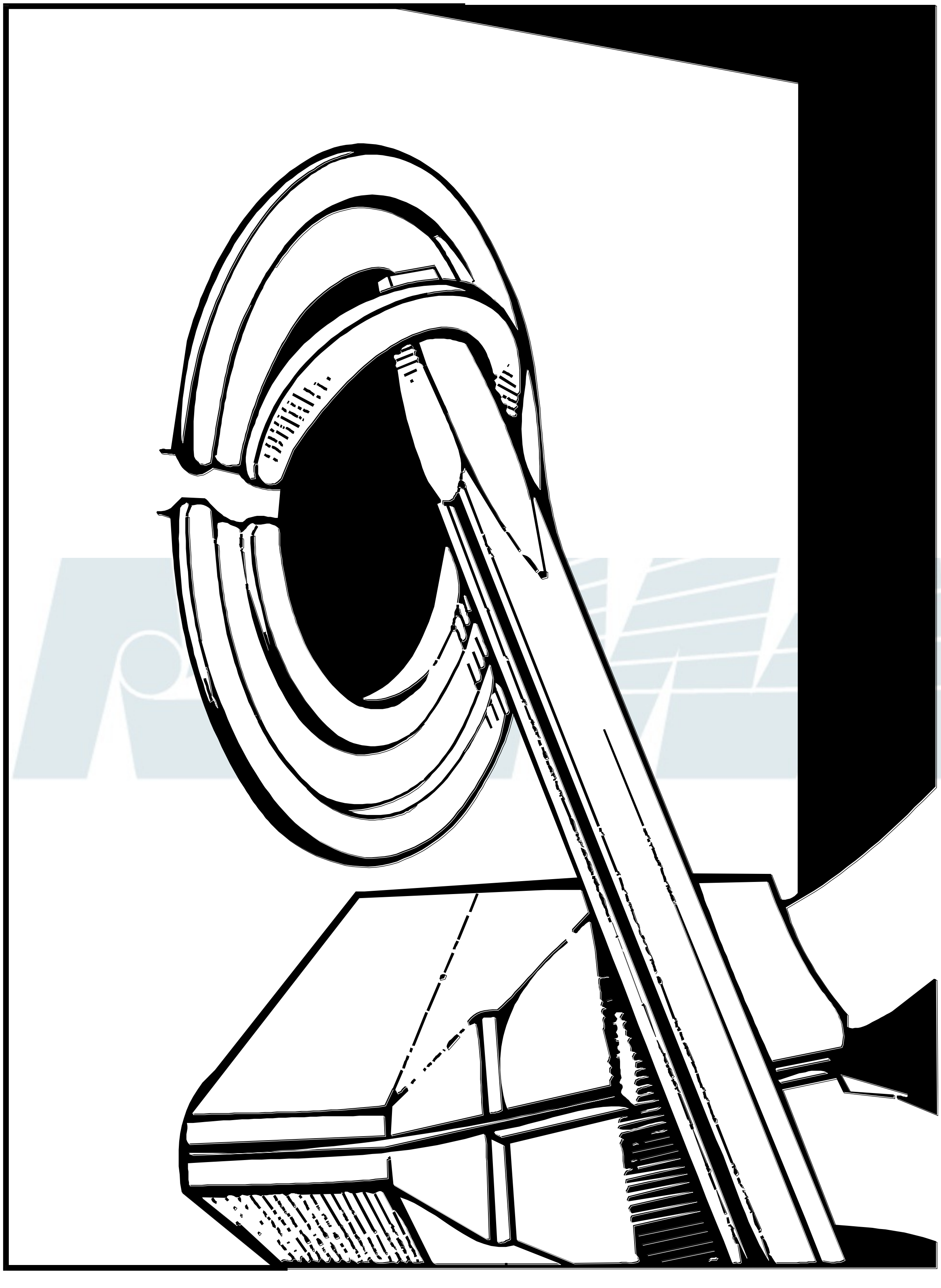

Figure 5–2
KNOCKOUT REMOVAL—STEP 2

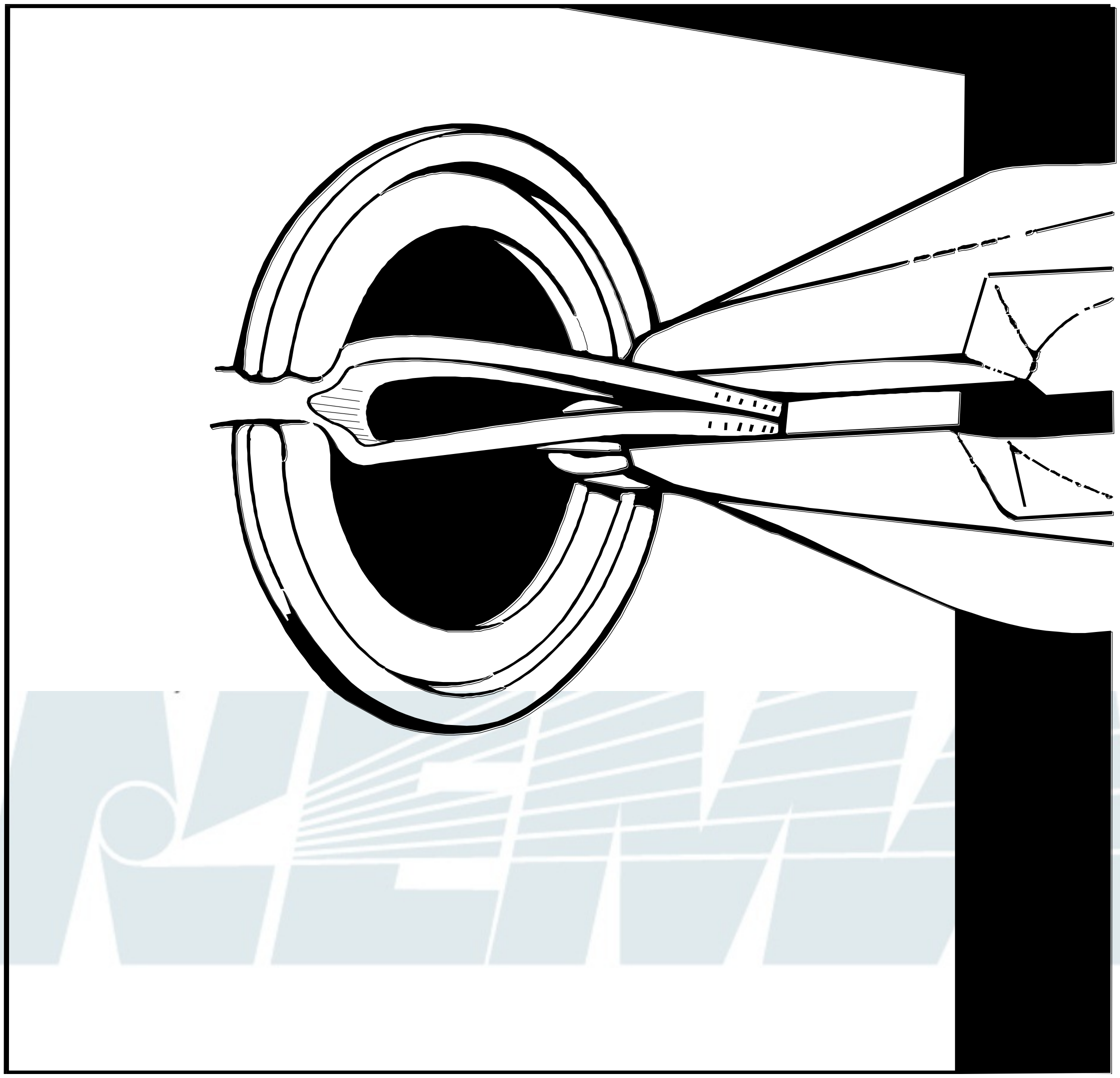

Figure 5–3
KNOCKOUT REMOVAL—STEP 3

Section 6
INSTALLATION OF PANELBOARD

6.1 PROPER STORAGE

Store the panelboard in a clean, dry place located so that mechanical damage from work personnel in the area is not likely to happen.

6.2 UNPACKING

Care should be exercised in unpacking the panelboard to prevent damage and loss of instruction materials and loose parts.

6.3 INSPECTION

Check for shipping damage and check to make sure that the panelboard is the correct one for installation in the cabinet.

6.4 CARE

Care should be taken to protect the panelboard internal parts from contamination during the installation process.

6.4.1 Cleaning

Clean the cabinet of all foreign materials. If parts at connection points are spattered with cement, plaster, paint, or other foreign material, remove the foreign materials with great care to avoid damage to the plating.

CAUTION—HYDROCARBON SPRAY PROPELLANTS AND HYDROCARBON BASED SPRAYS OR COMPOUNDS WILL CAUSE DEGRADATION OF CERTAIN PLASTICS. CONTACT THE PANELBOARD MANUFACTURER BEFORE USING THESE PRODUCTS TO CLEAN, DRY, OR LUBRICATE PANELBOARD COMPONENTS DURING INSTALLATION OR MAINTENANCE.

6.5 MANUFACTURER'S INSTRUCTIONS

Carefully follow the manufacturer's instructions and labels.

6.6 INSTALLATION

6.6.1 Alignment Devices

Adjust the alignment devices where provided.

6.6.2 Panelboard

Install the panelboard, finalize its alignment, and tighten it securely in the cabinet.

6.6.3 Flange of Deadfront Shield

Unless otherwise instructed by the manufacturer, adjust the panelboard so that the flange of the deadfront shield is no more than 3/16 inch from (1) the front of the cabinet for surface mounting or (2) the surrounding wall surfaces for flush mounting.

6.7 LINE AND BRANCH CONDUCTORS

Connect Line and Branch Conductors

6.7.1 Conductors

Use care in stripping insulation from conductors so as not to nick or ring the conductor. For aluminum, clean all oxide from the stripped portion and apply an antioxide compound.

6.7.1.1 Wiring Gutters

Distribute and arrange conductors neatly in the wiring gutters. (See Section 5.)

6.7.1.2 Types and Temperature Ratings

Care should be exercised to ensure that the types and temperature ratings of conductors being installed in the panelboard are suitable for use with the terminals, which have been provided.

6.7.1.3 Tighten All Terminals

Use the manufacturer's torque values. (See 7.1).

6.8 PANELBOARD GROUNDING AND BONDING

Ground the panelboard cabinet in accordance with 4.12. (See Section 408.40 of the *National Electrical Code®*.)

6.8.1 Equipment Grounding Conductors

Where separate equipment grounding conductors are used, prepare equipment grounding conductors in accordance with 6.7.1 and connect them to the equipment grounding terminal bar. Check to be sure that the terminal bar is securely bonded to the cabinet or panelboard frame and that it is not connected to the neutral bar except at service equipment (as permitted in Section 250.28 of the *National Electrical Code®*) or at separately derived systems (as permitted in Section 250.30 of the *National Electrical Code®*).

NOTE—An equipment grounding terminal bar is not always required. For example, when a properly installed metallic raceway is used as the equipment grounding path or when the grounded conductor terminals (neutral bar) complies with the conditions of the last sentence of Section 408.40 of the *National Electrical Code®*.

6.9 PROPER TYPE OR CLASS AND RATING

When installing circuit breakers or fuses, ensure that they are of the proper type or class and rating.

6.10 DEBRIS

Clean the cabinet of all debris, which has accumulated during the panelboard installation Ensure that all foreign materials, including cement, plaster and paint (overspray) are cleaned and removed. Remove all such materials with great care to avoid damage to conductors, plating, etc. (see 6.4.1).

6.11 STEPS IN SECTION 7

If the job is complete, perform the steps in Section 7 and then install the cabinet front (see Section 8).

Section 7
STEPS TO BE TAKEN BEFORE ENERGIZING

7.1 ACCESSIBLE ELECTRICAL CONNECTIONS

Tighten all accessible electrical connections to the manufacturer's torque specifications. If such information is not provided with the equipment, consult the manufacturer.

7.2 BLOCKS AND PACKING MATERIALS

Make certain that all blocks and packing materials used for shipment have been removed from all component devices and the panelboard.

7.3 SWITCHES, CIRCUIT BREAKERS, AND OTHER OPERATING MECHANISMS

Manually exercise all switches, circuit breakers, and other operating mechanisms to make certain they operate freely. If devices with self-test function are installed, perform test and verify proper operation per the manufacturer's instructions.

Check the integrity of all electrical and mechanical interlocks and padlocking mechanisms. For key interlocked systems, assure that only the required number of keys are accessible to the operator.

7.4 SHORT CIRCUITS AND GROUND FAULTS

To make sure that the system is free from short circuits and ground faults, conduct an insulation resistance test phase to ground and phase to phase with the switches or circuit breakers in both the open and closed positions. If the resistance reads less than 1 megohm while testing with the branch circuit devices in the open position, the system may be unsafe and should be investigated. If after investigation and possible correction, low readings are still observed, the manufacturer should be contacted. Some electronic equipment (metering, SPD, etc.) may be damaged by this testing. Refer to the manufacturers equipment markings for guidelines.

7.5 GROUND FAULT PROTECTION SYSTEM

Test the ground fault protection system (if furnished) in accordance with the manufacturer's instructions. See Section 230.95 of the *National Electrical Code®* and NEMA PB 2.2, *Application Guide for Ground Fault Protective Devices for Equipment*.

7.6 ADJUSTABLE TIME CURRENT TRIP DEVICE SETTINGS

Set any adjustable time current trip device settings to the proper values.

NOTE—Experience has indicated that damage from overcurrent can be reduced if the devices used for overload and short-circuit protection are set to operate instantaneously (that is, without intentional time delay) at 115 percent of the highest value of phase current which is likely to occur as the result of any anticipated motor starting or welding currents.

7.7 GROUNDING CONNECTIONS

Check to determine that all grounding connections are properly made. If the panelboard is used as service equipment, make certain that the neutral, if present, is properly bonded to the cabinet.

7.8 FOREIGN MATERIAL

Remove all foreign material from the panelboard and cabinet before installing the cabinet front. Make certain that all deadfront shields are properly aligned and tightened. Install the cabinet front in accordance with Section 8.

Section 8
INSTALLATION OF CABINET FRONT

8.1 CABINET FRONT OR TRIM PACKAGE

The cabinet front or trim package is designed to prevent damage to the front during shipment and handling.

8.2 UNPACKING

Care should be used when unpacking and handling the cabinet front.

8.3 COVERS AND DOORS

Install covers, close doors, and make certain that no conductors are pinched and that all enclosure parts are properly aligned and tightened. Hinged covers or doors must open a minimum of 90 degrees when installed.

8.4 TOUCH-UP

A suitable paint or other corrosion-resistant finish should be applied to those places where the finish is damaged.

8.5 FRONT ALIGNMENT

The cabinet front may be provided with an adjusting means to align it squarely with the building even though the cabinet may be slightly out of plumb with the building.

Section 9
ENERGIZING EQUIPMENT

WARNING—HAZARDOUS VOLTAGES IN ELECTRICAL EQUIPMENT CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. ENERGIZING A PANELBOARD FOR THE FIRST TIME AFTER INITIAL INSTALLATION OR MAINTENANCE IS POTENTIALLY DANGEROUS.

9.1 QUALIFIED PERSONNEL

Only qualified personnel should energize equipment for the first time. If short circuit conditions caused by damage or poor installation practices have not been detected in the procedures specified in Section 7, serious personal injury and damage can occur when the power is turned on.

9.2 LOAD ON THE PANELBOARD

There should be no load on the panelboard when it is energized. Turn off all of the downstream loads.

9.3 ENERGIZED IN SEQUENCE

The equipment should be energized in sequence by starting at the source end of the system and working towards the load end. In other words, energize the main devices, then the feeder devices, and then the branch-circuit devices. Turn the devices on with a firm positive motion.

9.4 LOADS SUCH AS LIGHTING CIRCUITS, CONTACTORS, HEATERS, AND MOTORS

After all main, feeder, and branch circuit devices have been closed, loads such as lighting circuits, contactors, heaters, and motors may be turned on.

Section 10
MAINTENANCE

10.1 MAINTENANCE PROGRAM

A maintenance program for panelboards should be conducted on a regularly scheduled basis in accordance with the following:

10.2 PANELBOARD WHICH HAS BEEN CARRYING ITS REGULAR LOAD FOR AT LEAST 3 HOURS

A panelboard which has been carrying its regular load for at least 3 hours just prior to inspection should be field tested by feeling the deadfront surfaces of circuit breakers, switches, interior trims, doors, and enclosure sides with the palm of the hand. If the temperature of these surfaces does not permit you to maintain contact for at least 3 seconds, this may be an indication of trouble and investigation is necessary. Thermographic (infrared) scanning has become a useful method of investigating thermal performance.

WARNING—HAZARDOUS VOLTAGES IN ELECTRICAL EQUIPMENT CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. UNLESS OTHERWISE SPECIFIED, INSPECTION AND MAINTENANCE SHOULD ONLY BE PERFORMED ON PANELBOARDS TO WHICH POWER HAS BEEN TURNED OFF, DISCONNECTED AND ELECTRICALLY ISOLATED SO THAT NO ACCIDENTAL CONTACT CAN BE MADE WITH ENERGIZED PARTS. FOLLOW ALL MANUFACTURER'S WARNINGS AND INSTRUCTIONS.

Safety related work practices, as described in NFPA 70E, should be followed at all times.

CAUTION—HYDROCARBON SPRAY PROPELLANTS AND HYDROCARBON BASED SPRAYS OR COMPOUNDS WILL CAUSE DEGRADATION OF CERTAIN PLASTICS. CONTACT THE PANELBOARD MANUFACTURER BEFORE USING THESE PRODUCTS TO CLEAN, DRY, OR LUBRICATE PANELBOARD COMPONENTS DURING INSTALLATION OR MAINTENANCE.

10.3 INSPECT PANELBOARD ONCE EACH YEAR

Inspect the panelboard once each year or after any severe short circuit.

10.4 ACCUMULATION OF DUST AND DIRT

If there is an accumulation of dust and dirt, clean out the panelboard by using a brush, vacuum cleaner, or clean lint-free rags. Avoid blowing dust into circuit breakers or other components. Do not use a blower or compressed air.

10.4.1 Visible Electrical Joints and Terminals

Carefully inspect all visible electrical joints and terminals in the bus and wiring system.

10.4.2 Conductors and Connections

Visually check all conductors and connections to be certain that they are clean and secure. Loose and/or contaminated connections increase electrical resistance which can cause overheating. Such overheating is indicated by discoloration or flaking of insulation and/or metal parts. Pitting or melting of connecting surfaces is a sign of arcing due to a loose or otherwise poor connection. Parts which show evidence of overheating or looseness should be cleaned and re-torqued or replaced if damaged. Tighten bolts and nuts at bus joints to manufacturer's torque specifications.

CAUTION—DO NOT REMOVE PLATING FROM ALUMINUM PARTS IN JOINTS OR TERMINATIONS. DAMAGE TO PLATING CAN RESULT IN OVERHEATING. REPLACE DAMAGED ALUMINUM PARTS.

10.4.3 Fuse Clip Contact Pressure and Contact Means

Examine fuse clip contact pressure and contact means. If there is any sign of overheating or looseness, follow the manufacturer's maintenance instructions or replace the fuse clips. Loose fuse clips can result in overheating.

10.4.4 Plug Fuses

Re-tighten plug fuses.

10.4.5 Conditions Which Caused Overheating

Be sure that all conditions which caused the overheating have been corrected.

10.5 PROPER AMPERE, VOLTAGE, AND INTERRUPTING RATINGS

Check circuit breakers, switches, and fuses to ensure they have the proper ampere, voltage, and interrupting ratings. Ensure that non-current-limiting devices are not used as replacements for current-limiting devices. Never attempt to defeat rejection mechanisms which are provided to prevent the installation of the incorrect class of fuse.

10.5.1 Mechanisms Free and in Proper Working Order

Operate each switch or circuit breaker several times to ensure that all mechanisms are free and in proper working order. Replace as required. See NEMA AB-4 for maintenance of molded case circuit breakers.

10.6 OPERATION OF ALL MECHANICAL COMPONENTS

Check the operation of all mechanical components. Replace as required.

10.6.1 Switch Operating Mechanisms

Exercise switch operating mechanisms and external operators for circuit breakers to determine that they operate freely to their full on and off positions.

10.6.2 Integrity of Electrical and Mechanical Interlocks

Check the integrity of all electrical and mechanical interlocks and padlocking mechanisms. For key interlocked systems, assure that only the required number of keys are accessible to the operator.

10.6.3 Missing or Broken Parts

Whenever practical, check all devices for missing or broken parts, proper spring tension, free movement, corrosion, dirt, and excessive wear.

10.6.4 Manufacturer's Instructions

Adjust, clean, and lubricate or replace parts according to the manufacturer's instructions.

10.6.4.1 Clean Nonmetallic Light Grease or Oil

Use *clean* nonmetallic light grease or oil as instructed.

10.6.4.2 Molded Case Circuit Breakers

Do *not* oil or grease parts of molded case circuit breakers.

10.6.4.3 Clean, Light Grease

If no instructions are given on the devices, sliding copper contacts, operating mechanisms, and interlocks may be lubricated with clean, light grease.

10.6.4.4 Excess Lubrication

Wipe off excess lubrication to avoid contamination.

CAUTION—HYDROCARBON SPRAY PROPELLANTS AND HYDROCARBON BASED SPRAYS OR COMPOUNDS WILL CAUSE DEGRADATION OF CERTAIN PLASTICS. CONTACT THE PANELBOARD MANUFACTURER BEFORE USING THESE PRODUCTS TO CLEAN, DRY, OR LUBRICATE PANELBOARD COMPONENTS DURING INSTALLATION OR MAINTENANCE.

10.6.5 Accessible Copper Electrical Contacts, Blades, and Jaws

Clean and dress readily accessible copper electrical contacts, blades, and jaws according to the manufacturer's instructions when inspection indicates the need.

10.7 DAMAGED INSULATING MATERIAL AND ASSEMBLIES

Look for and replace damaged insulating material and assemblies where sealing compounds have deteriorated.

10.8 MOISTURE OR SIGNS OF PREVIOUS WETNESS OR DRIPPING

Look for any moisture or signs of previous wetness or dripping inside the cabinet.

NOTE—Condensation in conduits or dripping from outside sources is one known cause of panelboard malfunction.

10.8.1 Conduits Which Have Dripped Condensate

Seal off any conduits which have dripped condensate, and provide means for further condensate to drain away from the panelboard.

10.8.2 Cracks or Openings

Seal off any cracks or openings which have allowed moisture to enter the enclosure. Eliminate the source of any dripping on the enclosure and any other source of moisture.

10.8.3 Insulating Material Which is Damp or Wet

Replace or thoroughly dry and clean any insulating material, which is damp or wet or shows an accumulation of deposited material from previous wettings.

10.8.4 Component Devices Which Show Evidence of Moisture Damage

Inspect all component devices. Replace any component device which shows evidence of moisture damage or has been subjected to water damage or flooding. Additional information may be found in the NEMA document “Guidelines for Handling Water Damaged Electrical Products.”

10.9 BEFORE CLEANUP AND CORRECTIVE ACTION IS ATTEMPTED

In the event of water damage, e.g., flooding or sprinkler discharge, the manufacturer should be consulted before clean up and corrective action is attempted.

10.10 SEVERE ELECTRICAL SHORT CIRCUIT

If a severe electrical short circuit has occurred, the excessive currents may have resulted in structural component and/or bus and conductor damage due to mechanical distortion, thermal damage, metal deposits, or smoke. Examine all devices and bus supports for cracks or breakage. The manufacturer should be consulted before cleanup and correction is attempted.

10.11 GROUND FAULT PROTECTION SYSTEM

Test the ground fault protection system (if furnished) in accordance with the manufacturer's instructions. See Section 230.95 of the *National Electrical Code*® and NEMA PB 2.2 *Application Guide for Ground Fault Protective Devices for Equipment.*

10.12 INSULATION RESISTANCE

Check insulation resistance (see 7.4) under any of the following conditions:

10.12.1 Severe Short Circuit

If a severe short circuit has occurred (see 10.10);

10.12.2 Parts Replaced

If it has been necessary to replace parts or clean insulating surfaces;

10.12.3 Panelboard Exposed to High Humidity

If the panelboard has been exposed to high humidity, condensation, or dripping moisture.

Section 11
PERMISSIBLE LOADING OF PANELBOARDS

11.1 *NATIONAL ELECTRICAL CODE®*

In compliance with the *National Electrical Code®*, the normal continuous loads (3 hours or more) of panelboard circuits should be not more than 80 percent of the rating of the overcurrent protective device, unless the marking of the device indicates that it is suitable for continuous duty at 100 percent of its rating.

11.2 HARMONICS IN ELECTRICAL SYSTEM

Some types of electrical equipment cause harmonics in the electrical system, which may result in overheating. This condition should be considered when determining panelboard loading.

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Technical Data **TD01415001E**

Effective May 2022
Supersedes October 2013

Panelboard seismic application guidelines

Equipment representing the products listed below were subjected to seismic testing in accordance with the 2018 International Building Code (IBC) and the 2019 California Building Code (CBC). The results of these tests exceeded the requirements as stated within the IBC and CBC and demonstrated the ability to function after the test. All installation guidelines covered in this document as well as the instruction and operations literature provided with the equipment must be followed to ensure installation suitable for a seismic application.

Certificates for various types of distribution and control equipment along with an application paper, "Earthquake Requirements and Seismic Capabilities for Eaton's Electrical Distribution and Control Equipment" can be found at **www.eaton.com/seismic**.

Mounting surface and mounting requirements

Proper mounting of the equipment is the single most important factor in withstanding a seismic event. The mounting surface must be designed to withstand the reaction loads imposed on it by the equipment during a seismic event. The mounting bolts, quantity, and torque values contained in **Table 1** represent the mounting characteristics for the specimens tested. The anchoring system should be put in place prior to equipment installation to reduce effort associated with anchoring. Wall plan drawings provided for the specific product should be utilized to identify anchoring locations.

Table 1. Equipment hardware and floor plan information (as tested)

Panelboard type	Enclosure type	Bolt type and size	Torque	Bolt quantity	Wall plan drawing number
PRL1a, 1aF, 2a, 2aF, 3a, 1X, 1XF, 2X, 2XF, 3X, 3E, 3XF and F-16	NEMA® 1	SAE grade 5, ½-13	60 lb ft	4	1A32158
PRL1a, 2a, 3a, 1X, 2X, 3X, 3E, 3XF and F-16	NEMA 12/3R	SAE grade 5, ½-13	60 lb ft	4	1A84756
PRL1a-LX, 2a-LX, 1X-LX and 2X-LX	NEMA 1	SAE grade 5, ½-13	60 lb ft	4	1A32472
PRL4 and 4X	NEMA 1	SAE grade 5, ½-13	60 lb ft	4	1A32157
PRL4 and 4X	NEMA 12/3R	SAE grade 5, ½-13	60 lb ft	4	6589C50
PRL5P	NEMA 1	SAE grade 5, ½-13	60 lb ft	4	47-35168
PRL5P	NEMA 12/3R	SAE grade 5, ½-13	60 lb ft	4	CE24213

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Displacement

Not applicable for wall-mounted equipment.

Center of gravity

For seismic calculations, the following dimensions should be used to locate the center of gravity for the equipment.

Table 2. Equipment center of gravity

Axis	PRL1a, 1aF, 1a-LX, 2a, 2aF, 2a-LX, 3a, 1X, 1XF, 1X-LX, 2X, 2XF, 2X-LX, 3X, 3E, 3XF and F-16	PRL 4/4X and 5P
Vertical	67 percent of overall enclosure height as taken from the bottom of the enclosure	67 percent of overall enclosure height as taken from the bottom of the enclosure
Left to right	Centerline of product	Centerline of product
Front to back	3 inches from rear mounting plane of enclosure	7 inches from rear mounting plane of enclosure

Equipment weight

The maximum weight of the products is given below. For job-specific weights, see order-specific drawings.

Table 3. Equipment weight

Panelboard type	Panelboard height ≤48 inches width ≤20 inches	Panelboard height ≤48 inches width >20 inches	Panelboard height >48 inches width ≤20 inches	Panelboard height >48 inches width >20 inches
PRL1a, 2a, 1X, 2X and F-16	187 lb	218 lb	392 lb	424 lb
PRL1aF, 2aF, 1XF and 2XF	N/A	252 lb	N/A	457 lb
PRL1a-LX, 2a-LX, 1X-LX and 2X-LX	N/A	N/A	213 lb	N/A
PRL3a, 3X, 3E and 3XF	240 lb	271 lb	504 lb	535 lb
PRL4 and 4X	N/A	N/A	N/A	904 lb
PRL5P	N/A	N/A	N/A	1000 lb

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Component Data

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PXM 1000 User Manual

Powering Business Worldwide

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Contents

Please read this manual carefully before installation, operation, and maintenance of PXM 1000 meter.

The following symbols in this manual and on PXM 1000 meters are used to provide warning of danger or risk during the installation and operation of the meters.

Safety Precautions

All safety codes, safety standards, and/or regulations must be strictly observed in the installation, operation, and maintenance of this device.

⚠ WARNING

The warnings and cautions included as part of the procedural steps in this document are for personnel safety and protection of equipment from damage. An example of a typical warning call-out is shown above. This will help to ensure that personnel are alert to warnings that may appear throughout the document. In addition, cautions are all upper case and boldfaced as shown below.

⚠ WARNING

Completely read and understand the material presented in this document before attempting installation, operation, or application of the equipment. Only qualified persons should be permitted to perform any work associated with the equipment. The wiring, installation and application use instructions presented in this document must be followed precisely. Failure to do so could cause permanent equipment damage, bodily injury, or death.

⚠ WARNING

Do not attempt to install or perform maintenance on equipment while it is energized. Death, severe personal injury, or substantial property damage can result from contact with energized equipment. Always verify that no voltage is present before proceeding with the task, and always follow generally accepted safety procedures.

Eaton is not liable for the misapplication or misinstallation of its products.

Congratulations!

You have purchased an advanced, versatile, multifunction power meter. This meter can work as a remote terminal unit (RTU) that contributes to your system”s stability and reliability by providing real-time power quality monitoring and analysis.

When you open the package, you will find the following items.

	QTY
1. PXM 1000 Meter	1
2. Terminal Blocks	3
3. Installation clips	4
4. Rubber Gasket	1
5. Additional documentation (Quick Setup Guide, Calibration Certificate)	2

To avoid complications, please read this manual carefully before installation and operation of the PXM 1000 meter.

1. Introduction

1.1 Meter Overview

Powerful Multifunction Power Meter

The PXM 1000 multifunction digital power meter is designed using modern MCU and DSP technology. It integrates three-phase energy measurement and display, energy accumulation, power quality analysis, malfunction alarms, data logging, and network communication. A vivid LCD display with large characters and time-of-use programmable backlight provides a clear real-time data readout.

Ideal for Electric Automation SCADA Systems

The PXM 1000 meter is the ideal choice for replacing traditional, analog electric meters. In addition to providing clear real-time readings on the front of the meter, it can also be used as a remote terminal unit (RTU) for monitoring and controlling for a SCADA system. Users can access all measurement parameters via the standard RS-485 communication port.

Energy Management

The PXM 1000 meter is able to measure bidirectional, four quadrants kWh and kvarh. It provides maximum/minimum records for power usage and power demand parameters. All power and energy parameters can be viewed remotely via software in order to easily monitor various parameters. In addition, measurement tables can be viewed from the free PXM 1000 software.

Remote Power Control

The PXM 1000 is designed for measuring and monitoring power quality parameters. Since different I/O modules can be added to the meter, this expands the capabilities and provides a very flexible platform for using the meter as a distributed RTU, for metering, monitoring, and remote controlling, all in one unit.

Power Quality Analysis

Utilizing digital signal processing (DSP) technology, the PXM 1000 meter provides high accuracy power quality analysis and supports remote monitoring via the Ethernet module. The meter continuously updates metering results and allows the users to access the meter online to monitor parameters such as voltage and current THD, harmonics up to 63rd, for PXM 1100/1200/1300), voltage crest factor, current K factor, and voltage and current unbalance factor, etc.

Data Logging

The PXM 1100/1200/1300 meters contain eight megabytes of onboard memory for data logging and historical trending. Since each meter contains a real-time clock, all events and logged data will be time stamped.

Time of Use (TOU - PXM 1200)

The user can assign up to four different tariffs (sharp, peak, valley, and normal) to different time periods within a day according to the billing requirements. The meter will calculate and accumulate energy to different tariffs, according to the meter's internal clock timing and TOU settings.

Power Quality Event Logging

When a power quality event happens, such as voltage sag and swell, etc., the PXM 1300 will record the timestamp and the triggering condition of the event. It can save up to 50,000 power quality events.

Waveform Capture

The PXM 1300 contains another eight megabytes of onboard memory for power quality event logging and waveform capture. The PXM 1300 can record eight groups of voltage and current waveforms. It logs at 32 points per cycle. It provides the waveform record of ten cycles before and after the triggering point. It also supports a configurable triggering condition.

1.2 Areas of Application

Power Distribution Automation

Industry Automation

Energy Management Systems

Renewable Energy

Electric Switch Gear and Control Panels

Building Automation

Marine Applications

1.3 Functionality

Multifunction

PXM 1000 meters provide powerful data collecting and processing functions. In addition to measuring various parameters, the meter is able to perform demand metering, harmonic analysis, max/min statistic recording, out-of-limit alarms, energy accumulation, and data logging.

High Accuracy

Accuracy of Voltage and Current is 0.2%, True-RMS.

Accuracy of Power and Energy is 0.5%, while monitoring all four quadrants.

Compact and Easy to Install

This meter can be installed into a standard ANSI C39.1
(4" Round) or an IEC 92 mm DIN (Square) cut out. With the 51 mm (2") depth after mounting, the PXM 1000 meter can be installed in a small cabinet. Note that I/O modules add 19.5 mm (0.77in) depth (see Figure 57). Maximum of three modules can be installed. Mounting clips are used for easy installation and removal.

Easy to Use

All metering data and setting parameters can be accessed using the front panel keys or via the communication port. Settings parameters are stored in the EEPROM so that content will be preserved when the meter is powered off.

Multiple Wiring Modes

The PXM 1000 series meter can be used in medium voltage (with PTs), low voltage, three-phase three-wire, three-phase four-wire, and single-phase systems using different wiring mode settings.

High Safety, High Reliability

PXM 1000 series meter was designed according to industrial standards. It can run reliably under high power disturbance conditions. This meter has been fully tested for EMC and safety compliance in accordance with UL and IEC standards.

Table 1. Function Comparison of PXM 1000 Series Meters. **● Function; ⊙ Option; Blank NA**

Category		Item	Parameters	1000	1100	1200	1300
Metering	Real-time Metering	Phase Voltage	V1, V2, V3, Vlnavg	●	●	●	●
		Line Voltage	V12, V23, V31, Vllavg	●	●	●	●
		Current	I1, I2, I3, In, Iavg	●	●	●	●
		Power	P1, P2, P3, Psum	●	●	●	●
		Reactive Power	Q1, Q2, Q3, Qsum	●	●	●	●
		Apparent Power	S1, S2, S3, Ssum	●	●	●	●
		Power Factor	PF1, PF2, PF3, PF	●	●	●	●
		Frequency	F	●	●	●	●
		Load Features	Load Features	●	●	●	●
		Four Quadrant Powers	Four Quadrant Powers	●	●	●	●
	Energy & Demand	Energy	Ep_imp, Ep_exp, Ep_total, Ep_net	●	●	●	●
		Reactive Energy	Eq_imp, Eq_exp, Eq_total, Eq_net	●	●	●	●
		Apparent Energy	Es	●	●	●	●
		Demand	Dmd_P, Dmd_Q, Dmd_S, Dmd_I1, Dmd_I2, Dmd_I3	●	●	●	●
TOU	Time of Use	Energy/Max Demand	TOU, 4 Tariffs, 12 Seasons, 14 Schedules			●	
	Daylight Saving Time	Two Formats Adjust	Month/Day/Hour/Minute; Month/Week/First few weeks/Hour/Minute			●	
Monitoring	Waveform Capture (Function not available for 400 Hz)	Voltage and Current Waveform	Trigger, Manual, DI change, Sag/Dips, Swell, Over Current				●
	Power Quality (Function not available for 400 Hz)	Voltage Unbalance Factor	U_unbl	●	●	●	●
		Current Unbalance Factor	I_unbl	●	●	●	●
		Voltage THD	THD_V1,THD_V2,THD_V3, THD_Vavg	●	●	●	●
		Current THD	THD_I1, THD_I2, THD_I, THD_Iavg	●	●	●	●
		Individual Harmonics	Harmonics 2nd to 63rd	●	●	●	●
		Voltage Crest Factor	Crest Factor	●	●	●	●
		TIF	THFF	●	●	●	●
		Current K factor	K Factor	●	●	●	●
	Statistics	MAX with Time Stamp MIN with Time Stamp	Each Phase of V & I; Total of P, Q, S,PF & F; Demand of P,Q & S; Each Phase THD of V & I; Unbalance factor of V & I	●	●	●	●

Note: This manual uses U and V interchangeably for voltage.

Table 1. Function Comparison of PXM 1000 Series Meters (continued). **● Function; ⊙ Option; Blank NA**

Category		Item	Parameters	1000	1100	1200	1300
Others	Alarm	Over/Under Limit Alarm	V,I,P,Q,S,PF,V_THD & I_THD Each Phase and Total or Average; Unbalance Factor of V & I; Load Type; Analog Input of Each Channel	●	●	●	●
	Power Quality Event Logging (Function not available for 400 Hz)	SAG/DIPS,SWELL	Voltage				●
	Data Logging	Data Logging 1 Data Logging 2 Data Logging 3	F, V1/2/3/lnavg, V12/23/13/lavg, I1/2/3/n/avg, P1/2/3/sum, Q1/2/3/sum, S1/2/3/sum, PF1/2/3, PF, U_unbl, I_unbl, Load Type, Ep_imp, Ep_exp, Ep_total, Ep_net, Eq_imp, Eq_exp, Eq_total, Eq_net, Es, THD_V1/2/3/avg, THD_I1/2/3/avg, Harmonics 2nd to 63rd, Crest Factor, THFF, K Factor, Sequence and Phase Angles, DI Counter, AI, AO, Dmd P/Q/S, Dmd I1/2/3		●	●	●
	Onboard Memory Size	Memory	Bytes		8MB	8MB	16 MB
	Communication	RS485 Port,Half Duplex, Optical Isolated	Modbus®-RTU Protocol	●	●	●	●
	Time	Real Time Clock	Year, Month, Date, Hour, Minute, Second	●	●	●	●
	400Hz Type:	Only Supports Full-wave (True RMS) Energy, Supports 2nd ~ 15th Individual Harmonics.		●	●	●	
Option Module	I/O Option	Switch Status (DI)	Digital Input (Wet)	⊙	⊙	⊙	⊙
		Power Supply for DI	24 Vdc	⊙	⊙	⊙	⊙
		Relay Output (RO)	NO, Form A	⊙	⊙	⊙	⊙
		Digital Output (DO)	Photo-MOS	⊙	⊙	⊙	⊙
		Pulse Output (PO)	By using DO	⊙	⊙	⊙	⊙
		Analog Input (AI)	0(4)~20mA, 0(1)~5V	⊙	⊙	⊙	⊙
		Analog Output (AO)	0(4)~20mA, 0(1)~5V	⊙	⊙	⊙	⊙
	Communication	Ethernet (PXM1K-MTCPP)	Modbus TCP, HTTP, SMTP, SNTP	⊙	⊙	⊙	⊙
		BACnet/IP (PXM1K-BIPP)	BACnet/IP, Modbus TCP, HTTP, SMTP, SNTP	⊙	⊙	⊙	⊙
		PXM1K-ETHMULTI	Modbus TCP, BACnet/IP, HTTP, SMTP, SNTP, EtherNet/IP, IPv6	⊙	⊙	⊙	⊙
				⊙	⊙	⊙	⊙

Note: This manual uses U and V interchangeably for voltage.

2. Installation

⚠ CAUTION

Installation of the meter must only be performed by qualified personnel, who follow standard safety precautions through the installation procedures. The personnel should have appropriate training and experience with high voltage devices. Appropriate safety gloves, safety glasses, and protective clothing are recommended. Follow NFPA 70E guidelines for protective equipment.

The meter and its I/O output channels are NOT designed as primary protection devices and shall NOT be used as primary circuit protection or in an energy-limiting capacity. The meter and its I/O output channels can only be used as secondary protection. AVOID using the meter under situations where failure of the meter may cause injury or death. AVOID using the meter for any application where risk of fire may occur.

⚠ WARNING

During normal operation, hazardous voltages will be present. This includes terminals and any connected current transformers (CTs) and potential transformers (PTs), input and output (I/O) modules, and their circuits. All primary and secondary circuits can, at times, produce lethal voltages and currents.

⚠ WARNING

Do not attempt to install or perform maintenance on equipment while it is energized. Death, severe personal injury, or substantial property damage can result from contact with energized equipment. Always verify that no voltage is present before proceeding with the task, and always follow generally accepted safety procedures.

Eaton is not liable for the misapplication or misinstallation of its products.

⚠ WARNING

All meter terminals should be inaccessible after installation.

DO NOT perform Dielectric (HIPOT) test to any inputs, outputs, or communication terminals. High voltage testing may damage electronic components of the meter.

Applying more than the maximum voltage to the meter and/or its modules will permanently damage the product. Please refer to the specifications for all devices before applying voltages.

When removing the meter for service, use shorting blocks and fuses for voltage leads and power supply to prevent hazardous voltage conditions or damage to the CTs. CT grounding is optional.

NOTE

The PXM1000 components are maintenance free once properly commissioned. There are no user serviceable components or features.

Cleaning of the various PXM1000 device housings should only be done with power and mains disconnected. A clean dry rag can be used to remove dust. No liquids should be used.

⚠ CAUTION

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

⚠ CAUTION

No preventive maintenance or inspection is required for safety. Any maintenance or repair should be performed by the factory.

⚠ WARNING

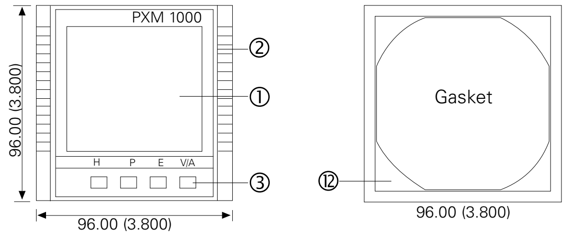
DISCONNECT DEVICE: The following part is considered the equipment disconnect device.

A switch or circuit-breaker shall be included in the installation. The switch shall be in close proximity to the equipment and within easy reach of the operator. The switch shall be marked as the disconnecting device for the equipment.

The installation method is introduced in this chapter. Please read this chapter carefully before beginning installation.

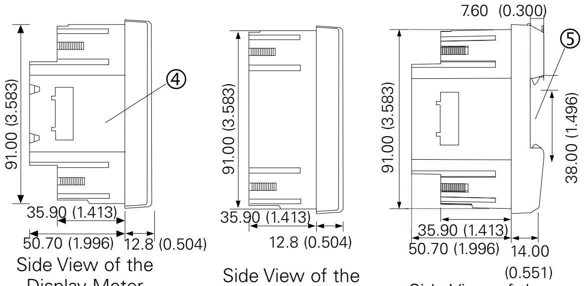
2.1 Appearance and Dimensions

Figure 1. Appearance and Dimensions of the PXM 1000 Meter.



Front View of the Display Meter and Remote Display Unit

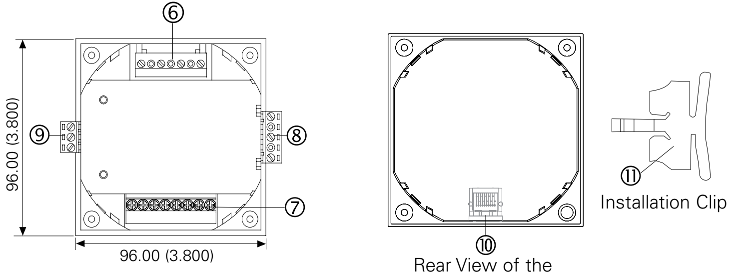
Gasket



Side View of the Display Meter

Side View of the Remote Display Unit

Side View of the DIN rail Meter



Installation Clip

Rear View

Rear View of the Remote Display Unit

Note: Unit: mm (inches).

Table 2. Part Name of the PXM 1000 Meter.

Part Name	Description
① LCD Display	Large, bright white backlight LCD display.
② Front Casing	Visible portion (for display and control) after mounting onto a panel.
③ Key	Four keys are used to interact with the meter.
④ Enclosure	The PXM 1000 meter enclosure is made of high strength, non-combustible plastic.
⑤ DIN rail	Used for Installation - 35 mm rail of the DIN rail meter.
⑥ Voltage Input Terminals	Used for voltage input.
⑦ Current Input Terminals	Used for current input.
⑧ Power Supply Terminals	Used for control power input.
⑨ Communication Terminals	Communication output.
⑩ Interface	Used to link the remote display unit and the DIN rail meter.
⑪ Installation Clip	Used for mounting the meter to the panel.
⑫ Gasket	Insert the gasket in between the meter and the cutout to cover up gaps from the round hole.

2.2 Installation Methods

Environmental

Before installation, please check the environment, temperature, and humidity to ensure optimum placement of the PXM 1000 for performance.

Temperature

Operation: -25˚C to 70˚C (-13˚F to 158˚F).

Storage: -40˚C to 85˚C (-40˚F to 185˚F).

Humidity

5% to 95% non-condensing.

The PXM 1000 meter should be installed in a dry and dust free environment. Avoid exposing the meter to excessive heat, radiation, and high electrical noise sources.

Installation Steps

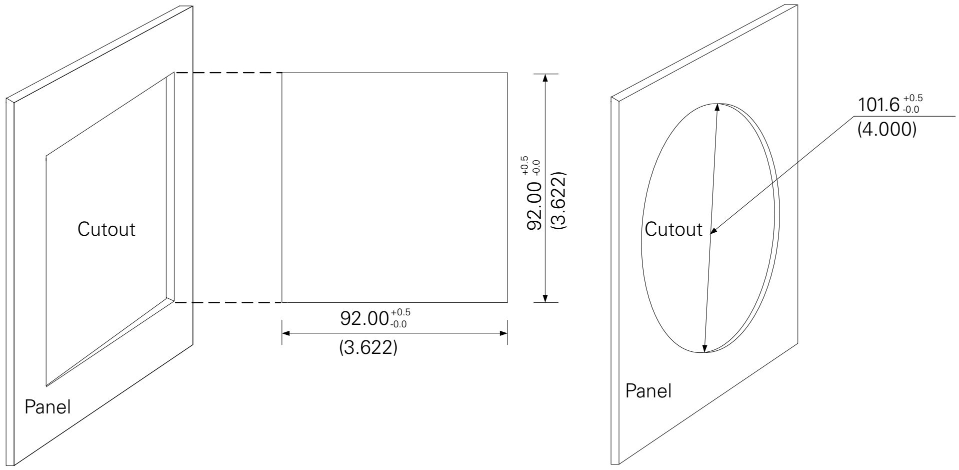
⚠ CAUTION

Before drilling or cutting, take the appropriate steps to ensure that drill shavings or metal chips from drilling and cutting do not fall onto or into any components mounted to the enclosure door or within the enclosure. Drill shavings and metal chips can cause short circuits and damage to the components within the enclosure.

The PXM 1000 meter can be installed into a standard ANSI C39.1 (4” round) or an IEC 92 mm DIN (square) form.

Step 1. Cut a square or round hole on the panel of the switch gear. The cutout size is shown in Figure 2.

Figure 2. Panel Cutout.

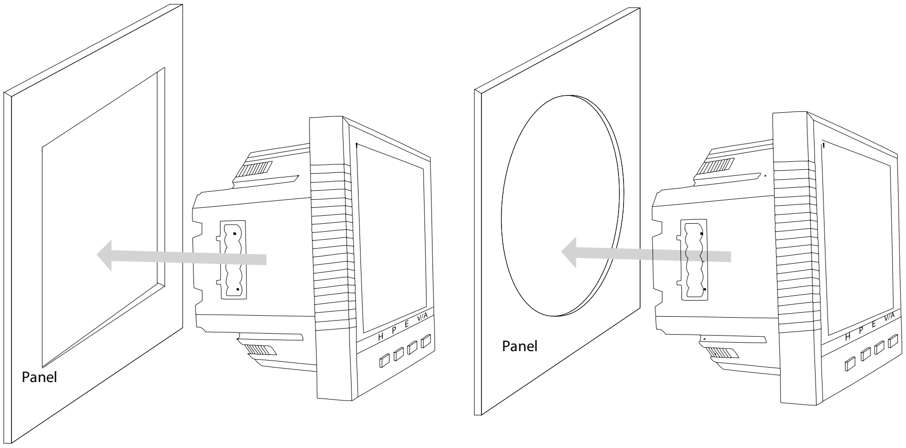


Units: mm (inches).

Step 2. Remove the clips from the meter and insert the meter into the square hole from the front side.

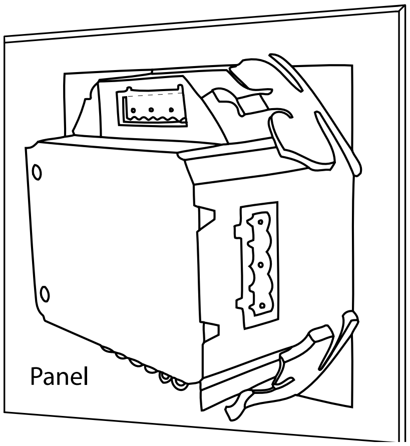
Note: Optional rubber gasket should be installed on the meter before inserting the meter into the cut out to cover up gaps from the round hole and to ensure IP ratings.

Figure 3. Installing Meter Into Cutout.



Step 3. Install clips on the back side of the meter and secure tightly to ensure the meter is tightly clamped to the panel.

Figure 4. Use the Clips to Mount the Meter on the Panel.



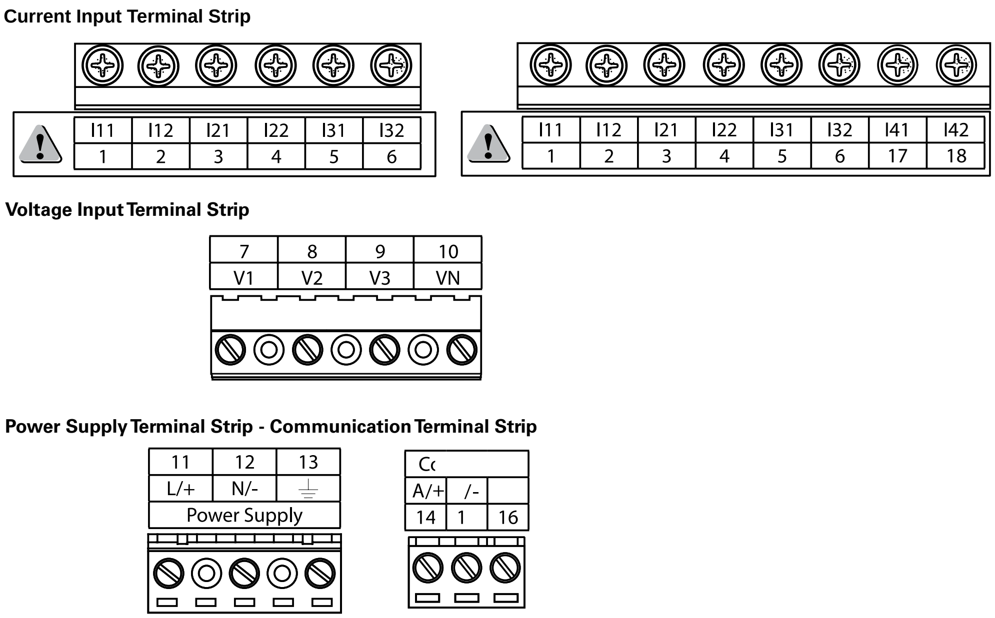
Note: The display meter and the remote display unit have the same installation method. The DIN rail meter is simply installed on a 35 mm DIN rail.

2.3 Wiring

2.3.1 Terminal Strips

There are four terminal strips at the back of the PXM 1000 meter. The three- phase voltage and current are represented by 1, 2, and 3 respectively. These numbers have the same meaning as A, B, and C, or R, S, and T used in other literature.

Figure 5. Terminal Strips of PXM 1000 Meter.



WARNING

Do not attempt to install or perform maintenance on equipment while it is energized. Death, severe personal injury, or substantial property damage can result from contact with energized equipment. Always verify that no voltage is present before proceeding with the task, and always follow generally accepted safety procedures.

WARNING

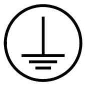
Switch main power off and wait five (5) minutes before making any connection or disconnection on the device. Danger of explosion!

Eaton is not liable for the misapplication or misinstallation of its products.

Safety Earth Connection

Before setting up the meter's wiring, please make sure that the switchgear has an earth ground terminal. Connect the meter''s earth ground terminal to that of the switchgear.. The following ground terminal symbol is used in this user manual.

Figure 6. Safety Earth Symbol.



2.3.2 Power Requirement

Control Power

There are two options for the Control Power of the PXM 1000 meter:

1. Standard: 100~415 Vac (50/60 Hz) or 100-300 Vdc.
2. Low Voltage DC Option: 20-60 Vdc.

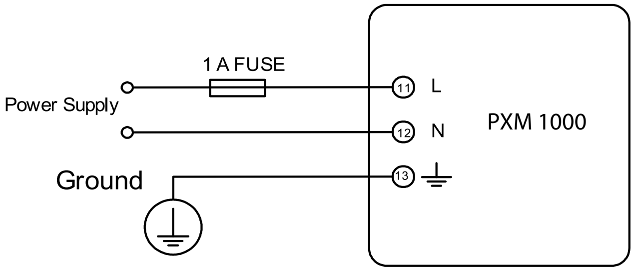
The correct option must be chosen for the application. Please see the ordering information in technical datasheet TD0262032EN for further details.

The meter's typical power consumption is very low and can be supplied by an independent source or by the measured load line. If the control power source is not reliable, an uninterruptible power supply (UPS) should be considered. Terminals for the control power supply are 11, 12, and 13 (L, N, and Ground). A switch or circuit-breaker shall be included in a building installation. It shall be in close proximity to the equipment, within easy reach of the operator, and shall be marked as the disconnecting device for the equipment.

Note: Make sure the control power ground terminal 13, is connected to earth ground.

Note: Make sure the control power supplied to the meter matches the meter's power supply ratings.

Figure 7. Power Supply.



A fuse (typical 1 A/250 Vac) should be used in the auxiliary power supply. Terminal 13 must be connected to the ground terminal of the switchgear. In very rare applications where a power quality problem exists in the power supply, an isolated transformer or EMC filter should be used in the control power supply.

Meter power supply input accepts AWG 14 maximum wire size.

Voltage Input

Maximum input voltage for the PXM 1000 meter shall not exceed 400LN/690LL VAC rms for three-phase or 400LN VAC rms for single-phase.

A potential transformer (PT) must be used for medium voltage systems. A typical secondary output for PTs is 100 or 120 V. Note that the PT secondary voltage setting defaults to 220. Make sure to change this to the appropriate PT setting when setting up the meter. Please make sure to select an appropriate PT to maintain the measurement accuracy of the meter. When connecting using the star configuration wiring method, the PT's primary side rated voltage should be approximately equal to the phase to neutral voltage of the system to utilize the full range of the PT. When connecting using the delta configuration wiring method, the PT's primary side rated voltage should be approximately equal to the line to line voltage of the system. A fuse (typical 1 A/250 Vac) should be used in the voltage input. The wire for voltage input is AWG 16-12 or 1.3-2.0 mm^2.

Note: In no circumstance should the secondary of the PT be shorted. The secondary of the PT should be grounded. Please refer to the wiring diagram section for further details.

Current Input

Current transformers (CTs) are required in most engineering applications. A typical current rating for the secondary side of the CT is 5 A (standard) or 1 A (optional). Please refer to the ordering information appendix for further details. CTs must be used if the system rated current is over 5 A. A CT with 0.5% accuracy or better, with a rating over 2.5 VA is recommended to ensure the meter's accuracy. The wire length between the CTs and meter shall not exceed the burden rating of the CT to insure accuracy.

Meter Current inputs accept AWG 15-10 or 1.5-2.5 mm^2.

⚠ WARNING

When power is on, the secondary side of the CT should not be open circuit in any circumstance. There should not be any fuse or switch in the CT loop. One end of the CT loop should be connected to Ground.

Vn Connection

Vn is the reference point of the PXM 1000 meter voltage input. Low wire resistance helps to improve the measurement accuracy. Different system wiring modes require different Vn connection methods. Please refer to the wiring diagram section for more details.

3-Phase Wiring Diagram

This meter can satisfy almost any kind of three-phase wiring diagrams. Please read this section carefully before choosing the optimum wiring configuration for your power system.

The voltage and current input wiring mode can be set separately in the meter parameter setting process. The voltage wiring mode can be set as 3-phase 4-wire Wye (3 LN), 3-phase 3-wire direct connection (3 LL), 3-phase 3-wire open delta (2 LL), single-phase 2-wire (1 LN), and single-phase 3-wire (1 LL). The current input wiring mode can be set as 3 CT, 2 CT, and 1 CT. The voltage mode can be grouped with the current mode as 3 LN-3 CT (3 CT or 2 CT), 3 LL-3 CT, 2 LL-3 CT, 2 LL- 2 CT, 1 LL-2 CT, 1 LN-1 CT.

2.3.3 Voltage Input Wiring

3-Phase 4-Wire Wye Mode (3 LN)

The 3-phase 4-wire wye mode is commonly used in low voltage electric distribution power systems. For voltage lower than 400 LN/690 LL Vac, a power line can be connected directly to the meter's voltage input terminal as shown in Figure 8.

For high voltage systems (over 400 LN/690 LL Vac), PTs are required as shown in Figure 9. The meter should be set to 3 LN for both voltage levels.

Figure 8. 3 LN Direct Connection.

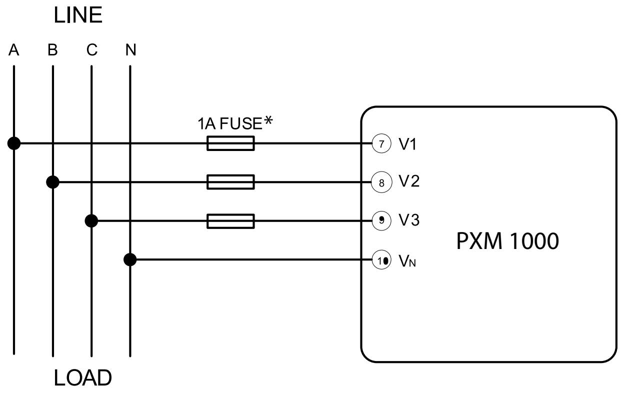
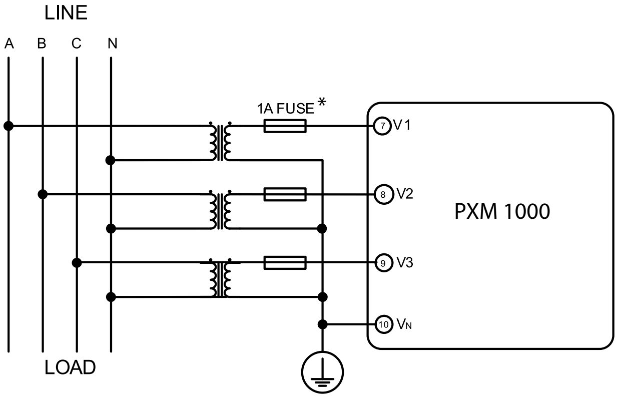


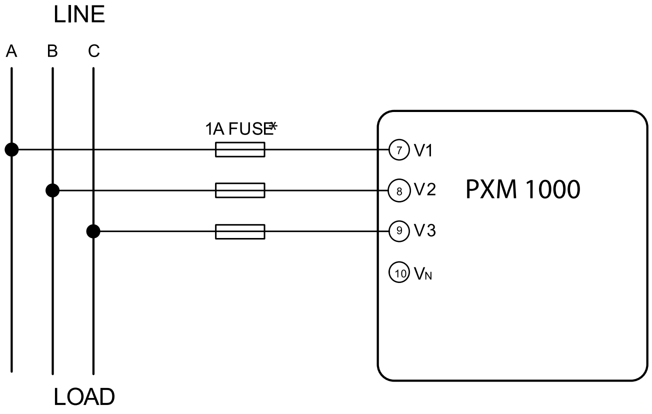
Figure 9. 3 LN with 3 PT.



3-Phase 3-Wire Direct Connection Mode (3 LL)

In a 3-phase 3-wire system, power line A, B, and C are connected to V1, V2, and V3 directly. Leave Vn disconnected. The voltage input mode of the meter should be set to 3 LL.

Figure 10. 3 LL 3-Phase 3-Line Direct Connection.

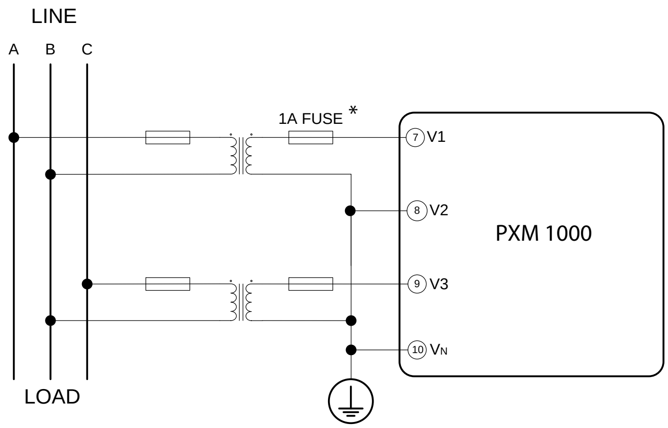


* 1A fuse typical

3-Phase 3-Line open Delta Mode (2 LL)

The open delta wiring mode is often used in high voltage systems. V2 and Vn are connected together in this mode. The voltage input mode of the meter should be set to 2 LL for this voltage input wiring mode.

Figure 11. 2 LL with 2PTs.



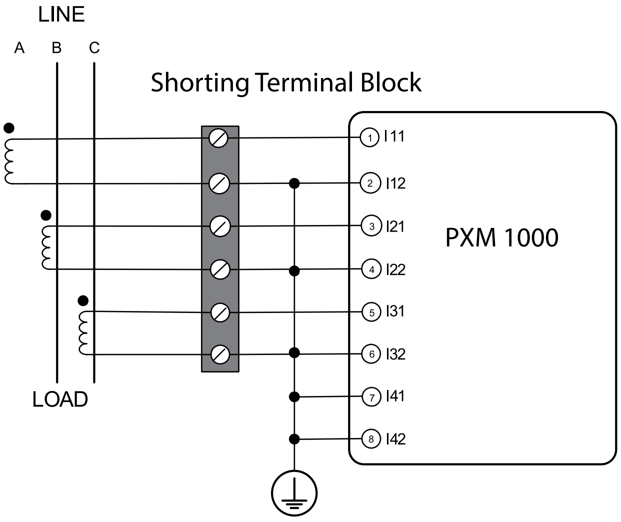
* 1A fuse typical

2.3.4 Current Input Wiring

3 CT

The 3CT current wiring configuration can be used when either 3 CTs are connected (as shown in Figure 12) or 2 CTs are connected (as shown in Figure 13) to the system. In either case, there is current flowing through all three current terminals.

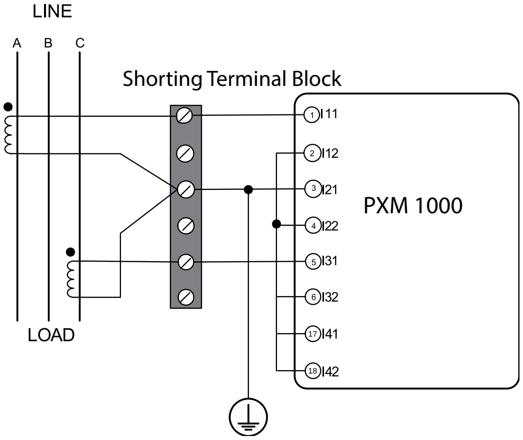
Figure 12. 3 CTs A.



- **Note 1:** Shorting terminal block not required when used with voltage input current sensors
- **Note 2:** For meters used with voltage input current sensors, unused channels need to be tied to ground as shown in the figures. If meters are used with amperage input current sensors, then the unused channels do not need to be tied to ground.
- **Note 3:** I41 and I42 are only available on non-ring terminal versions
- These notes apply to Figures 12, 14, and 15.

Shorting terminal block not required when used with voltage input current sensors.

Figure 13. 3 CTs B.



Note: Shorting terminal block not required when used with voltage input current sensors.

This applies to all figures on this page

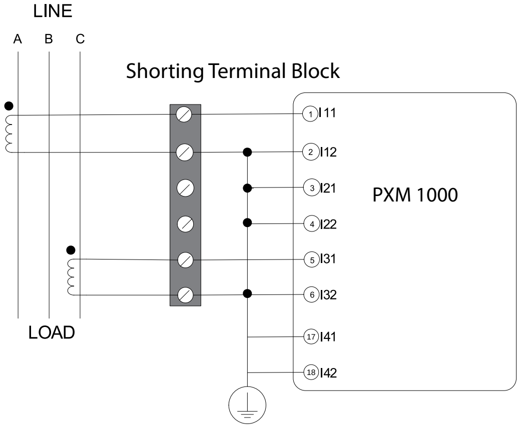
2 CT

For Figures 14 and 15, the meter should be set to the I2 value which is calculated from formula:

$$i1 + i2 + i3 = 0.$$

The current input mode of the meter should be set to 2CT .

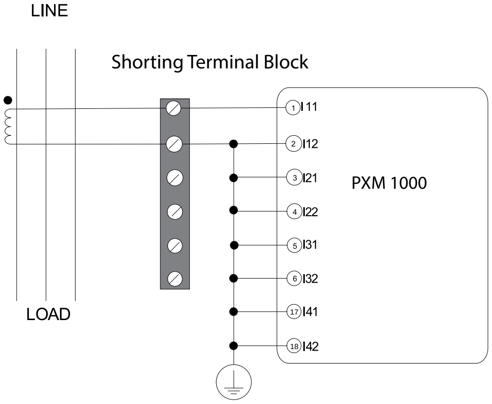
Figure 14. 2 CT.



See Note in Figure 12.

1CT

Figure 15. 1 CT.



See Note in Figure 12.

2.3.5 Frequently Used Wiring Configurations

In this section, the most common voltage and current wiring combinations are shown in different diagrams. In order to display measurement readings correctly, please select the appropriate wiring diagram for your setup and application.

1. 3LL, 3 CT with 3 CTs.

Figure 16. Three-phase, Three-wire (3LL, 3CT)

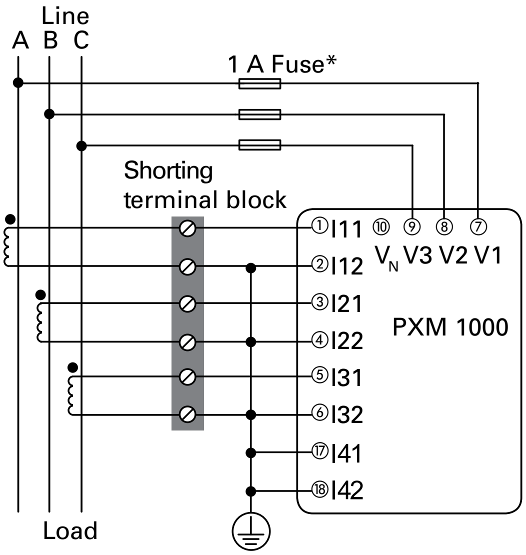
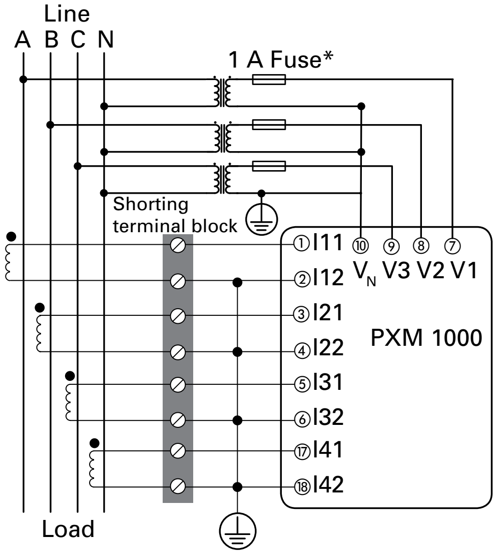
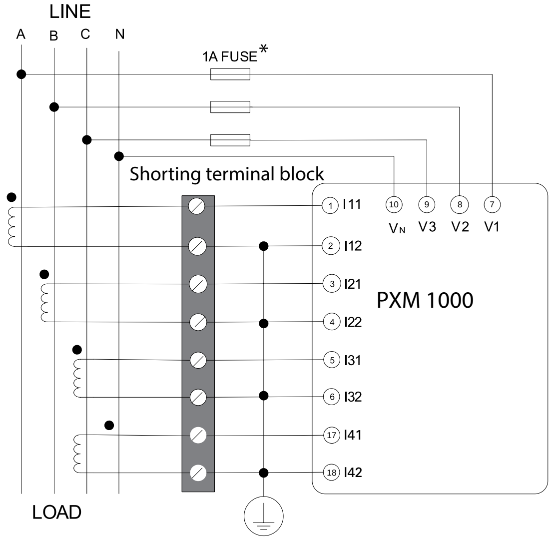


Figure 17. Three-phase, Four-wire with PT (3LN, 3CT)



* 1A fuse typical.

Figure 18. 3 LN, 3 CT.

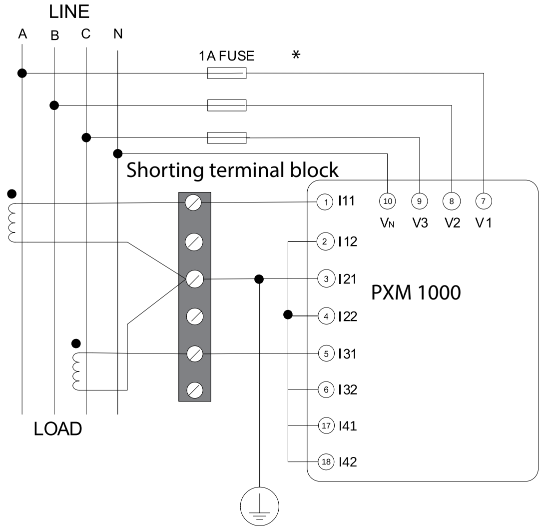


Note: Shorting terminal block not required when used with voltage input current sensors.

This applies to all figures on this page

2. 3 LN, 3 CT with 2 CTs.

Figure 19. 3 LN, 3 CT with 2 CTs.
Note: The sum of I1 and I3 is used as I2 input.

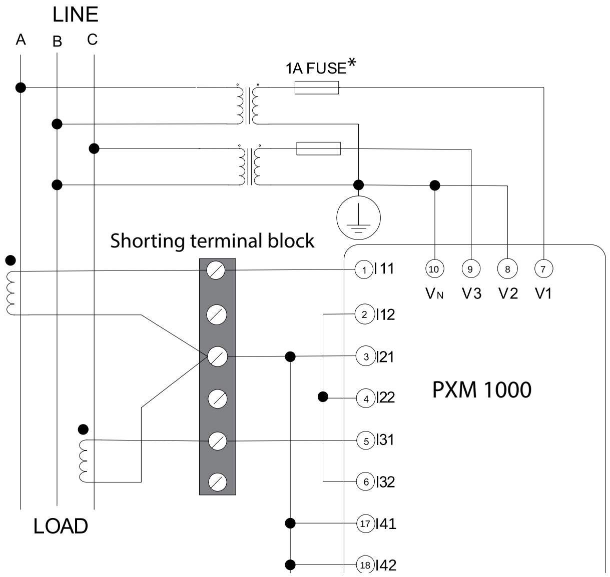


Note: For meters used with voltage input current sensors, unused channels need to be tied to ground as shown in the figures. If meters are used with amperage input current sensors, then the unused channels do not need to be tied to ground.

* 1A fuse typical.

3. 2 LL, 3 CT

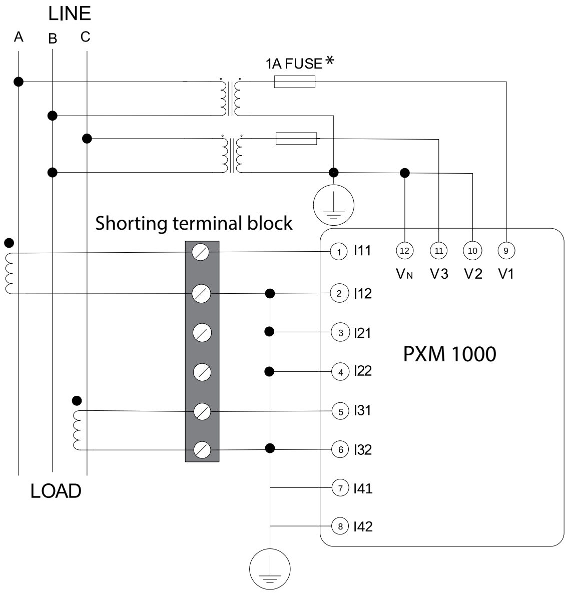
Figure 20. 2 LL, 3 CT.



Note: For meters used with voltage input current sensors, unused channels need to be tied to ground as shown in the figures. If meters are used with amperage input current sensors, then the unused channels do not need to be tied to ground.

4. 2 LL, 2 CT

Figure 21. 2 LL, 2 CT.



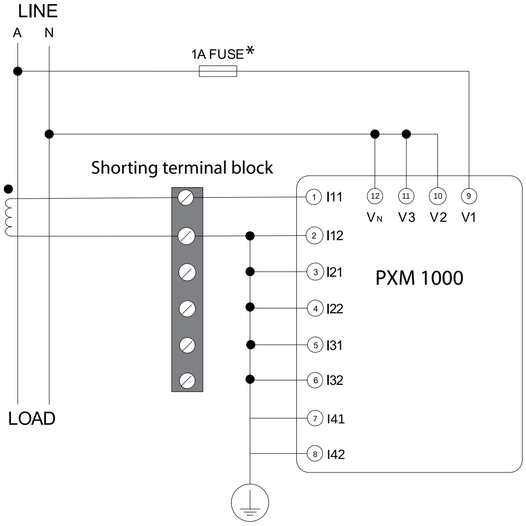
Note: Shorting terminal block not required when used with voltage input current sensors.

This applies to all figures on this page

* 1A fuse typical.

5. 1 LN, 1 CT (Wiring Mode Setting 1 LN, 1 CT).

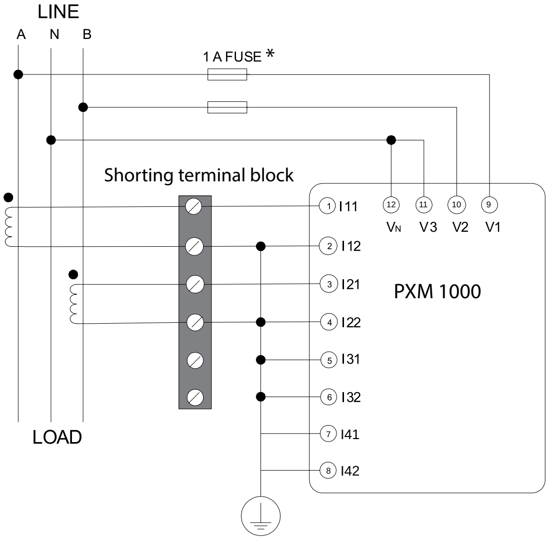
Figure 22. Single Phase 2 Lines.



Note: For meters used with voltage input current sensors, unused channels need to be tied to ground as shown in the figures. If meters are used with amperage input current sensors, then the unused channels do not need to be tied to ground.

6. 1 LL, 2 CT (Wiring Mode Setting 1 LL, 2 CT)

Figure 23. Single Phase 3 Lines.



Note: Shorting terminal block not required when used with voltage input current sensors.

This applies to all figures on this page

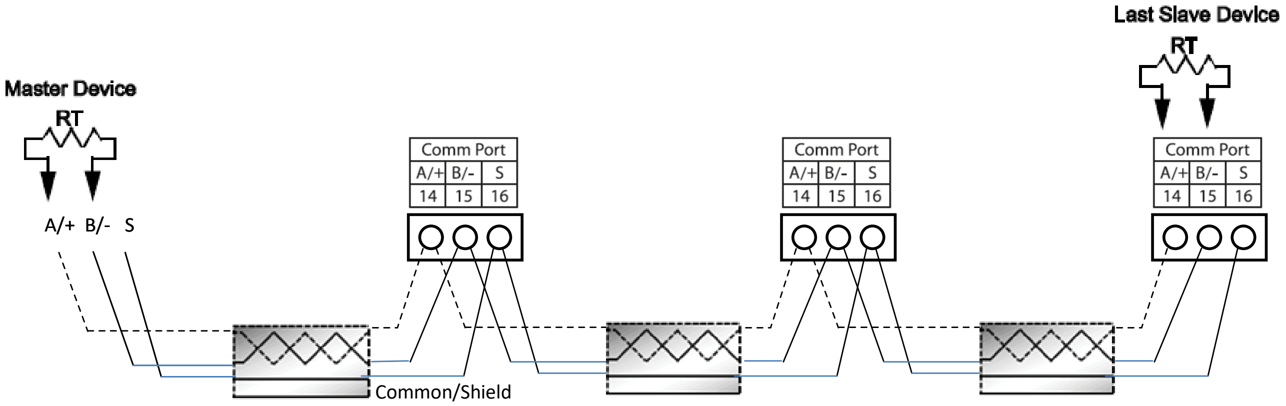
* 1A fuse typical.

2.3.6 Communication

PXM 1000 meter uses RS-485 serial communication and the Modbus-RTU protocol. The terminals for communication are A, B, and S (14, 15, and 16). A is differential signal +, B is differential signal -, and S is connected to the shield of the twisted pair cables. Up to
32 devices can be connected on a RS-485 bus. Use good quality shielded twisted pair cable, AWG 22 (0.5 mm2) or higher. The overall length of the RS-485 cable connecting all devices should not exceed 1200 m (4000 ft). The PXM 1000 meter is used as a slave device for masters such as a PC, PLC, Data Collector or RTU.

If the master does not have a RS-485 communication port, a converter (such as a RS-232/RS-485 or a USB/RS-485 converter) will be required. Do not use "Star" and "Tee" connections, daisy chain only. The shield of each segment of the RS-485 cable must be connected to the ground at one end only.

Figure 24. RS485 Daisy Chain Connection.



Avoid branching in a "T" configuration. Branches should begin at the source where possible.

Keep communication cables away from sources of electrical noise whenever possible.

When using a long communication cable to connect several devices, an anti signal reflecting resistor (typical value 120 Ω-300 Ω/0.25 W) is normally added to the end of the cable next to the last meter if the communication quality is distorted.

3. Meter Display and Parameter Settings

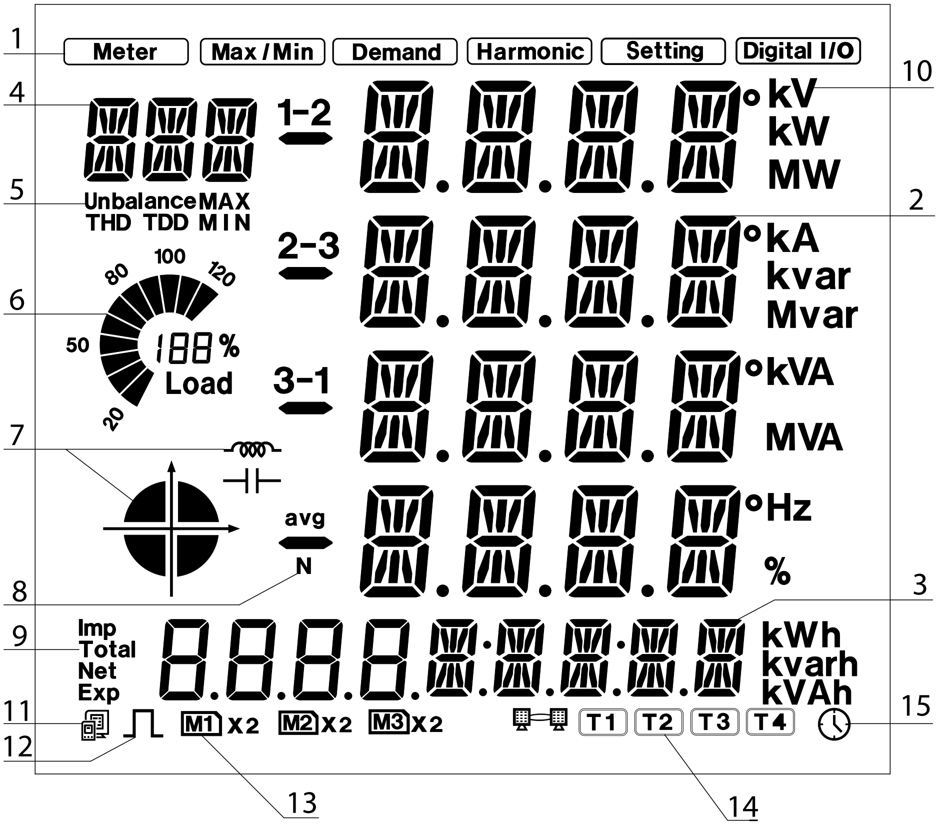
Details of the human-machine interface (HMI) of the meter will be described in this chapter. This includes viewing real-time metering data and setting parameters using different key combination.

3.1 Display Panel and Keys

The front of the PXM 1000 meter consists of an LCD screen and four control keys. All the display segments are illustrated in Figure 25. Users should note that under normal conditions, all segments will never be displayed simultaneously.

Figure 25. All Display Segments.

Below Figure shows all the possible icons and units, whose positions are fixed. Depending on what is selected, the relevant icons and units will be visible on the LCD screen and four control keys.



SN	Display	Description
1	Display mode indication	Shows different modes on the display area. “Meter” for real-time measurement; “Max/Min” to indicate maximum and minimum readings; “Demand” for power demand data; “Harmonic” for harmonic data; “Setting” for parameters setting; and “Digital I/O” for expanded I/O module data.
2	Four lines of “▒” digits in the metering area	Main display area: displays metering data such as voltage, current, power, power factor, frequency, unbalance, phase angle, etc. Displays statistics such as maximum and minimum, demand data, display settings, and expanded I/O data.
3	Four “8” and five “▒” digits	Displays energy data and real-time clock. Also used for the setting mode and digital I/O mode display.
4	Three “▒” digits	Item Icons: “U” for voltage; “I” for current; “P” for active power; “Q” for reactive power; “S” for apparent power; “PF” for power factor; “F” for frequency; “∠” for phase angles; “DMD” for demand; "Mxx" for expanded I/O module type; and display setting page number.
5	Unbalance, THD, TDD, MAX, MIN	Item Icons: “Unbalance” for unbalance of the voltage and current; “THD” for total harmonics distortion; “TDD” for total demand distortion; “MAX” for maximum, and “MIN” for minimum.
6	Load rate ◔	Displays the percentage of load current to the nominal current.
7	Four quadrant icon ⊕ Load type icon -ᴖᴖᴖ- ⊣⊢	⊕: quadrant of the system power. -ᴖᴖᴖ- : inductive load; ⊣⊢ : capacitive load.
8	1-2, 2-3, 3-1, avg, N	1, 2, 3 for 3-phase A, B, C; 1-2, 2-3, 3-1 for 3-phase line-to-line AB, BC, CA; avg for average, and N for neutral.
9	Energy icon: Imp, Total, Net, Exp	Imp: import energy. Exp: export energy. Total: absolute sum of Imp and Exp energy. Net: algebraic sum of Imp and Exp energy.
10	Units measured	Voltage: V, kV; Current: A, kA; Active power: kW, MW; Reactive power: kvar, Mvar; Apparent power: kVA, MVA; Frequency: Hz; Active energy: kWh; Reactive energy: kvarh; Apparent energy: kVAh; Percentage: %; Phase angle: °.
11	Communication icon ▤	No icon: no communication. One icon: query sent. Two icons: query sent and response received.
12	Energy pulse output indicator ⎍	No icon: no pulse output. With icon: icon blinks when sending pulse output.
13	Expanded I/O module indicator M1 x2 M2 x2 M3 x2	M1: one PXM1K-1 connected. M1x2: two PXM1K-1 connected. None: no PXM1K-1 connected. M2: one PXM1K-2 connected. M2x2: two PXM1K-2 connected. None: no PXM1K-2 connected. M3: one PXM1K-3 connected. M3x2: two PXM1K-3 connected. None: no PXM1K-3 connected.
14	Ethernet module indicator	No icon: Ethernet module not connected. With icon: Ethernet module connected, when the Second Communication Protocol is setting as Others. BACnet module connected, when the Second Communication Protocol is setting as BACnet.
15	T1 T2 T3 T4	Current tariff.
16	Time icon 🕓	Time display .

There are four keys on the front panel, labeled H, P, E, and V/A from left to right. Use these four keys to read real-time metering data, set parameters, and navigate the meter.

Note: If the LCD backlight is off, pressing any key will turn the backlight on.

3.2 Metering Data

Pressing H and V/A simultaneously will activate the display mode selection and the cursor will flash. Press P or E to move the cursor right or left. To enter the metering mode, move the cursor to "Meter" then press V/A.

In the metering mode, pressing P and E simultaneously will access the TOU mode.

In metering mode, the meter displays measurements such as voltage, current, power, power factor, phase angle, unbalance, etc.

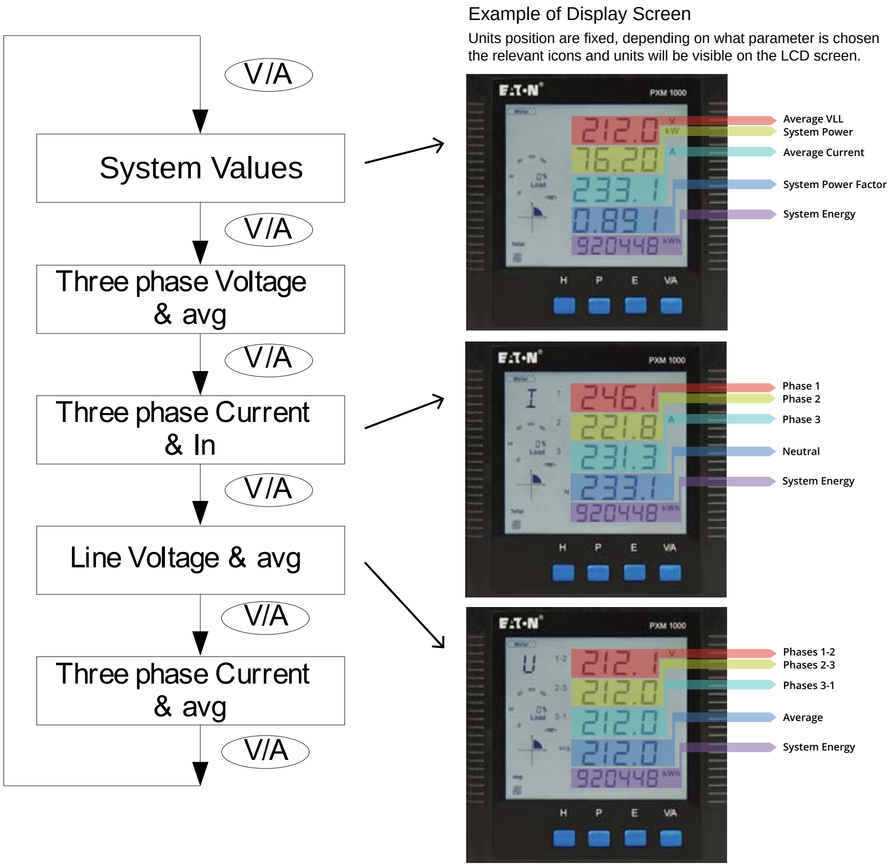
In the TOU mode, the meter displays the energy, maximum demand, and time in different tariffs.

A. Voltage and Current:

Press V/A to read the voltage and current in the metering area. Pressing V/A again will take the user to the next screen in the sequence.

The Figure 26 shows the sequence:

Figure 26. Voltage and Current Sequence.



Example of Display Screen

Units position are fixed, depending on what parameter is chosen the relevant icons and units will be visible on the LCD screen.

Notes: When the meter is set to "2LL" or "3LL", there is no phase voltage or neutral current display. Therefore, only the fourth screen (line voltage & avg) and the fifth screen (three phase current & avg) will be displayed.

When the meter is set to "1LN", only phase A voltage and phase A current will be displayed, without line voltages or other displays.

When the meter is set to "1LL", phase C voltage and phase C current will not be displayed.

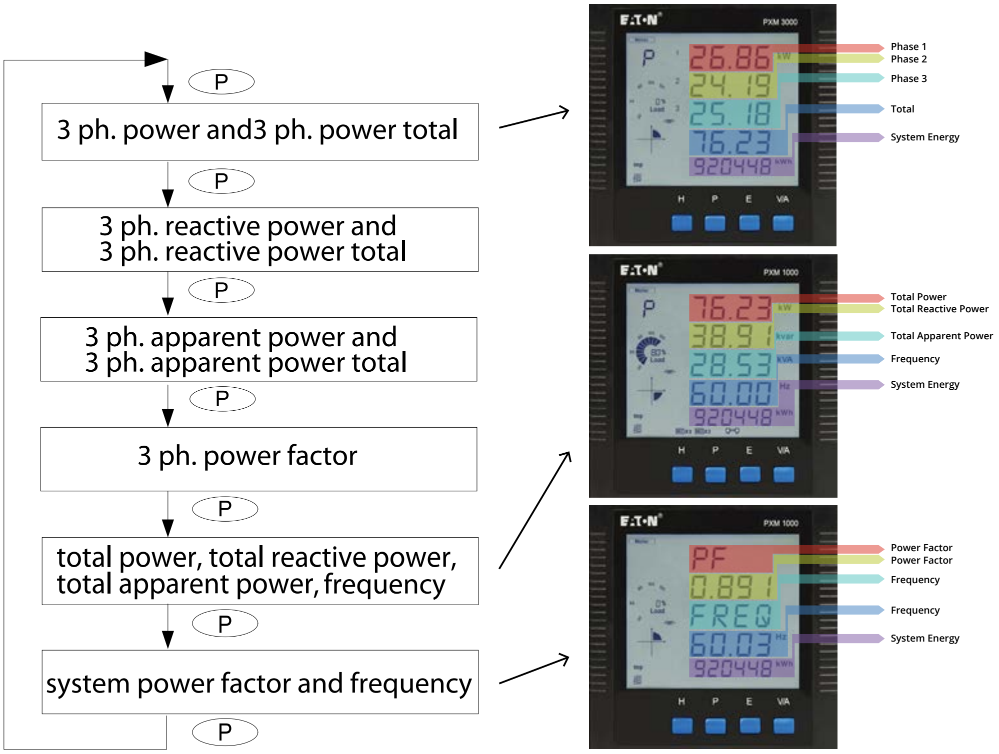
B. Power, Power, Factor and Frequency:

Press P to display power related data.

Pressing P again will take the user to the next screen in the sequence.

The Figure 27 shows the sequence.

Figure 27. Power, Power Factor, and Frequency Sequence.



Notes: When the meter is set to "2LL" or "3LL" only the fifth screen (system power) and the sixth screen (system power factor & frequency) will be displayed.

When the meter is set to "1LN", only phase A power and phase A power factor will be displayed.

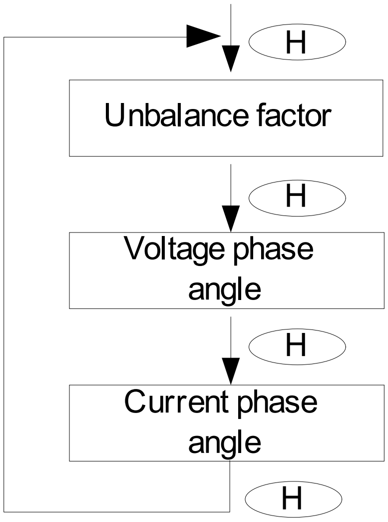
When the meter is set to "1LL" no phase C power and phase C power factor will be displayed.

C. Phase Angles and Unbalance:

Press H to display phase angles and unbalance data. Pressing H again will take the user to the next screen in the sequence.

The Figure 28 shows the sequence:

Figure 28. Phase Angles and Unbalance Sequence.



When using “2LL” or “3LL” wiring setting mode, voltage stands for line to line voltage. Otherwise, voltage stands for line-to-neutral voltage.

When the meter is set to “1LN”, there is only phase A current to phase A voltage angle display.

When the meter is set to “1LL”, there is no phase C voltage or current to phase A voltage angle factor display.

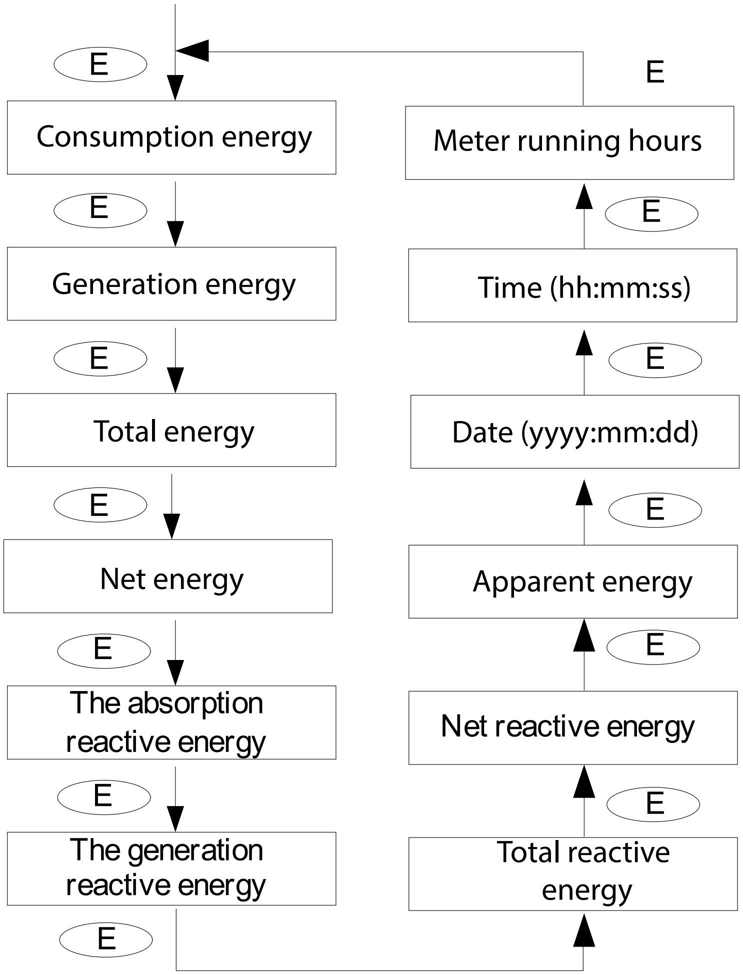
D. Energy:

Press the E key to display energy and real time clock. Pressing E again will take the user to the next screen in the sequence.

The PXM 1000 meter can be set to record primary energy or secondary energy. The unit of energy is kWh for active energy, kvarh for reactive energy, and kVAh for apparent energy. The running time has a resolution of 0.01h. The meter begins accumulating energy upon initial power-up of the unit. The accumulated data is stored in the non-volatile memory. It can be reset via communication or from the front of the meter.

The Figure 29 shows the sequence:

Figure 29. Energy Sequence.



E. TOU display

Press “P” and “E” simultaneously to enter the TOU energy and maximum demand page. Press “E” to display the TOU energy. Press “P” to display the TOU maximum demand. Pressing “P” again from this screen takes users to the TOU maximum demand year, month, and date. Pressing “P” for a second time takes users to the TOU maximum demand hour, minute, and second. Pressing “H” takes users to the tariffs screen. It displays energy under different tariffs in the energy page. It also displays demand under different tariffs in the maximum demand page. Pressing “V/A”will display the different types of energy and maximum demand. Press “P” and “E” simultaneously to exit the current page and return to metering mode.

Figure 30 shows the sequence:

Figure 30. TOU Sequence.

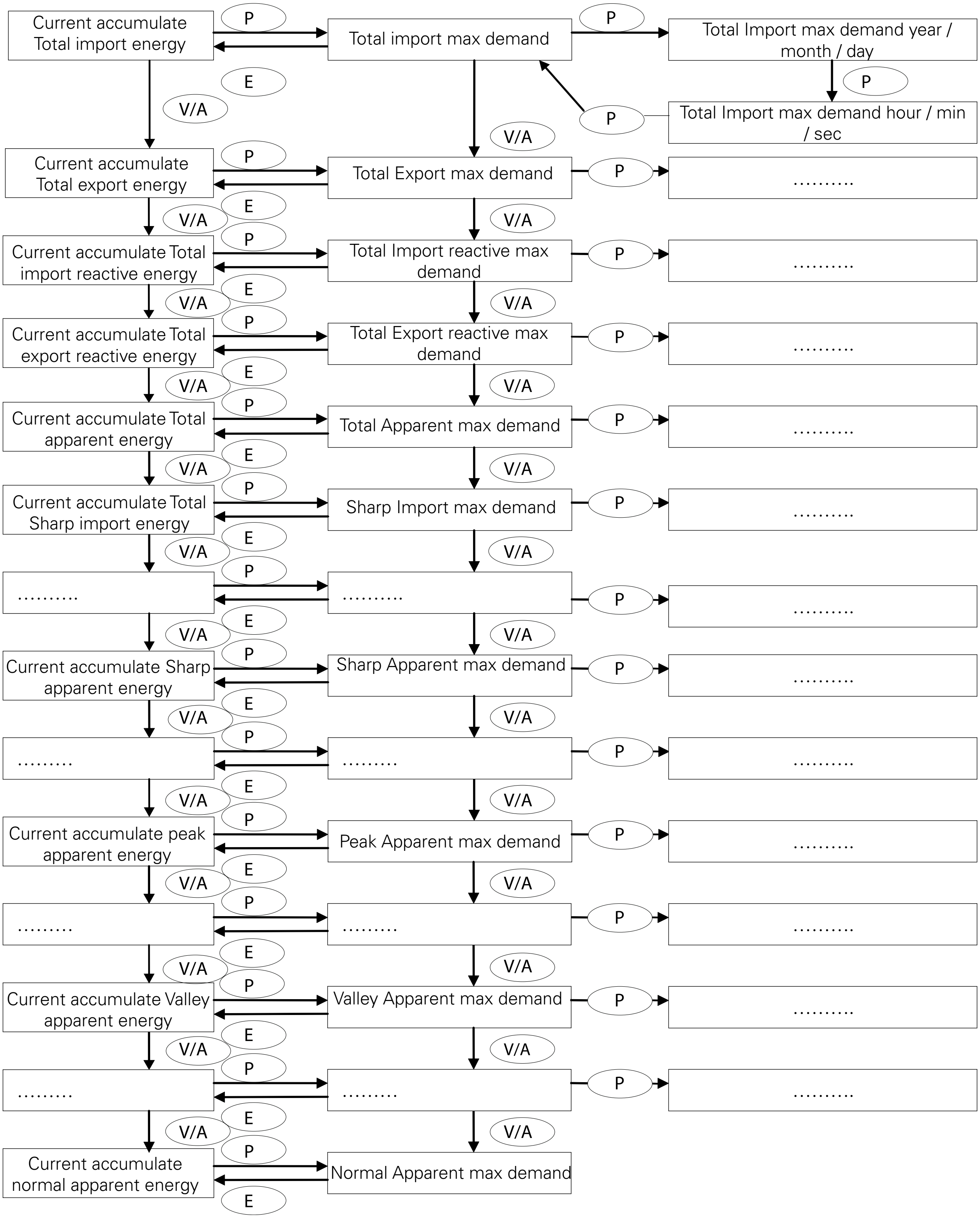
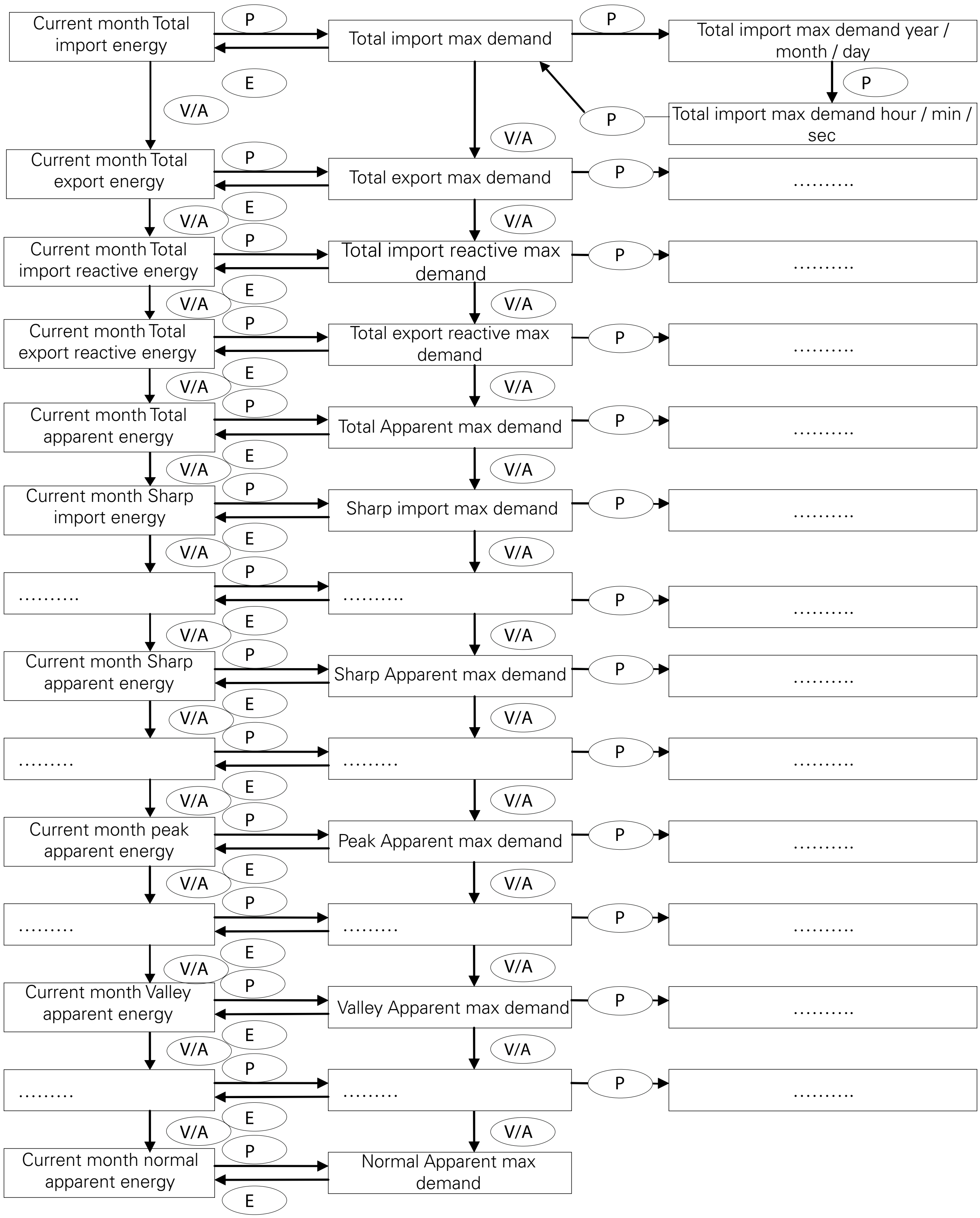


Figure 30. TOU Sequence (Continued).



3.3 Max/Min Data

Pressing H and V/A simultaneously will activate the display mode selection and the cursor will flash. Press P or E to move the cursor right or left. To enter the statistics data mode, scroll the cursor to "Max/Min" then press V/A.

In max/min data mode, the meter displays the maximum values and minimum values for voltage, current, power, power factor, unbalance, demand, THD, etc. The user should note that time stamp for the parameters can be viewed only from the software through communication. No commands are associated with the H key in "Max/Min" display mode.

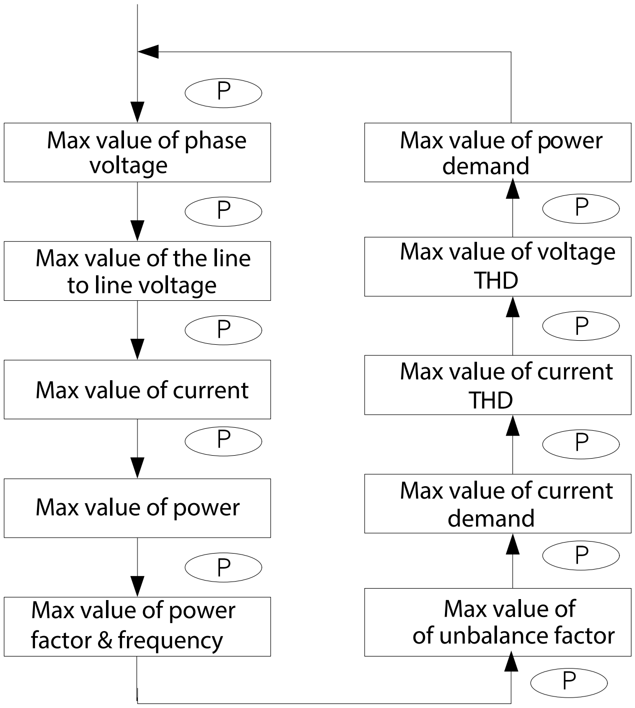
Pressing P will take the user to the next screen in the sequence.

Pressing E will take the user to the previous screen in the sequence.

Pressing V/A will toggle the displayed parameter between maximum and minimum. For example, if the current display is the maximum phase voltage value, when V/A is pressed, the display will show the minimum phase voltage value. If V/A is pressed again, the display will switch back to show the maximum phase voltage value.

Figure 31 shows the sequence:

Figure 31. Max/min Data Sequence.



Notes: The figure shows the rolling sequence when pressing P. The sequence will be reversed when pressing E.

When the meter is set to "2LL" or "3LL", the first screen (max value of phase voltage) will not be displayed.

When the meter is set to "1LL", there are no such displays as phase C voltage, Ubc and Uca line voltage, phase C current, three phase voltage and current unbalance factor, Uc and Ic THD, phase C current demand, etc.

When the meter is set to "1LN", there is only phase A display of phase voltage and current, only Ua and Ia THD display, only demand display of phase A. And there are no such displays as three-phase voltage and current unbalance factor, line voltage, etc.

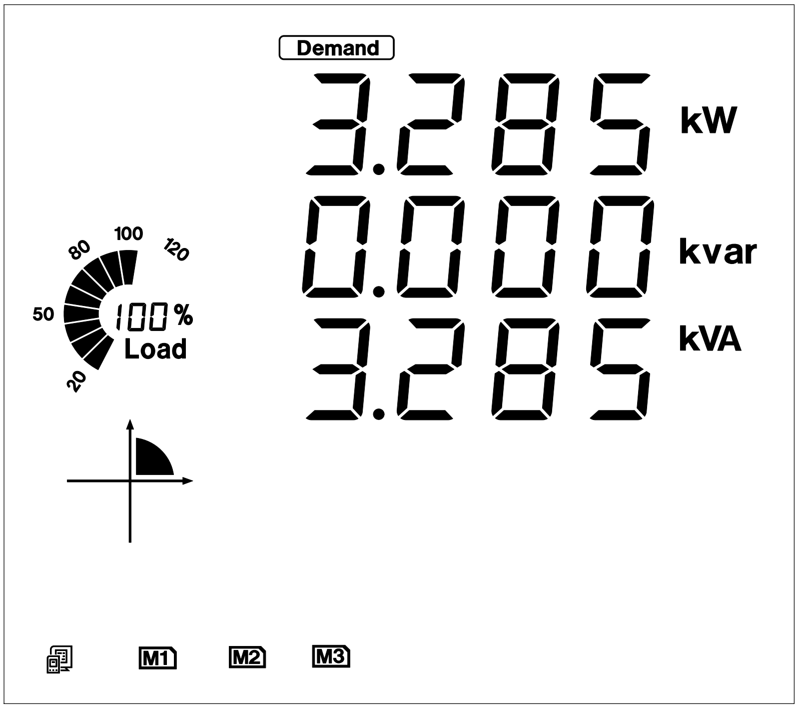
3.4 Demand Data

Pressing H and V/A simultaneously will activate the display mode selection and the cursor will flash. Press P or E to move the cursor right or left. To enter the demand mode, move the cursor to "Demand" then press V/A.

In the demand data mode, the first screen displays the demand of active power, reactive power, and apparent power, and the second screen displays the current demand of phase A, phase B, and phase C. When the meter is set to "1 LL," the current demand for phase C is not available. When the meter is set to "1 LN," phases B and C for current demand display are not available.

As shown in the Figure 32, system active power demand is 3.285 kW, system reactive power demand is 0 kvar, and system apparent power demand is 3.285 kVA.

Figure 32. Demand Data.



3.5 Harmonic Data

Pressing H and V/A simultaneously will activate the display mode selection and the cursor will flash. Press P or E to move the cursor right or left. To enter harmonic mode, move the cursor to "Harmonic" then press V/A.

In the harmonic data mode, the meter displays the harmonic ratio of voltage and current, THD, odd HD, even HD, THFF, CF, and KF.

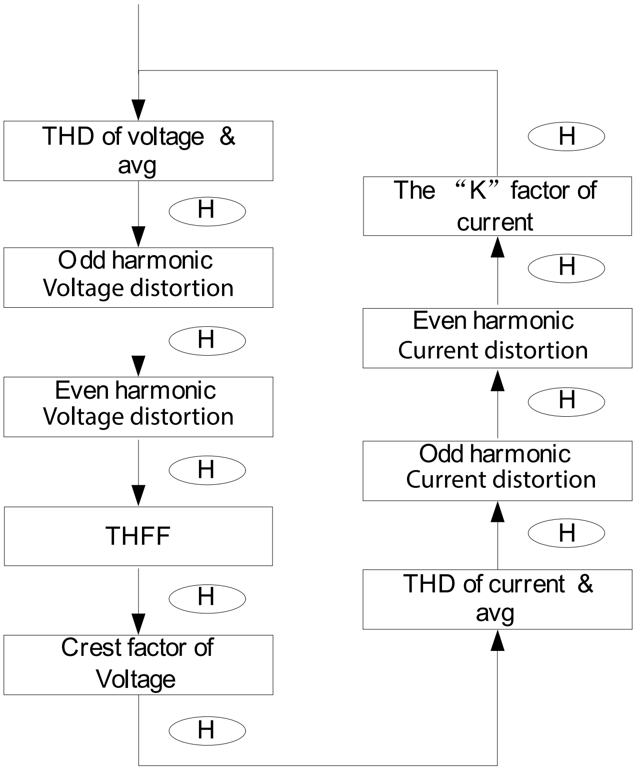
A. Power Quality Data:

Press H to display the power quality data. Pressing H again will take the user to the next screen in the sequence.

The P and E keys have no functionality in this mode.

Press V/A to switch to harmonic ratio data display.

Figure 33. Power Quality Data Sequence.



Notes: When the meter is set to "1LN", there is only phase A display for voltage THD, voltage odd HD, voltage even HD, THFF, voltage crest factor, current THD, current odd HD, current even HD, and current K factor.

When the meter is set to "1LL", there is no phase C display.

B. Harmonic Ratio Data

Press H to switch to power quality data display.

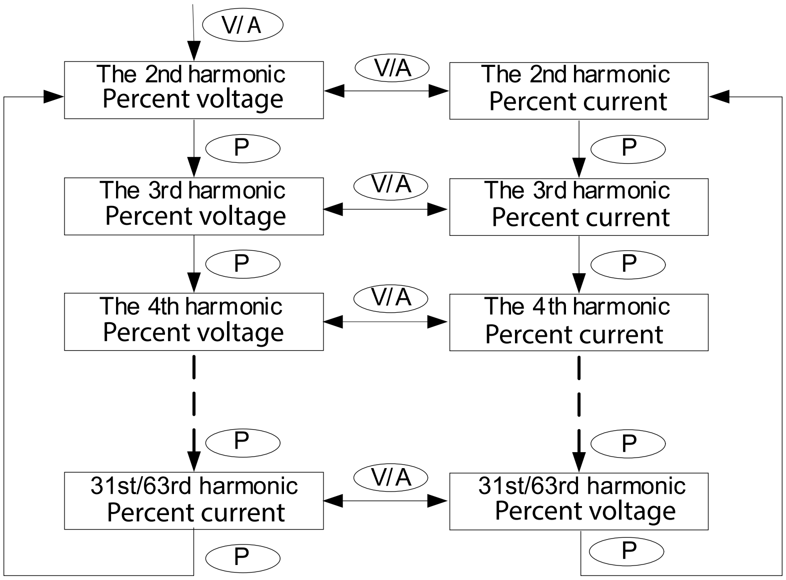
Pressing P increases the harmonic order by one until the user reaches the 63rd harmonic. The user will then be returned to the 2nd harmonic.

Pressing E decreases the harmonic order by 1 until the user reaches the 2nd harmonic. The user will then be returned to the 63rd harmonic.

Press V/A to switch display between voltage harmonics and current harmonics.

Figure 34 shows the sequence:

Figure 34. Individual Harmonic Data.



Notes: The figure shows the rolling sequence when pressing P. If E is pressed, the sequence will reverse.

Harmonic is 2nd ~ 63rd.

When the meter is set to "1LN", there is only phase A display for voltage and current harmonic magnitude.

When the meter is set to "1LL", there is no phase C display for voltage and current harmonic magnitude.

3.6 Expanded I/O Module Data

Pressing H and V/A simultaneously will activate the display mode selection and the cursor will flash. Press P or E to move the cursor right or left. To access data from the expanded I/O modules, move the cursor to "Digital I/O" then press V/A to enter the expanded I/O module data mode.

In the expanded I/O module data mode, the meter displays the data from expanded I/O modules, such as DI status, pulse counter number, relay status, analog input, analog output, etc.

In this mode, the first page is module selection. You can choose to view the available modules that are attached to the meter. If no expanded I/O modules are connected, the screen will display "NO I/O".

A. Module Selection:

The H key has no functionality on this screen.

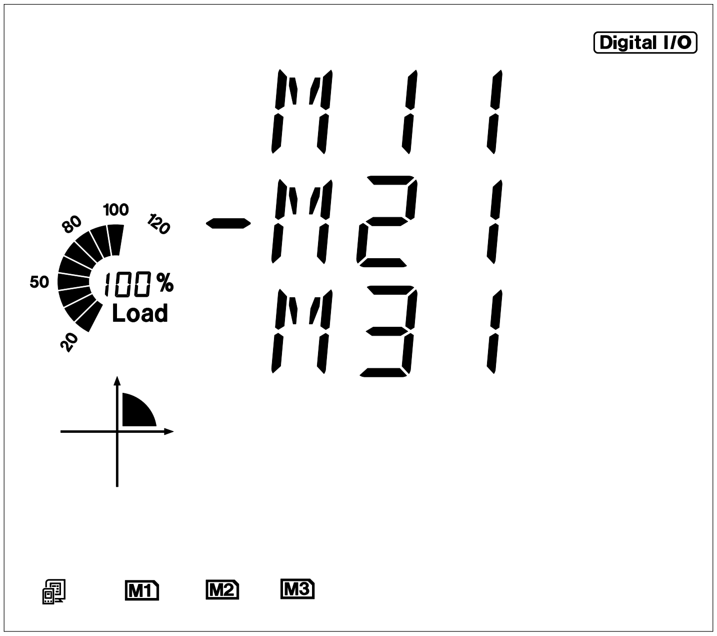
If more than one module is connected, pressing P will allow the user to select the module listed below. When the bottom of the list is reached, the cursor will return to the top.

If more than one module is connected, pressing E will allow the user to select the module listed above. When the top of the list is reached, the cursor will return to the bottom.

Press V/A to select the module and enter the I/O module data selection mode.

As shown in Figure 35, three modules are connected, PXM1K-11, PXM1K-21, PXM1K-31, which are indicated by M11, M21, M31 respectively. The cursor points to M21, which indicates that PXM1K-21 is chosen now.

Figure 35. Three Connected Modules Shown.



B. I/O Module Data Selection:

Press H to return to module selection screen.

Press P to move the cursor downwards; the cursor will return to the top when it reaches the bottom. Please note that there are three parameters for PXM1K-1, three parameters for PXM1K-1, and four parameters for PXM1K-3.

Press E to move the cursor upwards; the cursor will return to the bottom when it reaches the top.

Press V/A to select the parameter and take the user to the data display screen.

C. I/O Module Data Display

Pressing H returns the user to the I/O module data selection screen.

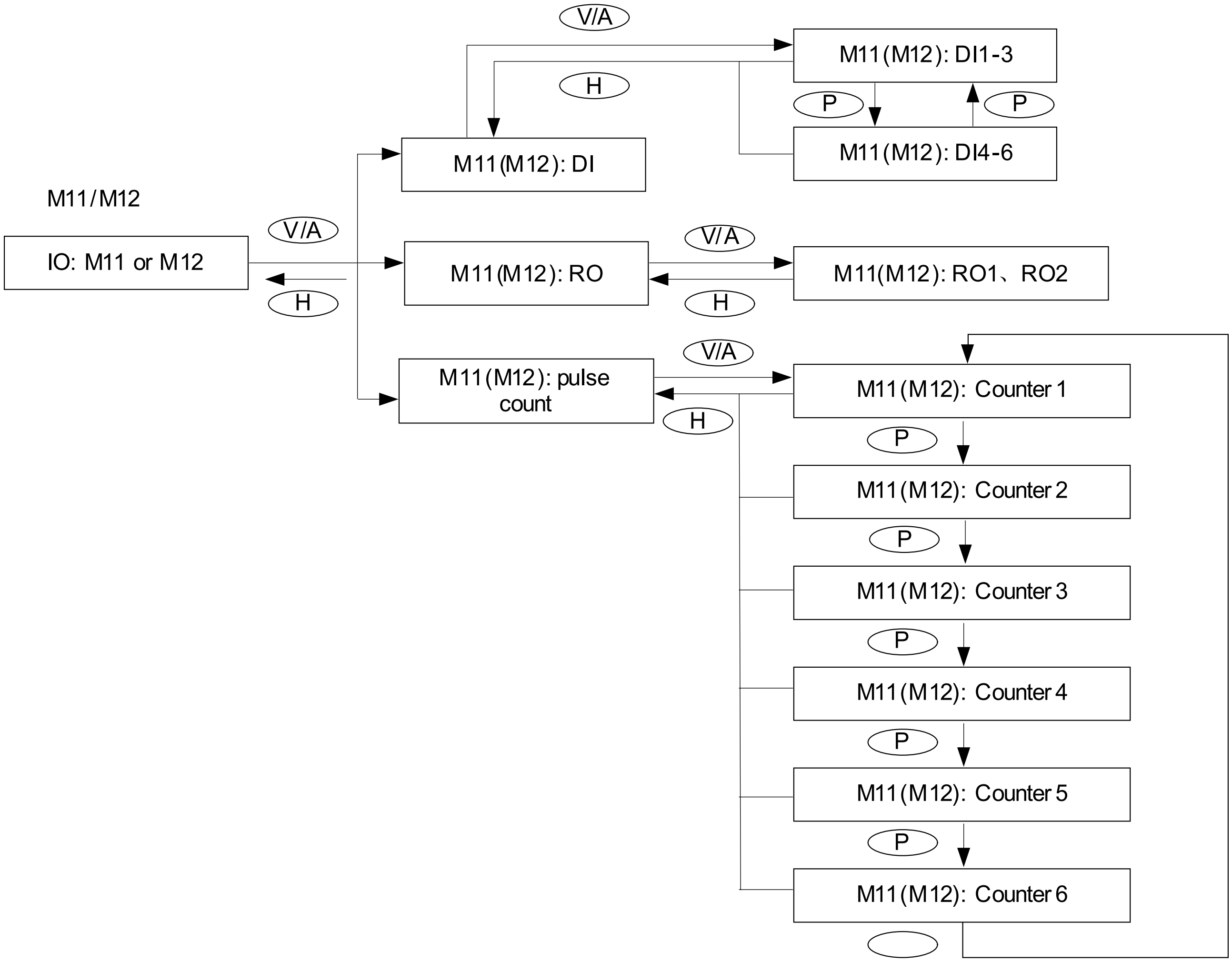
If more than one page is available, pressing P will take the user to the next screen in the sequence. Pressing E will take the user to the previous screen in the sequence.

The V/A key has no functionality on these screens.

Note: the local display uses abbreviated notation.
M11 for the PXM1K-11x modules
M12 for the PXM1K-12x modules
M21 for the PXM1K-21x modules
M22 for the PXM1K-22x modules
M31 for the PXM1K-31x modules
M32 for the PXM1K-32x modules

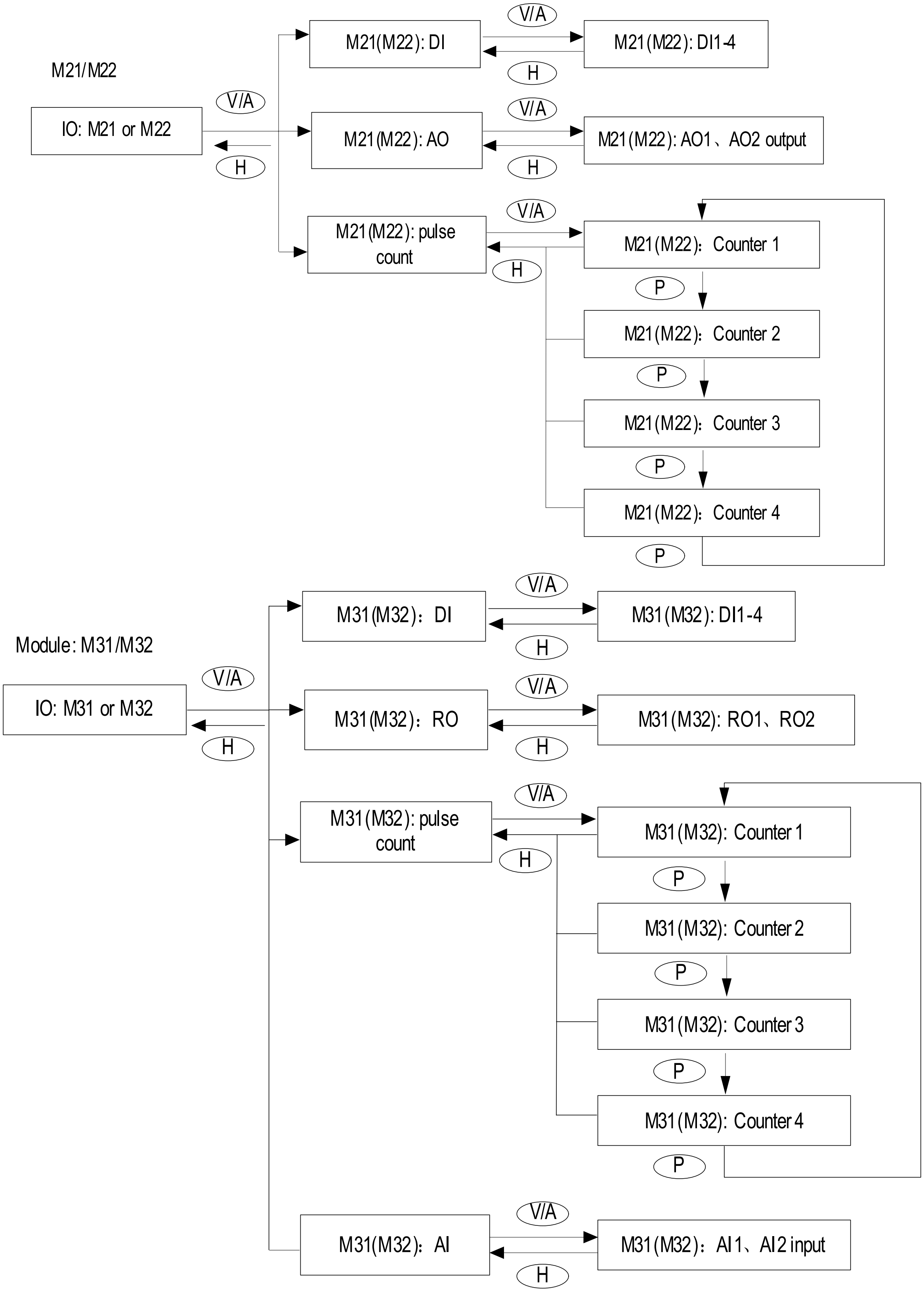
Figure 36 shows the sequence:

Figure 36. I/O Module Data Display Sequence.



Note: The Figure 36 shows the scrolling sequence for using the P key. If using the E key for scrolling the page, the sequence will be reversed.

Figure 36. I/O Module Data Display Sequence (continued).



3.7 Parameter Setting Mode

Pressing H and V/A simultaneously will activate the display mode selection and the cursor will flash. Press P or E to move the cursor right or left. To enter parameter setting mode, move the cursor to “Setting” then press V/A.

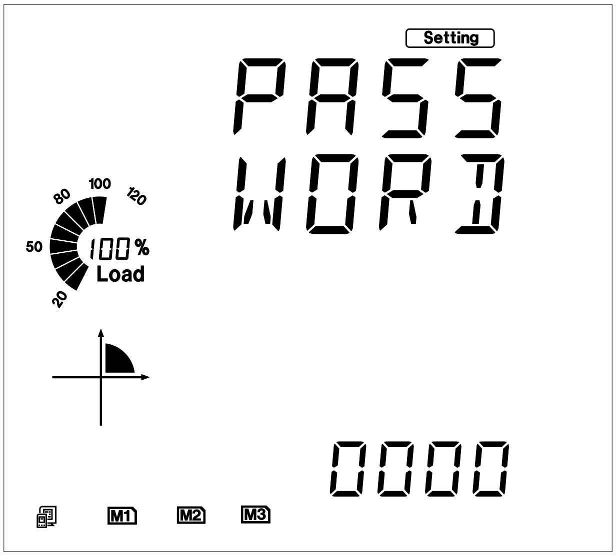
In the parameter setting mode, parameters such as system parameters, expanded I/O module parameters, alarm parameters, and Ethernet module parameters can be read and modified.

A. Password Entry

Parameter setting mode is password protected. Before entering the password and getting into the parameter setting mode, the meter’s device communication address will display for three seconds. A four digit password (0000 to 9999) is required every time before accessing the parameter setting mode. The default password is 0000. After entering the password, press V/A to go to the parameter selection page. The meter will be still in the password entry page if a wrong password is entered.

Figure 37 shows the password entry page.

Figure 37. Password Entry Page.



To input password:

1. Press H to move the flashing cursor to the next position.
2. Press P to increase the number by 1.
3. Press E to decrease the number by 1.
4. Press V/A to confirm the password.

B. Parameter Selection Mode

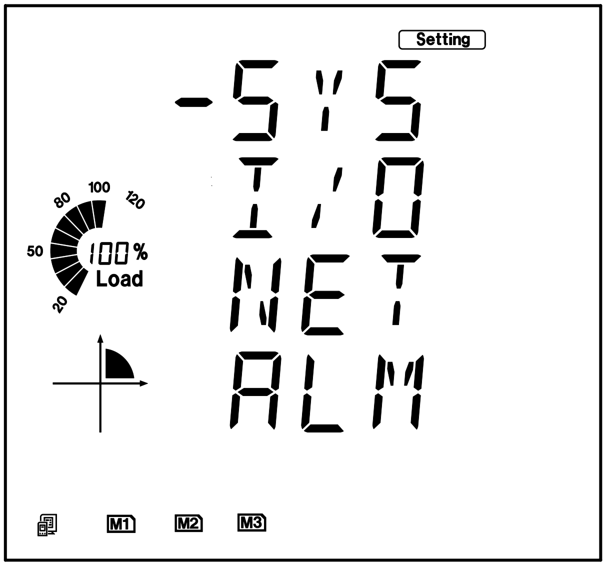
There are four parameters to choose from in the parameter selection manual: system, expanded I/O module, Ethernet module, and alarm.

The H key has no functionality in this mode.

Press P to move the cursor downwards. The cursor will return to the top when it reaches the bottom.

Press E to move the cursor upwards. The cursor will return to the bottom when it reaches the top.

Figure 38. Parameter Selection Mode Page.



Press V/A to select and modify the parameter. Figure 38 shows the parameter selection page. "SYS" stands for system parameter, "I/O" stands for expanded I/O module parameter, "NET" stands for Ethernet module parameter or BACnet module parameter, and "ALM" stands for alarm parameter. As shown in the figure, the cursor points to the "SYS", which means system parameter is selected.

C. System Parameter Setting

Users can select and modify system parameter in the system parameter setting mode.

Key functions for selecting a parameter:

Press H to return to the parameter selection mode.

Pressing P will take the user to the next screen in the sequence.

Pressing E will take the user to the previous screen in the sequence.

Press V/A to modify the selected parameter.

Key functions for modifying the parameter:

Press H to move the flashing cursor to the next position.

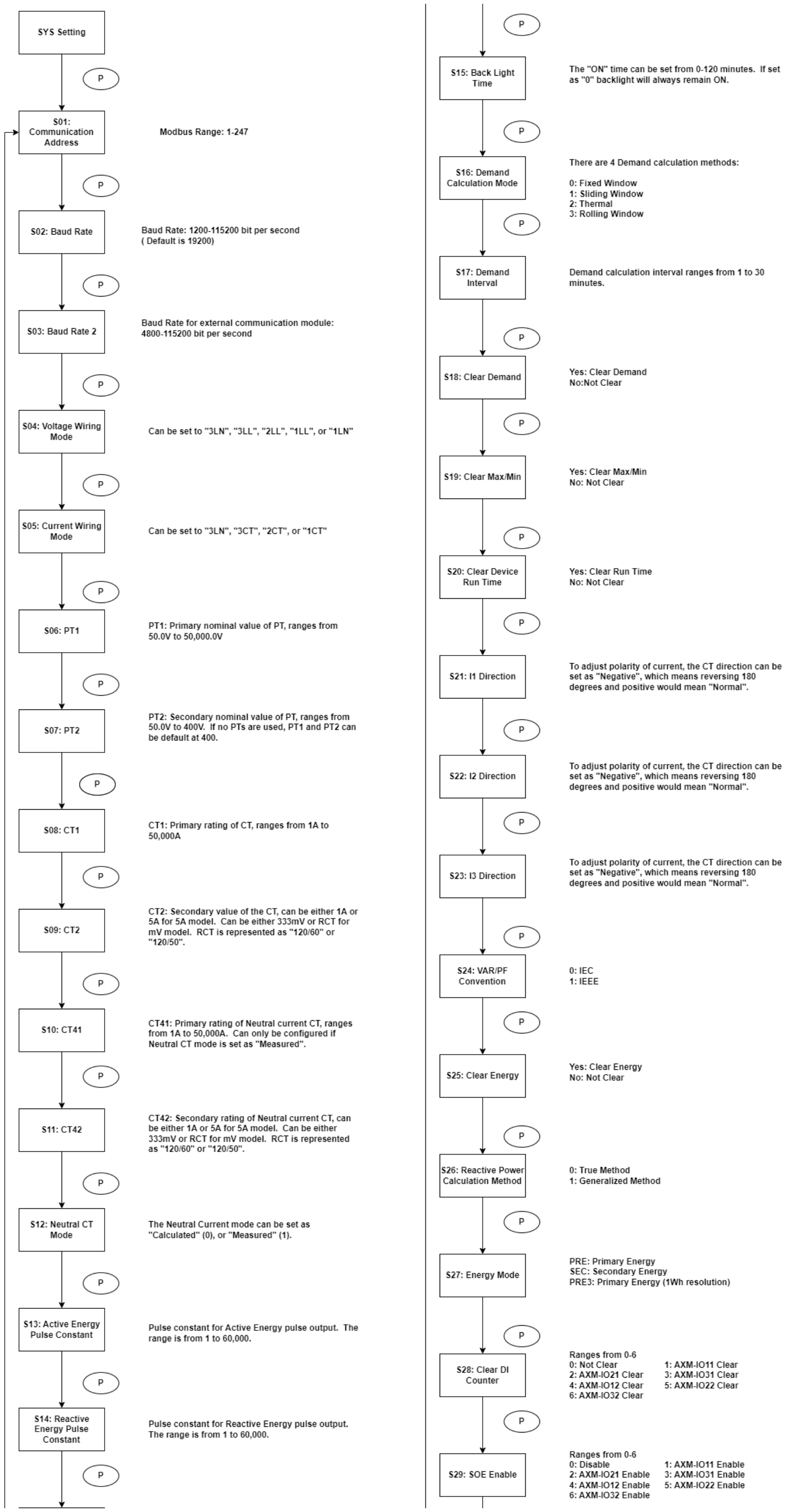
Press P to increase the number by 1.

Press E to decrease the number by 1.

Press V/A to confirm the modification and return to parameter selection mode.

Figure 39 shows the sequence:

Figure 39. System Parameter Setting Sequence.



S01: Communication Address
Modbus Range: 1-247

S02: Baud Rate
Baud Rate: 1200-115200 bit per second
(Default is 19200)

S03: Baud Rate 2
Baud Rate for external communication module:
4800-115200 bit per second

S04: Voltage Wiring Mode
Can be set to "3LN", "3LL", "2LL", "1LL", or "1LN"

S05: Current Wiring Mode
Can be set to "3LN", "3CT", "2CT", or "1CT"

S06: PT1
PT1: Primary nominal value of PT, ranges from 50.0V to 50,000.0V

S07: PT2
PT2: Secondary nominal value of PT, ranges from 50.0V to 400V. If no PTs are used, PT1 and PT2 can be default at 400.

S08: CT1
CT1: Primary rating of CT, ranges from 1A to 50,000A

S09: CT2
CT2: Secondary value of the CT, can be either 1A or 5A for 5A model. Can be either 333mV or RCT for mV model. RCT is represented as "120/60" or "120/50".

S10: CT41
CT41: Primary rating of Neutral current CT, ranges from 1A to 50,000A. Can only be configured if Neutral CT mode is set as "Measured".

S11: CT42
CT42: Secondary rating of Neutral current CT, can be either 1A or 5A for 5A model. Can be either 333mV or RCT for mV model. RCT is represented as "120/60" or "120/50".

S12: Neutral CT Mode
The Neutral Current mode can be set as "Calculated" (0), or "Measured" (1).

S13: Active Energy Pulse Constant
Pulse constant for Active Energy pulse output. The range is from 1 to 60,000.

S14: Reactive Energy Pulse Constant
Pulse constant for Reactive Energy pulse output. The range is from 1 to 60,000.

S15: Back Light Time
The "ON" time can be set from 0-120 minutes. If set as "0" backlight will always remain ON.

S16: Demand Calculation Mode
There are 4 Demand calculation methods:

0: Fixed Window
1: Sliding Window
2: Thermal
3: Rolling Window

S17: Demand Interval
Demand calculation interval ranges from 1 to 30 minutes.

S18: Clear Demand
Yes: Clear Demand
No:Not Clear

S19: Clear Max/Min
Yes: Clear Max/Min
No: Not Clear

S20: Clear Device Run Time
Yes: Clear Run Time
No: Not Clear

S21: I1 Direction
To adjust polarity of current, the CT direction can be set as "Negative", which means reversing 180 degrees and positive would mean "Normal".

S22: I2 Direction
To adjust polarity of current, the CT direction can be set as "Negative", which means reversing 180 degrees and positive would mean "Normal".

S23: I3 Direction
To adjust polarity of current, the CT direction can be set as "Negative", which means reversing 180 degrees and positive would mean "Normal".

S24: VAR/PF Convention
0: IEC
1: IEEE

S25: Clear Energy
Yes: Clear Energy
No: Not Clear

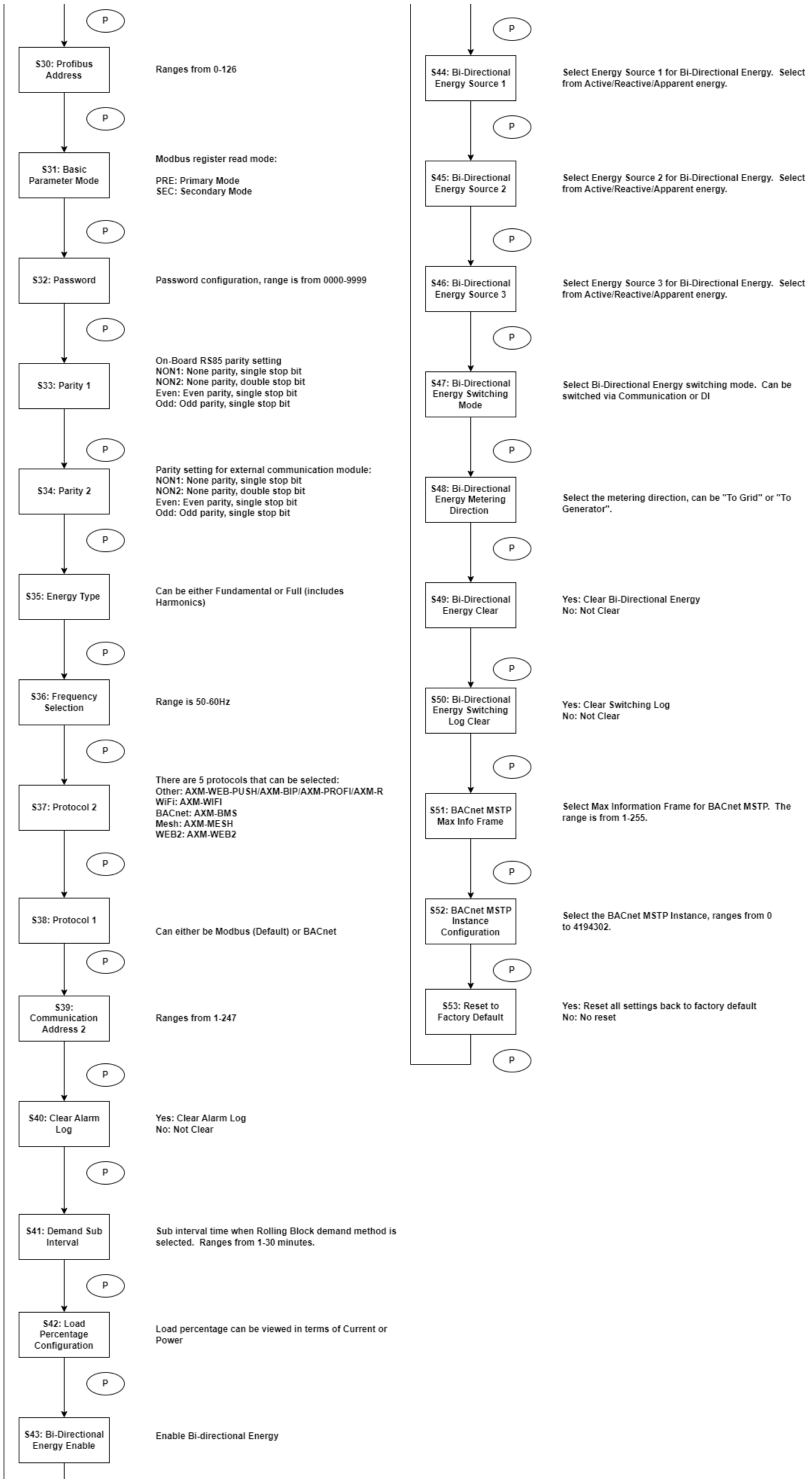
S26: Reactive Power Calculation Method
0: True Method
1: Generalized Method

S27: Energy Mode
PRE: Primary Energy
SEC: Secondary Energy
PRE3: Primary Energy (1Wh resolution)

S28: Clear DI Counter
Ranges from 0-6
0: Not Clear
1: AXM-IO11 Clear
2: AXM-IO21 Clear
3: AXM-IO31 Clear
4: AXM-IO12 Clear
5: AXM-IO22 Clear
6: AXM-IO32 Clear

S29: SOE Enable
Ranges from 0-6
0: Disable
1: AXM-IO11 Enable
2: AXM-IO21 Enable
3: AXM-IO31 Enable
4: AXM-IO12 Enable
5: AXM-IO22 Enable
6: AXM-IO32 Enable

Figure 39. System Parameter Setting Sequence (continued).



Note: The figure shows the sequence for using the P key. If using the E key to change the page, the sequence will reverse.

Note: Option only available on Version B for CT41 and CT42.

D. Expanded I/O Module Parameter

In the expanded I/O module parameter mode, the user can choose to view the available modules that are attached to the meter and modify their parameters. If no expanded I/O modules are connected, the screen will display "NO I/O". To return to system parameter setting mode main menu, press H (no other keys have functionality on this screen).

Key functions for I/O module selection:

Press H to return to parameter selection mode.

If more than one module is connected, pressing P moves the cursor downwards. The cursor will return to the top after it reaches the bottom. Pressing E will move the cursor back upwards.

Press V/A to select the module and enter the I/O module parameter setting mode.

Key functions for setting the I/O module parameter:

Press H to return to I/O module selection mode.

Pressing P will take the user to the next screen in the sequence.

Pressing E will take the user to the previous screen in the sequence. Press V/A to modify the selected parameter

Key functions for modifying the parameter:

Press H to move the flashing cursor to the next position.

Press P to increase the number by 1.

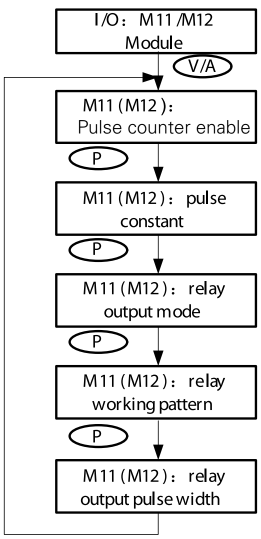
Press E to decrease the number by 1.

Press V/A to confirm the modification and return to parameter selection mode.

Table 3 shows the sequence:

Table 3. Expanded I/O Module Parameter Sequence.

Module M 11 /M12



DI of PXM1K-1 can be used as the pulse counter, each DI function corresponds to one bit of a 6-bit register. The correspondence bit of 0 means that the DI works as the digital status input and correspondence bit of 1 means that the DI works as the pulse counter. For example, if the setting value is 000001, it means that DI1 is set as the pulse counter and other DIs work as digital status inputs.

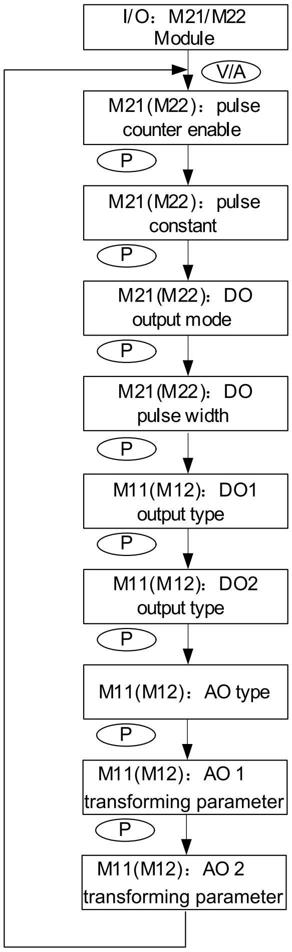
If the DI works as a pulse counter, when the number of pulses counted by the DI equals to the pulse constant, the pulse counter will increase by one. This means that the actual pulse number equals the number of pulses counted multiplied by the pulse constant.

Relays of PXM1K-1 can be used as alarm output or control output.
ALM: alarm output;
CTRL: control output

When set as control output, relays have two control methods: latch or pulse.
LATCH: latch mode;
PUL: pulse mode

If the relay pulse control method is selected, the relay contact will close for a preset period and open afterwards. The pulse width range is 50~3000 ms.

Module M 21/M22



DI of PXM1K-2 can be used as the pulse counter, each DI function corresponds to one bit of a 4-bit register. The correspondence bit of 0 means that the DI works as the digital status input and correspondence bit of 1 means that the DI works as the pulse counter. For example, if the setting value is 0001, it means that DI1 is set as the pulse counter and other DIs work as digital status inputs.

If the DI works as a pulse counter, when the number of pulses counted by the DI equals to the pulse constant, the pulse counter will increase by one. This means that the actual pulse number equals the number of pulses counted multiplied by the pulse constant.

DO of PXM1K-1 can be used as alarm output or energy pulse output.
ALM: alarm output;
PUL: energy pulse output

Range from 20-1000ms.

Choose output energy type for DO1. Range from 0-4.
0: no output; 1: import active energy; 2: export active energy 3: import reactive energy; 4: export reactive energy

Follow the DO1 setup method to setup DO2.
If DO type is set as alarm output, DO1 and DO2 output type parameters will have no effect.

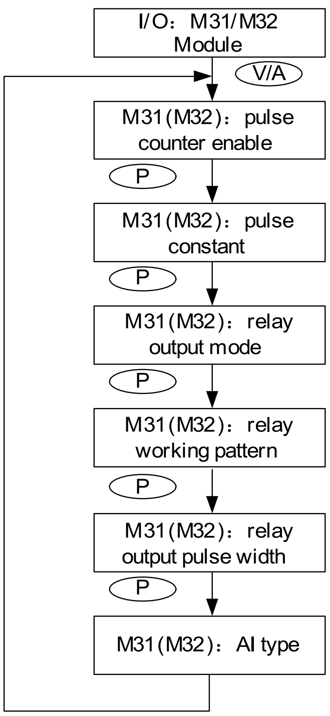
Range from 0 to 3.
0: 0-20mA; 1: 4~20mA; 2: 0-5V; 3: 1-5V

Be aware that module with current option cannot be set as voltage type (i.e. option 2 and 3 are unavailable); modules with voltage option cannot be set as current type (i.e. option 0 and 1 are unavailable).

For AO1 and AO2 parameter:
Range: 0~29, see Chapter 5 page 99 “AO transforming parameter settings” for more details. When modifying AO parameter, AO input/output values reset default value.

Table 3. Expanded I/O Module Parameter Sequence (continued).

Module M 31/M32



DI of PXM1K-3 can be used as the pulse counter, each DI function corresponds to one bit of a 4-bit register. The correspondence bit of 0 means that the DI works as the digital status input and correspondence bit of 1 means that the DI works as the pulse counter. For example, if the setting value is 0001, it means that DI1 is set as the pulse counter and other DIs work as digital status inputs.

If the DI works as a pulse counter, when the number of pulses counted by the DI equals to the pulse constant, the pulse counter will increase by one. This means that the actual pulse number equals the number of pulses counted multiplied by the pulse constant.

When set as a control output, relays have two control methods: latch or pulse.

Relays of PXM1K-3 can be used as alarm output or control output.
ALM: alarm output;
CTRL: control output.

If relay pulse control method is selected, the relay contact will close for a preset period and open afterwards. The pulse width range is 50~3000ms.

Range from 0 to 3.
0: 0~20mA; 1: 4~20mA; 2: 0~5V; 3: 1~5V
Be aware that module with current option cannot be set as voltage type (i.e. option 2 and 3 are unavailable); modules with voltage option cannot be set as current type (i.e. option 0 and 1 are unavailable).

Note: Table 3 shows the sequence for using the P key. If using the E key to change, the sequence will be reversed.

E. BACnet and Ethernet Module Parameter

When the second communication protocol is set to BACnet, BACnet parameters are shown once a module is detected. If meter does not detect any modules, the display will show “LOADING” page. Each parameter can be selected for modification. These settings will only be saved if a BACnet module is connected. They will be discarded otherwise.

When second communication protocol is “Other Protocol”, there are parameters displayed that are related to the Ethernet. As described above, settings are only saved if the appropriate module is connected.

Key functions for finding the Ethernet module parameter:

Press H to return to parameter selection mode.

Pressing P will take the user to the next screen in the sequence.

Pressing E will take the user to the previous screen in the sequence.

Press V/A to modify the selected parameter.

Key functions for modifying the parameter:

Press H to move the flashing cursor to the next position.

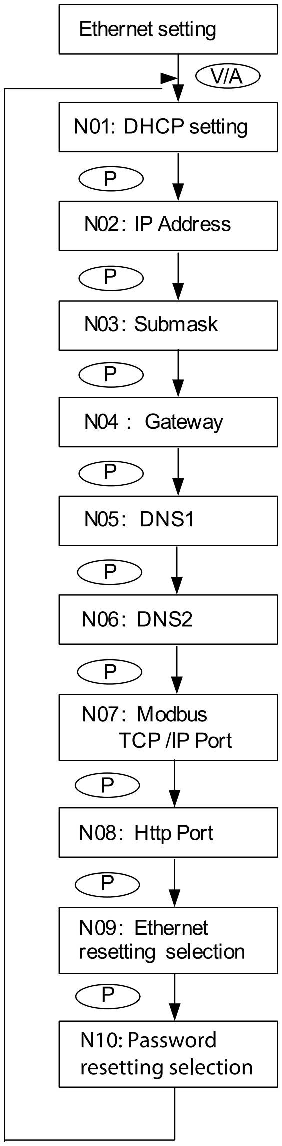
Pressing P will take the user to the next parameter in the sequence.

Pressing E will take the user to the previous parameter in the sequence.

Press V/A to confirm the modification and return to parameter selection mode.

Figure 40 shows the sequence of Ethernet module.

Figure 40. System Parameter Setting Sequence.



The selection of DHCP setting: MANU or AUTO

Default setting: MANU

IP address has four segments. Any segment can be set from 0~255.
Default setting: 192.168.1.254

Submask has four segments. Any segment can be set from 0~255.
Default setting: 255.255.255.0

Gateway has four segments. Any segment can be set from 0~255.
Default setting: 192.168.1.1

DNS1 has four segments. Any segment can be set from 0~255.
Default setting: 8.8.8.8

DNS2 has four segments. Any segment can be set from 0~255.
Default setting: 8.8.4.4

Range from 2000-5999, the default value is 502

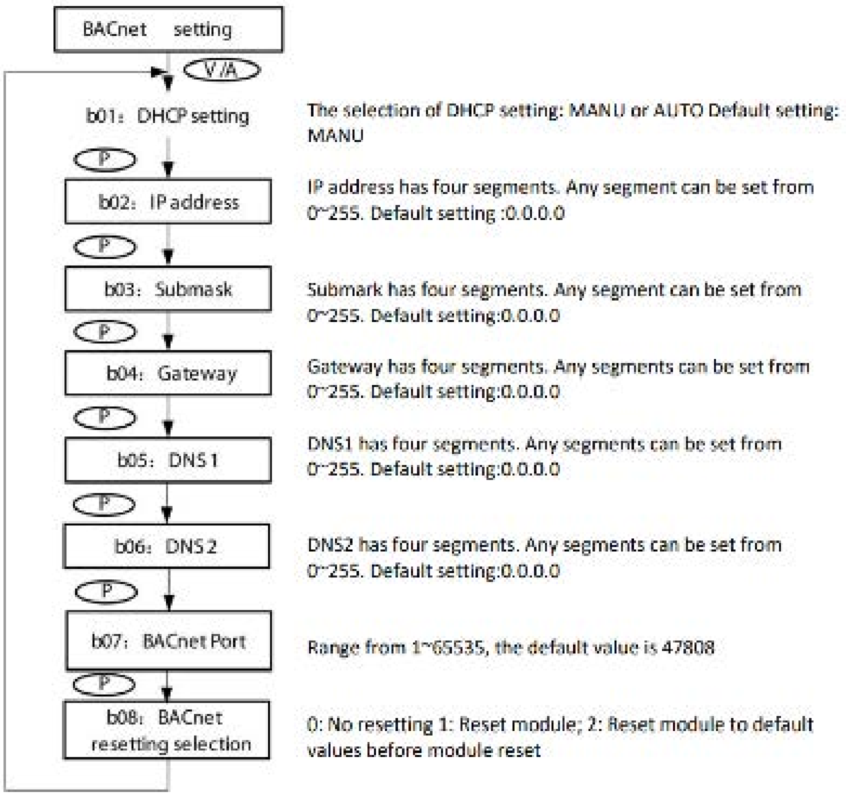
Range from 6000-9999, the default value is 80

0: No resetting; 1: Reset module after modifying parameters; 2: Reset module to default values

0:No resetting; 1: Reset password

Note: Figure 41 shows the sequence for using key P. If using E key to change the page, the sequence will be reversed.

Figure 41. BACnet IP Mod.



The selection of DHCP setting: MANU or AUTO Default setting: MANU

IP address has four segments. Any segment can be set from 0~255. Default setting :0.0.0.0

Submark has four segments. Any segment can be set from 0~255. Default setting:0.0.0.0

Gateway has four segments. Any segments can be set from 0~255. Default setting:0.0.0.0

DNS1 has four segments. Any segments can be set from 0~255. Default setting:0.0.0.0

DNS2 has four segments. Any segments can be set from 0~255. Default setting:0.0.0.0

Range from 1~65535, the default value is 47808

0: No resetting 1: Reset module; 2: Reset module to default values before module reset

F. Alarm Parameter

In the alarm parameter mode, the user can view and modify the parameters.

Key functions for finding the alarm parameter:

Press H to return to parameter selection mode.

Pressing P will take the user to the next page in the sequence.

Pressing E will take the user to the previous page in the sequence.

Press V/A to modify the selected parameter.

Key functions for modifying the parameter:

Press H to move the flashing cursor to the next position.

Press P to increase the number by one.

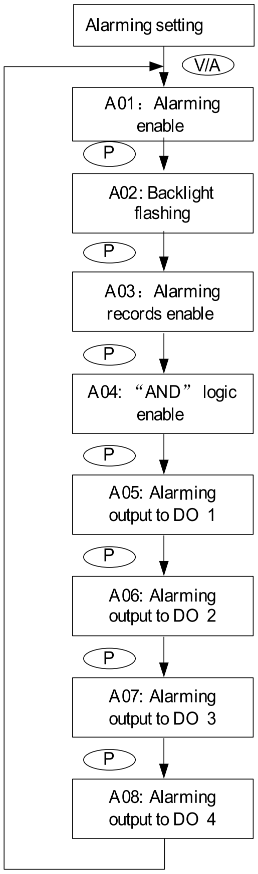
Press E to decrease the number by one.

Press V/A to confirm the modification and return to parameter selection mode.

Figure 40 shows the sequence:

Note: The figure shows the scrolling sequence for using key P. If using E for scrolling the page, the sequence will reverse.

Figure 42. Alarm Parameter Rolling Sequence.



Yes: Alarm enable; No: Alarm disable

It can be selected as cue signal for alarming.
Yes: backlight flashes upon alarm condition; No: no backlight flashing

There are 16 alarm channels available. Each channel is controlled and enabled 1 bit each from a 16-bit register. Bit value of 1 means that the corresponding alarm channel is enabled whereas 0 means that the channel is disabled. The meter will display the value of this 16-bit register in decimal numbers (for different channel combination). For example, 00000 means that all channels are disabled; 00001 means only the first channel is enabled; 65535 means that all channels are enabled. Refer to section 4.4 on page 65 for more details.

"AND" logic relationship can be set among channels. When an "AND" logic is in place, both channels have to be triggered before the meter sends out the alarm signal. The logic can be set according to the predefined rule (refer to section 4.4 for more details). User can set up to 8 logic relationships for alarming. Each logic relationship is controlled and enabled 1 bit each from a 16-bit register (only the lower 8 bits are used). Bit value of 1 means that the corresponding logic relationship is enabled whereas 0 means that the relationship is disabled. The meter will display this 8-bit value in decimal numbers (for different relationship combination). For example, 000 means that all relationships are disabled; 001 means only the first relationship is enabled; 255 means that all relationships are enabled.

When DO1 works in alarming mode, a 16-bit register is used to control which channels are associated with this output. Similar to the alarm channel selection, this 16-bit value is expressed in decimal when reading on the meter front. For example, 00000 means that no alarm channels are associated to this output; 00001 means that alarm channel 1 is associated to DO1; 65535 means that all alarm channels are associated to DO1. Refer to section 4.4 for more details.

If 2 PXM1K-2 modules are attached to the meter, DO1 and DO2 denote to the first and the second DO channel of PXM1K-21; DO3 and DO4 denote to the first and the second DO channel of PXM1K-22 respectively. DO2, DO3 and DO4 use the same setup method as DO1.

3.8 Page Recovery Function

The PXM 1000 meter has a page recovery function. This means that the meter stores the current display page in the non-volatile memory upon power loss and reloads the page when power recovers. If power is lost while in parameter setting mode, the meter will show voltage display when power recovers. If power is lost while in expanded I/O module data mode, but this module is no longer connected when power is recovered, the meter will return to the voltage display page instead.

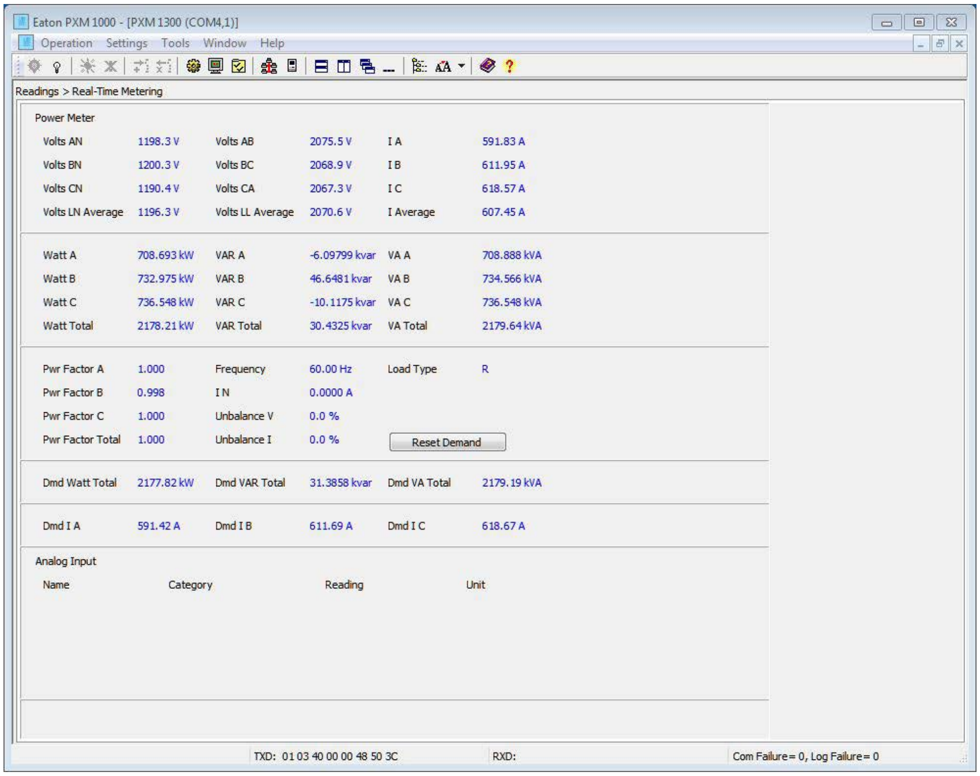
4. Detailed Functions and Software

The PXM 1000 meter contains advanced metering tools and is able to measure a multitude of power, energy, and power quality parameters. Some advanced functions may not be accessible directly from the front of the meter; therefore, every meter comes with a software that helps access the information. This chapter introduces these functions and the software.

4.1. Basic Analog Measurements

The PXM 1000 meter can measure voltage, current, power, frequency, power factor, demand, etc., with high accuracy via the software shown below.

Figure 43. Real-time Metering.



Power Meter

Volts AN	1198.3 V	Volts AB	2075.5 V	I A	591.83 A
Volts BN	1200.3 V	Volts BC	2068.9 V	I B	611.95 A
Volts CN	1190.4 V	Volts CA	2067.3 V	I C	618.57 A
Volts LN Average	1196.3 V	Volts LL Average	2070.6 V	I Average	607.45 A
Watt A	708.693 kW	VAR A	-6.09799 kvar	VA A	708.888 kVA
Watt B	732.975 kW	VAR B	46.6481 kvar	VA B	734.566 kVA
Watt C	736.548 kW	VAR C	-10.1175 kvar	VA C	736.548 kVA
Watt Total	2178.21 kW	VAR Total	30.4325 kvar	VA Total	2179.64 kVA
Pwr Factor A	1.000	Frequency	60.00 Hz	Load Type	R
Pwr Factor B	0.998	I N	0.0000 A		
Pwr Factor C	1.000	Unbalance V	0.0 %		
Pwr Factor Total	1.000	Unbalance I	0.0 %		
Dmd Watt Total	2177.82 kW	Dmd VAR Total	31.3858 kvar	Dmd VA Total	2179.19 kVA
Dmd I A	591.42 A	Dmd I B	611.69 A	Dmd I C	618.67 A

Analog Input

Name	Category	Reading	Unit

TXD: 01 03 40 00 00 48 50 3C

RXD:

Com Failure= 0, Log Failure= 0

Demand:

This meter has the capability to calculate several types of demand: total active power demand, total reactive power demand, total apparent power demand, phase A current demand, phase B current demand, and phase C current demand. When demand is reset, demand memory registers are set as 0.

The user can configure the demand calculation mode to sliding window or thermal. Figure 49 shows how it works.

When using the sliding window interval mode, the user defines an interval between 1 and 30 minutes (which is the period of calculation). The demand is updated once a minute as the window slides.

Thermal demand mode calculates the demand based on a thermal response (mimicking a thermal demand meter). The user defines the period for the calculation and the demand is updated at the end of each period.

Energy:

This meter measures and accumulates energy in different directions (import and export). For real-time energy monitoring, it accumulates energy in kWh, kvarh, and kVAh continuous (since its last reset).

Calculation Mode

1. The user can select different energy calculation, fundamental-based (not applicable to PXM 1100/1200/1300) or true RMS based. This selection can be made from the front of the meter or via communication. Fundamental-based calculations are used to accumulate energy without taking harmonics into consideration while true RMS based calculations are used to accumulate energy including fundamental and harmonics.

Note: When fundamental-based calculation mode is selected, PF calculation will be based on the fundamental wave.

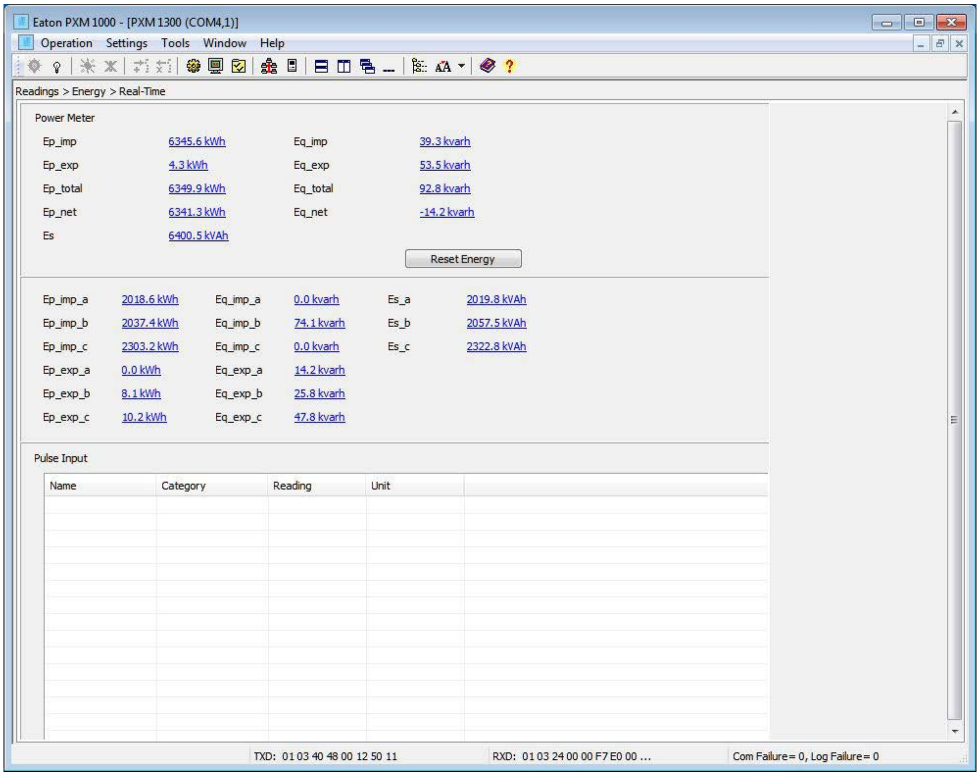
Note: When 400 Hz is the selected type, only true RMS calculations are supported.

2. There are two ways to calculate reactive energy (power):
   Mode 0: Real reactive energy $Q - \sqrt{S^2 - P^2 - D^2}$
   Mode 1: General reactive energy $Q - \sqrt{S^2 - P^2}$

3. The user can choose primary energy or secondary energy, either by pressing keys on the front of the meter or via communication as shown in Figure 49.

Note: PXM 1100/1200/1300 is able to display either primary energy or secondary energy on the LCD screen. However, it is only able to send out pulses based on secondary energy via the PXM1K-2 module.

Figure 44. Energy and Power Quality Parameters.



Ep_imp	6345.6 kWh	Eq_imp	39.3 kvarh
Ep_exp	4.3 kWh	Eq_exp	53.5 kvarh
Ep_total	6349.9 kWh	Eq_total	92.8 kvarh
Ep_net	6341.3 kWh	Eq_net	-14.2 kvarh
Es	6400.5 kVAh		

Ep_imp_a	2018.6 kWh	Eq_imp_a	0.0 kvarh	Es_a	2019.8 kVAh
Ep_imp_b	2037.4 kWh	Eq_imp_b	74.1 kvarh	Es_b	2057.5 kVAh
Ep_imp_c	2303.2 kWh	Eq_imp_c	0.0 kvarh	Es_c	2322.8 kVAh
Ep_exp_a	0.0 kWh	Eq_exp_a	14.2 kvarh		
Ep_exp_b	8.1 kWh	Eq_exp_b	25.8 kvarh		
Ep_exp_c	10.2 kWh	Eq_exp_c	47.8 kvarh		

Name	Category	Reading	Unit

TXD: 01 03 40 48 00 12 50 11
RXD: 01 03 24 00 00 F7 E0 00 ...
Com Failure= 0, Log Failure= 0

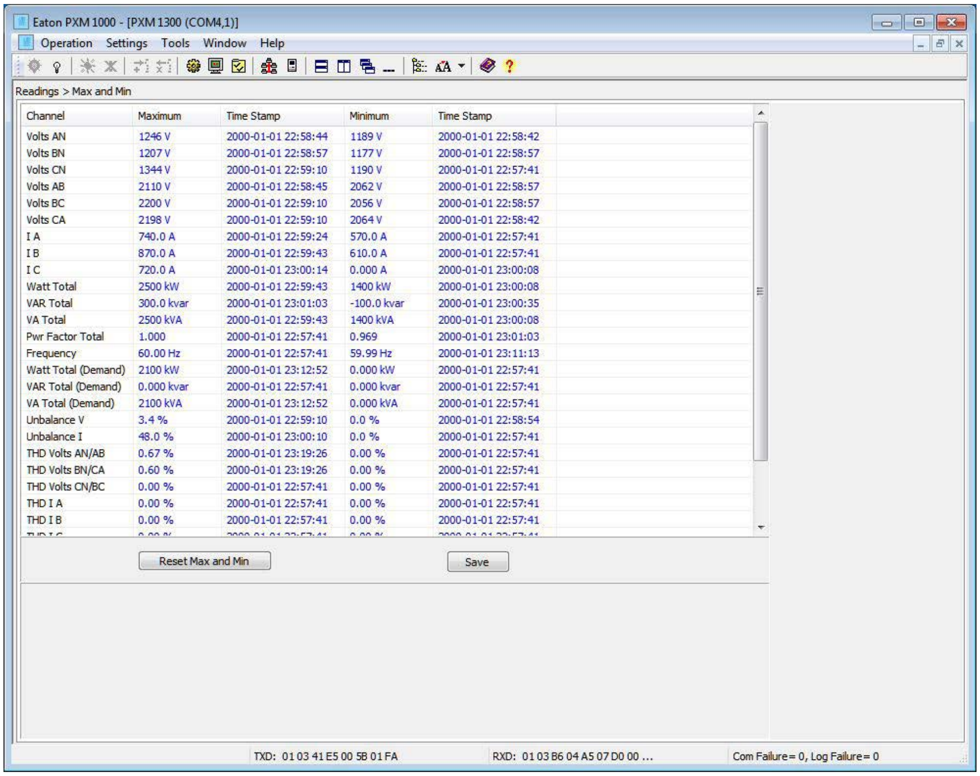
Current Direction Adjustment:

Under normal circumstances, current flows from input terminal 1 to terminal 2 (i.e. from I11 to I12 for phase A current). However, current may flow in the opposite direction due to incorrect wiring. In this scenario, users may reverse the polarity of the current by 180 degrees by setting the current direction to "negative." By default, the current direction is set as "positive". Refer to Figure 49 for more details.

4.2 Max/Min

The PXM 1000 meter logs maximum and minimum value statistics for phase/line voltages, current, power, reactive power, apparent power, power factor, frequency, demand, unbalance factor, and THD as well as the time they occur. All data is stored in non-volatile memory so that max/min information can be preserved even when the meter is powered off. All maximum and minimum data can be accessed via communication or from the front of the meter, but time stamps can only be accessed via communication. Max/min can be cleared either via communication or from the front of the meter.

Figure 45. Max/Min.



Channel	Maximum	Time Stamp	Minimum	Time Stamp
Volts AN	1246 V	2000-01-01 22:58:44	1189 V	2000-01-01 22:58:42
Volts BN	1207 V	2000-01-01 22:58:57	1177 V	2000-01-01 22:58:57
Volts CN	1344 V	2000-01-01 22:59:10	1190 V	2000-01-01 22:57:41
Volts AB	2110 V	2000-01-01 22:58:45	2062 V	2000-01-01 22:58:57
Volts BC	2200 V	2000-01-01 22:59:10	2056 V	2000-01-01 22:58:57
Volts CA	2198 V	2000-01-01 22:59:10	2064 V	2000-01-01 22:58:42
I A	740.0 A	2000-01-01 22:59:24	570.0 A	2000-01-01 22:57:41
I B	870.0 A	2000-01-01 22:59:43	610.0 A	2000-01-01 22:57:41
I C	720.0 A	2000-01-01 23:00:14	0.000 A	2000-01-01 23:00:08
Watt Total	2500 kW	2000-01-01 22:59:43	1400 kW	2000-01-01 23:00:08
VAR Total	300.0 kvar	2000-01-01 23:01:03	-100.0 kvar	2000-01-01 23:00:35
VA Total	2500 kVA	2000-01-01 22:59:43	1400 kVA	2000-01-01 23:00:08
Pwr Factor Total	1.000	2000-01-01 22:57:41	0.969	2000-01-01 23:01:03
Frequency	60.00 Hz	2000-01-01 22:57:41	59.99 Hz	2000-01-01 23:11:13
Watt Total (Demand)	2100 kW	2000-01-01 23:12:52	0.000 kW	2000-01-01 22:57:41
VAR Total (Demand)	0.000 kvar	2000-01-01 22:57:41	0.000 kvar	2000-01-01 22:57:41
VA Total (Demand)	2100 kVA	2000-01-01 23:12:52	0.000 kVA	2000-01-01 22:57:41
Unbalance V	3.4 %	2000-01-01 22:59:10	0.0 %	2000-01-01 22:58:54
Unbalance I	48.0 %	2000-01-01 23:00:10	0.0 %	2000-01-01 22:57:41
THD Volts AN/AB	0.67 %	2000-01-01 23:19:26	0.00 %	2000-01-01 22:57:41
THD Volts BN/CA	0.60 %	2000-01-01 23:19:26	0.00 %	2000-01-01 22:57:41
THD Volts CN/BC	0.00 %	2000-01-01 22:57:41	0.00 %	2000-01-01 22:57:41
THD I A	0.00 %	2000-01-01 22:57:41	0.00 %	2000-01-01 22:57:41
THD I B	0.00 %	2000-01-01 22:57:41	0.00 %	2000-01-01 22:57:41

TXD: 01 03 41 E5 00 5B 01 FA

RXD: 01 03 B6 04 A5 07 D0 00 ...

Com Failure= 0, Log Failure= 0

4.3 Harmonics and Power Quality Analysis

1. Harmonics:

The PXM 1000 meter can measure and analyze THD, calculate 2nd to 63rd order harmonics, even HD, odd HD, crest factor, THFF, K factor etc.

Note: When 400 Hz type is selected, only 2nd~15th harmonics are supported.

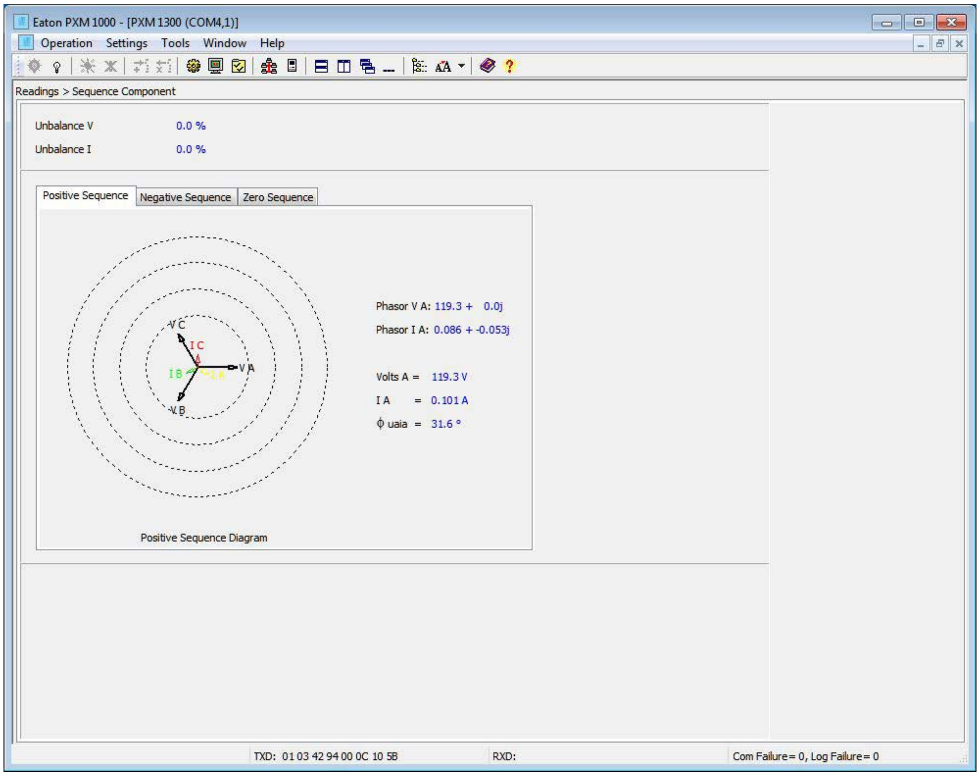
2. Phase Angle:

The term “phase angle” refers to angle of voltage/current parameters with respect to Phase A voltage. Angles ranges from 0 to 360 degrees. This function is to help users find the relationship between all input signals and avoid incorrect wiring. When the mode is set to “2 LL” or “3 LL,” it gives the phase angles of u23, u31, i1, i2, i3 corresponding to u12. When it is set to “3 LN,” it gives the phase angles of u2, u3, i1, i2, and i3 corresponding to u1. When it is set to “1 LL,” it gives the phase angles of u2, i1, i2, corresponding to u1. They are shown in Figure 46.

3. Sequence Component and Unbalance Analysis:

The PXM 1000 meter is able to perform sequence analysis on the input signal. It looks at the positive sequence, negative sequence, and zero sequence of the fundamental frequency and performs unbalance analysis for voltage and current. Sequence components are shown in Figure 46, unbalance of voltage and current are shown in Figure 43.

Figure 46. Sequence Component and Phase Angle.



Unbalance V 0.0 %

Unbalance I 0.0 %

Phasor V A: 119.3 + 0.0j

Phasor I A: 0.086 + -0.053j

Volts A = 119.3 V

I A = 0.101 A

ϕ uaia = 31.6 °

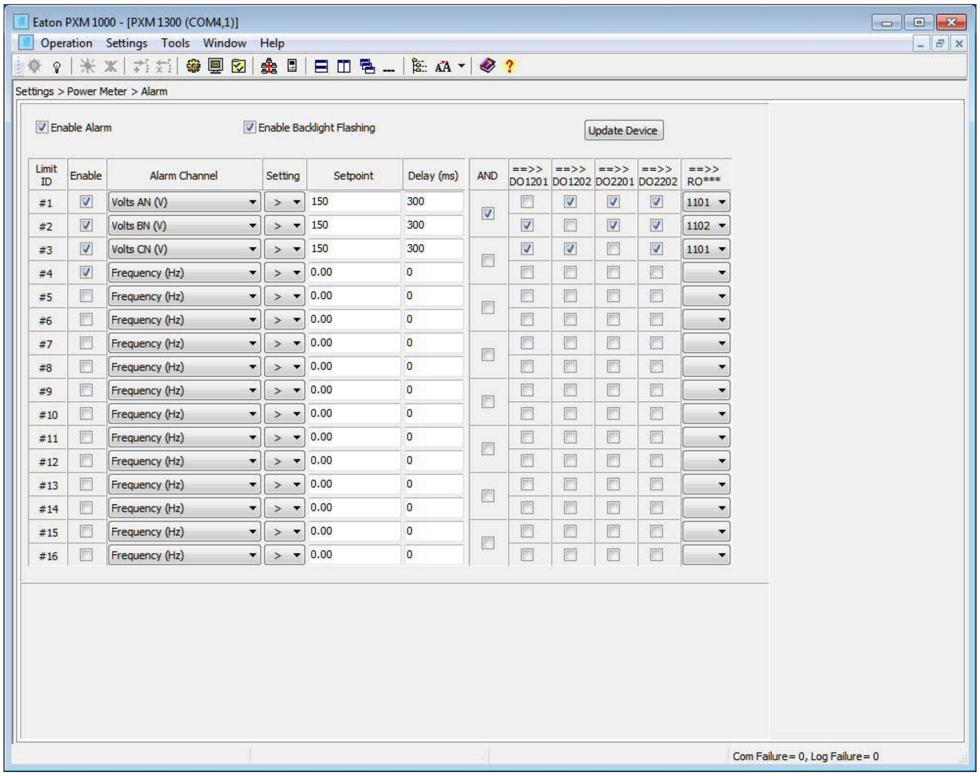
TXD: 01 03 42 94 00 0C 10 5B RXD: Com Failure= 0, Log Failure= 0

4.4 Out-of-limits Alarms

The PXM 1000 meter has configurable alarms for out-of-limits conditions. The alarm is triggered when the monitored parameter exceeds the set limit for some duration (delay, given in ms). The event is recorded in the alarms log with the parameter value and time stamp. The meter stores up to 16 triggers. When extended I/O modules are used, alarms can be used to trigger digital outputs (DO) and relay outputs (RO) in order to activate downstream devices such as a beacon light or a buzzer.

Before alarms can be used, alarm conditions such as logic dependency, target setpoint, time delay, etc., must be set correctly. Settings can be accessed and modified from the software via communication connection as shown in Figure 47.

Figure 47. Alarm Setting.



☑ Enable Alarm

☑ Enable Backlight Flashing

Limit ID	Enable	Alarm Channel	Setting	Setpoint	Delay (ms)	AND	==>> DO1201	==>> DO1202	==>> DO2201	==>> DO2202	==>> RO***
#1	☑	Volts AN (V)	>	150	300	☑	☐	☑	☑	☑	1101
#2	☑	Volts BN (V)	>	150	300		☑	☐	☑	☑	1102
#3	☑	Volts CN (V)	>	150	300	☐	☑	☑	☐	☑	1101
#4	☑	Frequency (Hz)	>	0.00	0		☐	☐	☐	☐	
#5	☐	Frequency (Hz)	>	0.00	0	☐	☐	☐	☐	☐	
#6	☐	Frequency (Hz)	>	0.00	0		☐	☐	☐	☐	
#7	☐	Frequency (Hz)	>	0.00	0	☐	☐	☐	☐	☐	
#8	☐	Frequency (Hz)	>	0.00	0		☐	☐	☐	☐	
#9	☐	Frequency (Hz)	>	0.00	0	☐	☐	☐	☐	☐	
#10	☐	Frequency (Hz)	>	0.00	0		☐	☐	☐	☐	
#11	☐	Frequency (Hz)	>	0.00	0	☐	☐	☐	☐	☐	
#12	☐	Frequency (Hz)	>	0.00	0		☐	☐	☐	☐	
#13	☐	Frequency (Hz)	>	0.00	0	☐	☐	☐	☐	☐	
#14	☐	Frequency (Hz)	>	0.00	0		☐	☐	☐	☐	
#15	☐	Frequency (Hz)	>	0.00	0	☐	☐	☐	☐	☐	
#16	☐	Frequency (Hz)	>	0.00	0		☐	☐	☐	☐	

1. Single Alarms Settings Groups:

Table 4 indicates the first group of settings. There are 16 groups in total with the same format.

Table 4. First Group of Alarming Settings.

Address	Parameter	Range	Property
104eH	First group: parameter code	0~50	R/W
104fH	First group: comparison mode	1: larger, 2:equal, 3:smaller	R/W
1050H	First group: setpoint value	Related with parameters	R/W
1051H	First group: delay time	0~3000(*10ms)	R/W
1052H	First group: output to relay	0: none, 1-8: related relay	R/W

Parameter code: select the target parameter for alarm monitoring. For example: 0-frequency, 44-AI4 sampling data.

Comparison mode: set alarm condition 1: greater than, 2: equal to, 3: less than. For example, if you choose the target parameter to be "frequency", condition to be "greater than" and setpoint to be "50", an alarm will be triggered when the frequency is greater than 50 Hz.

Note: Setpoint value is the same as the actual value of the selected parameter.

Delay time: If the alarm condition lasts for the configured time period, the alarm signal will be triggered. The delay range is from 0 to 3000 (unit: 10 ms). When it is set to 0, there is no delay. An alarm will be triggered as soon as the alarm condition is met. If it is set to 20, there will be a 200 ms (20 x 10 ms) delay.

Output to relay: 0-alarm signal will not be sent to RO. If it is set as 1 and PXM1K-11 is connected, it will output to RO1 when the alarm is triggered. RO1 will be turned off when the alarm output to RO1 is cleared. Relays RO2 - RO8 work in the same way.

Note: If an alarm is sent to RO, it can only work in "latch" mode.

Note: If the parameter code is set with a value between 51 and 79, please refer to Chapter 6 for detailed description of parameter and usage.

In addition to configuring an individual alarm, users must also configure global alarm settings in order to use alarms

2. Global Settings:

Register addresses for global alarm settings are from 1046H~104dH.

"Global alarming enable" enables alarms across the meter. Alarms are enabled when this register is set to 1, and disabled when set to 0.

Setting "Alarming flash enable" to 1 will cause the backlight to flash when an alarm is triggered.

The "Alarming channel enable setting" is a 16-bit register that controls the different alarm groups. There are a total of 16 groups, each is controlled by one bit of the register. An alarm channel is activated when the corresponding bit is set to 1.

Logical AND between pairs of alarm triggers: The 16 alarm triggers can be considered in 8 pairs (with two alarm groups in each). If the logical AND check box is selected, the two triggering conditions are considered together. An alarm will only occur of both conditions are met. If the logical AND check box for a pair remains unchecked, the two alarm channels will work independently.

The 8 "AND" logic pairs are arranged as follows: 1st, 2nd channel form Pair 1; 3rd, 4th channel form Pair 2; 5th, 6th channel form Pair 3; 7th, 8th channel form Pair 4; 9th, 10th channel form Pair 5; 11th, 12th channel form Pair 6; 13th, 14th channel form Pair 7; 15th, 16th channel form Pair 8.

This functionality is controlled by the lower 8 bits of this 16-bit register with each bit corresponding to a pair. "1" means this function is enabled and "0" means disabled.

"Alarm output to DO1 setting": "Digital output mode" allows DO1 to be used as an alarming output. This is controlled by a 16 bit register. Each bit in the register corresponds to one of the 16 groups. When the appropriate I/O module is connected and alarms are enabled, the corresponding bit will be set to 1. When the alarm is triggered, the signal will be sent to DO1 until the alarm is cleared. Setting the corresponding bit to 0 disables this functionality. Outputs DO2-DO4 work the same way.

3. Setting Example:

Here is an example showing how to apply the logic “AND” function for a pair of alarm channels.

The conditions are as follows: I1 greater than 180 A, delay 5s for the 1st alarm channel; U1 less than 9,980 V, delay 10 s for the 2nd alarm channel. No alarm signals will be sent to outputs. The CT has a primary value of I1 is 200 A, and CT2 is 5 A. The PT ratio for U1 is 10000:100. The following shows how all the related registers are to be set.

Table 5. Register Settings.

Trigger Threshold	I1 (current)	Greater than 180 A	Delay 5s for the 1st alarm channel	Output none
	U1 (voltage)	Less than 9,980 V	Delay 10 s for the 2nd alarm channel	Output none
CT Primary	CT1	200A		
CT Secondary	CT2	5A		
PT Primary	PT1	10000		
PT Secondary	PT2	100		
Secondary Value	Rx			

Settings of first group:

- “Parameter code (104eH)” is set to 9, which represents I1.
- “Comparison mode (104fH)” is set to 1, which represents “greater than”.
- “Setpoint value (1050H)” is set to 4500 since the 4.5 is represented as an integer . Rx=(I/(CT1/CT2))*1000.
- “Delay time (1051H)” is set to 500, so the actual delay time is 500*10 ms = 5 s.
- “Output to relay (1052H)” is set to 0, because there is no output to RO.

Settings of second group:

- “Parameter code (1053H)” is set to 1, which represents U1.
- “Comparison mode (1054H)” is set to 3, which represents “smaller than”.
- “Setpoint value (1055H)” is set to 998, since the 9980 is represented as an integer . Rx=(U/(PT1/PT2))*10.
- “Delay time (1056H)” is set to 1000, so the actual delay time is 1000*10 ms = 10 s.
- “Output to relay (1057H)” is set to 0, because there is no output to RO.

Global settings:

- “Alarming channel enable setting (1048H)” set to 0003H to enable the first and the second channel.
- “Logic “AND” between alarming setting (1049H)” set to 0001H to enable logic “AND” in Pair 1.
- “Alarming output to DO1 setting (104aH)” set to 0, since no output to DO1.
- “Alarming output to DO2 setting (104bH)” set to 0.
- “Alarming output to DO3 setting (104cH)” set to 0.
- “Alarming output to DO4 setting (104dH)” set to 0.
- “Alarming flash enable (1047H)” set to 0 to disable backlight flashing when alarming occurs.
- “Global alarming enable (1046H)” set to 1 to enable over/under limit alarming.

4. Records of Alarming Event:

The PXM 1000 meter has built in alarm logging capabilities. A total of 16 entries can be recorded. The record sequence of these entries does not depend on the sequence of the 16 alarm channels. The meter begins logging alarm status starting from the first record location to the last one. Alarm logs are recorded in a "FIFO" fashion which means the latest event will overwrite the oldest record. When out-of-limit parameters return to normal, its value and time stamp will be recorded as well. Therefore, users can determine the out-of-limit duration by checking the time difference.

Table 6 shows the first group of records. Other groups of records have the same format.

Table 6. Alarming Status of the 1st Group of Records.

Address	Parameter	Range
42a9H	First group: alarming status	0~65535
42aaH	First group: parameter code	0~79
42abH	First group: over/under limit or reset value	Related with parameters
42acH~42b2H	First group: occur time: yyyy:mm:dd:hh:mm:ss:ms	Time

"Alarm status" indicates information of the current alarm status. It is a 16-bit unsigned integer. The Parameter code is stored in the higher 8 bits. Bit1 indicates whether logic "AND" is enabled or not. 1 means enabled and 0 means not enabled. Bit0 indicates whether the alarm has occurred or recovered. 1 means occurred and 0 means recovered. Undefined bits are 0.

"Parameter code" specifies the monitored parameter.

"Value" shows the recorded value of the selected parameter when an alarm is triggered and when it recovers.

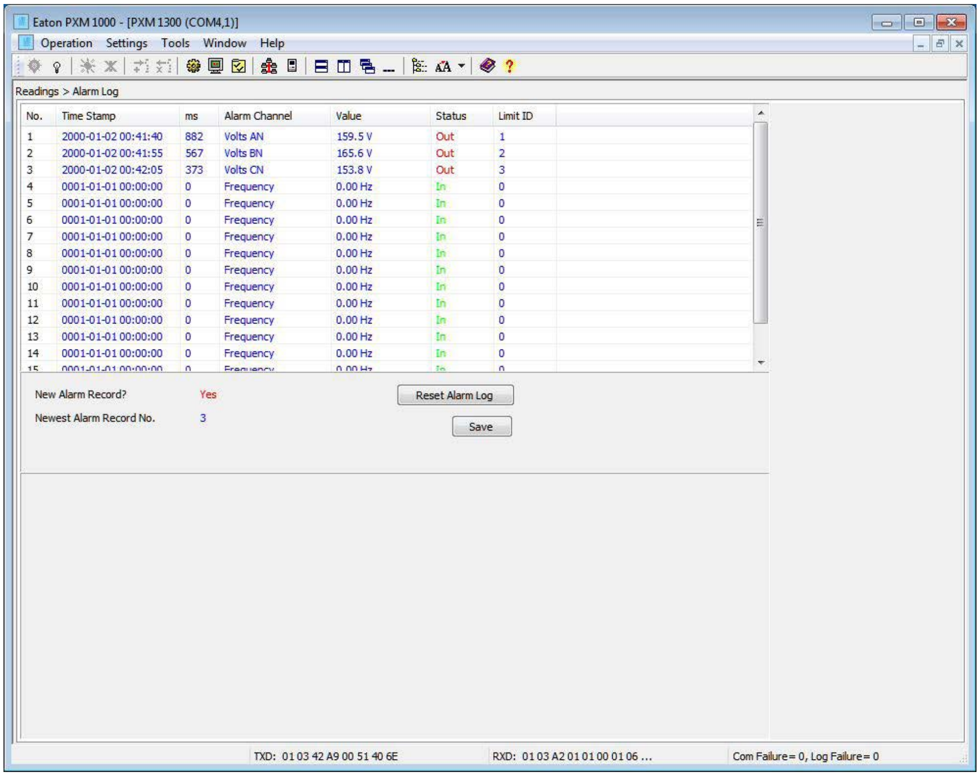
"Time" indicates the time stamp with the precision in milliseconds (ms).

An alarm event will set bit0 of the "system status (102eH)" to be 1. When the software sends clear alarm command, bit0 of "system status (102eH)" will be set to 0.

Alarm group number (1032H): the range is 0~16, 0 is no alarm record, and 1~16 identify the records from newest alarm to oldest. The alarm group number can be saved during meter power off.

Here is an example:

Figure 48. Alarming Records.



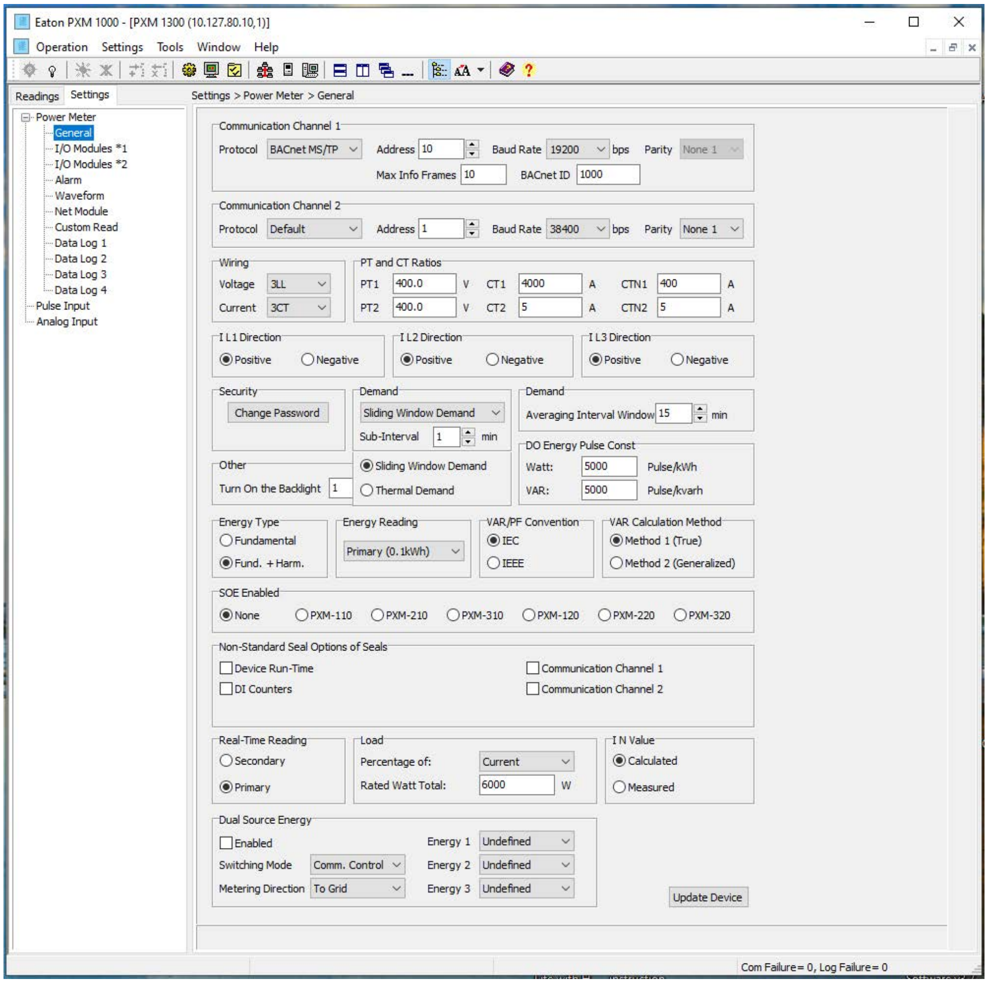
No.	Time Stamp	ms	Alarm Channel	Value	Status	Limit ID
1	2000-01-02 00:41:40	882	Volts AN	159.5 V	Out	1
2	2000-01-02 00:41:55	567	Volts BN	165.6 V	Out	2
3	2000-01-02 00:42:05	373	Volts CN	153.8 V	Out	3
4	0001-01-01 00:00:00	0	Frequency	0.00 Hz	In	0
5	0001-01-01 00:00:00	0	Frequency	0.00 Hz	In	0
6	0001-01-01 00:00:00	0	Frequency	0.00 Hz	In	0
7	0001-01-01 00:00:00	0	Frequency	0.00 Hz	In	0
8	0001-01-01 00:00:00	0	Frequency	0.00 Hz	In	0
9	0001-01-01 00:00:00	0	Frequency	0.00 Hz	In	0
10	0001-01-01 00:00:00	0	Frequency	0.00 Hz	In	0
11	0001-01-01 00:00:00	0	Frequency	0.00 Hz	In	0
12	0001-01-01 00:00:00	0	Frequency	0.00 Hz	In	0
13	0001-01-01 00:00:00	0	Frequency	0.00 Hz	In	0
14	0001-01-01 00:00:00	0	Frequency	0.00 Hz	In	0
15	0001-01-01 00:00:00	0	Frequency	0.00 Hz	In	0

New Alarm Record? Yes

Newest Alarm Record No. 3

```
TXD:  01 03 42 A9 00 51 40 6E     RXD:  01 03 A2 01 01 00 01 06 ...     Com Failure= 0, Log Failure= 0
```

Figure 49. Basic Settings.



Settings > Power Meter > General

Communication Channel 1: Protocol BACnet MS/TP, Address 10, Baud Rate 19200 bps, Parity None 1, Max Info Frames 10, BACnet ID 1000

Communication Channel 2: Protocol Default, Address 1, Baud Rate 38400 bps, Parity None 1

Wiring: Voltage 3LL, Current 3CT

PT and CT Ratios: PT1 400.0 V, PT2 400.0 V, CT1 4000 A, CT2 5 A, CTN1 400 A, CTN2 5 A

I L1 Direction: ● Positive ○ Negative

I L2 Direction: ● Positive ○ Negative

I L3 Direction: ● Positive ○ Negative

Demand: Sliding Window Demand, Sub-Interval 1 min, ● Sliding Window Demand ○ Thermal Demand

Demand: Averaging Interval Window 15 min

DO Energy Pulse Const: Watt: 5000 Pulse/kWh, VAR: 5000 Pulse/kvarh

Other: Turn On the Backlight 1

Energy Type: ○ Fundamental ● Fund. + Harm.

Energy Reading: Primary (0.1kWh)

VAR/PF Convention: ● IEC ○ IEEE

VAR Calculation Method: ● Method 1 (True) ○ Method 2 (Generalized)

SOE Enabled: ● None ○ PXM-110 ○ PXM-210 ○ PXM-310 ○ PXM-120 ○ PXM-220 ○ PXM-320

Non-Standard Seal Options of Seals: ☐ Device Run-Time ☐ DI Counters ☐ Communication Channel 1 ☐ Communication Channel 2

Real-Time Reading: ○ Secondary ● Primary

Load: Percentage of: Current, Rated Watt Total: 6000 W

I N Value: ● Calculated ○ Measured

Dual Source Energy: ☐ Enabled, Switching Mode Comm. Control, Metering Direction To Grid, Energy 1 Undefined, Energy 2 Undefined, Energy 3 Undefined

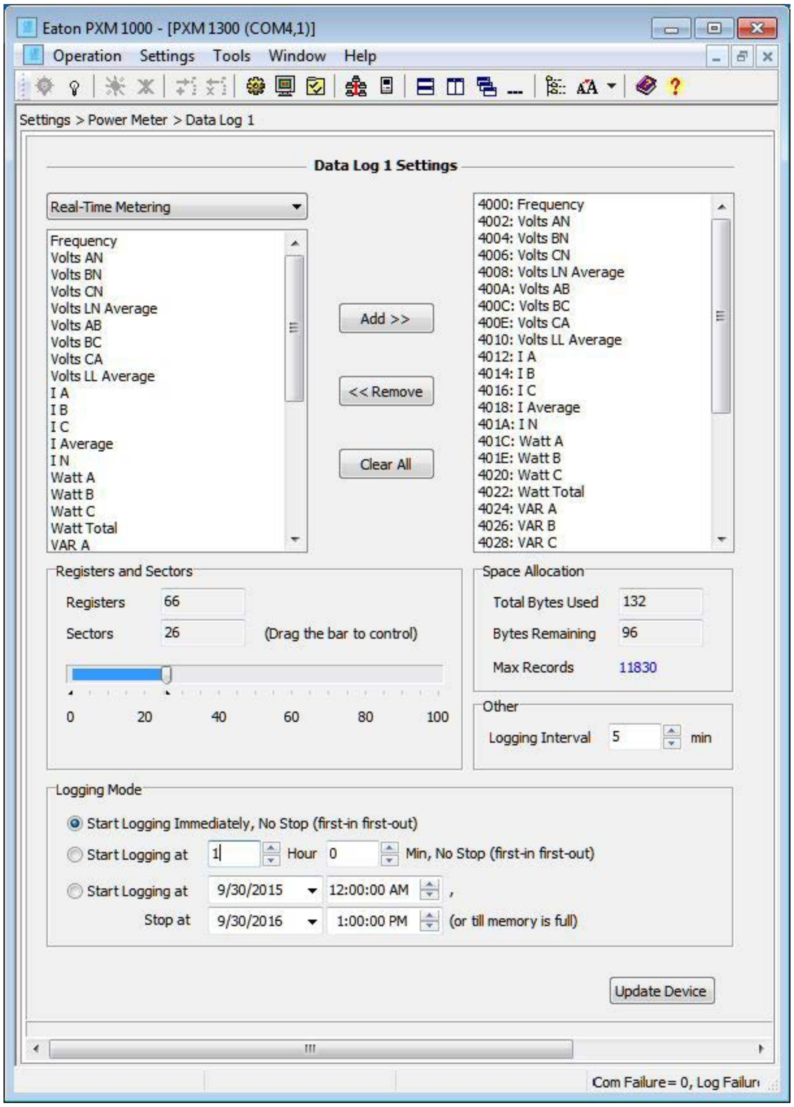
4.5 Data Logging

The PXM 1100/1200/1300 meters provide data logging that records the data at a set interval. This meter has four megabytes of memory which gives it extensive data-logging capabilities. It has a real-time clock that allows logs to be time-stamped when log events are created.

1. Data Log Settings:

The PXM 1100/1200/1300 meters have three sets of historical data logs. Each log can be independently programmed with individual settings, meaning that each can be used to monitor different parameters. The user can program up to 117 parameters per log. The user also has the ability to allocate available system resources among the three logs, to increase or decrease the size of the individual historical logs. The total size is no more than 63 sectors that have 64 k-bytes. The data log 1 setting is shown in Figure 50.

Figure 50. Data Log 1 Setting.



Real-Time Metering

Frequency
Volts AN
Volts BN
Volts CN
Volts LN Average
Volts AB
Volts BC
Volts CA
Volts LL Average
I A
I B
I C
I Average
I N
Watt A
Watt B
Watt C
Watt Total
VAR A

4000: Frequency
4002: Volts AN
4004: Volts BN
4006: Volts CN
4008: Volts LN Average
400A: Volts AB
400C: Volts BC
400E: Volts CA
4010: Volts LL Average
4012: I A
4014: I B
4016: I C
4018: I Average
401A: I N
401C: Watt A
401E: Watt B
4020: Watt C
4022: Watt Total
4024: VAR A
4026: VAR B
4028: VAR C

Registers and Sectors
Registers 66
Sectors 26 (Drag the bar to control)
0 20 40 60 80 100

Space Allocation
Total Bytes Used 132
Bytes Remaining 96
Max Records 11830

Other
Logging Interval 5 min

Logging Mode
● Start Logging Immediately, No Stop (first-in first-out)
○ Start Logging at 1 Hour 0 Min, No Stop (first-in first-out)
○ Start Logging at 9/30/2015 12:00:00 AM ,
Stop at 9/30/2016 1:00:00 PM (or till memory is full)

Having three sets of historical logs provides the user with the option of programming each log with unique parameters. For example, you can program historical log 1 to record measured values parameters (for example, frequency, voltage, current), log 2 to record energy values parameters, and log 3 to record power quality parameters. Historical log parameters can be selected from the following 13 groups:

- Real-Time Metering (Frequency; Instantaneous Voltage; Instantaneous Current; Total and Per Phase Power and Power Factor; Neutral Current ; Unbalance V/I; load type; Current demand; and Per Phase/ Total Power demand)
- Energy (Ep_imp; Ep_exp; Ep_total; Ep_net; Eq_imp; Eq_exp; Eq_total; Eq_net; Es; Epa_imp; Epa_exp; Epb_imp; Epb_exp; Epc_imp; Epc_exp; Eqa_imp; Eqa_exp; Eqb_imp; Eqb_exp; Eqc_imp; Eqc_exp; Esa; Esb; Esc).
- THD Volts AN/AB(THD, 2nd -63rd Harmonic Magnitudes, ODD, EVEN, CF and THFF of Volts AN/AB).
- THD Volts BN/BC (THD,2nd -63rd Harmonic Magnitudes,ODD,EVEN,CF and THFF of Volts BN/BC).

- THD Volts CN/CA (THD, Average THD, 2nd-63rd Harmonic Magnitudes, ODD, EVEN, CF and THFF of Volts CN/CA).
- THD IA (THD, 2nd -63rd Harmonic Magnitudes, ODD, EVEN, KF of IA).
- THD IB (THD, 2nd -63rd Harmonic Magnitudes, ODD, EVEN, KF of IB).
- THD IC (THD, average THD, 2nd -63rd Harmonic Magnitudes, ODD, EVEN, KF of IC).
- Sequence Component (positive, negative, and zero sequence).
- Phase Angles(the angle between U1 and other voltage and current parameters).
- DI Counter (the DI numbers of the I/O modules).
- AO/AI Raw Value (the AO output register values and the AI sample register values).
- AO/AI Value(the AO output values and the AI sample values)

The following procedures show how to select and store parameters in historical log 1. The Group field determines the items that are available for selection.

1. Select a Group. The possible selections are: Real-Time Metering, Energy, THD Volts AN/AB, THD Volts BN/BC , THD Volts CN/CA , THD IA , THD IB , THD IC, Sequence Component, Phase Angles, DI Counter, AO/AI Raw Value, and AO/AI Value.
2. Select items for your log:
   A. Highlight the parameter(s) you want to log into the meter's memory.
   B. Click Add to add the parameter to the Selected Parameter Area.
   C. To remove parameter(s), highlight them in the Selected Parameter Area and click Remove.
3. Set the logging interval (in minutes). Interval can be set from 0 - 1444 minutes according to different applications.

   The logging interval determines when the meter takes a snapshot. When the interval is set as 0, the set of historical data log is disabled.
4. There are 100 sectors in total for the 3 historical data logs. The user can assign a different sector size to each log according to different applications (as long as the total sector sizes of the 3 logs do not exceed 100).
5. Three Modes of historical log:

   Mode 1: The historical log can record, even if date and time are not set. The log is first-in first-out, so earlier entries are replaces as the log fills.

   Mode 2: With date and time set, the historical log can record for the duration. Recording will stop once the buffer fills.

   Mode 3: With the hour and minute set, the historical log can record, starting at that set time. This log is also first-in first-out.

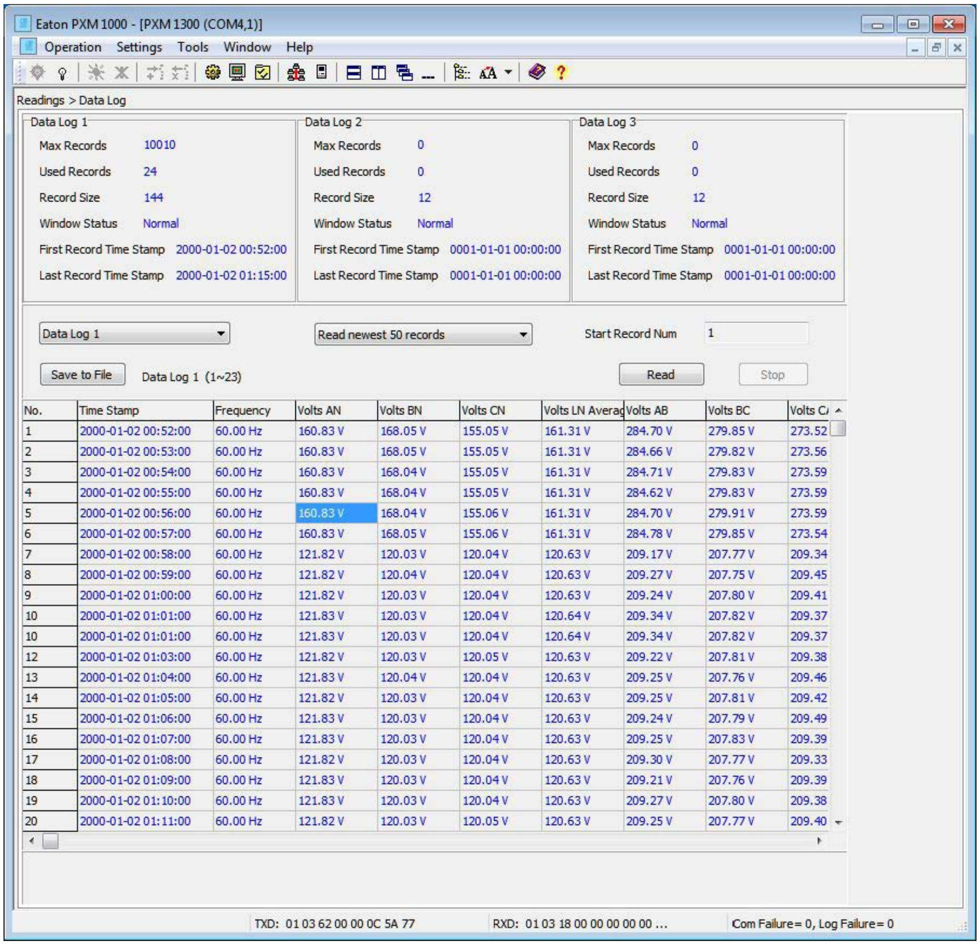
Note: If the memory of the historical data log is full, the meter will erase the first sector in which the memory size is 65536 bytes (64kb). The following sector (the second sector) will become the first sector and the data from the erased sector will not be recoverable. Therefore, the user should save the whole log before memory is full to maintain all the data.

Note: There are two display fields at the bottom of the data log setting screen. They show the registers in the logs, the total bytes used, and the bytes remaining for this historical log. These fields are updated as you make selections on the screen. The total number of bytes available per log record is approximately 234.

2. Retrieving Logs:

There are two ways of retrieving the logs: "read one window" and "read all". The retrieval screen is shown in Figure 51.

Figure 51. Retrieval Screen.



Data Log 1
Max Records 10010
Used Records 24
Record Size 144
Window Status Normal
First Record Time Stamp 2000-01-02 00:52:00
Last Record Time Stamp 2000-01-02 01:15:00

Data Log 2
Max Records 0
Used Records 0
Record Size 12
Window Status Normal
First Record Time Stamp 0001-01-01 00:00:00
Last Record Time Stamp 0001-01-01 00:00:00

Data Log 3
Max Records 0
Used Records 0
Record Size 12
Window Status Normal
First Record Time Stamp 0001-01-01 00:00:00
Last Record Time Stamp 0001-01-01 00:00:00

Data Log 1
Read newest 50 records
Start Record Num 1
Data Log 1 (1~23)

No.	Time Stamp	Frequency	Volts AN	Volts BN	Volts CN	Volts LN Averag	Volts AB	Volts BC	Volts C/
1	2000-01-02 00:52:00	60.00 Hz	160.83 V	168.05 V	155.05 V	161.31 V	284.70 V	279.85 V	273.52
2	2000-01-02 00:53:00	60.00 Hz	160.83 V	168.05 V	155.05 V	161.31 V	284.66 V	279.82 V	273.56
3	2000-01-02 00:54:00	60.00 Hz	160.83 V	168.04 V	155.05 V	161.31 V	284.71 V	279.83 V	273.59
4	2000-01-02 00:55:00	60.00 Hz	160.83 V	168.04 V	155.05 V	161.31 V	284.62 V	279.83 V	273.59
5	2000-01-02 00:56:00	60.00 Hz	160.83 V	168.04 V	155.06 V	161.31 V	284.70 V	279.91 V	273.59
6	2000-01-02 00:57:00	60.00 Hz	160.83 V	168.05 V	155.06 V	161.31 V	284.78 V	279.85 V	273.54
7	2000-01-02 00:58:00	60.00 Hz	121.82 V	120.03 V	120.04 V	120.63 V	209.17 V	207.77 V	209.34
8	2000-01-02 00:59:00	60.00 Hz	121.82 V	120.04 V	120.04 V	120.63 V	209.27 V	207.75 V	209.45
9	2000-01-02 01:00:00	60.00 Hz	121.82 V	120.03 V	120.04 V	120.63 V	209.24 V	207.80 V	209.41
10	2000-01-02 01:01:00	60.00 Hz	121.83 V	120.03 V	120.04 V	120.64 V	209.34 V	207.82 V	209.37
10	2000-01-02 01:01:00	60.00 Hz	121.83 V	120.03 V	120.04 V	120.64 V	209.34 V	207.82 V	209.37
12	2000-01-02 01:03:00	60.00 Hz	121.82 V	120.03 V	120.05 V	120.63 V	209.22 V	207.81 V	209.38
13	2000-01-02 01:04:00	60.00 Hz	121.83 V	120.04 V	120.04 V	120.63 V	209.25 V	207.76 V	209.46
14	2000-01-02 01:05:00	60.00 Hz	121.82 V	120.03 V	120.04 V	120.63 V	209.25 V	207.81 V	209.42
15	2000-01-02 01:06:00	60.00 Hz	121.83 V	120.03 V	120.04 V	120.63 V	209.24 V	207.79 V	209.49
16	2000-01-02 01:07:00	60.00 Hz	121.83 V	120.03 V	120.04 V	120.63 V	209.25 V	207.83 V	209.39
17	2000-01-02 01:08:00	60.00 Hz	121.82 V	120.03 V	120.04 V	120.63 V	209.30 V	207.77 V	209.33
18	2000-01-02 01:09:00	60.00 Hz	121.83 V	120.03 V	120.04 V	120.63 V	209.21 V	207.76 V	209.39
19	2000-01-02 01:10:00	60.00 Hz	121.83 V	120.03 V	120.04 V	120.63 V	209.27 V	207.80 V	209.38
20	2000-01-02 01:11:00	60.00 Hz	121.82 V	120.03 V	120.05 V	120.63 V	209.25 V	207.77 V	209.40

TXD: 01 03 62 00 00 0C 5A 77
RXD: 01 03 18 00 00 00 00 00 ...
Com Failure= 0, Log Failure= 0

The "read one window" method allows the user to access and read a specific log location at an offset from the first log. The "window record num" is the maximum number of record entries the software can read at a time. It is calculated by:

246 / record size.

The larger this number is, the faster data can be retrieved. "Log type" is used to retrieve the logs the user wants to retrieve. For example, log type 0 is data logging 1, log type 1 is data logging 2, and log type 2 is data logging 3.

The "read all" method accesses and reads the historical data log automatically. The offset increases automatically until all the logs are retrieved.

The data logs contents are shown on the bottom section of the screen.

4.6 Time of Use (TOU)

The user can assign up to four different tariffs (sharp, peak, valley, and normal) to different time periods within a day depending on the billing requirements. The meter will calculate and accumulate energy to different tariffs according to the meter's internal clock timing and TOU settings.

The user can set a maximum of 12 TOU seasons. Each season can be assigned to a TOU schedule (a maximum of 14 TOU schedules are available). Each schedule can be divided up into 14 segments (in which each segment can have its own tariff). The user can customize the TOU calendar (including its tariffs, seasons, schedules, and segments) according to different applications. To make sure that the TOU calendar is setup correctly, the meter will check the TOU settings according to the predefined rules (see below for "TOU Setting Format Requirements" for details). The TOU function will be disabled if the TOU calendar is configured incorrectly. If no errors are found in the calendar and the TOU function is enabled, TOU energy accumulation will begin.

TOU Setting Format Requirements:

1. Season setting parameter: The calendar year will be divided into different seasons depending on the season setting parameter. The parameter can be selected from any integer between 1 and 12. The user must enter the correct value for the season setting parameter in accordance with the TOU season table. If the season setting parameter is set as 2, the first 2 slots of the TOU season table must be set. Otherwise it will be considered as an invalid input (TOU function will be disabled).
2. TOU season format: Enter the start date into the TOU season table slot following this format "MM-DD ID" (MM stands for the month; DD stands for the day; and ID stands for the TOU schedule ID [available from 01 to 14]). The dates should be organized so that they are in sequence according to the calendar year (the earlier date comes first and the later date comes last). For example, if 3 seasons are selected, the date parameters are January 1, June 6, and September 7, and TOU schedule 02, 01, 03 will be used. The first TOU season table slot will enter 01-01 02, the second slot will enter 06-06 01, and the third slot will enter 09-07 03. Entering 01-01 02 for the first slot, 09-07 03 for the second slot, and 06-06 01 for the third slot is considered invalid.
3. Schedule setting parameter: The number of available TOU schedules depends on the schedule setting parameter. The parameter can be selected from any integer between 1 and 14. This parameter determines the number of TOU schedules available for the TOU calendar setting. A maximum of 14 TOU schedules (from TOU Schedule #1 to TOU Schedule #14) can be used.
4. Segment setting parameter: Each TOU schedule consists of various timing segments. The number of segments depends on the segment setting parameter configured. The parameter can be selected from any integer between 1 and 14 (inclusively). The user must enter the correct value for the segment setting parameter in accordance to the TOU schedule table. If the segment setting parameter is set as 3, the first 3 slots of the TOU schedule table must be set. Otherwise, it will be considered as an invalid input (TOU function will be disabled).
5. TOU schedule format: Each TOU schedule represents a 24 hour cycle. Similar to the TOU season format, enter the start time into the TOU schedule table slot following this format "HH:MM ID" (HH stands for hour [in 24 hr format]; MM stands for minutes; and ID stands for tariffs [available from 00 to 03]). The time should be organized according to the hour sequence. For example, if 3 segments are selected, timing parameters are 01:00, 15:30, 22:45, the order of the 3 segments should be one of the following: 01:00, 15:30, 22:45 or 15:30, 22:45, 01:00, or 22:45, 01:00, 15:30. Entering time information in a wrong sequence (for example, entering 15:30, 01:00, 22:45) is considered as an invalid operation and the TOU function will be disabled.
6. Tariff setting parameter: This parameter corresponds to the number of tariffs available for the TOU calendar and can be selected from any integer from 0 to 3. The four tariffs: sharp, peak, valley, and normal are represented by four integers: 0, 1, 2, and 3 respectively. If the tariff setting parameter is set to 3, all of the 4 tariffs will be available for the TOU calendar. If the parameter is set to 1, only the first 2 tariffs (sharp and peak) will be available.

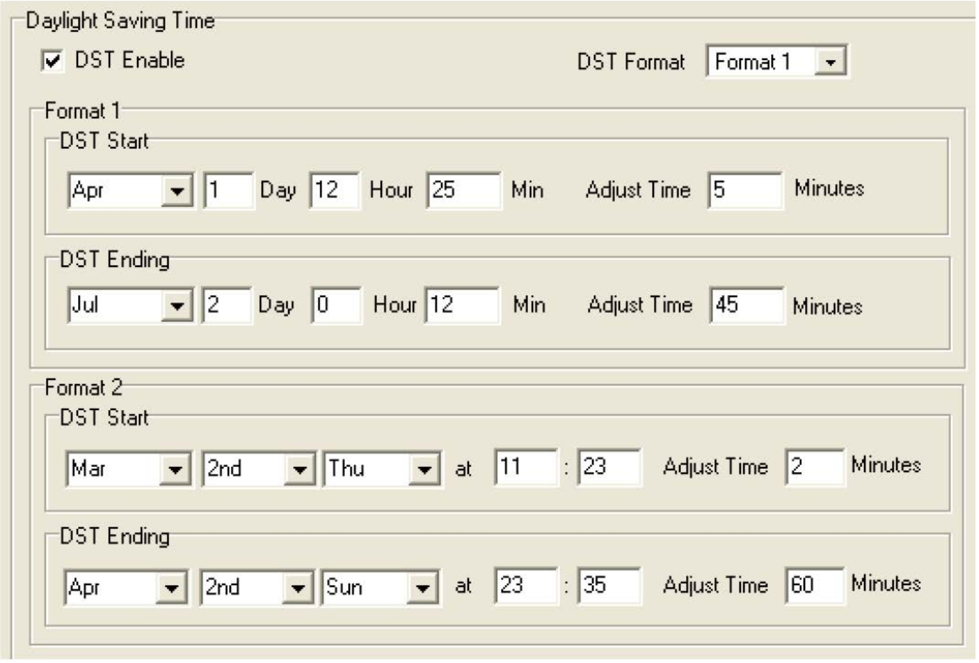
7. Holiday setting parameter: This parameter can be set from any integer between 1 and 30, meaning a maximum of 30 holidays can be programmed to the TOU calendar. If the holiday setting parameter is set as 3, the first 3 slots of the holiday schedule must be set. Otherwise it will be considered as an invalid input (TOU function will be disabled).

Note: User can either customize the TOU calendar factory settings or use the default factory settings. The user can reset the TOU calendar to its default value either via communication or from the front of the meter.

8. Holiday schedule: The holiday schedule uses the same format as the TOU seasons "MM-DD ID". The user can select which TOU schedule to be used for the holiday. The dates of the holiday schedule do not need to be organized in a sequential order (i.e.: the first slot can be January 1, the second slot can be December 26 and the third slot can be December 25).
9. Daylight saving time (DST): Daylight saving time can be enabled in one of two formats: 1. the fixed date option, or 2. a fixed day of one of the weeks in the month (also named as the non-fixed date option). If the user choose a fixed date option for the DST switch, set the format according to a fixed date. The format is month / day / hour / minute / adjust time (in minutes). If the user selects the non-fixed date option, DST will be implemented by which day of which week. The format is month/which day (i. e. Tuesday)/which week (i. e. 1st week)/hour/minute/adjust time (in minutes)

   By using this function, the user can cause the instrument to automatically switch to and from DST. When the clock starts to run to daylight saving time, the meter will automatically adjust the clock to a time period in advance. While the clock is running to the end of daylight saving time, the meter will automatically adjust the clock, pushing it back to a time period, as shown in Figure 52.

Figure 52. Daylight Saving Time Setting Interface.



Daylight Saving Time

☑ DST Enable

DST Format: Format 1

Format 1

DST Start: Apr 1 Day 12 Hour 25 Min Adjust Time 5 Minutes

DST Ending: Jul 2 Day 0 Hour 12 Min Adjust Time 45 Minutes

Format 2

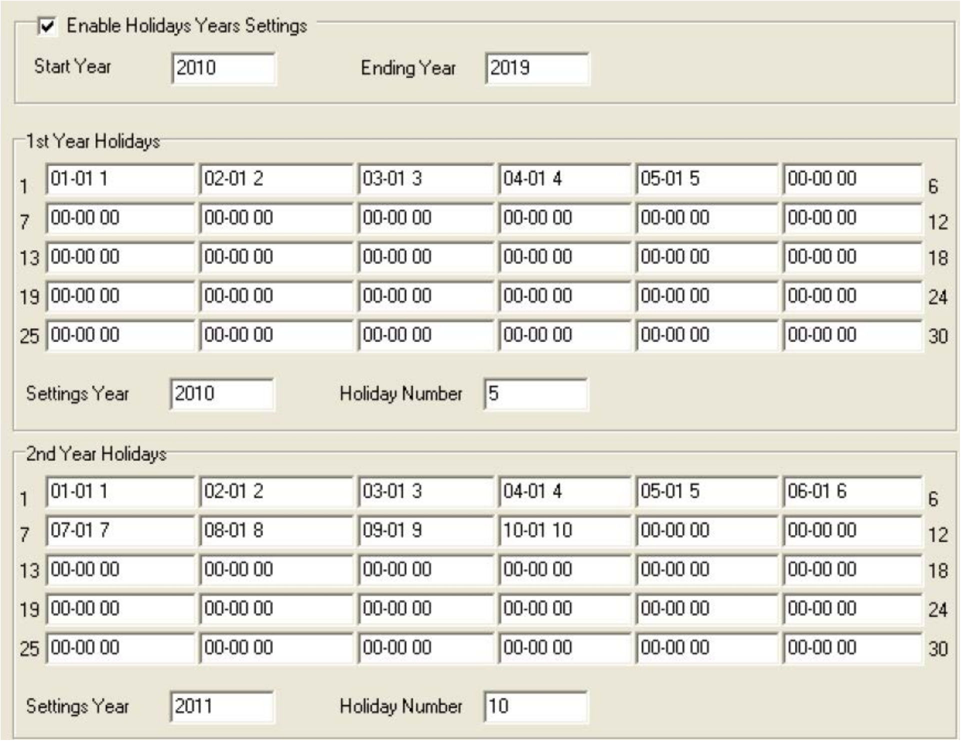
DST Start: Mar 2nd Thu at 11 : 23 Adjust Time 2 Minutes

DST Ending: Apr 2nd Sun at 23 : 35 Adjust Time 60 Minutes

10. Ten-Year Holiday setting: Users can preset holidays of the next decade via the meter software. The holiday format is month/day/year; holiday code; holiday schedule. After the format setup, click on "Make Holiday Settings (10 year)", then a holiday table for the next decade will be generated.

    Holiday Auto Switch: When Ten-Year Holiday is enabled, if the current year of the meter falls into the Ten-Year Holiday setting, it automatically loads the Ten-Year Holiday settings into the current TOU settings. If the current year of the meter does not fall into the Ten-Year Holiday setting, it retains the current TOU settings.

Figure 53. Ten-Year Holiday Settings.



☑ Enable Holidays Years Settings

Start Year: 2010 Ending Year: 2019

1st Year Holidays

1	01-01 1	02-01 2	03-01 3	04-01 4	05-01 5	00-00 00	6
7	00-00 00	00-00 00	00-00 00	00-00 00	00-00 00	00-00 00	12
13	00-00 00	00-00 00	00-00 00	00-00 00	00-00 00	00-00 00	18
19	00-00 00	00-00 00	00-00 00	00-00 00	00-00 00	00-00 00	24
25	00-00 00	00-00 00	00-00 00	00-00 00	00-00 00	00-00 00	30

Settings Year: 2010 Holiday Number: 5

2nd Year Holidays

1	01-01 1	02-01 2	03-01 3	04-01 4	05-01 5	06-01 6	6
7	07-01 7	08-01 8	09-01 9	10-01 10	00-00 00	00-00 00	12
13	00-00 00	00-00 00	00-00 00	00-00 00	00-00 00	00-00 00	18
19	00-00 00	00-00 00	00-00 00	00-00 00	00-00 00	00-00 00	24
25	00-00 00	00-00 00	00-00 00	00-00 00	00-00 00	00-00 00	30

Settings Year: 2011 Holiday Number: 10

11. Weekend Schedule: Weekend Setting (bit0 : Sunday; bit1 ~ bit6: Monday to Saturday; bit 0 means not effective, bit 1 means effective). For example, when the Weekend Setting bit0 is 1, it means Sunday is effective. When the Weekend Setting bit1 is 1, it means Monday is effective. If a user wants to set Saturday and Sunday effective, he should put 65 (1000001) into the Weekend Setting field. When the meter clock is within the preset Weekend schedule, the energy will accumulate under the tariff that corresponds to the schedule.

Note: The Holiday schedule has the highest priority among all the schedules. Weekend schedule's priority is followed by Holiday schedule. When Holiday schedule is not enabled, Weekend schedule has the highest priority, overriding the normal (weekday) schedule.

The PXM 1200 can record maximum power and current demand under different tariffs, as well as the time stamp of the maximum value. It can also clear the maximum demand under different tariffs.

Except normal energy parameter readings, the PXM 1200 has four separate logs: 1. Current Accumulation Month TOU; 2. Prior Accumulation Month TOU; 3. Current Month TOU; and 4. Prior Month TOU. When setup appropriately and when TOU is enabled, energy will be accumulated in a month-to-month basis. The current energy usage will be stored under Current Month TOU (or Current Accumulation Month TOU) and is divided up into different tariffs. When the next month (or counting period) starts, all Current Month TOU values will be moved to Prior Month TOU (or Prior Accumulation Month TOU).

There are two ways of automatic resetting of current month TOU.

1. End of Month: This is the default method. All values from Current Accumulation Month TOU will be copied over to Prior Accumulate Month TOU at the very beginning of each month (the first day of each month at time 00:00:00). Current Accumulation Month TOU will continue to accumulate. All values from Current Month TOU will be copied over to Prior Month TOU at the beginning of each month (the first day of each month at time 00:00:00) will be cleared and reset to 0.
2. Assigned Clock: The user can select when the values from Current Accumulation Month TOU or Current Month TOU would be copied over to Prior Accumulation Month TOU or Prior Month TOU. The user can set the time in the following format: "DD HH:MM:SS": DD stands for day; HH stands for hour; MM stands for minute; and SS stands for second. Similar to the previous method, once the Current Accumulation Month TOU is transferred to Prior Accumulation Month TOU, Current Accumulation Month TOU will continue to accumulate. Once the Current Month TOU is transferred to Prior Month TOU, Current Month TOU will be cleared and reset to 0.

4.7 Power Quality Event Logging and Waveform Capture

Power Quality Event Logging:

When a power quality event happens, such as voltage sag and swell, the PXM 1300 will record the event timestamp and the triggering condition. It can save up to 50,000 events.

1. Event Logging Data Format
   Timestamp (4 words) + Triggering Condition (1 word) + Rated Value (1 word) + Threshold (1 word) + Half Cycle Count (1 word)

   Each event has 8 words in total.

   Event Time: W1: Year-High Byte; Month-Low Byte; W2: Day-High Byte, Hour-Low Byte; W3: Minute-High Byte; Second-Low Byte; W4: Millisecond Triggering Condition; W5: Voltage Sags or Voltage Swells; 0: Logging Disabled;

   Bit0: 1 – u1 voltage sag, 0 – no u1 voltage sag;

   Bit1: 1 – u2 voltage sag, 0 – no u2 voltage sag;

   Bit2: 1 – u3 voltage sag, 0 – no u3 voltage sag;

   Bit3: 1 – u1 voltage swell, 0 –u1 no voltage swell;

   Bit4: 1 – u2 voltage swell, 0 –u2 no voltage swell;

   Bit5: 1 – u3 voltage swell, 0 –u3 no voltage swell;

   Rated Value: W6 - voltage rated value; threshold:

   W7 - threshold for voltage sag and swell, (expressed in secondary volts when PT's are used).

   Half cycle count: W8 (voltage swell: 0; voltage sag: 4-200).

2. Logging Events

   The event logging feature can log 50,000 events. If the 50,000 events are full, no more events will be logged even if the triggering condition happens. The user must clear the event log, and then the logging feature will log the new event. When the log is cleared, the new event will be logged from the first event that happens. There will be no data loss after the power is off.

3. Event Logging Triggering Conditions

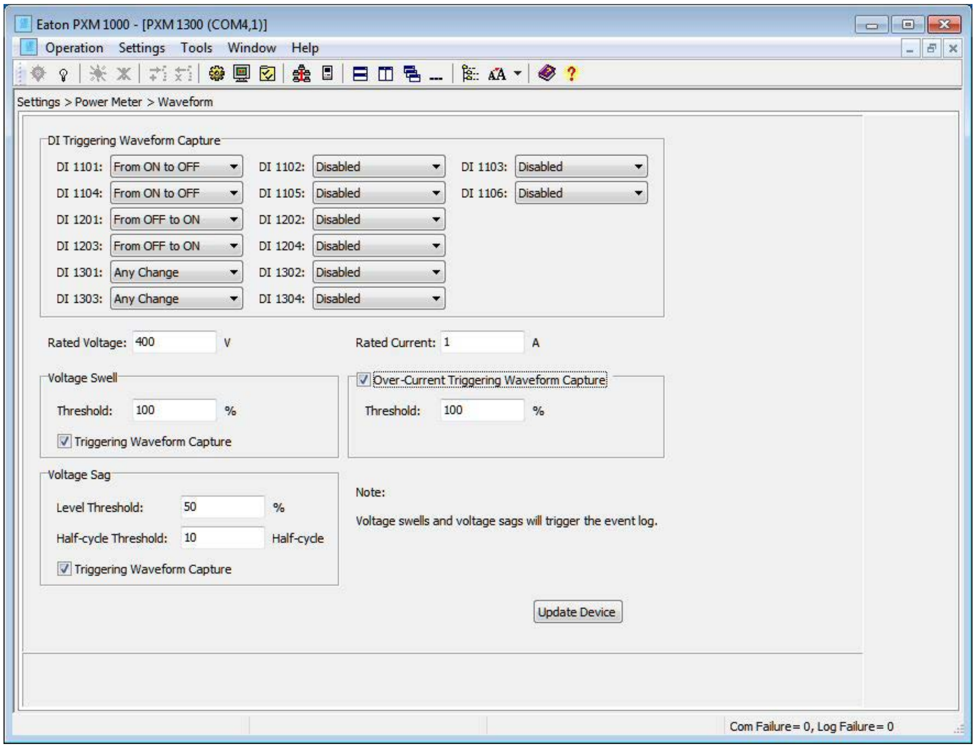
   A. Voltage Sag
   When any phase of the three-phase voltage is lower than the set value (voltage rated value x threshold %), there will be a voltage sag event. When one phase voltage sag happens, the other phase will not respond to voltage sag event logging. A new voltage sag event will be responded to only when all of the phase voltages are restored to normal.

B. Voltage Swell

When any phase of the three-phase voltage is higher than the set value (voltage rated value x threshold %), there will be a voltage swell event. When a voltage swell happens on one phase, the other phase will not respond to the voltage swell event logging. A new voltage swell event will be responded to only when all of the phase voltages are restored to normal.

Note: Figure 54 demonstrates how to set the parameters for Power Quality Event Logging and Waveform Capture. In the parameter settings, voltage sag and voltage swell share the same voltage rated value. The parameters for event logging includes: voltage rated value, voltage sag threshold, voltage sag half cycle count, and voltage swell threshold. Those parameters also fit the voltage sag waveform capture. The other triggering conditions for waveform capture can be set when necessary. When the waveform capture triggering by voltage sag and voltage swell is enabled, the corresponding event log and waveform will be recorded when voltage sag or voltage swell happens.

Figure 54. Event Triggering Conditions.



Settings > Power Meter > Waveform

DI Triggering Waveform Capture

DI 1101: From ON to OFF
DI 1102: Disabled
DI 1103: Disabled
DI 1104: From ON to OFF
DI 1105: Disabled
DI 1106: Disabled
DI 1201: From OFF to ON
DI 1202: Disabled
DI 1203: From OFF to ON
DI 1204: Disabled
DI 1301: Any Change
DI 1302: Disabled
DI 1303: Any Change
DI 1304: Disabled

Rated Voltage: 400 V
Rated Current: 1 A

Voltage Swell

Threshold: 100 %
☑ Triggering Waveform Capture

☑ Over-Current Triggering Waveform Capture

Threshold: 100 %

Voltage Sag

Level Threshold: 50 %
Half-cycle Threshold: 10 Half-cycle
☑ Triggering Waveform Capture

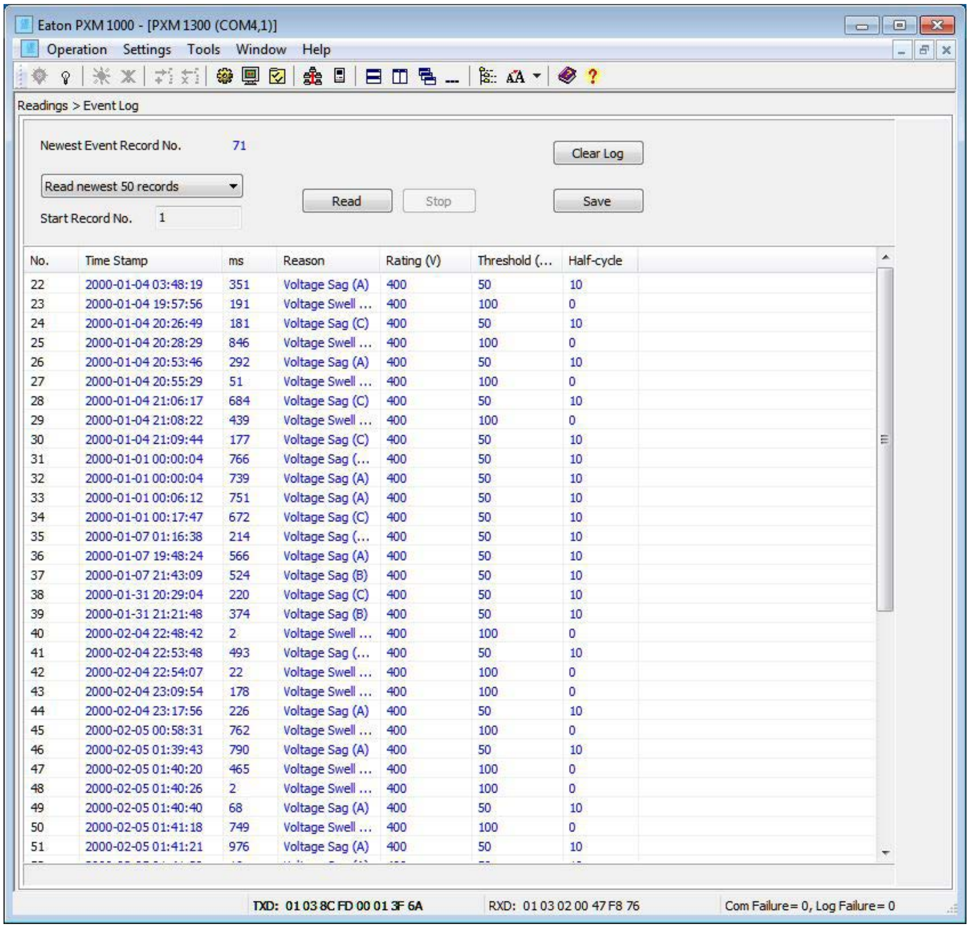
Note:

Voltage swells and voltage sags will trigger the event log.

4. Event Log Retrieve

When a new event log starts, the newest event number address (0X8CFDH) contains the newest event number. When the log is being retrieved, the starting event log number (0X8CFEH) and the event quantity for each retrieve (0X8CFF) must be set correctly. It must be ensured that the starting number of event log should equal or be smaller than the newest log number. When setup is correct, reading registers 0X8D00H-0X8D4FH will acquire the event log data. Each time, a maximum of ten logged events can be retrieved. The event log retrieve page is shown in Figure 55. The Modbus register address of the event log is shown in the Table 7 (see details in Chapter 6).

Figure 55. Event Log Retrieve Page.



Readings > Event Log

Newest Event Record No. 71

Read newest 50 records

Start Record No. 1

No.	Time Stamp	ms	Reason	Rating (V)	Threshold (...	Half-cycle
22	2000-01-04 03:48:19	351	Voltage Sag (A)	400	50	10
23	2000-01-04 19:57:56	191	Voltage Swell ...	400	100	0
24	2000-01-04 20:26:49	181	Voltage Sag (C)	400	50	10
25	2000-01-04 20:28:29	846	Voltage Swell ...	400	100	0
26	2000-01-04 20:53:46	292	Voltage Sag (A)	400	50	10
27	2000-01-04 20:55:29	51	Voltage Swell ...	400	100	0
28	2000-01-04 21:06:17	684	Voltage Sag (C)	400	50	10
29	2000-01-04 21:08:22	439	Voltage Swell ...	400	100	0
30	2000-01-04 21:09:44	177	Voltage Sag (C)	400	50	10
31	2000-01-01 00:00:04	766	Voltage Sag (...	400	50	10
32	2000-01-01 00:00:04	739	Voltage Sag (A)	400	50	10
33	2000-01-01 00:06:12	751	Voltage Sag (A)	400	50	10
34	2000-01-01 00:17:47	672	Voltage Sag (C)	400	50	10
35	2000-01-07 01:16:38	214	Voltage Sag (...	400	50	10
36	2000-01-07 19:48:24	566	Voltage Sag (A)	400	50	10
37	2000-01-07 21:43:09	524	Voltage Sag (B)	400	50	10
38	2000-01-31 20:29:04	220	Voltage Sag (C)	400	50	10
39	2000-01-31 21:21:48	374	Voltage Sag (B)	400	50	10
40	2000-02-04 22:48:42	2	Voltage Swell ...	400	100	0
41	2000-02-04 22:53:48	493	Voltage Sag (...	400	50	10
42	2000-02-04 22:54:07	22	Voltage Swell ...	400	100	0
43	2000-02-04 23:09:54	178	Voltage Swell ...	400	100	0
44	2000-02-04 23:17:56	226	Voltage Sag (A)	400	50	10
45	2000-02-05 00:58:31	762	Voltage Swell ...	400	100	0
46	2000-02-05 01:39:43	790	Voltage Sag (A)	400	50	10
47	2000-02-05 01:40:20	465	Voltage Swell ...	400	100	0
48	2000-02-05 01:40:26	2	Voltage Swell ...	400	100	0
49	2000-02-05 01:40:40	68	Voltage Sag (A)	400	50	10
50	2000-02-05 01:41:18	749	Voltage Swell ...	400	100	0
51	2000-02-05 01:41:21	976	Voltage Sag (A)	400	50	10

TXD: 01 03 8C FD 00 01 3F 6A RXD: 01 03 02 00 47 F8 76 Com Failure= 0, Log Failure= 0

Table 7. Modbus Register Address of the Event Log.

8CFDH	The newest event number	word	R	Range: 1~50000; 0: No event
8CFEH	The starting event log number	word	R/W	Range: 1-50000 **Note**: smaller than or equal to the newest event number.
8CFFH	The event quantity of each time retrieve	word	R/W	1-10

Waveform Post:

The PXM 1000 supports a waveform post function that allows users to send waveform data to an HTTP/FTP server. The PXM 1000 will send Comtrade (.cfg and .dat) files to either an HTTP or FTP whenever a power quality event has occurred. The settings for the Waveform Post can be found by clicking on the 'Settings' tab and selecting 'Communications', from the Communications page click on the 'Waveform Post' tab.

Note: This function is only available on PXM 1000 models which support the Waveform Capture Function, all other models will not have this feature available.

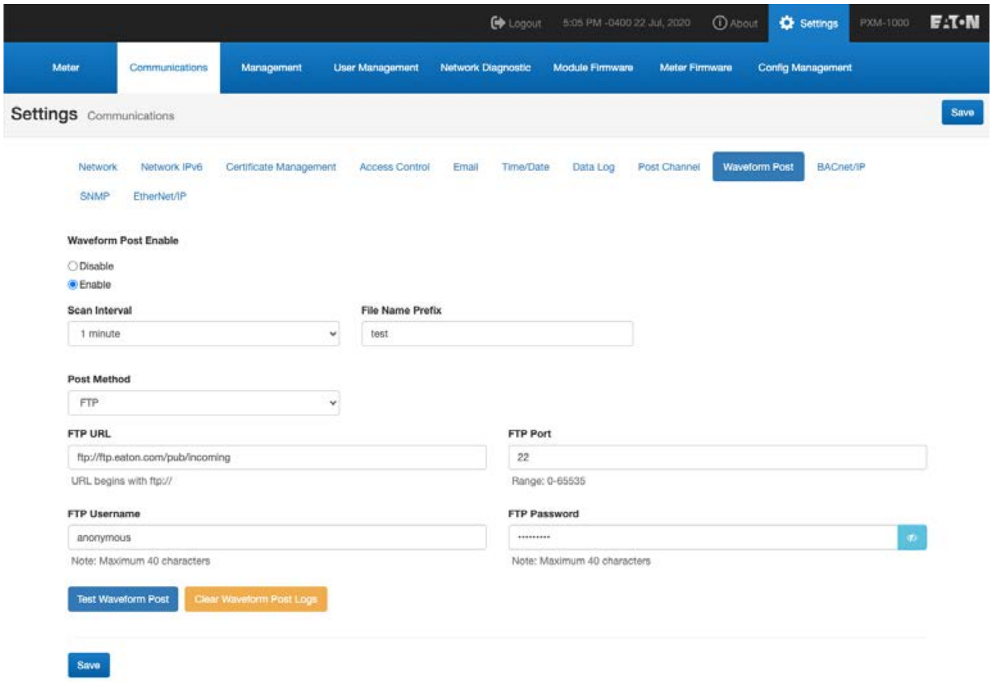
Waveform Post Enable: Select Enable to enable the waveform post and configure the settings further.

Scan Interval: Users can configure a scan interval where the PXM 1000 module scans at the Acuvim II meter to check whether there are any power quality events that occurred during the selected scan interval. For example if the scan interval is set for 15 minutes the module will scan for all the power quality events that occurred within 15 minutes and post it to the server. The scan interval ranges from 15 seconds to 1 month.

File Name Prefix: Users can configure the file name prefix for the Comtrade file that is sent to the server.

Post Method: From the drop down menu select either FTP or HTTP/HTTPs

Figure 56. Communications Page.



Waveform Post Enable
○ Disable
● Enable

Scan Interval: 1 minute
File Name Prefix: test

Post Method: FTP

FTP URL: ftp://ftp.eaton.com/pub/incoming
URL begins with ftp://
FTP Port: 22
Range: 0-65535

FTP Username: anonymous
Note: Maximum 40 characters
FTP Password: ·········
Note: Maximum 40 characters

Note: The 'Test Waveform Post' button should only be utilized after clicking the 'Save' button otherwise a fail response will be observed. If the test post fails users can view the test post details by clicking on the 'Details' option from the test post screen.

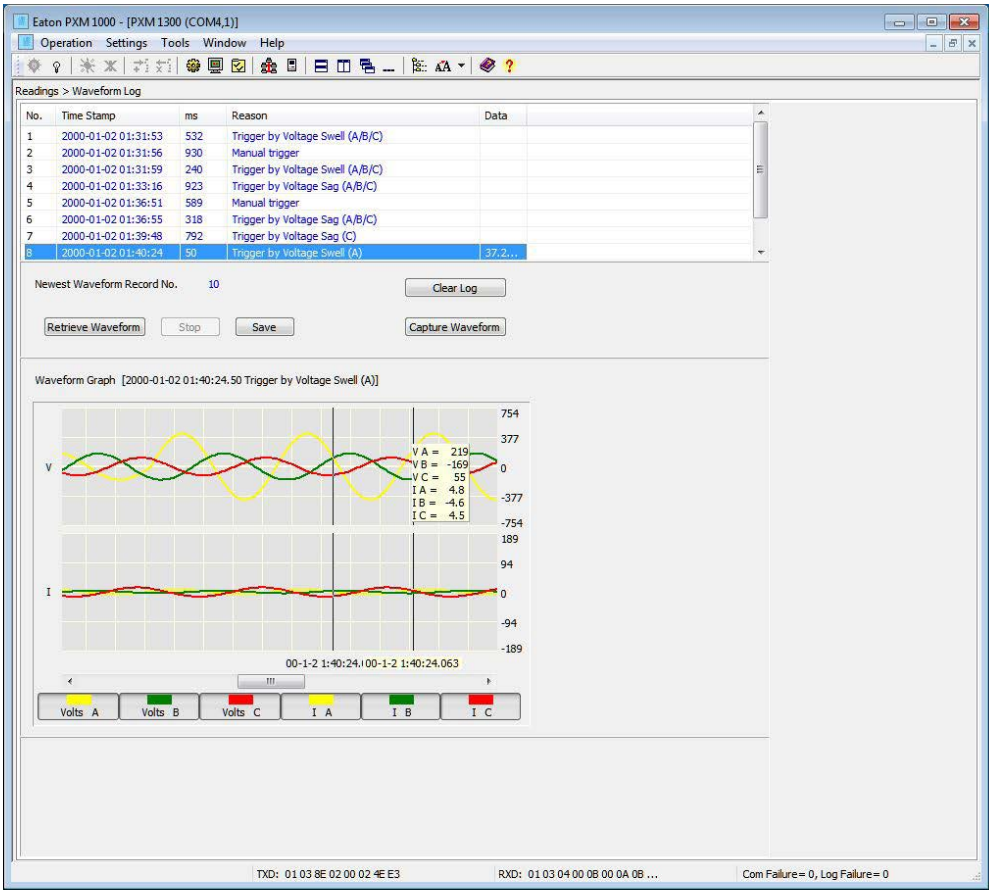
Similar to the Post Channel function discussed earlier, in the case when there is no connection to the server the PXM 1000 will store the posts and send it out after the connection is restored.

A maximum of 3000 files will be buffered on module. The 'Clear Waveform Post Channel Logs' button will allow users to clear the buff ered waveform files on meter.

There is no interval setting for sending the waveform data using the waveform post, the data will post directly to the FTP/HTTP server when a power quality event has occurred.

The waveform capture retrieve page is shown in Figure 56.

Figure 57. Waveform Capture Retrieve Page.



No.	Time Stamp	ms	Reason	Data
1	2000-01-02 01:31:53	532	Trigger by Voltage Swell (A/B/C)	
2	2000-01-02 01:31:56	930	Manual trigger	
3	2000-01-02 01:31:59	240	Trigger by Voltage Swell (A/B/C)	
4	2000-01-02 01:33:16	923	Trigger by Voltage Sag (A/B/C)	
5	2000-01-02 01:36:51	589	Manual trigger	
6	2000-01-02 01:36:55	318	Trigger by Voltage Sag (A/B/C)	
7	2000-01-02 01:39:48	792	Trigger by Voltage Sag (C)	
8	2000-01-02 01:40:24	50	Trigger by Voltage Swell (A)	37.2...

Newest Waveform Record No. 10

Waveform Graph [2000-01-02 01:40:24.50 Trigger by Voltage Swell (A)]

V A = 219
V B = -169
V C = 55
I A = 4.8
I B = -4.6
I C = 4.5

TXD: 01 03 8E 02 00 02 4E E3

RXD: 01 03 04 00 0B 00 0A 0B ...

Com Failure= 0, Log Failure= 0

4.8 Seal Function

Panels with the Seal function, which has a sealed key control, are different from the panels without a seal. When the seal is in Opened status, the functions are the same as normal meters. But when the Seal function is in Sealed status, some functions of the meters, which includes parameters blocked by seal and optional parameters, will be blocked. These parameters can still be accessible by the local display and via communications the same way they could be accessed before. But, in Seal, these parameters cannot be modified by the local display and via communications in the way they were before.

Addresses for the Seal function are 101EH and 101FH.

Address 101EH is for the parameters blocked by Seal, which can be configured by the user. These setting will be valid only when the Seal function is in sealed status.

Address 101FH is for the status of Seal Function. When the panel is a normal one, or the seal panel is in Invalid Sealed status, this address will show that the Seal is open. When the Seal is valid, this address will show the sealed status and corresponding parameters will be blocked.

Table 8. Seal Function Address Status.

101EH	Sealed Nonstandard Parameters Selection	Bit0: 1st communication parameters Bit1: 2nd communication parameters Bit2: run time clear Bit3: DI pulse count Bit4:TOU 1: valid of corresponding selection 0: invalid
101FH	Seal Status	0x0A: Seal sealed; Other: Seal opened.

Parameters blocked by the Seal function:

As long as Seal is in the Sealed status, the parameters below must be blocked, no matter what the value of address 101EH.

Table 9. Seal Parameters Status.

System Parameters Setting:

Address	Parameter	Keys	Communication
1003H	Voltage input wiring type	√	√
1004H	Current input wiring type	√	√
1005H	PT1 (High 16 bit)	√	√
1006H	PT1 (Low 16 bit)	√	√
1007H	PT2	√	√
1008H	CT1	√	√
1009H	CT2	√	√
100AH	kWh pulse constant	√	√
100BH	Kvarh pulse constant	√	√
100DH	Demand slid window time	√	√
100EH	Demand calculating mode	√	√
100FH	Clear demand memory	√	√
1012H	Current I1 direction	√	√
1013H	Current I2 direction	√	√

1014H	Current I3 direction	√	√
1015H	VAR/PF convention	√	√
1016H	Energy clear	√	√
1017H	Energy calculating mode	√	√
1018H	Reactive power measuring mode	√	√
1019H	Energy display mode	√	√
101DH	Basic parameter mode	√	√
101EH	Sealed nonstandard parameters selection	-	√

Note: “√” means these addresses will be blocked for keys and communication, and”-“ means this function is unavailable.

Table 10. Seal Parameters Status (continued).

Energy:

Address	Parameter	Keys	Communication
4048H--4049H	Energy IMP	-	√
404AH--404BH	Energy EXP	-	√
404CH--404DH	Reactive Energy IMP	-	√
404EH--404FH	Reactive Energy EXP	-	√
4050H--4051H	Energy TOTAL	-	√
4052H--4053H	Energy NET	-	√
4054H--4055H	Reactive Energy TOTAL	-	√
4056H--4057H	Reactive Energy NET	-	√
4058H--4059H	Apparent Energy	-	√
4620H~4621H	Phase A Energy IMP	-	√
4622H~4623H	Phase A Energy EXP	-	√
4624H~4625H	Phase B Energy IMP	-	√
4626H~4627H	Phase B Energy EXP	-	√
4628H~4629H	Phase C Energy IMP	-	√
462AH~462BH	Phase C Energy EXP	-	√
462CH~462DH	Phase A Reactive Energy IMP	-	√
462EH~462FH	Phase A Reactive Energy EXP	-	√
4630H~4631H	Phase B Reactive Energy IMP	-	√
4632H~4633H	Phase B Reactive Energy EXP	-	√
4634H~4635H	Phase C Reactive Energy IMP	-	√
4636H~4637H	Phase C Reactive Energy EXP	-	√
4638H~4639H	Phase A Apparent Energy	-	√
463AH~463BH	Phase B Apparent Energy	-	√
463CH~463DH	Phase C Apparent Energy	-	√

DO:

Address	Parameter	Keys	Communication
10A5H	Working mode of DO 1 and 2	√	√
10A6H	DO pulse width	√	√
10A7H	DO1 output	√	√
10A8H	DO2 output	√	√
10B7H	Working mode of DO 3 and 4	√	√
10B8H	DO pulse width	√	√
10B9H	DO3 output	√	√
10BAH	DO4 output	√	√

Sealed Nonstandard Parameters:

Table 10. Sealed Nonstandard Parameters

1. When bit 0 of address 101EH is valid, parameters about 1st communication should be blocked.

Address	Parameter	Keys	Communication
0FFEH	Communication Protocol 1	√	√
0FFFH	Parity Setting 1	√	√
1000H	Password	√	√
1001H	Communication address 1	√	√
1002H	Baud rate 1	√	√

2. When bit 1 of address 101EH is valid, parameters about 2nd communication should be blocked.

Address	Parameter	Keys	Communication
102FH	Baud rate 2	√	√
1030H	Parity Setting 2	√	√
1031H	Communication address 2	√	√
Ethernet Module			
	DHCP setting	√	√
	IP address 1st byte (high)	√	√
	IP address 2nd byte (low)	√	√
	IP address 3rd byte (high)	√	√
	IP address 4th byte (low)	√	√
	Submask 1st byte (high)	√	√
	Submask 2nd byte (low)	√	√
	Submask 3rd byte (high)	√	√
	Submask 4th byte (low)	√	√
	Gateway 1st byte (high)	√	√
	Gateway 2nd byte (low)	√	√
	Gateway 3rd byte (high)	√	√
	Gateway 4th byte (low)	√	√
	DNS1 1st byte (high)	√	√
	DNS1 2nd byte (low)	√	√

Address	Parameter	Keys	Communication
	DNS1 3rd byte (high)	√	√
	DNS1 4th byte (low)	√	√
	DNS2 1st byte (high)	√	√
	DNS2 2nd byte (low)	√	√
	DNS2 3rd byte (high)	√	√
	DNS2 4th byte (low)	√	√
	Modbus Tcp/IP port	√	√
	Http port	√	√
BACnet Module			
	BACnet module enable	√	√
	DHCP setting	√	√
	IP address 1st byte (high)	√	√
	IP address 2nd byte (low)	√	√
	IP address 3rd byte (high)	√	√
	IP address 4th byte (low)	√	√
	Submask 1st byte (high)	√	√
	Submask 2nd byte (low)	√	√
	Submask 3rd byte (high)	√	√
	Submask 4th byte (low)	√	√
	Gateway 1st byte (high)	√	√
	Gateway 2nd byte (low)	√	√
	Gateway 3rd byte (high)	√	√
	Gateway 4th byte (low)	√	√
	DNS1 1st byte (high)	√	√
	DNS1 2nd byte (low)	√	√
	DNS1 3rd byte (high)	√	√
	DNS1 4th byte (low)	√	√
	DNS2 1st byte (high)	√	√
	DNS2 2nd byte (low)	√	√
	DNS2 3rd byte (high)	√	√
	DNS2 4th byte (low)	√	√
	MAC address	√	√
	BACnet baud rate	√	√
	Max info frames	√	√
	BACnet Port	√	√

3. When bit 2 of address 101EH is valid, parameters below should be blocked.

Address	Parameter	Keys	Communication
1011H	Run time clear	√	√

4. When bit 3 of address 101EH is valid, parameters below should be blocked.

Address	Parameter	Keys	Communication
101CH	Pulse counter clear	√	√

109eH	DI1-6 type	√	√
109fH	DI pulse constant	√	√
10a3H	DI7-10 type	√	√
10a4H	DI pulse constant	√	√
10aaH	DI11-14 type	√	√
10abH	DI pulse constant	√	√
10b0H	DI15-20 type	√	√
10b1H	DI pulse constant	√	√
10b5H	DI21-24 type	√	√
10b6H	DI pulse constant	√	√
10bcH	DI25-28 type	√	√
10bdH	DI pulse constant	√	√

5. When bit 4 of address 101EH is valid, parameters below should be blocked.

Address	Parameter	Keys	Communication
103fH	Week	-	√
1040H	Year	-	√
1041H	Month	-	√
1042H	Day	-	√
1043H	Hour	-	√
1044H	Minute	-	√
1045H	Second	-	√

Note: Standard time is valid within ±5 minutes, it will be invalid if not in this range.

Address	Parameter	Keys	Communication
TOU			
1039H	Ten-year download setting enable	-	√
103aH	Sharp demand clear	-	√
103bH	Peak demand clear	-	√
103cH	Valley demand clear	-	√
103dH	Normal demand clear	-	√
103eH	Total demand clear	-	√
Current and last month TOU energy			
7200H-7263H	Current and last month TOU energy	-	√
DST setting			
7700H-7717H	DST setting	-	√
Season setting			
7800H-780EH	Basis parameter of TOU	-	√
7820H-7AECH	Season setting	-	√
Ten-year holiday setting			
7B00H-7E97H	Ten-Year Holiday setting	-	√

5. Extended Modules

5.1 I/O Modules

5.1.1 The Purpose of I/O Modules

The standard PXM 1000 meter base does not have any built-in I/O functions. However, with the addition of the extended modules, multiple I/O options can be added. These functions include digital input, pulse counter, relay output, analog output, analog input, etc.

There are three types of I/O modules, PXM1K-1, PXM1K-2, and PXM1K-3. Please note that a maximum of three modules may be attached to the meter. If a communication module is used, it must be installed on the back of the meter first before any I/O modules are attached. No more than two of the same type I/O modules can be attached. According to the difference in communication with PXM 1000 meter, each type of I/O module also has two modes, logic NO. 1 and logic NO. 2. This means, two of each type of I/O module can be linked to the PXM 1000 meter simultaneously (one being logic NO. 1 and the other being logic NO. 2).

The PXM1K-1 module is composed of:

> Six Digital Inputs (DI) - Each DI can be used to detect remote signals, or be used as an input pulse counter. When it is used to detect remote signals, it also can enable sequence of events (SOE), recording the event and time of the event.
>
> Two Relay Outputs (RO) - Can be used for controlling or alarms. Each of the ROs work in the same mode. When it operates in controlling mode, there are two output options; latching and pulse. When it operates in alarm mode, it has only one latching output mode.
>
> 24 V Isolated Power Supply - Used as an auxiliary power supply for digital inputs.

The PXM1K-2 module is composed of:

> Four Digital Inputs (DI) - Each DI can be used to detect remote signals, or be used as an input pulse counter. When it is used to detect remote signals, it can also enable a sequence of events (SOE), recording the events and time of the events.
>
> Two Analog Outputs (AO) - Can output analog voltage or analog current. When it outputs analog voltage, the range of voltage is from 0 to 5 V or from 1 to 5 V. When it outputs analog current, the range of current is from 0 to 20 mA or from 4 to 20 mA.
>
> Two Digital Outputs (DO) - Can be used in alarm mode or energy pulse output mode. Both of the DOs work in the same mode. When the DOs operate in the energy pulse output mode, they can output various types of energy.

The PXM1K-3 module is composed of:

> Four Digital Inputs (DI) - Each DI can be used to detect remote signals, or be used as an input pulse counter. When a DI is used to detect remote signals, it can also enable a sequence of events (SOE), recording the events and time of the events.
>
> Two Relay Outputs (RO) - Can be used for controlling or alarms. Each of the ROs work in the same mode. When a RO operates in the controlling mode, there are two output options: latching mode and pulse . When it operates in alarm mode, it has only one latching output mode.
>
> Two Analog Inputs (AI) - Can detect input analog voltage or analog current. When an AI detects input analog voltage, the range of voltage is from 0 to 5 V or from 1 to 5 V. When it detects input analog current, the range of current is from 0 to 20 mA or from 4 to 20 mA.

Table 11. Sealed Nonstandard Parameters (continued).

5.1.2 List of Functions of I/O Modules

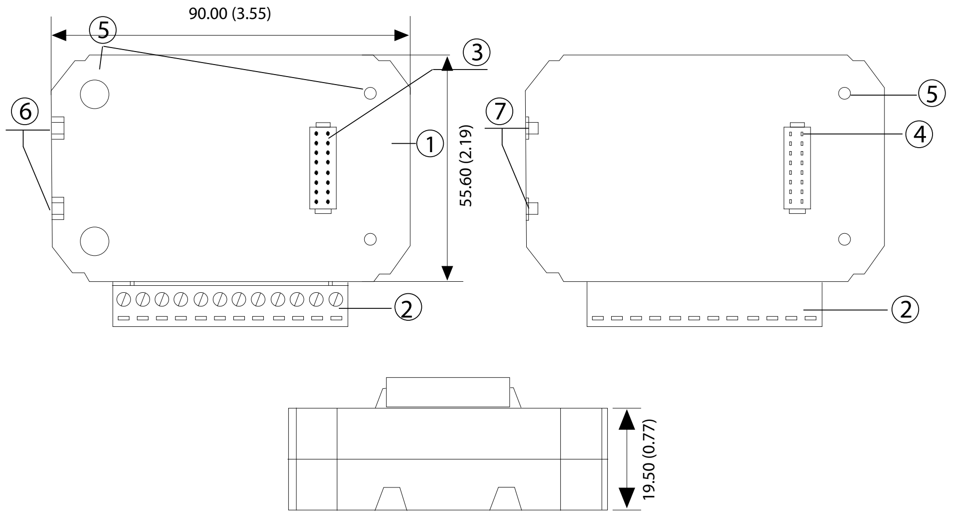
Table 11. Functions of I/O Modules.

Functions	PXM1K-1	PXM1K-2	PXM1K-3
Detection of remote signals	•	•	•
Recording of SOE	•	•	•
Counting of input pulses	•	•	•
Output remote controlling by relay	•		•
Output alarm by relay	•		•
Output alarm by digital output		•	
Output power pulses by digital output		•	
Analog output		•	
Analog input			•
24 V isolated voltage output	•		

Note: PXM1K-1 includes the PXM1K-110 and PXM1K-120
PXM1K-2 includes the PXM1K-21x and PXM1K-22x
PXM1K-3 includes the PXM1K-31x and PXM1K-32x

5.1.3 Appearance and Dimensions

Figure 58. Dimensions



1	Enclosure	5	Installation Screw
2	Wiring Terminals	6	Counterpart of Clip
3	Linking Pins	7	Installation Clip
4	Linking Socket		

5.1.4 Installation Method

Environment

Please verify the installation environment meets the requirements listed as follows:

Table 11. Sealed Nonstandard Parameters (continued).

Temperature:

Operation: -25°C to 70°C (-13°F to 158°F)

Storage: -40°C to 85°C (-40°F to 185°F)

Humidity:

5% to 95% non-condensing.

Location:

The PXM 1000 meter and I/O modules should be installed in a dry and dust free environment avoiding heat, radiation, and high electrical noise sources.

Installation Method:

The I/O modules are linked to the meter and to each other with link pins. The maximum number of extended modules linked to a PXM 1000 meter, including I/O module, Ethernet module, RS-485 module, and BACnet module is three. The communication modules must be installed first. No other module can be installed before them.

1. Insert the installation clips into the module to be linked to the PXM 1000 meter. Press the I/O module lightly into the meter until a solid link is established.
2. Tighten the installation screws. Torque is 0.2 nm ± 0.02 (1.77 lb-in ± 0.177)
3. Install other I/O modules in the same way.

Note: Install the I/O Modules carefully to avoid damage;

⚠ WARNING

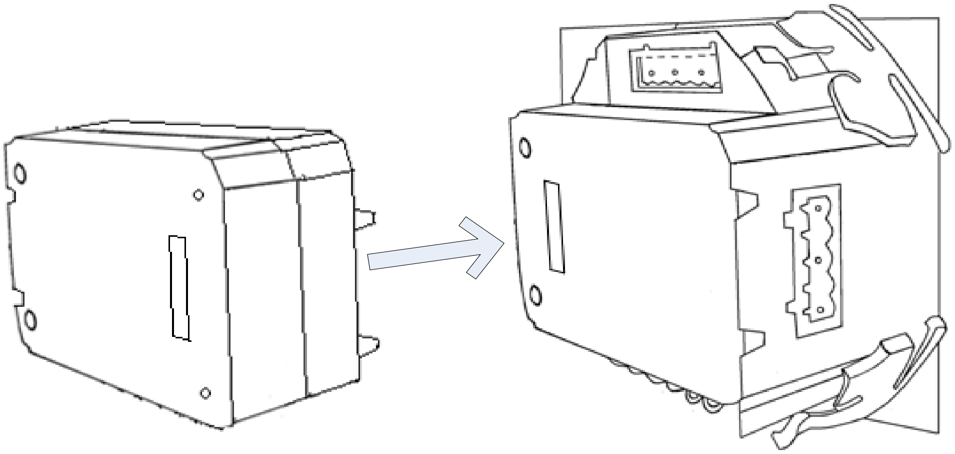
Do not attempt to install or perform maintenance on equipment while it is energized. Death, severe personal injury, or substantial property damage can result from contact with energized equipment. Always verify that no voltage is present. Before proceeding with the task, and always follow generally accepted safety procedures.

⚠ WARNING

Switch main power off and wait five (5) minutes before making any connection or disconnection on the device. Danger of explosion!

Eaton is not liable for the misapplication or misinstallation of its products.

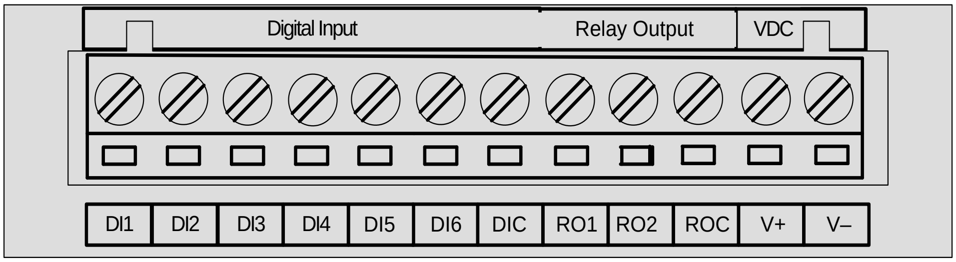
Figure 59. Installation of the I/O Modules.



5.1.5 Wiring the I/O Modules:

Terminal strips of PXM1K-1 module:

Figure 60. Terminal Strips of PXM1K-1 Module.



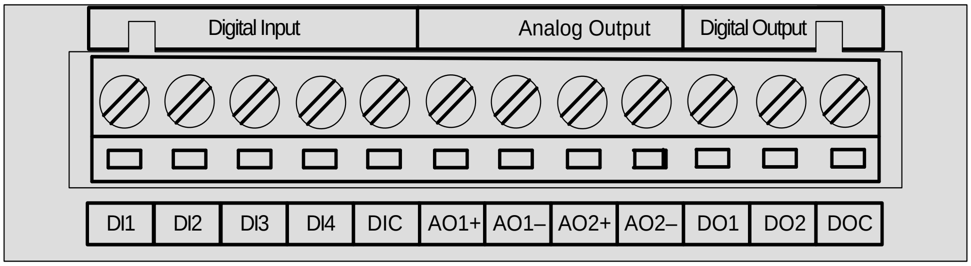
DI1 to DIC: digital input terminals, where DIC is the common terminal for DI1 to DI6 circuits.

RO1 to ROC: relay output terminals, where ROC is the common terminal for RO1 and RO2 circuits.

V24+ and V24-: auxiliary voltage supply terminals.

Terminal Strips of PXM1K-2 Module:

Figure 61. Terminal Strips of PXM1K-2 Module.

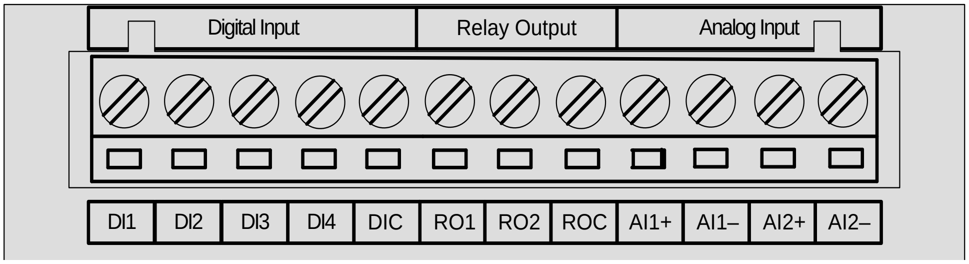


DI1 to DIC: digital input terminals, where DIC is the common terminal for DI1 to DI4 circuits.

AO1+, AO1-, AO2+, AO2-: analog output terminals.

DO1 to DOC: digital output terminals, where DOC is the common terminals for the DO1 to DO2 circuits.

Figure 62. Terminals Strips of PXM1K-3 module:



DI1 to DIC: digital input terminals, where DIC is the common terminal for the DI1 to DI4 circuits.

RO1 to ROC: relay output terminals, where ROC is the common terminal for the RO1 and RO2 circuits.

AI1+, AI1-, AI2+, AI2-: analog input terminals.

Sequence of DI, RO, DO, AO, AI in I/O Modules (according to the logical order in the communication address table of the main body):

DI Sequence:
PXM1K-11x (PXM1K-1xx module with address 1): DI1-6

PXM1K-21x (PXM1K-2xx module with address 1): DI7-10

PXM1K-31x (PXM1K-3xx module with address 1): DI11-14

PXM1K-12x (PXM1K-1xx module with address 2): DI15-20

PXM1K-22x (PXM1K-2xx module with address 2): DI21-24

PXM1K-32x (PXM1K-3xx module with address 2): DI25-28

RO Sequence:
PXM1K-11x (PXM1K-1xx module with address 1): RO1-2

PXM1K-31x (PXM1K-3xx module with address 1): RO3-4

PXM1K-12x (PXM1K-1xx module with address 2): RO5-6

PXM1K-32x (PXM1K-3xx module with address 2): RO7-8

DO Sequence:
PXM1K-21x (PXM1K-2xx module with address 1): DO1-2

PXM1K-22x (PXM1K-2xx module with address 2): DO3-4

AO Sequence:
PXM1K-21x (PXM1K-2xx module with address 1): AO1-2

PXM1K-22x (PXM1K-2xx module with address 2): AO3-4

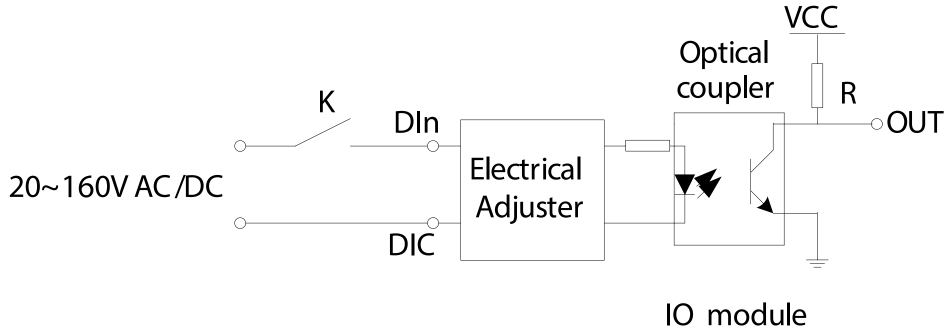
AI Sequence:
PXM1K-31x (PXM1K-3xx module with address 1): AI1-2

PXM1K-32x (PXM1K-3xx module with address 2): AI3-4

Wiring of Digital Input Circuit:

There are six digital input circuits, four digital input circuits and four digital input circuits in PXM1K-1, PXM1K-2, and PXM1K-3 modules respectively. The digital input circuit can be used to detect remote signals, or be used as an input pulse counter.

Figure 63. Schematic Diagram of Digital Input Circuit.



The circuit drawing of the digital input is simplified as shown in Figure 62. When K is switched off, OUT is in high state. When K is switched on, OUT is in low state.

The external power supply for the digital input is 20-160 Vac/Vdc. The maximum current in the loop line is 2 mA.

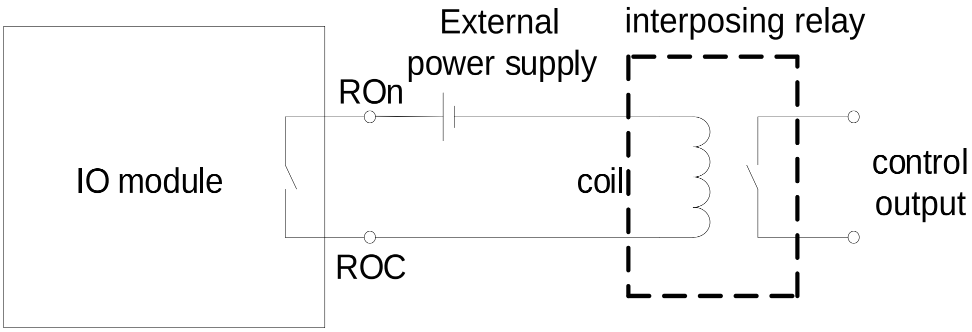
The wire selected for digital input should be between AWG 22~16 or 0.5~ 1.3 mm^2.

Wiring of Relay Output Circuit:

There are two relay output circuits in PXM1K-1 and PXM1K-3 modules respectively. The relay output circuit can work in a controlling state or an alarm state. When it operates in a controlling state, it has two optional output modes: latching and pulse. When it operates in an alarm state, it has only one latching output mode.

The relay type is a mechanical Form A contact with 3 A/250 Vac or 3 A/30 Vdc. An interposing relay is recommended in the output circuit as in Figure 63.

Figure 64. Schematic Diagram of Relay Output Circuit.



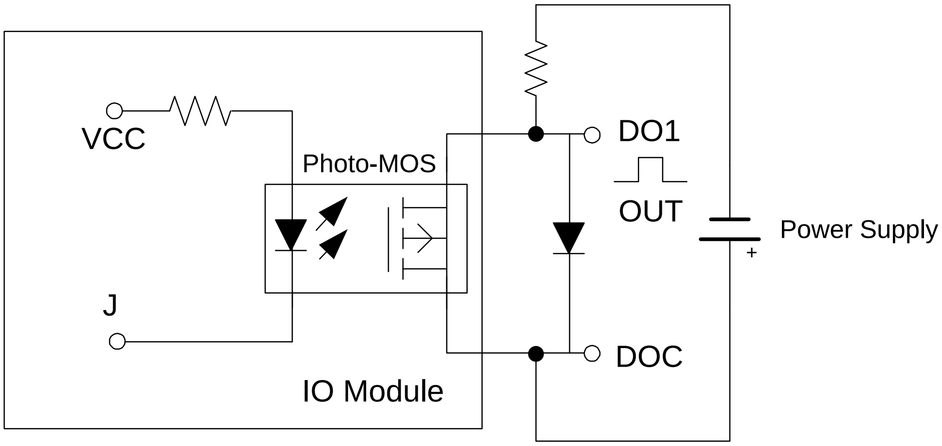
The wire selected for the relay output should be between AWG 22~16 or 0.5~1.3 mm^2.

Wiring of Digital Output Circuit:

There are two digital output circuits in the PXM1K-2 module. The digital output circuit can work in an alarm state or work in an energy pulse output state.

Digital output circuit form is Photo-MOS. The simplified circuit is shown in Figure 64.

Figure 65. Schematic Diagram of Digital Output Circuit 1.

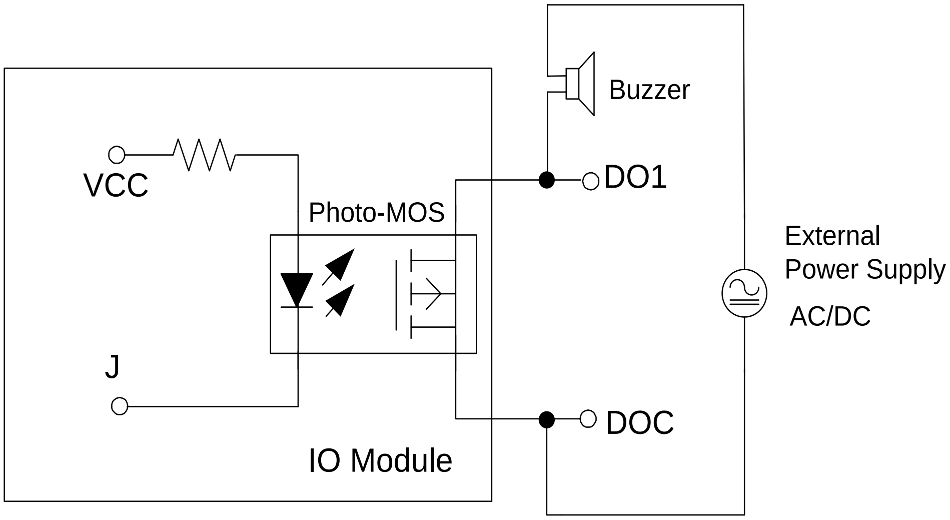


When J is in the low state as shown in Figure 64, OUT is in low state. When J is in the high state, OUT is in high state. OUT can therefore output pulse signals under the control of J.

The max output voltage and current of the digital output circuit are 250 V and 100 mA respectively.

Another drawing of the alarming output with buzzer is shown in Figure 65.

Figure 66. Schematic Diagram of Digital Output Circuit 2.



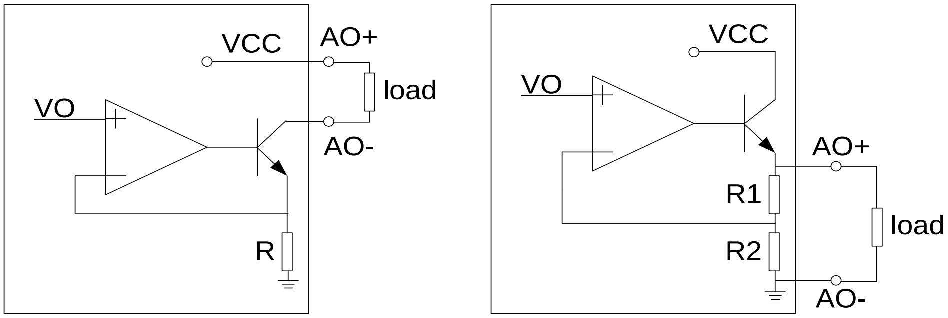
The wire selected for the digital output circuit should be between AWG22~16 or 0.5~1.3 mm^2.

Wiring of Analog Output Circuit:

There are two analog output circuits in PXM1K-2 modules. The terminals of the analog output circuits are AO1+, AO1-, and AO2+, AO2-. The analog output circuit can convert any one of 30 electrical quantities, which is selected by user, to analog voltage or current. The analog output circuit supplies four output modes, including 0 to 20 mA mode, 4 to 20 mA mode, 0 to 5 V mode, and 1 to 5 V mode.

The simplified circuit is as shown in Figure 66.

Figure 67. Schematic Diagram of the Analog Output Circuit.



Current Analog Output

Voltage Analog Output

The Load Capability of the Analog Output Circuit:

0 to 20 mA mode: the max load resistance is 500 Ω.

4 to 20 mA mode: the max load resistance is 500 Ω.

0 to 5 V mode: the max load current is 20 mA.

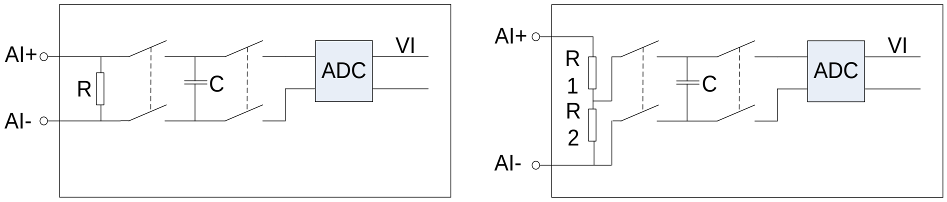
1 to 5 V mode: the max load current is 20 mA.

Wiring of the Analog Input Circuit:

There are two analog input circuits in PXM1K-3 modules. The terminals of analog input circuit are AI1+, AI1- and AI2+, AI2-. The analog input circuit supplies four input modes, including 0 to 20 mA mode, 4 to 20 mA mode, 0 to 5 V mode, and 1 to 5 V mode.

The simplified circuit is as shown in Figure 67.

Figure 68. Schematic Diagram of the Analog Input Circuit.



Current Analog Input

Voltage Analog Input

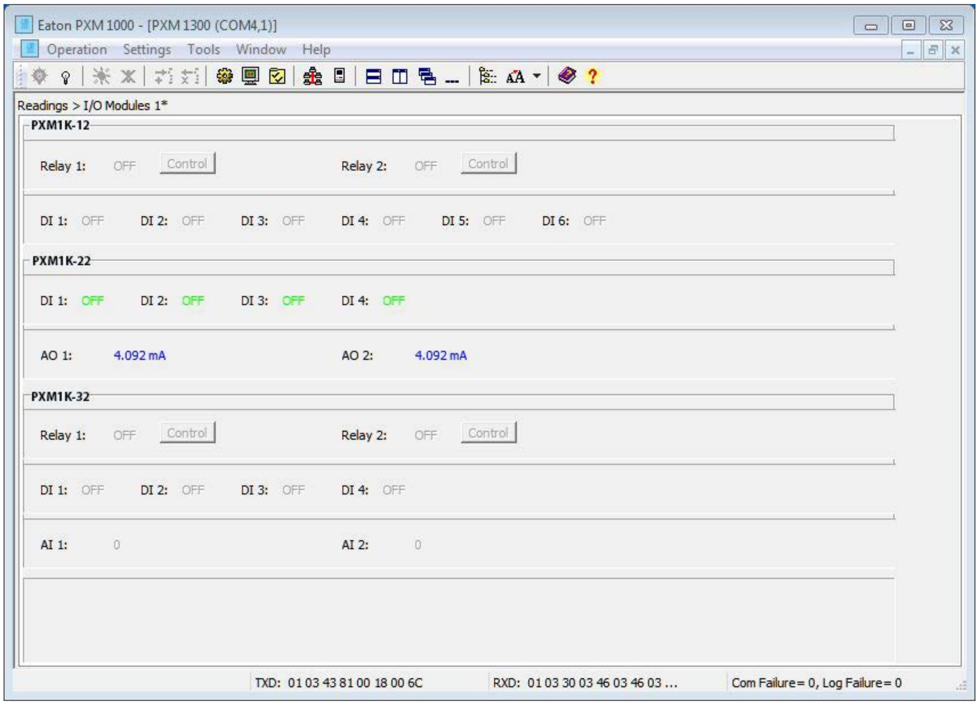
24 V Isolated Power Supply:

To simplify and make it more convenient for the end user, there is a DI auxiliary power supply provided in PXM1K-1 module. The voltage of the DI auxiliary power supply is 24 Vdc (1W). This power supply can NOT be used for other purposes.

Figure 68 shows the function of I/O modules, which is displayed in the utility software as follows, where PXM1K-12 (PXM1K-1 module with address 2), PXM1K-22 (PXM1K-2 module with address 2), and PXM1K-32 (PXM1K-3 module with address 2) are linked to PXM 1000 meter.

Note: PXM1K-1 includes the PXM1K-110 and PXM1K-120
PXM1K-2 includes the PXM1K-21x and PXM1K-22x
PXM1K-3 includes the PXM1K-31x and PXM1K-31x

Figure 69. Functions of the I/O Modules.



Readings > I/O Modules 1*

PXM1K-12

Relay 1: OFF

Relay 2: OFF

DI 1: OFF DI 2: OFF DI 3: OFF DI 4: OFF DI 5: OFF DI 6: OFF

PXM1K-22

DI 1: OFF DI 2: OFF DI 3: OFF DI 4: OFF

AO 1: 4.092 mA

AO 2: 4.092 mA

PXM1K-32

Relay 1: OFF

Relay 2: OFF

DI 1: OFF DI 2: OFF DI 3: OFF DI 4: OFF

AI 1: 0

AI 2: 0

```
TXD: 01 03 43 81 00 18 00 6C    RXD: 01 03 30 03 46 03 46 03 ...    Com Failure= 0, Log Failure= 0
```

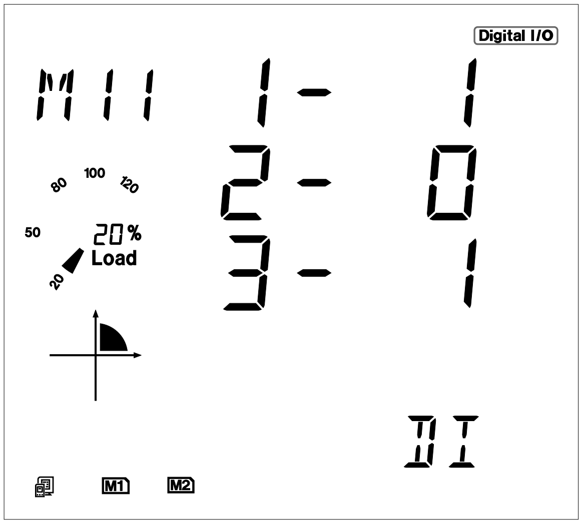
5.1.6 Detection of Remote Signals

The digital input circuit can be set to detect remote signals.

A. Detection of Remote Signals

When the digital input circuit detects a qualified voltage input, it will show “1” on screen and “ON” in the software. Otherwise, it will show “0” on screen and “OFF” in the software.

Figure 70. Showing the DI State on the Screen.



B. Record of SOE

When the digital input circuit is set to detect remote signals, the recording function of SOE can be enabled. Therefore, when the remote signals change, the I/O module can record this information accordingly.

SOE Record: Including “4399H to 4439H” address registers. “4399H to 4438H” address registers record 20 groups of SOE records. “4439H” records the I/O module which generates the SOE records. For example, if register “4439H” is 1, the 20 groups of SOE records are all generated by PXM1K-11 (PXM1K-1 module with address 1).

The 20 groups of SOE records are arranged based on time. When more than 20 groups of SOE records are generated, the records will begin at the first group.

When the PXM 1000 meter is powered on, the SOE begins to record. The data in the SOE records will not be lost if the meter is powered off. When the enabled SOE function is changed, the records will be lost.

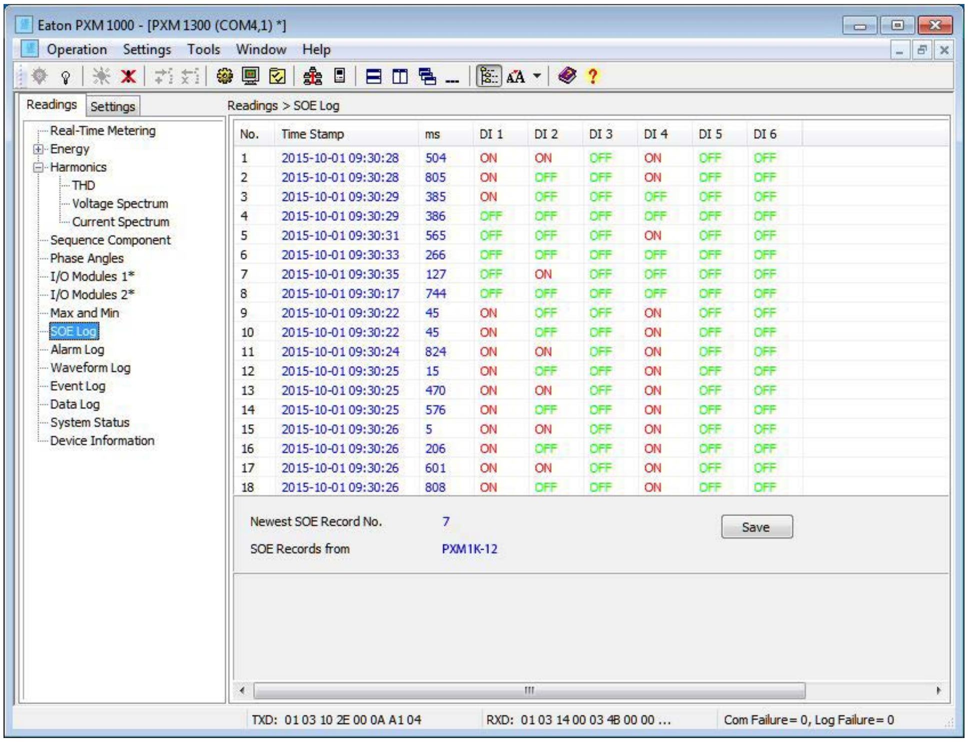
All groups of SOE records are in the same format. Take the first group of SOE records for example. The “4399H to 439fH” registers record the time information, including year, month, day, hour, minute, second, and millisecond. “43a0H” register records the state information, which is an unsigned integer, where bit 0 records DI1 state, bit 1 records DI2 state, and so on. For example, if “43a0H” is “1”, it means that DI1 is “1”, and others are all “0”.

Note: If one of digital input circuits is set to be a pulse counter when the I/O module is SOE enabled, then the counterpart bit of “43a0H” register will always be “0”.

Data of SOE records can only be read by the utility software. It cannot be read on screen.

Figure 70 shows the data information of SOE records of PXM1K-12 (PXM1K-1 module with address 2) read by the utility software.

Figure 71. Data Information of SOE Records Read by the Utility Software.



No.	Time Stamp	ms	DI 1	DI 2	DI 3	DI 4	DI 5	DI 6
1	2015-10-01 09:30:28	504	ON	ON	OFF	ON	OFF	OFF
2	2015-10-01 09:30:28	805	ON	OFF	OFF	ON	OFF	OFF
3	2015-10-01 09:30:29	385	ON	OFF	OFF	OFF	OFF	OFF
4	2015-10-01 09:30:29	386	OFF	OFF	OFF	OFF	OFF	OFF
5	2015-10-01 09:30:31	565	OFF	OFF	OFF	ON	OFF	OFF
6	2015-10-01 09:30:33	266	OFF	OFF	OFF	OFF	OFF	OFF
7	2015-10-01 09:30:35	127	OFF	ON	OFF	OFF	OFF	OFF
8	2015-10-01 09:30:17	744	OFF	OFF	OFF	OFF	OFF	OFF
9	2015-10-01 09:30:22	45	ON	OFF	OFF	ON	OFF	OFF
10	2015-10-01 09:30:22	45	ON	OFF	OFF	ON	OFF	OFF
11	2015-10-01 09:30:24	824	ON	ON	OFF	ON	OFF	OFF
12	2015-10-01 09:30:25	15	ON	OFF	OFF	ON	OFF	OFF
13	2015-10-01 09:30:25	470	ON	ON	OFF	ON	OFF	OFF
14	2015-10-01 09:30:25	576	ON	OFF	OFF	ON	OFF	OFF
15	2015-10-01 09:30:26	5	ON	ON	OFF	ON	OFF	OFF
16	2015-10-01 09:30:26	206	ON	OFF	OFF	ON	OFF	OFF
17	2015-10-01 09:30:26	601	ON	ON	OFF	ON	OFF	OFF
18	2015-10-01 09:30:26	808	ON	OFF	OFF	ON	OFF	OFF

Newest SOE Record No. 7

SOE Records from PXM1K-12

TXD: 01 03 10 2E 00 0A A1 04 RXD: 01 03 14 00 03 4B 00 00 ... Com Failure= 0, Log Failure= 0

C. Parameter Setting of Detection of Remote Signals

Take the parameter setting of PXM1K-11 (PXM1K-1 module with address 1) for example.

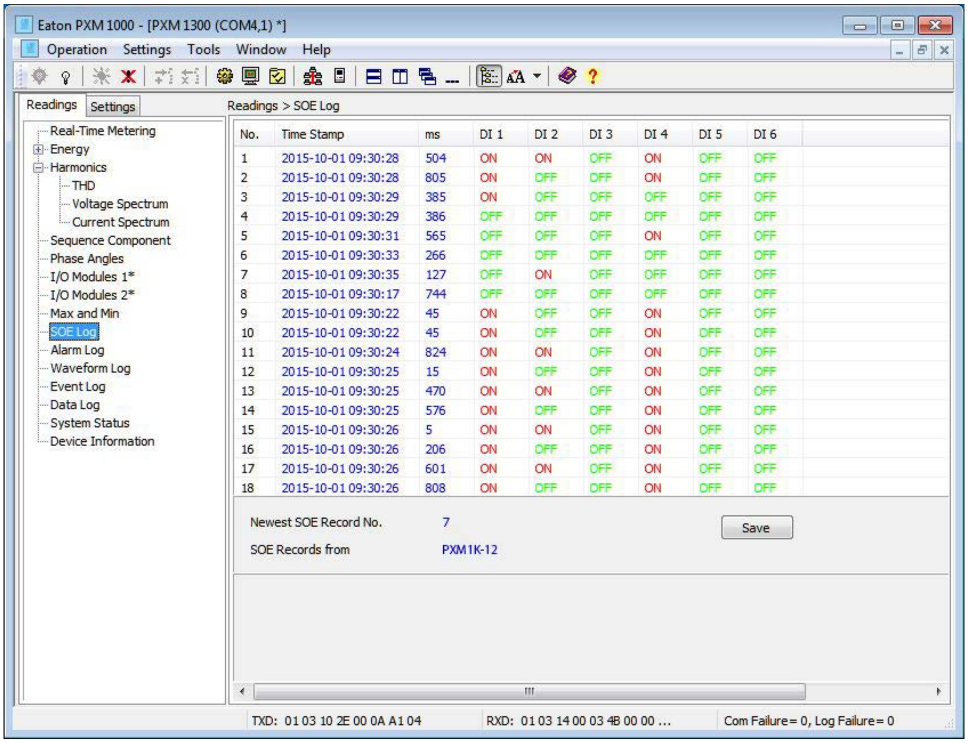
"109eH" register: This register is an unsigned integer, where bit0 determines DI1's working mode, bit1 determines DI2's working mode, and so on. If the bit is "1", then the DI circuit is set to be a pulse counter. Otherwise, the DI circuit is set to detect remote signals. Figure 71 shows the parameter setting of the digital input circuits.

"101bH" register: This register is an unsigned integer. It determines which I/O module will be SOE enabled. If the register is "0", then any I/O module is SOE disabled. If the register is "1", then PXM1K-11 (PXM1K-1 module with address 1) is SOE enabled. If the register is "2", then PXM1K-21 (PXM1K-2 module with address 1) is SOE enabled. If the register is "3", then PXM1K-31 (PXM1K-3 module with address 1) is SOE enabled. If the register is "4", then PXM1K-12 (PXM1K-1 module with address 2) is SOE enabled. If the register is "5", then PXM1K-22 (PXM1K-2 module with address 2) is SOE enabled. If the register is "6", then PXM1K-32 (PXM1K-3 module with address 2) is SOE enabled.

Only one I/O module can be SOE enabled at a time. If the I/O module is not linked to the PXM 1000 meter, then there is no need to enable the SOE function in the utility software.

Figure 71 shows the parameters setting of I/O module's SOE function.

Figure 72. Parameter Settings of the I/O Module's SOE Function.



No.	Time Stamp	ms	DI 1	DI 2	DI 3	DI 4	DI 5	DI 6
1	2015-10-01 09:30:28	504	ON	ON	OFF	ON	OFF	OFF
2	2015-10-01 09:30:28	805	ON	OFF	OFF	ON	OFF	OFF
3	2015-10-01 09:30:29	385	ON	OFF	OFF	OFF	OFF	OFF
4	2015-10-01 09:30:29	386	OFF	OFF	OFF	OFF	OFF	OFF
5	2015-10-01 09:30:31	565	OFF	OFF	OFF	ON	OFF	OFF
6	2015-10-01 09:30:33	266	OFF	OFF	OFF	OFF	OFF	OFF
7	2015-10-01 09:30:35	127	OFF	ON	OFF	OFF	OFF	OFF
8	2015-10-01 09:30:17	744	OFF	OFF	OFF	OFF	OFF	OFF
9	2015-10-01 09:30:22	45	ON	OFF	OFF	ON	OFF	OFF
10	2015-10-01 09:30:22	45	ON	OFF	OFF	ON	OFF	OFF
11	2015-10-01 09:30:24	824	ON	ON	OFF	ON	OFF	OFF
12	2015-10-01 09:30:25	15	ON	OFF	OFF	ON	OFF	OFF
13	2015-10-01 09:30:25	470	ON	ON	OFF	ON	OFF	OFF
14	2015-10-01 09:30:25	576	ON	OFF	OFF	ON	OFF	OFF
15	2015-10-01 09:30:26	5	ON	ON	OFF	ON	OFF	OFF
16	2015-10-01 09:30:26	206	ON	OFF	OFF	ON	OFF	OFF
17	2015-10-01 09:30:26	601	ON	ON	OFF	ON	OFF	OFF
18	2015-10-01 09:30:26	808	ON	OFF	OFF	ON	OFF	OFF

Newest SOE Record No. 7

SOE Records from PXM1K-12

TXD: 01 03 10 2E 00 0A A1 04

RXD: 01 03 14 00 03 4B 00 00 ...

Com Failure= 0, Log Failure= 0

5.1.7 Pulse Counter

The digital input circuit can also be set to count pulses.

Recorded number of pulses: including "4349H to 4380H" address. The "4349H to 4380H" registers record 28 groups of the individual number of pulses. This includes six groups of records for PXM1K-11 (PXM1K-1 module with address 1), four groups of records for PXM1K-21 (PXM1K-2 module with address 1), four groups of records for PXM1K-31 (PXM1K-3 module with address 1), six groups of records for PXM1K-12 (PXM1K-1 module with address 2), 4 groups of records for PXM1K-22 (PXM1K-2 module with address 2), and four groups of records for PXM1K-32 (PXM1K-3 module with address 2) in sequence. One group of records is an unsigned long integer, for example, "4349H to 434aH" registers record the number of pulses for the DI1 circuit of PXM1K-11 (PXM1K-1 module with address 1).

Figure 72 shows the recorded number of pulses read on the screen.

Figure 73. Recorded Number of Pulses Read on the Screen.

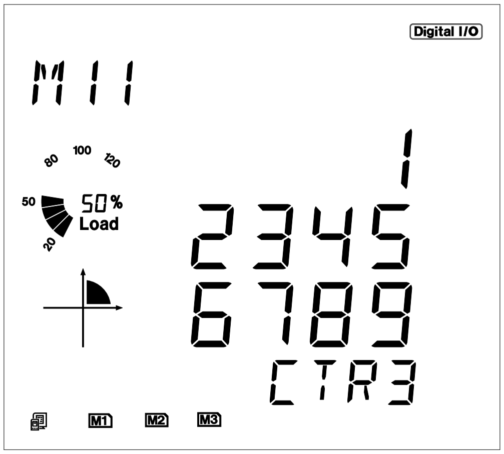
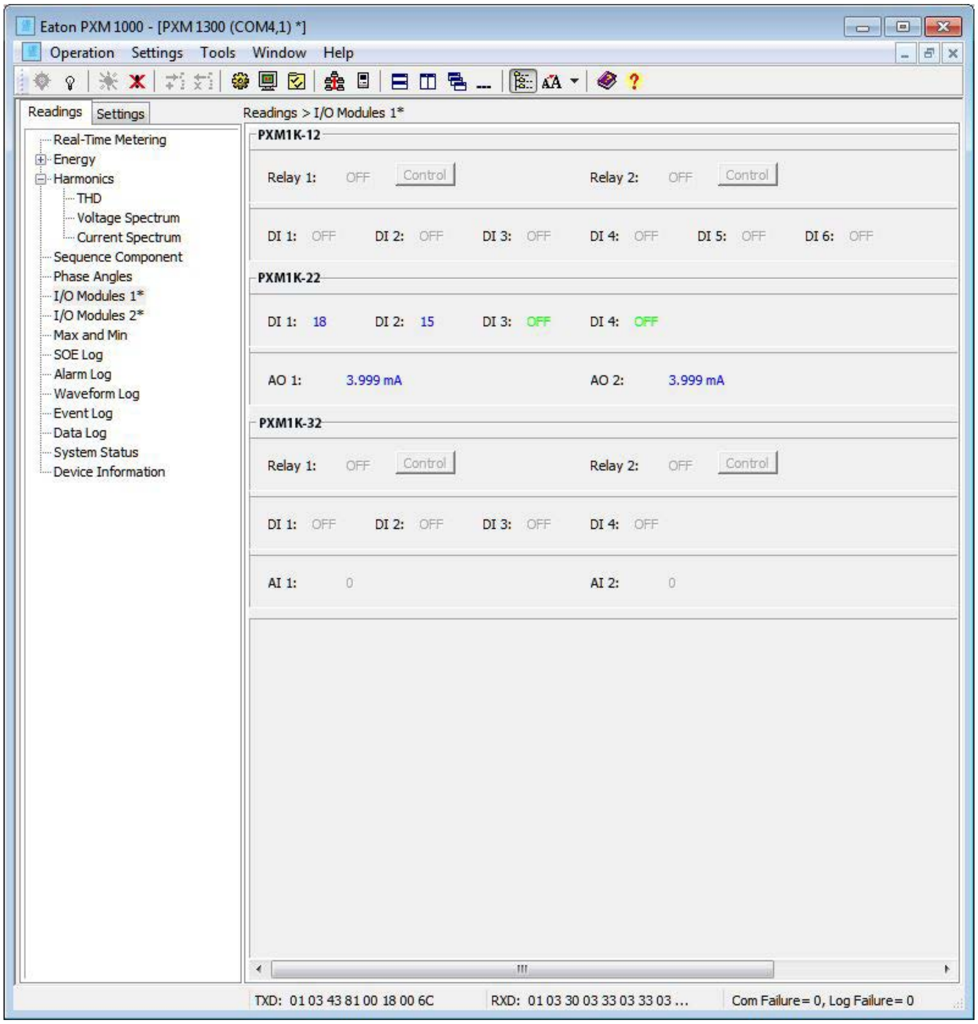


Figure 73 shows the recorded number of pulses read by the utility software.

Figure 74. Recorded Number of Pulses Read by the Utility Software.



PXM1K-12

Relay 1: OFF   Relay 2: OFF

DI 1: OFF   DI 2: OFF   DI 3: OFF   DI 4: OFF   DI 5: OFF   DI 6: OFF

PXM1K-22

DI 1: 18   DI 2: 15   DI 3: OFF   DI 4: OFF

AO 1: 3.999 mA   AO 2: 3.999 mA

PXM1K-32

Relay 1: OFF   Relay 2: OFF

DI 1: OFF   DI 2: OFF   DI 3: OFF   DI 4: OFF

AI 1: 0   AI 2: 0

TXD: 01 03 43 81 00 18 00 6C   RXD: 01 03 30 03 33 03 33 03 ...   Com Failure= 0, Log Failure= 0

Parameter Settings for Counting Input Pulses:

Take PXM1K-11 (PXM1K-1 module with address 1) for example.

1. “109eH” register: if the bit is set as “1”, the counterpart digital input circuit is set to be a counter of input pulses.
2. “109fH” register: this register is an unsigned integer. If this register is A , and the digital input circuit is set to be a pulse counter, then the real number of pulses counted by this DI circuit will be as follows:

   Real number of pulses = A × Recorded number of pulses.

For example, if A = 20, the recorded number of pulses counted by DI1 circuit of PXM1K-11 is 100 (4349H to 434aH registers), then the real number of pulses is 20 × 100 = 2,000.

The parameter setting is shown in Figure 71.

5.1.8 Relay Output

Relays in I/O modules can work in two different modes, one is the controlling mode, and the other is the alarm mode. For the controlling mode, relays can be switched on and off directly. For the alarm mode, the action of the relays is controlled by whether the alarm has occurred or not.

There are two mode selections for relay output: one is latching and the other is pulse. For the latching mode, the relay can be used to output two states (On or Off). For the pulse mode, the output of the relay changes from Off to On for a period of time and then goes Off. The period can be set from 50 to 3,000 ms.

Note: When the relay is working in alarm mode, the default output mode is latching mode.

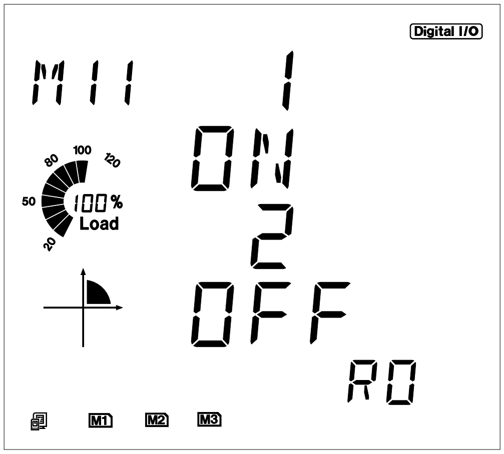
A. Display of Relay State

If the relay state is "ON", it means that relay is switched On. If relay state is "OFF", it means that relay is switched Off.

Figure 72 shows the status of relays read on the screen.

Figure 68 shows the status of relays read by the utility software.

Figure 75. Status of the Relays Read on Screen.



B. Parameter Setting

Take PXM1K-11 (PXM1K-1 module with address 1) for example.

"RO working mode (10a0H)" register: This register determines the working mode of the relays. If the register is "0", then RO1 and RO2 will work in the controlling mode. If the register is "1", then RO1 and RO2 will work in the alarm mode.

"RO output mode (10a1H)" register: This register determines the output mode of the relays. If the register is "0", then RO1 and RO2 will work in the latching output mode. If the register is "1", then RO1 and RO2 will work in the pulse output mode.

"RO pulse width (10a2H)" register: When the relays are working in the pulse mode, this register determines the period of time which can be set from 50 to 3,000 ms. For example, if this register is "100", the relay (RO1 or RO2) will be switched on for 100 ms after receiving the "ON" instruction and then be switched off.

The parameter setting is shown in Figure 69.

5.1.9 Digital Output

There are two mode selections for the digital output circuit: one is the alarm mode and the other is the energy output mode. For the alarm mode, the action of the digital output circuit is controlled by whether the alarm is triggered or not. For the energy output mode, the digital output circuits can output various types of energy, such as import active energy, export active energy, import reactive energy, and export reactive energy. When outputting energy pulses, the pulse width can be set from 20 to 1000 ms. The minimum interval between two pulses is 20 ms.

Parameter Setting:

Take PXM1K-21 (PXM1K-2 module with address 1) for example.

"DO working mode (10a5H)" register: This register determines the working mode of the DO circuits. If the register is "0", then DO1 and DO2 will work in the energy output mode. If the register is "1", then DO1 and DO2 will work in the alarm mode.

"DO pulse width (10a6H)" register: When the DO circuits work in the energy output mode, this register determines the width of energy pulses.

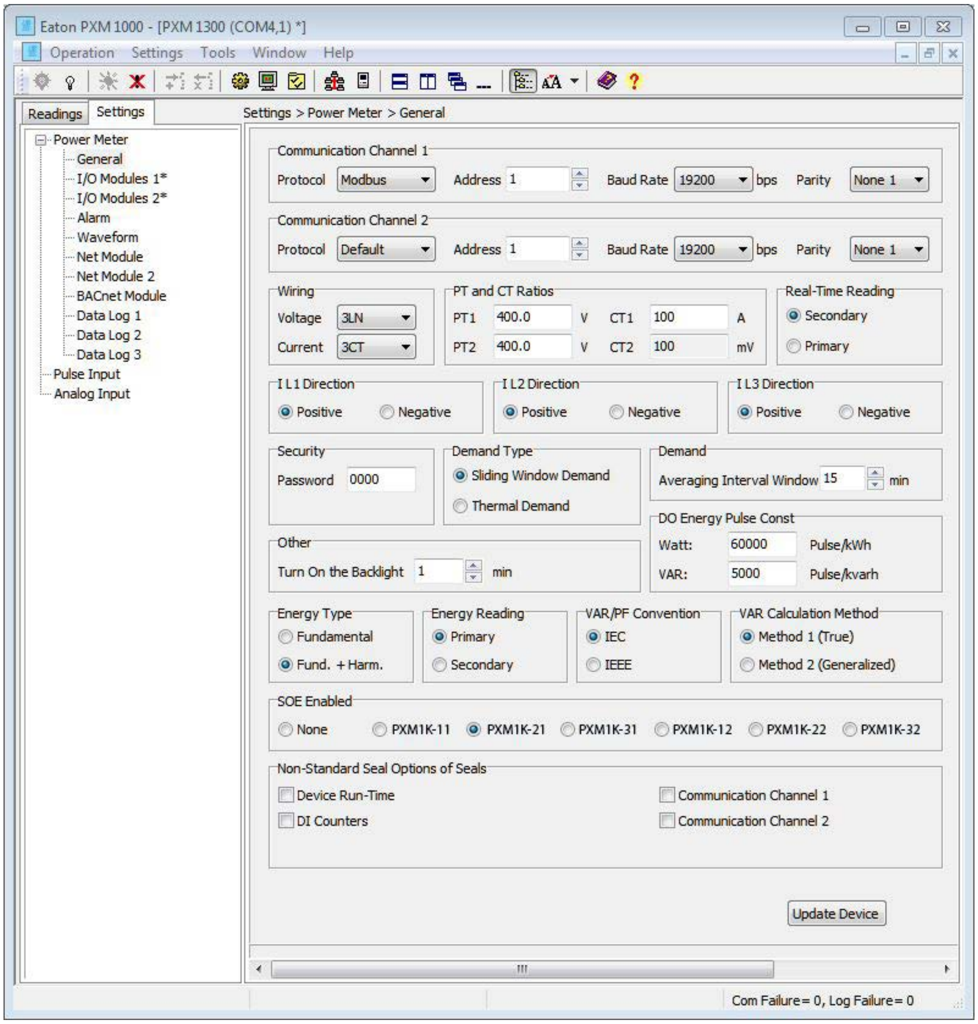
"DO1 output type (10a7H)" register: When the DO circuits work in the energy output mode, this register determines the energy output type for DO1. If this register is "0", DO1 outputs nothing. If this register is "1", DO1 outputs import active energy. If this register is "2", DO1 outputs export active energy. If this register is "3", DO1 outputs import reactive energy. If this register is "4", DO1 outputs export reactive energy.

"DO2 output type (10a8H)" register: When DO circuits work in the energy output mode, this register determines the energy output type for DO2. The value of this register is defined as the same as "DO1 output type" register.

The "DO1 output type" register and "DO2 output type" register can be set to the same value or different values.

The parameter setting is shown in Figure 73.

Figure 76. Parameter Setting of the DO Energy Pulse Constant.



Eaton PXM 1000 - [PXM 1300 (COM4,1) *]

Settings > Power Meter > General

- Power Meter
  - General
  - I/O Modules 1*
  - I/O Modules 2*
  - Alarm
  - Waveform
  - Net Module
  - Net Module 2
  - BACnet Module
  - Data Log 1
  - Data Log 2
  - Data Log 3
- Pulse Input
- Analog Input

Communication Channel 1
Protocol Modbus Address 1 Baud Rate 19200 bps Parity None 1

Communication Channel 2
Protocol Default Address 1 Baud Rate 19200 bps Parity None 1

Wiring
Voltage 3LN
Current 3CT

PT and CT Ratios
PT1 400.0 V CT1 100 A
PT2 400.0 V CT2 100 mV

Real-Time Reading
● Secondary
○ Primary

I L1 Direction
● Positive ○ Negative

I L2 Direction
● Positive ○ Negative

I L3 Direction
● Positive ○ Negative

Security
Password 0000

Demand Type
● Sliding Window Demand
○ Thermal Demand

Demand
Averaging Interval Window 15 min

DO Energy Pulse Const
Watt: 60000 Pulse/kWh
VAR: 5000 Pulse/kvarh

Other
Turn On the Backlight 1 min

Energy Type
○ Fundamental
● Fund. + Harm.

Energy Reading
● Primary
○ Secondary

VAR/PF Convention
● IEC
○ IEEE

VAR Calculation Method
● Method 1 (True)
○ Method 2 (Generalized)

SOE Enabled
○ None ○ PXM1K-11 ● PXM1K-21 ○ PXM1K-31 ○ PXM1K-12 ○ PXM1K-22 ○ PXM1K-32

Non-Standard Seal Options of Seals
☐ Device Run-Time
☐ DI Counters
☐ Communication Channel 1
☐ Communication Channel 2

Com Failure= 0, Log Failure= 0

Note: In Figure 73 the DO Energy Pulse Constants are based on the secondary reading; refer to calculator for more information.

5.1.10 Analog Output

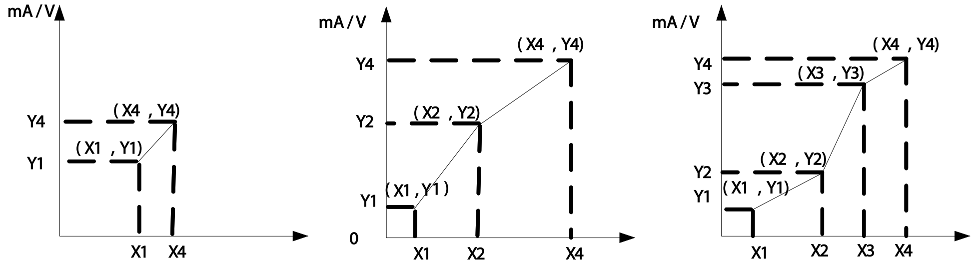
1. Analog Output Relationship with Electrical Quantities

The analog output (AO) circuit can convert anyone of 30 electrical quantities selected by the user (reference Chapter 6) to analog voltage or current.

The analog output circuit supplies four output modes including: 0 to 20 mA mode, 4 to 20 mA mode, 0 to 5 V mode, and 1 to 5 V mode.

Figure 74 shows the relationship between analog output and various electrical quantities.

Figure 77. Relationship Between Analog Output and Various Electrical Quantities.



Note: The following section introduces how the AO function works.

Addresses about the AO function are from 10D0H to 10F3H, which include three groups of parameters such as gradient number, AO following value range, and AO output range.

A. AO Gradient Number Selection of input/output transfer curve.

When the number is 1, which includes (X1, Y1) and (X4, Y4), only the following parameters should be set:

- AO following value range setting start point;
- AO following value range setting end point
- AO1 output range setting start point; and
- AO1 output range setting end point.

When the number is 2, which includes (X1, Y1), (X2, Y2), and (X4, Y4), only the following parameters should be set:

- AO following value range setting start point;
- AO1 following value range setting point 2;
- AO following value range setting end point;
- AO1 output range setting start point;
- AO1 output range setting point 2; and
- AO1 output range setting end point.

When the number is 3, which includes (X1, Y1), (X2, Y2) , (X3, Y3), and (X4, Y4), only the following parameters should be set:

- AO following value range setting start point;
- AO1 following value range setting point 2;
- AO1 following value range setting point 3; and
- AO following value range setting end point.

At the same time, the AO1 output range setting start point, AO1 output range setting point 2, AO1 output range setting point 3, and AO1 output range setting end point should be set.

B. Following the value range setting:

The AO following value range setting start point (X1), AO1 following value range setting point 2 (X2), AO1 following value range setting point 3 (X3), and AO following value range setting end point (X4) are increasing value, while they should be within range of AO following value. Otherwise, the function of the AO will be affected.

- Frequency: When selecting 50 Hz or 60 Hz type, frequency range is 45 Hz ~ 65 Hz, real setting value is 4,500 ~ 6,500. When selecting 400 Hz type, the frequency range is 300 Hz ~ 500 Hz, real setting value is 30,000~50,000.
- Phase voltage V1, V2, V3, and average phase voltage: 0~480 V, real setting value is 0~4,800.
- Line voltage V12, V23, V31, and average line voltage: 0~831 V, real setting value is 0~8,310.
- Current I1, I2, I3, and average current: 0~10 A, real setting value is 0~10,000.
- Power Pa, Pb, and Pc: -4,800~4,800 W, real setting value is -4,800~4,800.
- System power: -14,400~14,400,W, real setting value is -14,400~14,400.
- Reactive power Qa, Qb, and Qc: -4,800~4,800 Var, real setting value is- 4,800~4,800.
- System reactive power: -14,400~14,400 Var, real setting value is -14,400 ~ 14,400
- Apparent power Sa, Sb, and Sc: 0~4,800 VA, real setting value is 0~4,800.
- System apparent power: 0~14,400 VA, real setting value is 0~14,400.
- Power factor PFa, PFb, PFc, and System power factor: -1~1, real setting value is -1,000~1,000.

C. AO output range setting:

The AO output value range setting start point (Y1), AO1 output value range setting point 2 (Y2), AO1 output value range setting point 3 (Y3), and AO output value range setting end point (Y4) are increasing value, while they should be within range of the AO output value.

When the AO type is 0 ~ 20 mA, the corresponding range is 0 ~ 24 mA, the setting value range is 0 ~ 4,915, and the relationship is:

mA = setting value x 20/4,096.

When the AO type is 4 ~ 20 mA, the corresponding range is 4 ~ 24 mA, the setting value range is 819 ~ 4,915, and the relationship is:

mA = setting value x 20/4,096.

When the AO type is 0 ~ 5 V, the corresponding range is 0 ~ 6 V, the setting value range is 0 ~ 4,915, and the relationship is:

V = setting value x 5/4,096.

When the AO type is 1 ~ 5 V, the corresponding range is 1 ~ 6 V, the setting value range is 819 ~ 4,915, and the relationship is

V = setting value x 5/4,096.

Note: If the voltage input wiring of the meter is 2LL or 3LL, then the analog outputs relative to phase voltage, neutral current, phase active/reactive/apparent power, and phase power factor will always be 0.

Note: The maximum of analog output is 1.2 times the range.

2. Display of Analog Output

Value of the analog output is displayed in hex on the screen. The relationship between the displayed value and real value of analog output is:

$$\text{Real value} = \frac{\text{Displayed Value}}{4096} \times 20\ \text{mA (current output mode)}$$

or

$$\text{Real value} = \frac{\text{Displayed Value}}{4096} \times 5\ \text{V (voltage output mode)}$$

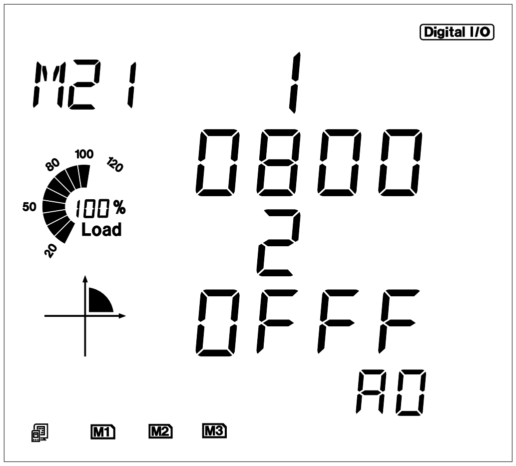
As shown in Figure 75, the displayed value of AO1 is 0 x 0800, so the real value of AO1 is:

(0 x 0800/4096) × 5 V

or

(0 x 800/4096) × 20 mA.

Figure 78. AO Value Read on the Screen.



3. Parameter Setting

Take the PXM1K-21 (PXM1K-2 module with address 1) for example.

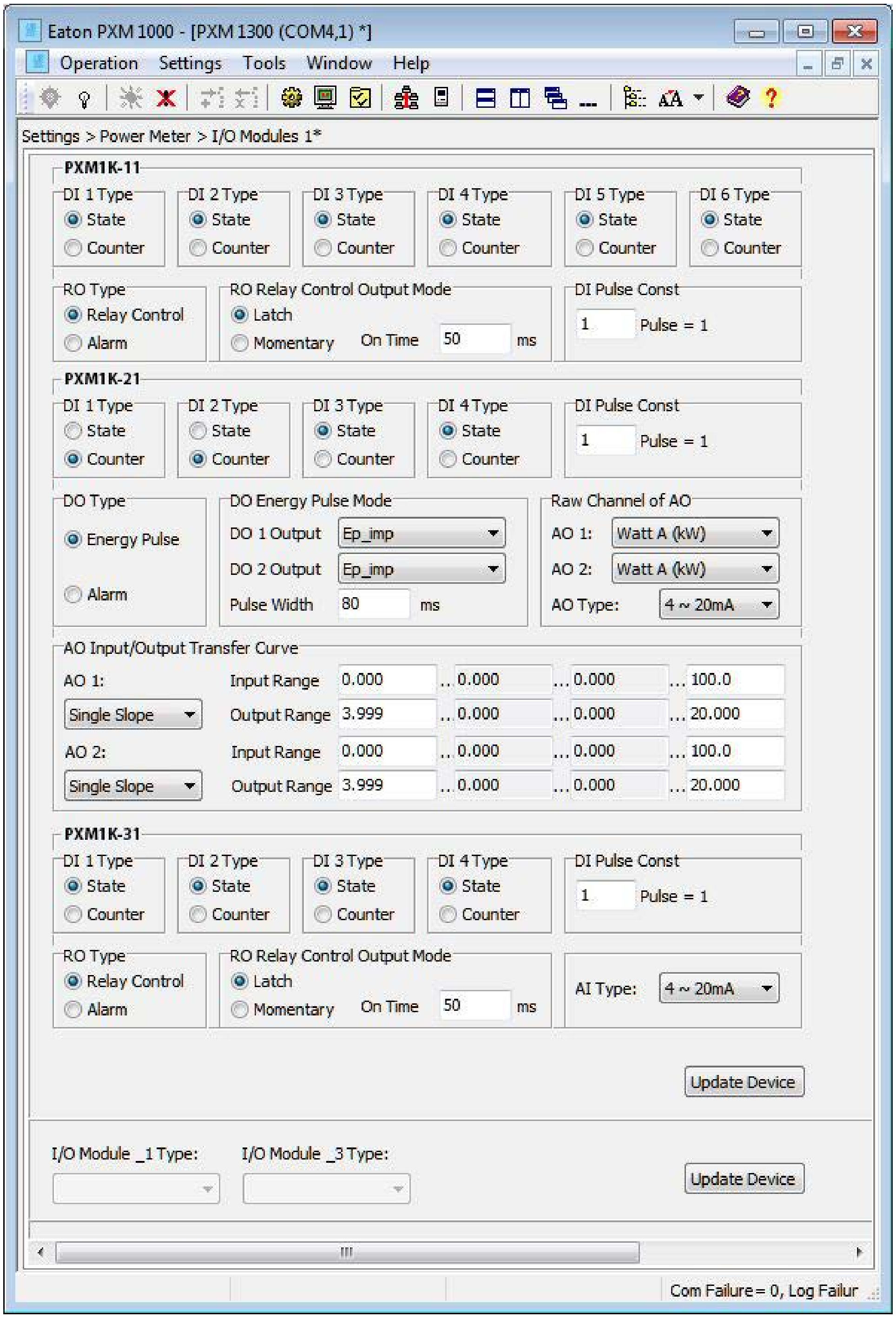
"Electrical quantities mapped to AO1 (10c2H)" register: This register determines to which electrical quantity AO1 should be mapped (see Chapter 6 for explanation). For example, if this register is "0", then AO1 is mapped to "Frequency".

"Electrical quantities mapped to AO2 (10c3H)" register: This register determines to which electrical quantity the AO2 should be mapped. The value of this register is defined as the same as "Electrical quantities mapped to AO1 (10c2H)" register.

"Electrical quantities mapped to the AO1 (10c2H)" register and "Electrical quantities mapped to AO2 (10c3H)" register can be set to the same value .

The parameter setting is shown in Figure 76:

Figure 79. Parameter Setting of the I/O Modules.



Settings > Power Meter > I/O Modules 1*

PXM1K-11

DI 1 Type: ● State ○ Counter
DI 2 Type: ● State ○ Counter
DI 3 Type: ● State ○ Counter
DI 4 Type: ● State ○ Counter
DI 5 Type: ● State ○ Counter
DI 6 Type: ● State ○ Counter

RO Type: ● Relay Control ○ Alarm
RO Relay Control Output Mode: ● Latch ○ Momentary On Time 50 ms
DI Pulse Const: 1 Pulse = 1

PXM1K-21

DI 1 Type: ○ State ● Counter
DI 2 Type: ○ State ● Counter
DI 3 Type: ● State ○ Counter
DI 4 Type: ● State ○ Counter
DI Pulse Const: 1 Pulse = 1

DO Type: ● Energy Pulse ○ Alarm
DO Energy Pulse Mode:
DO 1 Output: Ep_imp
DO 2 Output: Ep_imp
Pulse Width: 80 ms

Raw Channel of AO:
AO 1: Watt A (kW)
AO 2: Watt A (kW)
AO Type: 4 ~ 20mA

AO Input/Output Transfer Curve

AO 1: Single Slope
Input Range 0.000 ... 0.000 ... 0.000 ... 100.0
Output Range 3.999 ... 0.000 ... 0.000 ... 20.000

AO 2: Single Slope
Input Range 0.000 ... 0.000 ... 0.000 ... 100.0
Output Range 3.999 ... 0.000 ... 0.000 ... 20.000

PXM1K-31

DI 1 Type: ● State ○ Counter
DI 2 Type: ● State ○ Counter
DI 3 Type: ● State ○ Counter
DI 4 Type: ● State ○ Counter
DI Pulse Const: 1 Pulse = 1

RO Type: ● Relay Control ○ Alarm
RO Relay Control Output Mode: ● Latch ○ Momentary On Time 50 ms
AI Type: 4 ~ 20mA

I/O Module _1 Type:
I/O Module _3 Type:

5.1.11 Analog Input

Analog input circuits supply four types of input modes including: 0 to 20 mA mode, 4 to 20 mA mode, 0 to 5 V mode, and 1 to 5 V mode.

Figure 77 shows the relationship between the AI value and the input analog value.

AI value ranges from 0 to 4,095 without any unit. The AI value is displayed in hex on screen.

Figure 78 shows the AI value read on screen.

Figure 80. Relationship Between the AI Value and the Input Analog Value.

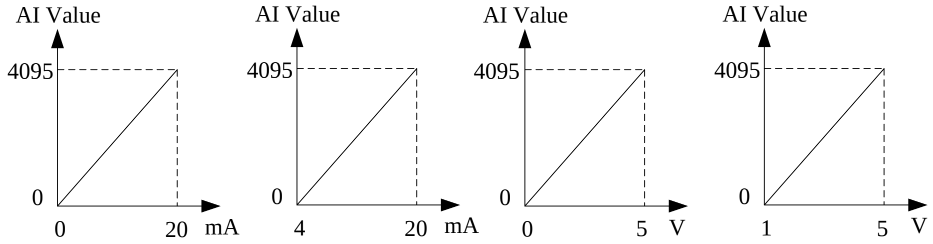
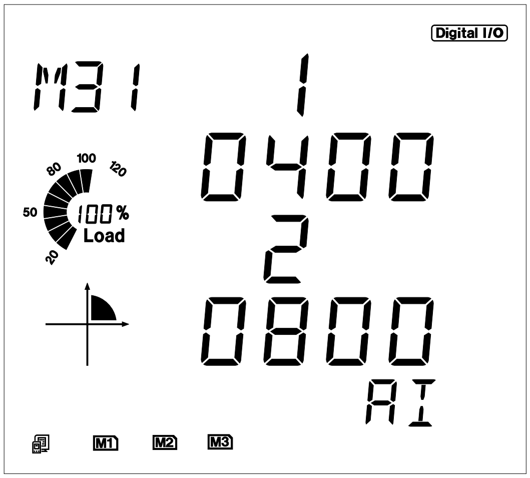


Figure 78 shows the AI value read on screen.

Figure 81. The AI Value Read on the Screen.



5.2 Ethernet Module

5.2.1 Functional Description of the Ethernet Module

Please read the Technical Data and specifications of the Ethernet module in the Appendix prior to using it.

The PXM 1000 Ethernet Module module supports the Modbus-TCP protocol. When connected to the PXM 1000 series meter, it is a slave device that can only respond to queries. The default value for the Modbus Port is 502. The user defined range is 2000~5999.

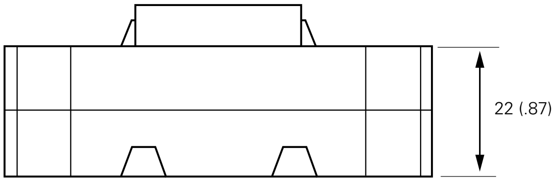
The PXM 1000 Ethernet Module supports the SMTP protocol. It has the ability to send emails based on a time interval or when there is a triggered event. It can send mail from encrypted servers and servers that use different SMTP ports.

The PXM 1000 Ethernet Module protocol supports HTTPS protocol. It is used as an HTTPS server and the default value of the protocol port is 443.

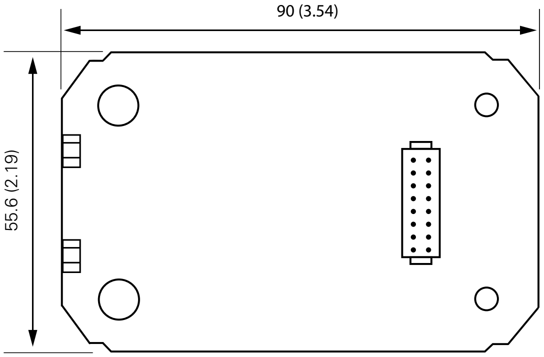
Using the HTTPS protocol, the PXM 1000 Ethernet Module can send post requests to both HTTP and HTTPS servers.

5.2.2. Appearance and Dimensions

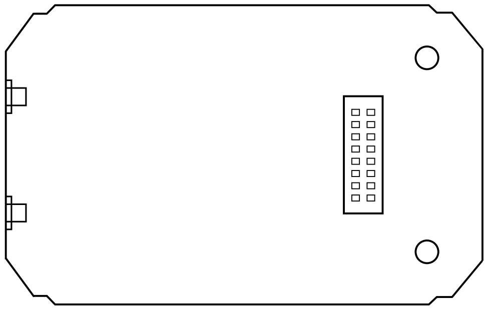
Figure 82. Ethernet Module Dimensions



(Side View)



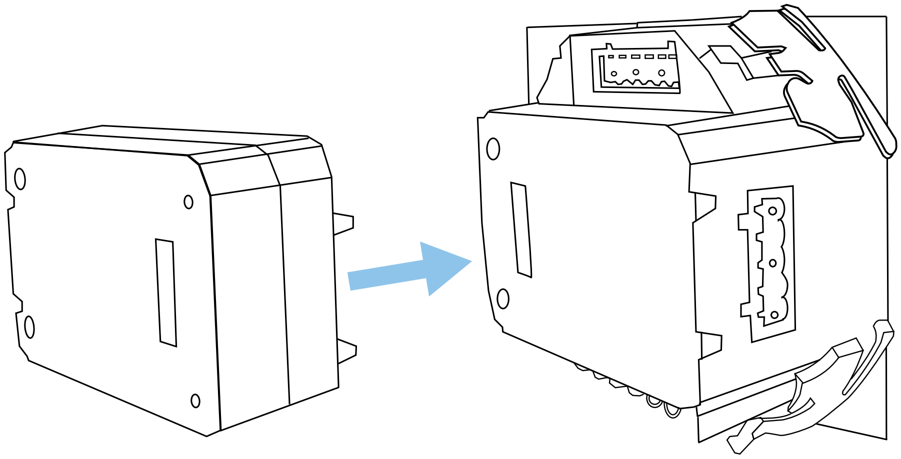
(Top View)



(Bottom View)

5.2.3. Installation Method

Figure 83. Plugging the Ethernet Module into the PXM 1000.



The PXM 1000 Ethernet Module module is linked to the PXM 1000 series meter by a communication plug. Other extended modules such as the I/O modules can be linked to the PXM 1000 series meter through the PXM 1000 Ethernet Module.

1. Remove the cover from the back of the PXM 1000 series meter exposing the communication socket
2. Insert the installation clips to the grooves in the PXM 1000 series meter and then press the PXM 1000 Ethernet Module module lightly to establish a linking between meter and module
3. Tighten the installation screws

Note: Installation with power supplied to the PXM 1000 meter is forbidden.

5.2.4. Definition of RJ45

The PXM 1000 Ethernet Module uses a standard RJ45 connector to access the Ethernet network.

Figure 84. Ethernet Module LED Indicator Locations.

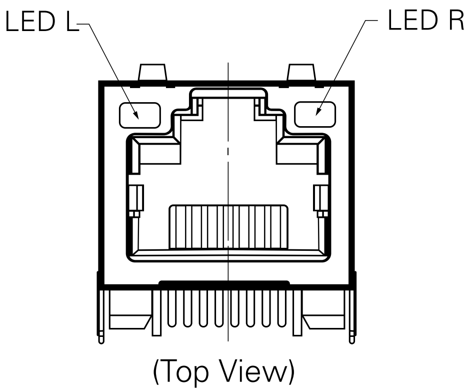


Table 12. Ethernet Module RJ45 Pinout Configuration

Pin	Signal	Description
1	TX+	Tranceive Data+
2	TX-	Tranceive Data-
3	RX+	Receive Data+
4	n/c	Not connected
5	n/c	Not connected
6	RX-	Receive Data-
7	n/c	Not connected
8	n/c	Not connected

LED_L (Yellow): Displays the speed status. When the LED is on, it indicates 100 Mpbs, while an off LED represents a speed of 10 Mbps.

LED_R (Green): Displays the link and activity status. When the LED is on, it indicates that the link status. When the LED is flashing, it indicates that there is activity.

5.2.5. Initializing the Ethernet module

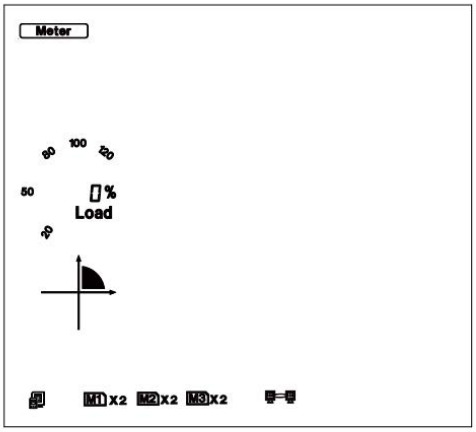
The default settings in the PXM 1000 series meter are as follows.

- IP address (192.168.1.254);
- Subnet mask (255.255.255.0);
- Gateway (192.168.1.1);
- Primary DNS server (202.106.0.20);
- Modbus Port 502.

This information can be found by using the buttons from the meter display. The following is how to configure the Ethernet module settings from the display:

1. Press the “H” and “V/A” buttons simultaneously on the PXM 1000 series meter. Release the buttons and the meter will enter the meter selecting mode, as indicated by the flashing “Meter” cursor.

Figure 85. Selecting Mode Menu.



2. Press the "P" or "E" button to move the cursor to "Setting". Press "V/A" button to enter the parameter setting mode. The device address page is the first page of the "Setting" mode. It will show the Modbus address of the meter for a second before changing to the Password Setting Page and prompting for the password on the device. Press the "P" or "E" button to modify the password. Press the "V/A" button to confirm the password (default password is 0000) and enter the parameter setting page. Press the "P" or "E" button to move the cursor to "NET" and press the "V/A" button to enter the Ethernet module settings.

Figure 86. Password Setting Page.

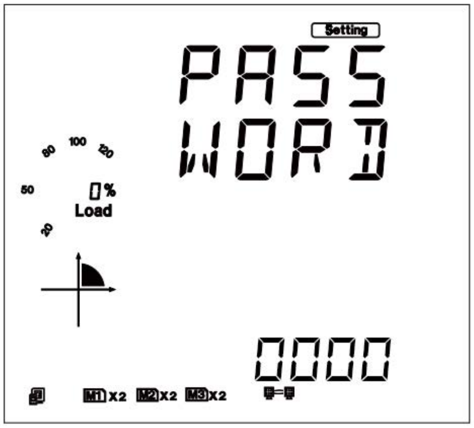


Figure 87. Parameter Setting Page.

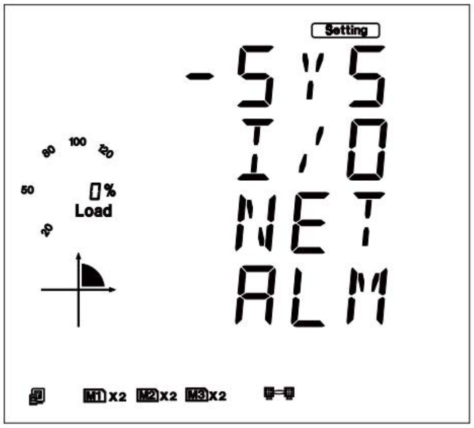
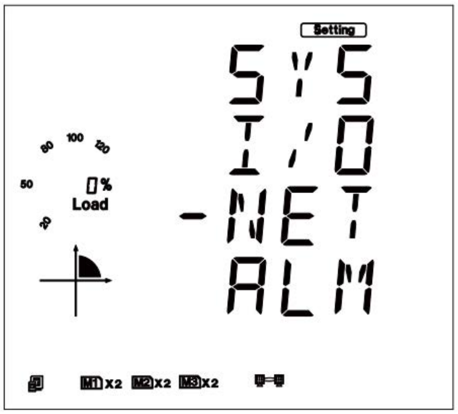


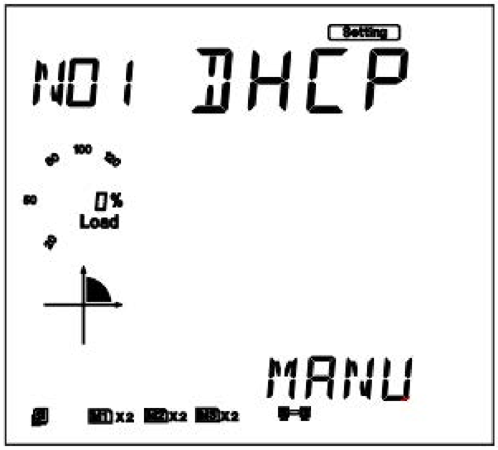
Figure 88. Ethernet Module Settings Page.



3. The first page of the NET Settings will be the N01 DHCP setting. By default, this is configured to Manual. Setting this configuration to Auto will allow the router to assign the meter with an IP address, while Manual will allow the user to configure the IP address. Press the “V/A” button to enter edit mode. Press “P” or “E” to change the setting and press “V/A” to confirm.

Note: If the DHCP is selected as Auto, the Ethernet module needs to be rebooted before it can be assigned with the new IP address. The reboot option is available in Step 11.

Figure 89. N01 DHCP Settings Page.

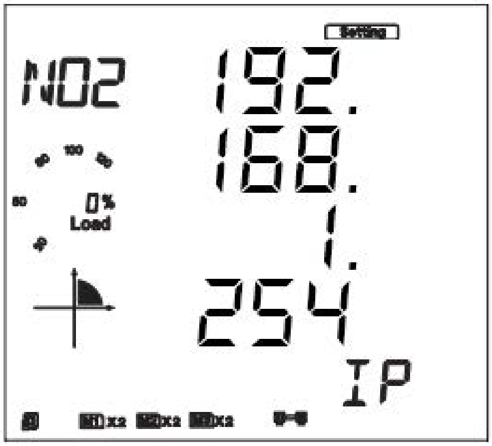


N01 DHCP

MANU

4. Press “P” to get to “N02 IP address” page. This is the IP address of the meter and will be the IP address to access the web interface of the module. Users can configure the IP address if the DHCP is configured to Manual. Press “V/A” to configure the IP address. The cursor of the first digit will begin to flash. Press the “H” button to scroll through the digits, press the “P” or “E” to change the value of the flashing cursor and press “V/A” to confirm.

Figure 90. N02 IP Address Page.

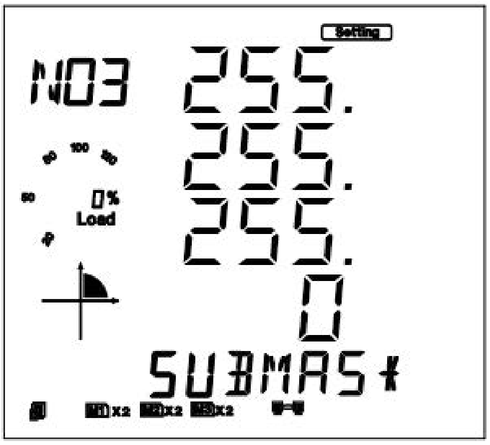


N02 192.168.1.254

IP

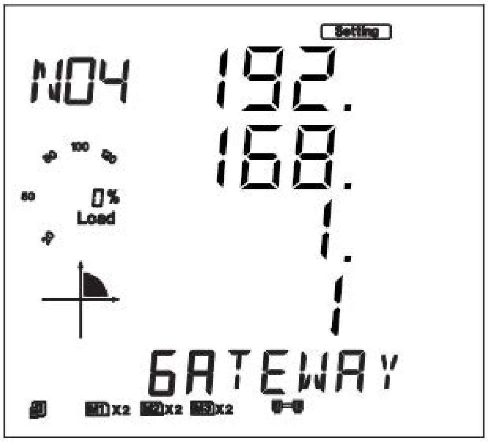
5. Press “P” to get to “N03 Subnet Mask” page. Press “V/A” to configure the subnet address. The cursor of the first digit will begin to flash. Press the “H” button to scroll through the digits, press the “P” or “E” to change the value of the flashing cursor and press “V/A” to confirm

Figure 91. N03 Subnet Mask Page.



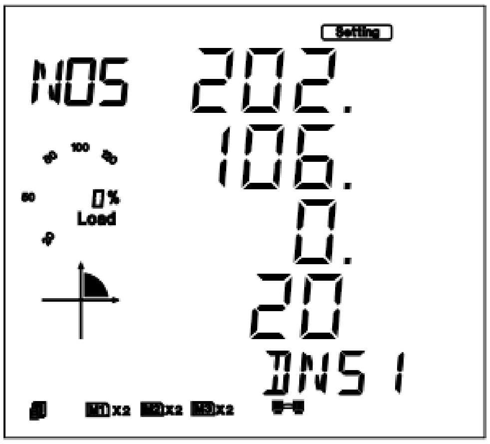
6. Press “P” to get to “N04 Gateway” page. Press “V/A” to configure the gateway address. The cursor of the first digit will begin to flash. Press the “H” button to scroll through the digits, press the “P” or “E” to change the value of the flashing cursor and press “V/A” to confirm.

Figure 92. N04 Gateway Address Page.



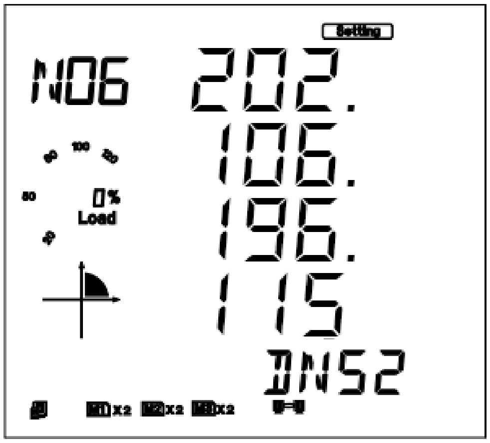
7. Press “P” to get to “N05 DNS Primary Server” page. Press “V/A” to configure the DNS address. The cursor of the first digit will begin to flash. Press the “H” button to scroll through the digits, press the “P” or “E” to change the value of the flashing cursor and press “V/A” to confirm. The DNS parameters must be set correctly to use the SMTP & FTP/HTTP Post functions.

Figure 93. N05 DNS Primary Server Page.



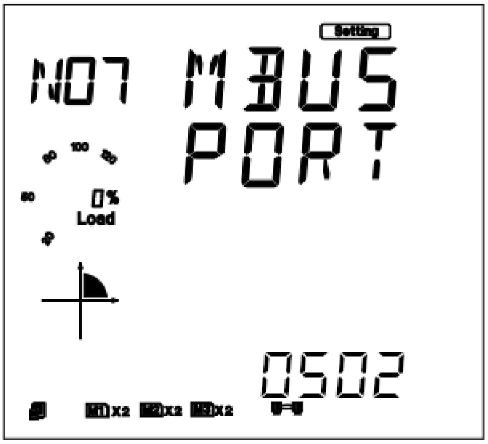
8. Press “P” to get to "N06 DNS Secondary Server" page. Press “V/A” to configure the DNS secondary address. The cursor of the first digit will begin to flash. Press the “H” button to scroll through the digits, press the “P” or “E” to change the value of the flashing cursor and press “V/A” to confirm.

Figure 94. N06 DNS Secondary Server Page.



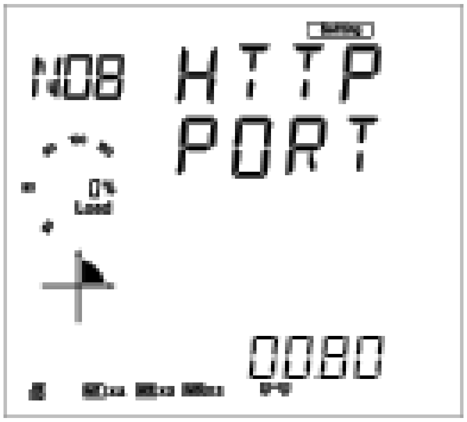
9. Press “P” to get to “N07 Modbus Port” page. Press “V/A” to configure the Modbus port. The cursor of the first digit will begin to flash. Press the “H” button to scroll through the digits, press the “P” or “E” to change the value of the flashing cursor and press “V/A” to confirm.

Figure 95. N07 Modbus Port Page.



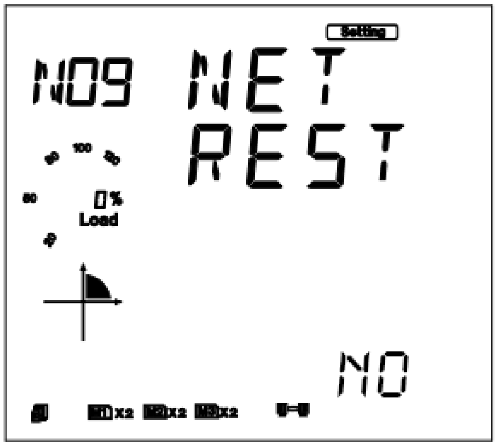
10. Press “P” to get to “N08 HTTP Port” page. Press “V/A” to configure the HTTP port. The cursor of the first digit will begin to flash. Press the “H” button to scroll through the digits, press the “P” or “E” to change the value of the flashing cursor and press “V/A” to confirm.

Figure 96. N08 HTTP Port Page.



11. Press "P" to get to "N09 Net Rest" page . After making any changes to the Network settings, users must reboot the Ethernet module from this page for the settings to take effect. Press "V/A" to reboot the module and the cursor will begin to flash. Press the "P" or "E" button to change the setting to "Reset" and press "V/A" to confirm. The cursor will return to "No" once successful.

Figure 97. N09 Network Reset page.



After configuring the PXM 1000 Ethernet Module module, press the "H" and "V/A" buttons simultaneously to return to the menu selection.

5.2.6. Cable

An RJ45 cable is needed to connect the meter to the network. A shielded twisted pair cable (standard 568A or standard 568B) is recommended as reference to the EIA/TIA standard.

5.2.7. Connection Method

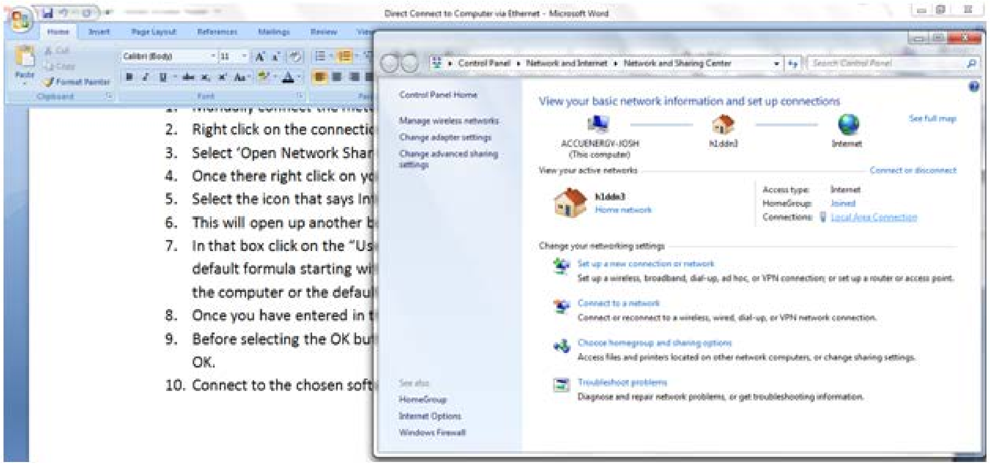
5.2.7.1. Direct Connect to a Computer

The PXM 1000 Ethernet Module can be connected to a computer using a crossover cable (standard 568A). The PXM 1000 Ethernet Module module supports Modbus-TCP and HTTPS functions for this method of connection.

To connect meter directly to the computer, the following can be done using a computer running the Windows OS.

1. Manually connect the meter via Ethernet cable to the computer.
2. Right click on the connection icon.
3. Select "Open Network Sharing Center".

Figure 98. Network and Sharing Center Page.


Direct Connect to Computer via Ethernet - Microsoft Word

Control Panel ▸ Network and Internet ▸ Network and Sharing Center

View your basic network information and set up connections

View your active networks

Access type: Internet
HomeGroup: Joined
Connections: Local Area Connection

Change your networking settings

Set up a new connection or network
Set up a wireless, broadband, dial-up, ad hoc, or VPN connection; or set up a router or access point.

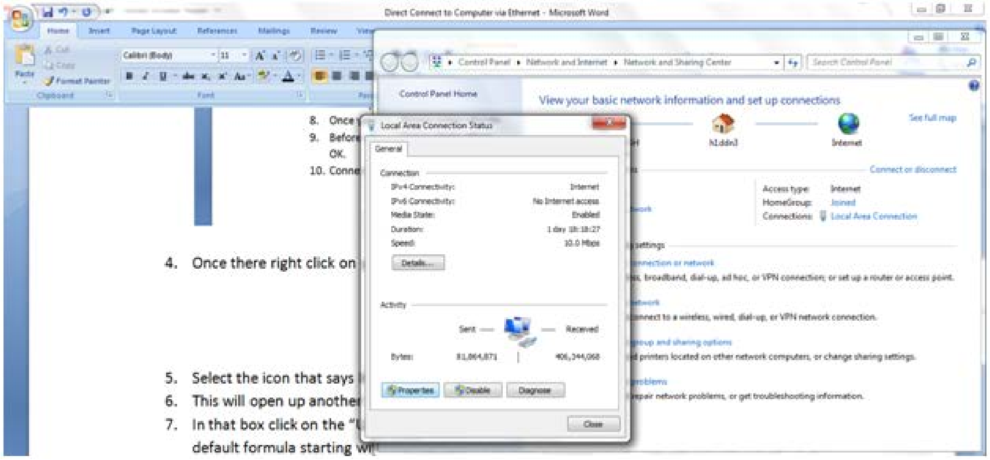
Connect to a network
Connect or reconnect to a wireless, wired, dial-up, or VPN network connection.

Choose homegroup and sharing options
Access files and printers located on other network computers, or change sharing settings.

Troubleshoot problems
Diagnose and repair network problems, or get troubleshooting information.

4. Once there, right click on the "Local Area Connection" icon and click properties.

Figure 99. Local Area Connection Status Page.


Local Area Connection Status

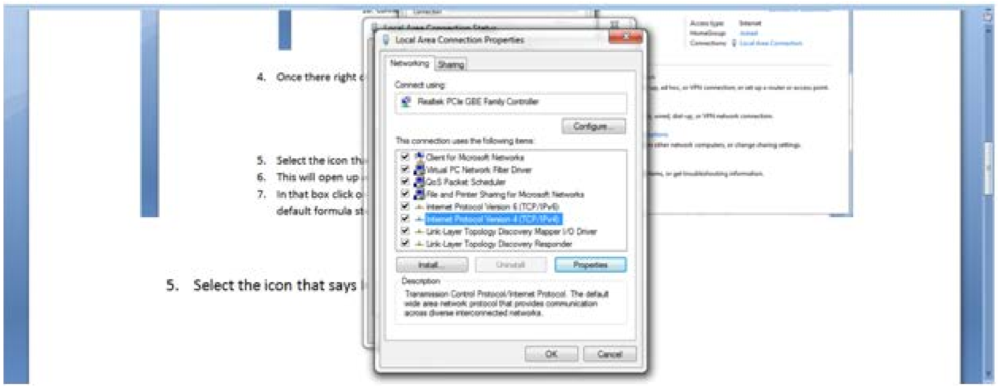
Connection
IPv4 Connectivity: Internet
IPv6 Connectivity: No Internet access
Media State: Enabled
Duration: 1 day 18:18:27
Speed: 10.0 Mbps

Activity

Sent — Received
Bytes: 81,864,871 | 406,344,068

5. Select the icon that says "Internet Protocol Version 4 TCP/IP".

Figure 100. Selecting the "Internet Protocol Version 4 TCP/IP" Icon.


Local Area Connection Properties

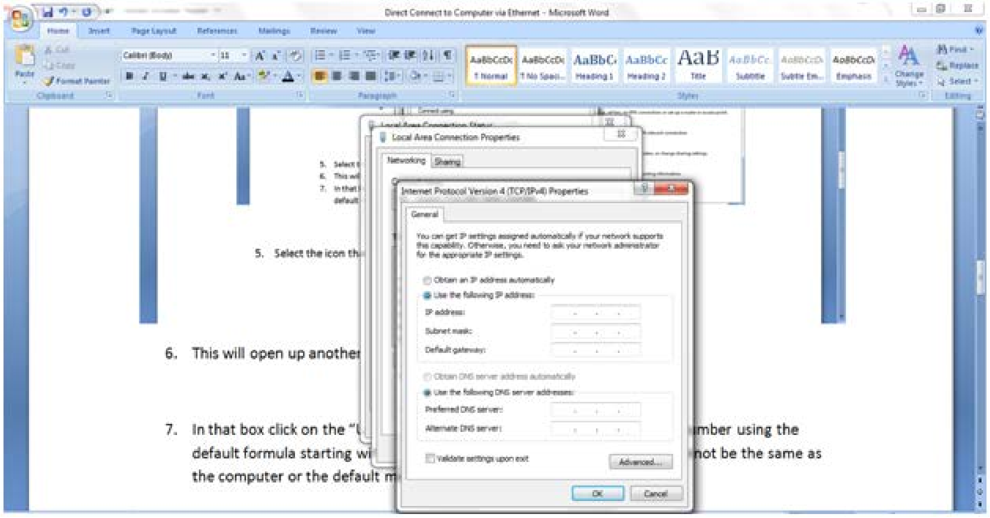
Connect using:
Realtek PCIe GBE Family Controller

This connection uses the following items:
☑ Client for Microsoft Networks
☑ Virtual PC Network Filter Driver
☑ QoS Packet Scheduler
☑ File and Printer Sharing for Microsoft Networks
☑ Internet Protocol Version 6 (TCP/IPv6)
☑ Internet Protocol Version 4 (TCP/IPv4)
☑ Link-Layer Topology Discovery Mapper I/O Driver
☑ Link-Layer Topology Discovery Responder

Description
Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.

6. The "Internet Protocol Version 4(TCP/IP) Properties" box will pop up.

Figure 101. The Internet Protocol Version 4 (TCP/IP) Properties box.



Internet Protocol Version 4 (TCP/IPv4) Properties

General

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

○ Obtain an IP address automatically

● Use the following IP address:

IP address: . . .

Subnet mask: . . .

Default gateway: . . .

○ Obtain DNS server address automatically

● Use the following DNS server addresses:

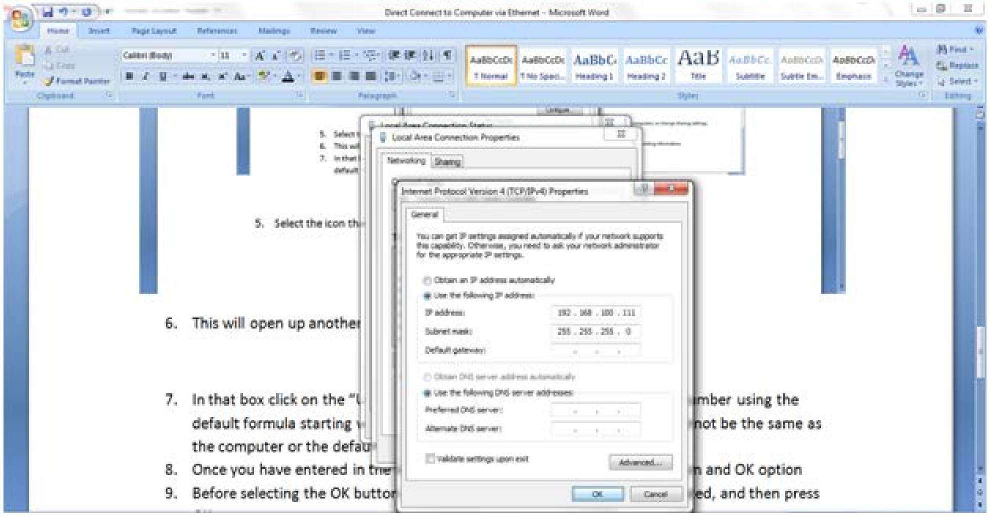
Preferred DNS server: . . .

Alternate DNS server: . . .

☐ Validate settings upon exit

7. Click on “Use the following IP address” and enter in an IP number so that meter and computer are in the same local network range. For example, if the meter has IP address of 192.168.1.254, then the computer must be assigned with a IP 192.168.1.xxx, where xxx can be any number but cannot be the same as the value assigned to the meter.

Figure 102. Entering the IP Addresses.



Internet Protocol Version 4 (TCP/IPv4) Properties

General

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

○ Obtain an IP address automatically

● Use the following IP address:

IP address: 192 . 168 . 100 . 111

Subnet mask: 255 . 255 . 255 . 0

Default gateway: . . .

○ Obtain DNS server address automatically

● Use the following DNS server addresses:

Preferred DNS server: . . .

Alternate DNS server: . . .

☐ Validate settings upon exit

8. Once you have entered in the IP address, press the Tab key on your keyboard until you reach the bottom and click OK.

9. Before selecting the OK button, make note of the IP address you have assigned to the meter and then press OK.

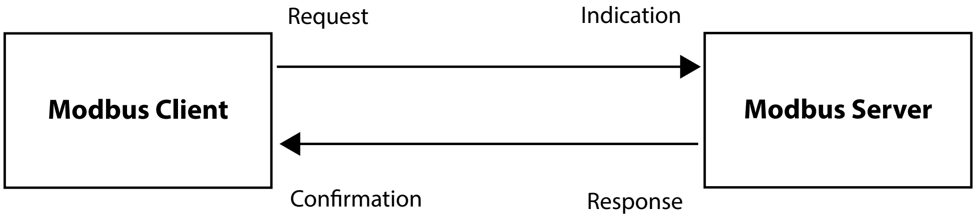
5.2.7.2 Direct Connect to Router/Switch

The PXM 1000 Ethernet Module can be connected to a router or switch using a patch cable. The DHCP can be configured to "Auto" to have the router assign the meter with an IP address or can be configured to "Manual" to set an IP address using the information in Chapter 5.

5.2.8 Description of Modbus-TCP Protocol

The Modbus-TCP protocol is the communication protocol in the PXM 1000 Ethernet Module. The protocol establishes a master and slave connection in Ethernet. The master device (client) first sets up a TCP-IP link with slave device (server). The master device then sends a request to the slave device and the slave device in return sends a response to the master device. The figure below shows how the Modbus-TCP protocol works.

Figure 103. Modbus-TCP Protocol.



5.2.8.1 Protocol

5.2.8.1.1 Data Frame Format

MBAP Header	Function	Data
7x8-Bits	8-Bits	Nx8-Bits

5.2.8.1.2 Modbus Application Header (MBAP Header) Field

Table 13. Modbus Codes Meaning and Actions.

Code	Meaning	Action
Transaction Identifier	2 bytes	Identification of a Modbus request/response transaction
Protocol Identifier	2 bytes	Modbus protocol = 0
Length	2 bytes	Number of following bytes
Unit Identifier	1 byte	Slave address, in the range of 0~247 decimal

5.2.8.1.3 Function Field

The function code field of a message frame contains eight bits. Valid codes are in the range of 1-255. When a message is sent from a client to as server device the function code field tells the server what kinds of action to perform.

Table 14. Function Codes Meaning and Actions.

Code	Meaning	Action
01	Read relay output status	Obtain current status of relay output
02	Read digital input (DI) status	Obtain current status of DI
03	Read data	Obtain current binary value in one or more registers

05	Control single relay output	Force relay to a state of On or Off
16	Write multiple registers	Place specific value into a series of consecutive multiple-registers

5.2.8.1.4 Data Field

The data field is constructed using sets of two hexadecimal digits, in the range of 00 to FF. The data field of messages sent from a master to slave contains additional information which the slave must use to take the action defined by the function code. This can include information such as the register addresses, the quantity of registers to query, and the count of the actual number of data bytes. For example, if the master requests a slave to read a group of holding registers (function code 03) and the data field specifies the starting register and how many registers are to be read.

If the master needs to perform a write to a group of registers in the slave (function code 10 hexadecimal), the data field specifies the starting register, how many registers to write, the count of data bytes to follow in the data field, and the data to be written into the registers.

5.2.8.2 Format of Communication

Table 15. Explanation of Frame.

Transaction Identifier High	Transaction Identifier Low	Protocol Identifier High	Protocol Identifier Low	Length High	Length Low	Unit Identifier
00H	00H	00H	00H	00H	06H	01H

Fun.	Data Start Reg. High	Data Start Reg. Low	Data # of Regs. High	Data # of Regs. Low
03H	40H	00H	00H	48H

The meaning of each abbreviated field in Table 16 is:

- Transaction Identifier High: High byte of transaction identifier;
- Transaction Identifier Low: Low byte of transaction identifier;
- Protocol Identifier High: High byte of protocol identifier;
- Protocol Identifier Low: Low byte of protocol identifier;
- Length High: High byte of length;
- Length Low: Low byte of length;
- Unit Identifier: Slave address;
- Fun.: Function code;
- Data Start Reg. High: High byte of starting register address;
- Data Start Reg. Low: Low byte of starting register address;
- Data # of Regs. High: High byte of number of registers;
- Data # of Regs. Low: Low byte of number of registers .

5.2.8.2.1 Read Status of Relay (Function Code 01)

This function code is used to read the relay output status in the PXM 1000 series meter.

1 = On   0 = Off

There are eight relay outputs in the PXM 1000 series meter and they start at address 0000H.

The following query is to read two relay output status of the PXM 1000 series address 1.

Query:

Table 16. Read Two Relay Output Status Query.

Transaction Identifier High	Transaction Identifier Low	Protocol Identifier High	Protocol Identifier Low	Length High	Length Low	Unit Identifier
00H	00H	00H	00H	00H	06H	01H

Fun.	Data Start Reg. High	Data Start Reg. Low	Data # of Regs. High	Data # of Regs. Low
01H	00H	00H	00H	02H

Response:

The PXM 1000 series meter responds back with the MBAP header, function code, quantity of data bytes, and the data.

An example of response to read the status of the first two relay outputs starting at 0000H is shown below. The status of relay output 1 and 2 corresponds to the last two bits of data.

Relay 1: Bit 0 **Relay 2: Bit 1**

Table 17. Example of Read Two Relay Output Status Response.

Transaction Identifier High	Transaction Identifier Low	Protocol Identifier High	Protocol Identifier Low	Length High	Length Low	Unit Identifier
00H	00H	00H	00H	00H	04H	01H

Fun.	Byte Count	Data
02H	01H	02H

The content of the data is:

7	6	5	4	3	2	1	0
0	0	0	0	0	0	1	0

MSB **LSB**

(Relay 1 = OFF, Relay 2 = ON)

5.2.8.2.2 Read Status of DI (Function Code 02)

1 = On 0 = Off

There are 28 DIs in the PXM 1000 series meter starting at address 0000H.

The following query is to read four DI statuses of PXM1K-11X module with logic address of 1 in the PXM 1000 series meter.

Query:

Table 18. Read Four DI Statuses Query.

Transaction Identifier High	Transaction Identifier Low	Protocol Identifier High	Protocol Identifier Low	Length High	Length Low	Unit Identifier
00H	00H	00H	00H	00H	06H	01H

Fun.	Data Start Reg. High	Data Start Reg. Low	Data # of Regs. High	Data # of Regs. Low
02H	00H	00H	00H	04H

Response:

The response includes the MBAP header, function code, quantity of data characters, and the data.

An example response from the meter to read the status of four DIs (DI1 = On, DI2 = On, DI3 = On, DI4 = On) is shown below. The status of each corresponds to the last four bits of the data.

DI1: bit0 **DI2:bit1** **DI3:bit2** **DI4:bit3**

Table 19. Example of Read Four DI Statuses Response.

Transaction Identifier High	Transaction Identifier Low	Protocol Identifier High	Protocol Identifier Low	Length High	Length Low	Unit Identifier
00H	00H	00H	00H	00H	04H	01H

Fun.	Byte Count	Data
02H	01H	0FH

The content of the data is:

7	6	5	4	3	2	1	0
0	0	0	0	1	1	1	1

MSB **LSB**

5.2.8.2.3 Read Data (Function Code 03)

Query:

This function allows the user to obtain the measurement results of the PXM 1000 series meter.

Below is an example to read six registers corresponding to the device clock of the meter, starting at 1040H.

Table 20. Read Six Register Time Query.

Transaction Identifier High	Transaction Identifier Low	Protocol Identifier High	Protocol Identifier Low	Length High	Length Low	Unit Identifier
00H	00H	00H	00H	00H	06H	01H

Fun.	Data Start Reg. High	Data Start Reg. Low	Data # of Regs. High	Data # of Regs. Low
03H	10H	40H	00H	06H

Response:

An example response is provided to read the time (2017-12-18 14:15:20).

Table 21. Example of Read Six Register Time Response.

Transaction Identifier High	Transaction Identifier Low	Protocol Identifier High	Protocol Identifier Low	Length High	Length Low	Unit Identifier
00H	00H	00H	00H	00H	06H	01H

Fun.	Data Count	Data 1 High	Data 1 Low	Data 2 High	Data 2 Low	Data 3 High	Data 3 Low	Data 4 High	Data 4 Low	Data 5 High	Data 5 Low	Data 6 High	Data 6 Low
03H	0CH	07H	D6H	00H	0CH	00H	12H	00H	0EH	00H	0FH	00H	14H

5.2.8.2.4 Control Relay(Function Code05)

Query:

This function code enables the control of a single relay output in the PXM 1000 series meter. Any relay output in the PXM 1000 series meter can be controlled On or Off starting at 0000H.

Sending the data "FF00H" will set the relay output On and sending "0000H" will turn it Off. All other values are illegal and will not affect they relay output status.

Table 22. Example of Request to a PXM 1000 Series Meter to Turn On Relay Output 1.

Transaction Identifier High	Transaction Identifier Low	Protocol Identifier High	Protocol Identifier Low	Length High	Length Low	Unit Identifier
00H	00H	00H	00H	00H	06H	01H

Fun.	Data Start Reg. High	Data Start Reg. Low	Data # of Regs. High	Data # of Regs. Low
05H	00H	00H	FFH	00H

Response:

The normal response to the command request is to retransmit the message as received after the relay output status has been altered.

Table 23. Example of Turn On Relay Output 1 Response.

Transaction Identifier High	Transaction Identifier Low	Protocol Identifier High	Protocol Identifier Low	Length High	Length Low	Unit Identifier
00H	00H	00H	00H	00H	06H	01H

Fun.	Data Start Reg. High	Data Start Reg. Low	Value High	Value Low
05H	00H	00H	FFH	00H

5.2.8.2.5 Preset/Reset Multi-register (Function Code 16)

Query

This function code allows the user to modify the contents of a register. The example below is a request to a PXM 1000 series meter with device address 1 to preset the CT1(500) and CT2(5) registers. The CT1 data address is 1008H and CT2 is at 1009H.

Table 24. Example of Request to Preset the CT1(500) and CT2(5) Registers.

Transaction Identifier High	Transaction Identifier Low	Protocol Identifier High	Protocol Identifier Low	Length High	Length Low	Unit Identifier
00H	00H	00H	00H	00H	06H	01H

Fun.	Data Start Reg. High	Data Start Reg. Low	Data # of Regs. High	Data # of Regs. Low	Byte Count	Value 1 High	Value 1 Low	Value 2 High	Value 2 Low
10H	10H	08H	00H	02H	04H	01H	F4H	00H	05H

Response

The normal response to a preset multi-register request including the MBAP header, function code, data start register, and the number of registers is shown below.

Table 25. Example of Preset the CT1(500) and CT2(5) Registers Response.

Transaction Identifier High	Transaction Identifier Low	Protocol Identifier High	Protocol Identifier Low	Length High	Length Low	Unit Identifier
0010H	00H	00H	00H	00H	06H	01H

Fun.	Data Start Reg. High	Data Start Reg. Low	Data # of Regs. High	Data # of Regs. Low
10H	10H	08H	00H	02H

5.2.9 Web Interface Readings and Parameter Settings

The PXM 1000 Ethernet Module module supports the HTTPS protocol to allow for the use of a web interface. The user will need to access the PXM 1000 Ethernet Module web interface to configure the module and use its functions. The web interface allows for remote initial setup of the PXM 1000 meter.

The PXM 1000 Ethernet Module web interface allows for different user access levels.

In the following cases, the IP address of the module will be "192.168.1.161".

5.2.9.1 User Access Login

Enter the correct IP address of the module in the search bar of the internet browser to access the web interface of the PXM 1000 Ethernet Module.

The user will be redirected to a web page prompting to select the Access Level and enter appropriate password for that level.

The User level is ideal for users who need only to take readings and view status from the meter.

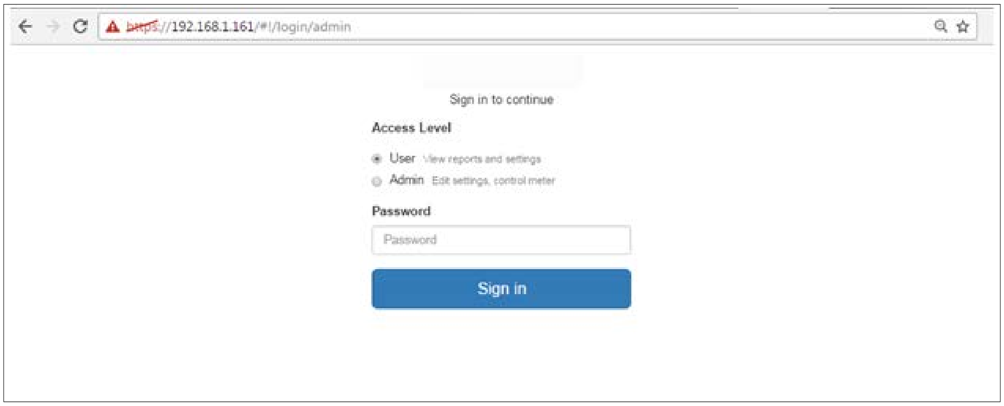
The default password for the User level is "view".

The Admin level is ideal for users who need access to configurations on the meter or the web interface and to view readings.

The default password for the Admin level is ”admin".

The PXM 1000 Ethernet Module web interface will only allow one administrator and one user to be logged in at the same time. If another user logs in with the same access level, the previous user with that access level will be logged out.

Figure 104. Access Level Selection and Password Page.



~~https~~://192.168.1.161/#!/login/admin

Sign in to continue

Access Level

● User View reports and settings

○ Admin Edit settings, control meter

Password

The two different access levels are summarized below:

Table 26. Access Levels Summary.

Access Level	Default Password	Read Parameter/Status	Configure Settings
User	view	Yes	No
Admin	admin	Yes	Yes

5.2.9.2 Dashboard

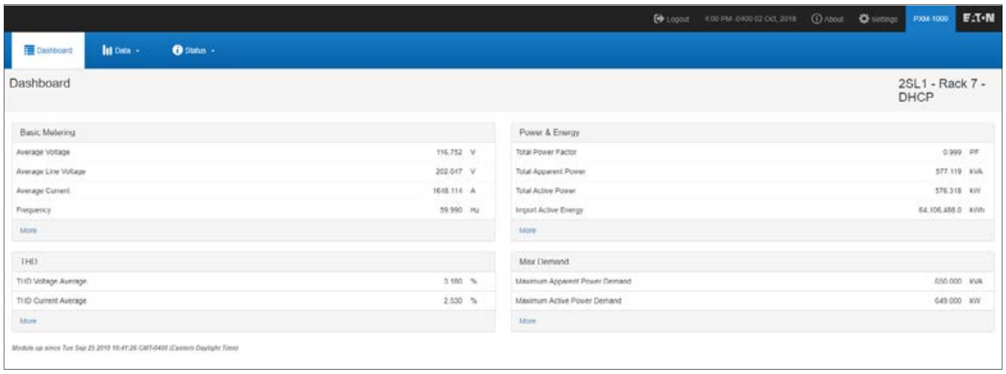
In the dashboard, the user will find the tabs to access different pages in the web interface such as "Data", "Status", and "Settings". The dashboard is the first page the user will see once they have entered the correct password for the appropriate access level. The dashboard is the same for both access levels.

The dashboard displays selected parameters from the different groups of metering parameters such as "Basic Metering", "Power & Energy", "THD" and "Max Demand". Clicking on "More" under any one of these four metering parameter groups will take the user to the web page which contains all the parameters supported by that metering parameter group.

In the bottom left corner of the page, the dashboard also displays how long the PXM 1000 Ethernet Module module has been connected to the network since the last reboot of the module.

The parameters on this page are updated every five seconds.

Figure 105. Dashboard Page.



Dashboard

2SL1 - Rack 7 - DHCP

Basic Metering		
Average Voltage	116.752	V
Average Line Voltage	202.047	V
Average Current	1648.114	A
Frequency	59.990	Hz

Power & Energy		
Total Power Factor	0.999	PF
Total Apparent Power	577.119	kVA
Total Active Power	576.318	kW
Import Active Energy	64,106,488.0	kWh

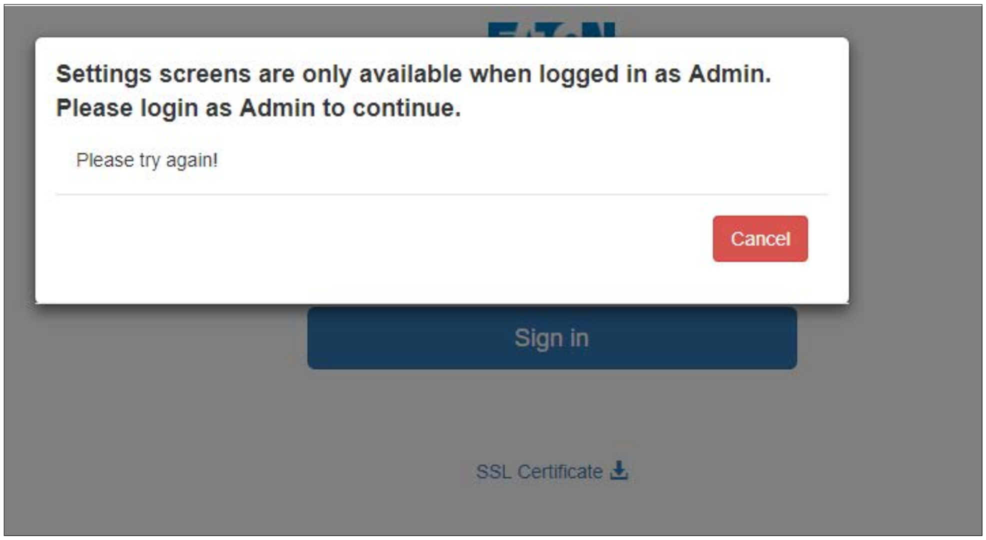
THD		
THD Voltage Average	3.180	%
THD Current Average	2.530	%

Max Demand		
Maximum Apparent Power Demand	650.000	kVA
Maximum Active Power Demand	649.000	kW

Module up since Tue Sep 25 2018 10:41:26 GMT-0400 (Eastern Daylight Time)

Note: If user is logged in with "User" access, clicking on "Settings" will automatically log the user out from the web interface.

Figure 106. Access Level Verification and Password Page.



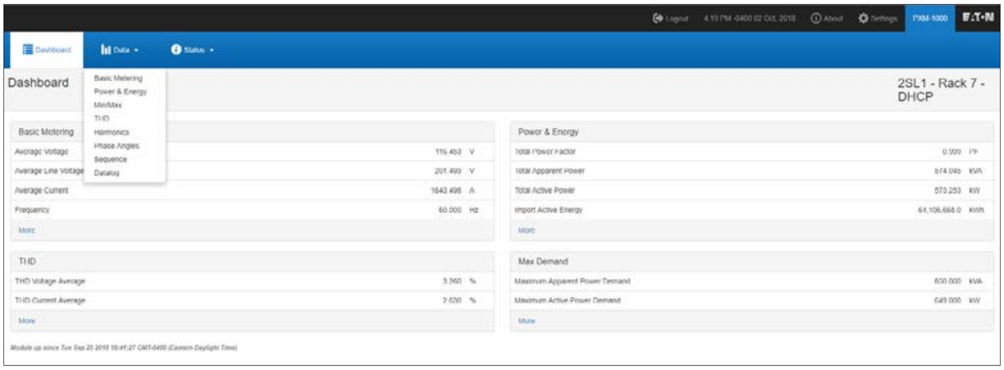
Settings screens are only available when logged in as Admin.
Please login as Admin to continue.

Please try again!

5.2.9.3 Data Web Page

Click on the “Data" tab to visit the metering data web pages. There are seven kinds of data parameter web pages. They are “Basic Metering”, “Power & Energy”, “THD", “Harmonics” “Harmonic”, “Phase Angles”, and “Sequence and Datalog”. Each web page shows data from the PXM 1000 series meter.

Figure 107. Available Data Parameter Pages.



Dashboard

2SL1 - Rack 7 - DHCP

Basic Metering		
Average Voltage	116.453	V
Average Line Voltage	201.493	V
Average Current	1643.498	A
Frequency	60.000	Hz

Power & Energy		
Total Power Factor	0.999	PF
Total Apparent Power	574.045	kVA
Total Active Power	573.253	kW
Import Active Energy	64,106,668.0	kWh

THD		
THD Voltage Average	3.260	%
THD Current Average	2.630	%

Max Demand		
Maximum Apparent Power Demand	630.000	kVA
Maximum Active Power Demand	649.000	kW

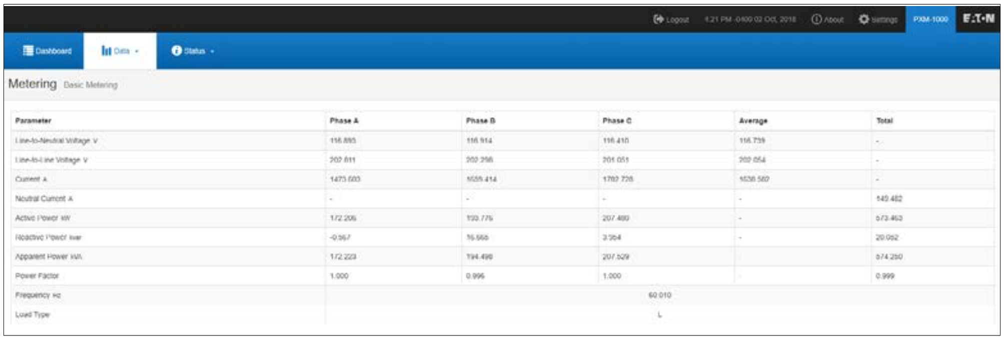
Module up since Tue Sep 25 2018 10:41:27 GMT-0400 (Eastern Daylight Time)

Basic Metering:

The Basic Metering web page includes the data of real-time parameters for the PXM 1000 series meter. This includes the Line Voltages, Phase Voltages, Current, Neutral Current, Active, Reactive and Apparent Power, Power Factor, Frequency, and Load type.

The parameters on this page are updated every five seconds.

Figure 108. Basic Metering Page.



Metering Basic Metering

Parameter	Phase A	Phase B	Phase C	Average	Total
Line-to-Neutral Voltage V	116.893	116.914	116.410	116.739	-
Line-to-Line Voltage V	202.811	202.298	201.051	202.054	-
Current A	1473.603	1655.414	1702.726	1636.582	-
Neutral Current A	-	-	-	-	149.482
Active Power kW	172.206	193.775	207.480	-	573.463
Reactive Power kvar	-0.967	16.666	3.364	-	20.062
Apparent Power kVA	172.223	194.498	207.529		574.250
Power Factor	1.000	0.996	1.000		0.999
Frequency Hz	60.010				
Load Type	L				

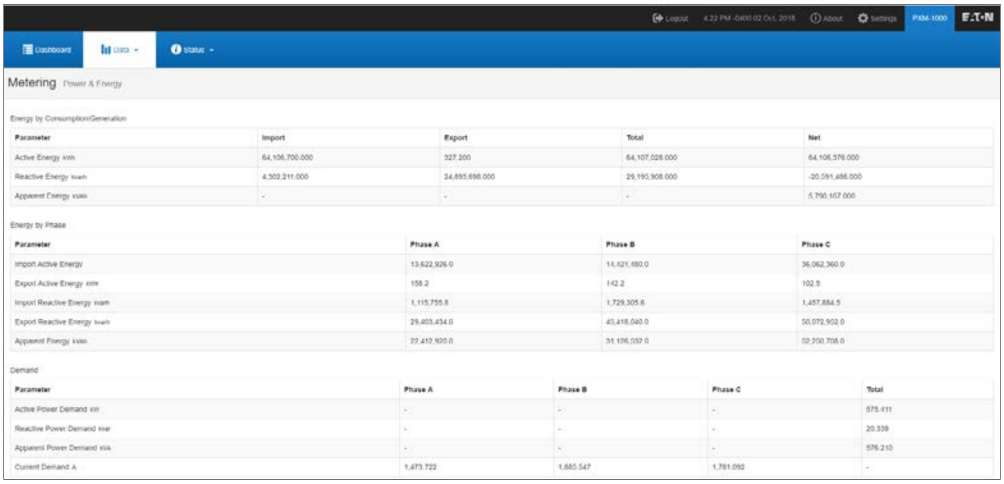
Power & Energy:

The Power & Energy web page shows the energy data for the PXM 1000 series meter such as the Active and Reactive energy that is consumed and delivered as well as the Apparent energy per phase and total.

This web page also shows the Demand parameters for the Active, Reactive, and Apparent Power as well as the three phase Current demands.

The parameters in this web page are updated every five seconds.

Figure 109. Power & Energy Page.



Energy by Consumption/Generation

Parameter	Import	Export	Total	Net
Active Energy kWh	64,106,700.000	327.200	64,107,028.000	64,106,376.000
Reactive Energy kvarh	4,302,211.000	24,893,698.000	29,195,908.000	-20,591,486.000
Apparent Energy kVAh	-	-	-	5,790,167.000

Energy by Phase

Parameter	Phase A	Phase B	Phase C
Import Active Energy	13,622,926.0	14,421,480.0	36,062,360.0
Export Active Energy kWh	158.2	142.2	102.5
Import Reactive Energy kvarh	1,115,755.8	1,729,305.6	1,457,884.5
Export Reactive Energy kvarh	29,403,434.0	45,418,040.0	50,072,902.0
Apparent Energy kVAh	22,412,920.0	31,126,532.0	52,250,708.0

Demand

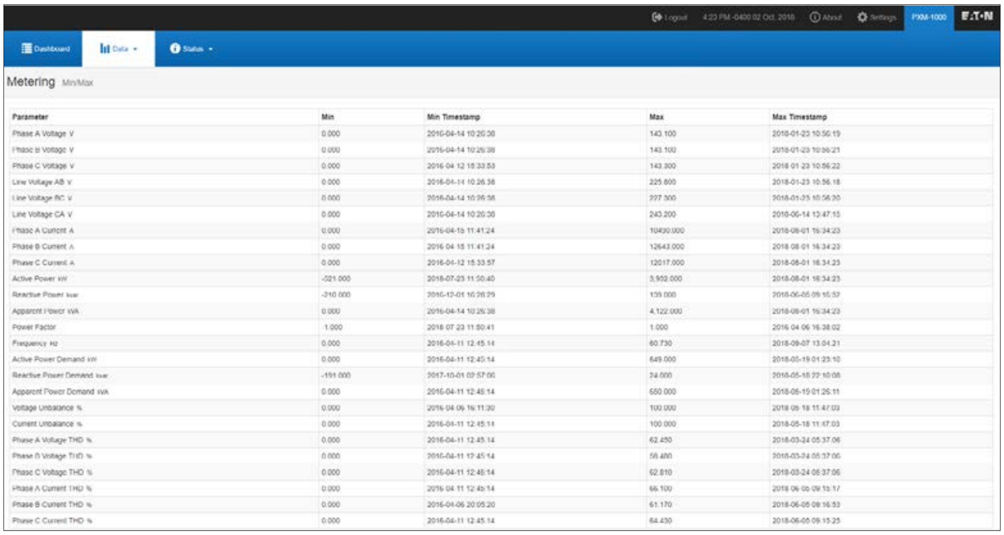
Parameter	Phase A	Phase B	Phase C	Total
Active Power Demand kW	-	-	-	575.411
Reactive Power Demand kvar	-	-	-	20.339
Apparent Power Demand kVA	-	-	-	576.210
Current Demand A	1,473.722	1,685.547	1,781.092	-

Min/Max:

The Min/Max page shows the maximum and minimum statistics that the meter has recorded since the lifetime of the meter, or from the last reset of the min/max statistics as well as the time stamps at which they were recorded.

The parameters in this web page are updated every ten seconds.

Figure 110. Min/Max Page.



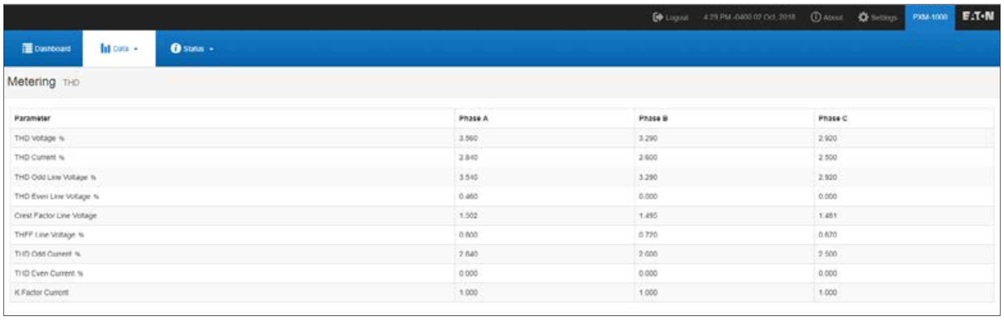
Parameter	Min	Min Timestamp	Max	Max Timestamp
Phase A Voltage V	0.000	2016-04-14 10:20:30	143.100	2018-01-23 10:56:19
Phase B Voltage V	0.000	2016-04-14 10:26:38	143.100	2018-01-23 10:56:21
Phase C Voltage V	0.000	2016-04-12 15:33:53	143.300	2018-01-23 10:56:22
Line Voltage AB V	0.000	2016-04-14 10:26:38	225.800	2018-01-23 10:56:18
Line Voltage BC V	0.000	2016-04-14 10:26:38	227.300	2018-01-23 10:56:20
Line Voltage CA V	0.000	2016-04-14 10:20:30	243.200	2016-06-14 13:47:15
Phase A Current A	0.000	2016-04-15 11:41:24	10490.000	2018-08-01 16:34:23
Phase B Current A	0.000	2016-04-15 11:41:24	12643.000	2018-08-01 16:34:23
Phase C Current A	0.000	2016-04-12 15:33:57	12017.000	2018-08-01 16:34:23
Active Power kW	-321.000	2018-07-23 11:50:40	3,932.000	2018-08-01 16:34:23
Reactive Power kvar	-210.000	2016-12-01 16:28:29	139.000	2018-06-05 09:16:52
Apparent Power kVA	0.000	2016-04-14 10:26:38	4,122.000	2018-08-01 16:34:23
Power Factor	-1.000	2018-07-23 11:50:41	1.000	2016-04-06 16:38:02
Frequency Hz	0.000	2016-04-11 12:45:14	60.730	2018-09-07 13:04:21
Active Power Demand kW	0.000	2016-04-11 12:45:14	649.000	2018-05-19 01:23:10
Reactive Power Demand kvar	-191.000	2017-10-01 02:57:06	24.000	2018-05-18 22:10:08
Apparent Power Demand kVA	0.000	2016-04-11 12:46:14	650.000	2018-05-19 01:26:11
Voltage Unbalance %	0.000	2016-04-06 16:11:30	100.000	2018-05-18 11:47:03
Current Unbalance %	0.000	2016-04-11 12:45:14	100.000	2018-05-18 11:47:03
Phase A Voltage THD %	0.000	2016-04-11 12:45:14	62.450	2018-03-24 05:37:06
Phase B Voltage THD %	0.000	2016-04-11 12:45:14	56.480	2018-03-24 05:37:06
Phase C Voltage THD %	0.000	2016-04-11 12:46:14	62.810	2018-03-24 05:37:06
Phase A Current THD %	0.000	2016-04-11 12:46:14	66.100	2018-06-05 09:15:17
Phase B Current THD %	0.000	2016-04-06 20:05:20	61.170	2018-06-05 09:16:53
Phase C Current THD %	0.000	2016-04-11 12:45:14	64.430	2018-06-05 09:15:25

THD:

The THD web page shows the power quality data such as the THD, THFF, Crest, and K Factor for both the voltage and current.

The parameters in this web page are updated every 15 seconds.

Figure 111. THD Page.



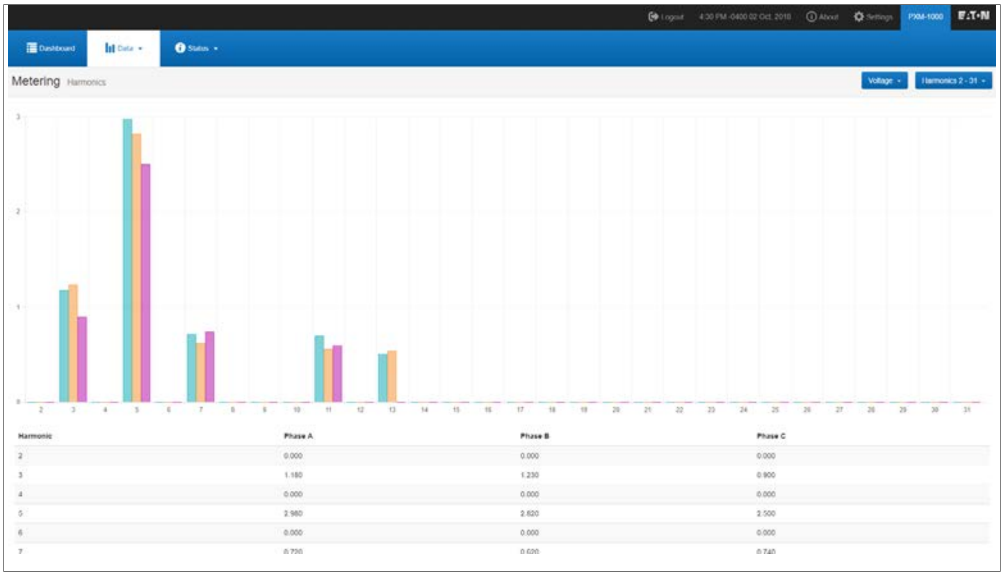
Parameter	Phase A	Phase B	Phase C
THD Voltage %	3.560	3.290	2.920
THD Current %	2.840	2.600	2.500
THD Odd Line Voltage %	3.540	3.290	2.920
THD Even Line Voltage %	0.460	0.000	0.000
Crest Factor Line Voltage	1.502	1.495	1.481
THFF Line Voltage %	0.800	0.720	0.670
THD Odd Current %	2.840	2.600	2.500
THD Even Current %	0.000	0.000	0.000
K Factor Current	1.000	1.000	1.000

Harmonics:

The Harmonics web page will show the harmonics of the voltage and the current waveform being measured. It will display the harmonics of each phase in graphical and tabular format. Select between voltage and current to view their respective harmonics as well as between the 2nd-31st harmonics or 32nd-63rd from the drop down list.

The parameters in this web page are updated every 15 seconds.

Figure 112. Harmonics Page.



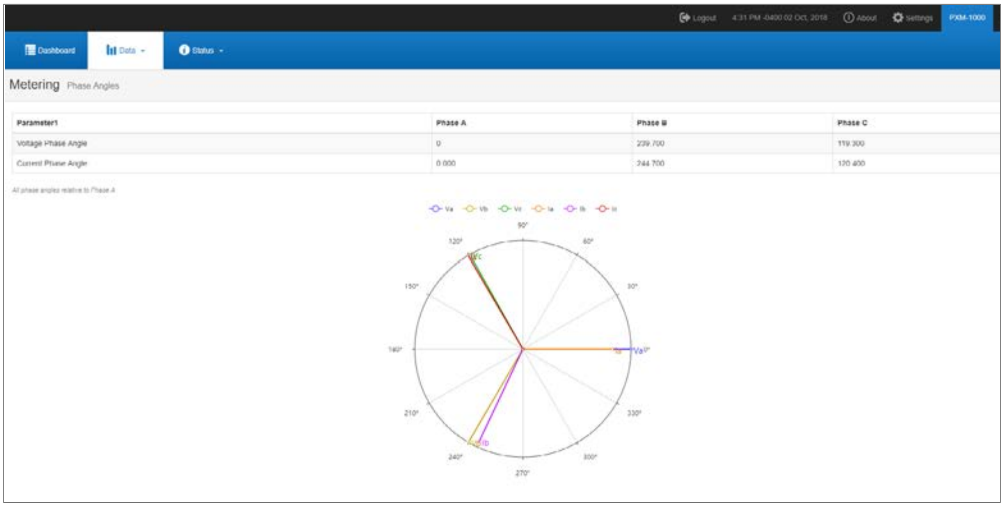
Harmonic	Phase A	Phase B	Phase C
2	0.000	0.000	0.000
3	1.180	1.230	0.900
4	0.000	0.000	0.000
5	2.980	2.820	2.500
6	0.000	0.000	0.000
7	0.720	0.620	0.740

Phase Angles:

The Phase Angles web page will show the phase angles of the voltage and current waveform being measured which can be used for remote troubleshooting. This page provides a visual diagram of the phase angles with respect to the voltage connected to the Phase A voltage input.

The parameters in this web page are updated every five seconds.

Figure 113. Phase Angles Page.



Parameter1	Phase A	Phase B	Phase C
Voltage Phase Angle	0	239.700	119.300
Current Phase Angle	0.000	244.700	120.400

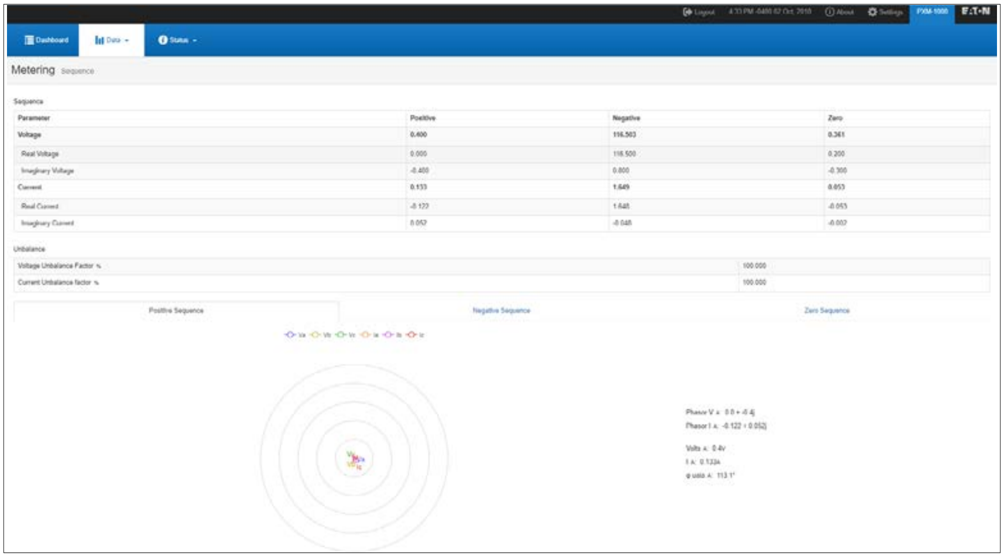
All phase angles relative to Phase A

Sequence:

The Sequence web page will show the positive, negative, and zero components of the voltage and current waveform being measured.

The parameters in this web page are updated every 15 seconds.

Figure 114. Sequence Page.



Sequence

Parameter	Positive	Negative	Zero
Voltage	**0.400**	**116.503**	**0.361**
Real Voltage	0.000	116.500	0.200
Imaginary Voltage	-0.400	0.800	-0.300
Current	0.133	1.649	0.053
Real Current	-0.122	1.648	-0.053
Imaginary Current	0.052	-0.048	-0.002

Unbalance

Voltage Unbalance Factor %	100.000
Current Unbalance factor %	100.000

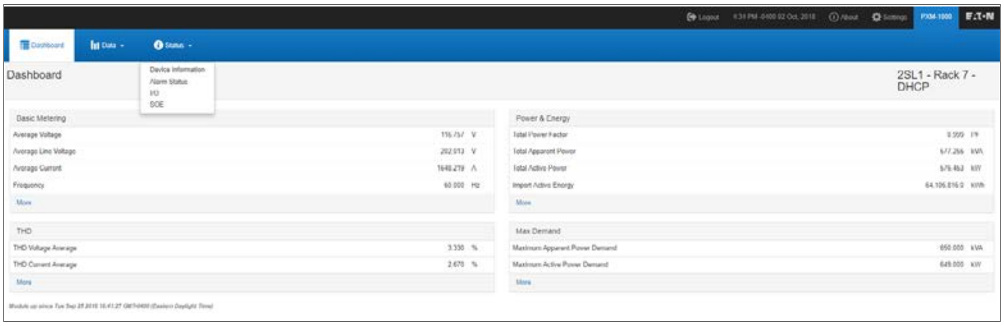
Phasor V a: 0.0 + -0.4j
Phasor I a: -0.122 + 0.052j

Volts a: 0.4v
I a: 0.133A
φ volts a: 113.1°

5.2.9.4 Status Web Page

Click on the “Status” tab to visit the status parameter web pages. There are four kinds of status web pages. They are "Device Information", "Alarm Status", “I/O”, and “SOE” statuses. Each web page shows different statuses or information about the PXM 1000 series meter.

Figure 115. Available Status Pages.



Basic Metering		
Average Voltage	116.757	V
Average Line Voltage	202.013	V
Average Current	1648.279	A
Frequency	60.000	Hz

Power & Energy		
Total Power Factor	0.999	PF
Total Apparent Power	677.266	kVA
Total Active Power	676.463	kW
Import Active Energy	64,106,816.0	kWh

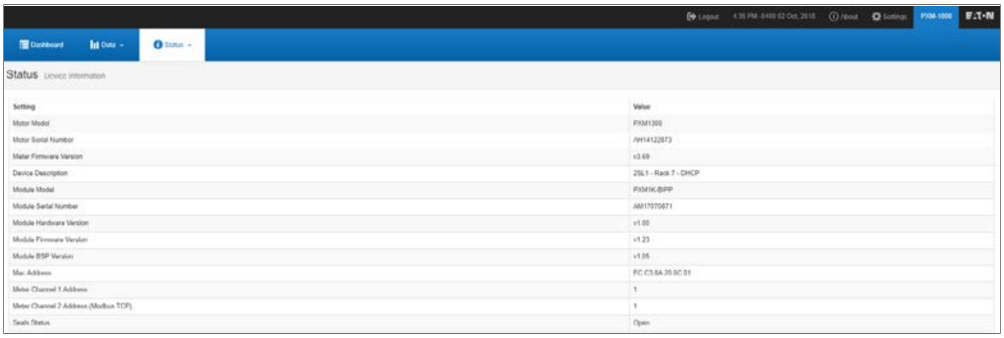
THD		
THD Voltage Average	3.330	%
THD Current Average	2.670	%

Max Demand		
Maximum Apparent Power Demand	650.000	kVA
Maximum Active Power Demand	649.000	kW

Device Information:

The Device Information web page shows information about the PXM 1000 series meter and PXM 1000 Ethernet Module module. It contains the model of the PXM 1000 series meter, serial number, firmware version, and meter addresses. It also contains the serial number, hardware and firmware version, as well as the MAC address of the PXM 1000 Ethernet Module module.

Figure 116. Device Information Page.



Setting	Value
Meter Model	PXM1300
Meter Serial Number	AH14122873
Meter Firmware Version	v3.69
Device Description	2SL1 - Rack 7 - DHCP
Module Model	PXM1K-BIPP
Module Serial Number	AM17070671
Module Hardware Version	v1.00
Module Firmware Version	v1.23
Module BSP Version	v1.05
Mac Address	FC:C3:8A:20:0C:01
Meter Channel 1 Address	1
Meter Channel 2 Address (Modbus TCP)	1
Seals Status	Open

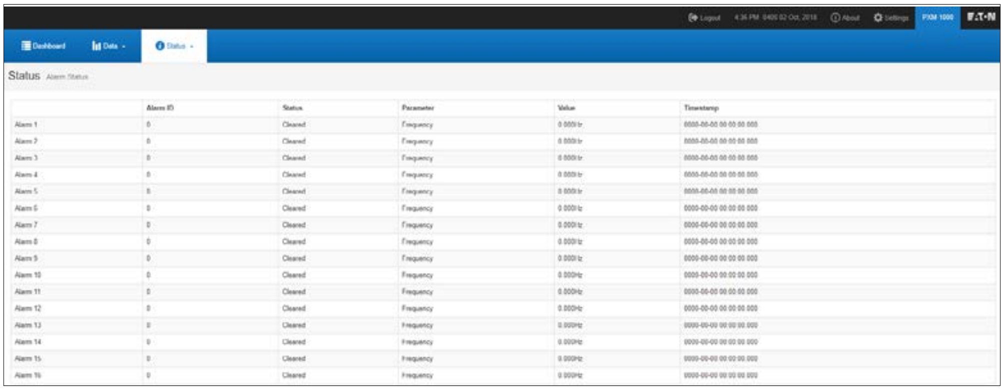
Alarm Status:

The alarm status web page shows the alarm log of the meter. It will show the status of up to 16 alarm events indicating the alarm ID, status, parameter, value, and time stamp of the alarm event.

Once all 16 alarm events are full, the newest alarm event will then wrap around to alarm 1.

The parameters in this web page are updated every ten seconds.

Figure 117. Alarm Status Page.



Status Alarm Status

	Alarm ID	Status	Parameter	Value	Timestamp
Alarm 1	0	Cleared	Frequency	0.000Hz	0000-00-00 00:00:00.000
Alarm 2	0	Cleared	Frequency	0.000Hz	0000-00-00 00:00:00.000
Alarm 3	0	Cleared	Frequency	0.000Hz	0000-00-00 00:00:00.000
Alarm 4	0	Cleared	Frequency	0.000Hz	0000-00-00 00:00:00.000
Alarm 5	0	Cleared	Frequency	0.000Hz	0000-00-00 00:00:00.000
Alarm 6	0	Cleared	Frequency	0.000Hz	0000-00-00 00:00:00.000
Alarm 7	0	Cleared	Frequency	0.000Hz	0000-00-00 00:00:00.000
Alarm 8	0	Cleared	Frequency	0.000Hz	0000-00-00 00:00:00.000
Alarm 9	0	Cleared	Frequency	0.000Hz	0000-00-00 00:00:00.000
Alarm 10	0	Cleared	Frequency	0.000Hz	0000-00-00 00:00:00.000
Alarm 11	0	Cleared	Frequency	0.000Hz	0000-00-00 00:00:00.000
Alarm 12	0	Cleared	Frequency	0.000Hz	0000-00-00 00:00:00.000
Alarm 13	0	Cleared	Frequency	0.000Hz	0000-00-00 00:00:00.000
Alarm 14	0	Cleared	Frequency	0.000Hz	0000-00-00 00:00:00.000
Alarm 15	0	Cleared	Frequency	0.000Hz	0000-00-00 00:00:00.000
Alarm 16	0	Cleared	Frequency	0.000Hz	0000-00-00 00:00:00.000

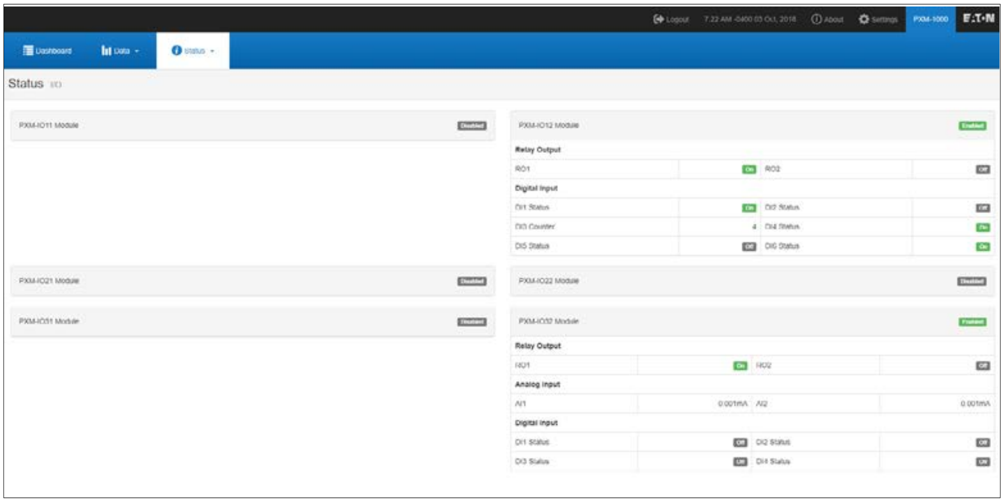
I/O:

The I/O web page will display the status of the I/O modules that are connected and their values, depending on the model of the module that is connected to the meter - i.e. - the PXM1K-110 module will display the Relay Output status (on/off), DI status/counter.

The parameters in this web page are updated every five seconds.

Note: PXM-IO11 Module refers to the PXM1K-110 module, and PXM-IO12 Module refers to the PXM1K-120 module
PXM-IO21 Module refers to the PXM1K-21x modules, and PXM-IO22 Module refers to the PXM1K-22x modules
PXM-IO31 Module refers to the PXM1K-31x modules, and PXM-IO32 Module refers to the PXM1K-32x modules

Figure 118. I/O Page.



Status I/O

PXM-IO11 Module Disabled

PXM-IO12 Module Enabled

Relay Output

RO1	On	RO2	Off

Digital Input

DI1 Status	On	DI2 Status	Off
DI3 Counter	4	DI4 Status	On
DI5 Status	Off	DI6 Status	On

PXM-IO21 Module Disabled

PXM-IO22 Module Disabled

PXM-IO31 Module Disabled

PXM-IO32 Module Enabled

Relay Output

RO1	On	RO2	Off

Analog Input

AI1	0.001mA	AI2	0.001mA

Digital Input

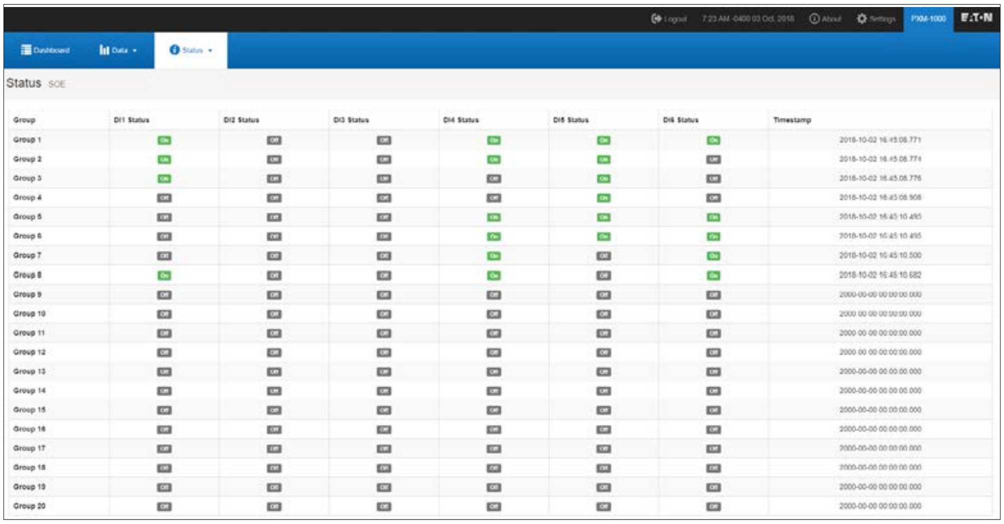
DI1 Status	Off	DI2 Status	Off
DI3 Status	Off	DI4 Status	Off

SOE (Sequence of Event):

The SOE web page will display the Sequence of Event log for the enabled I/O module that is attached to the PXM 1000 series meter with time stamps. It will display the DI status for up to 20 events.

The parameters in this web page are updated every ten seconds.

Figure 119. SOE Page.



Status SOE

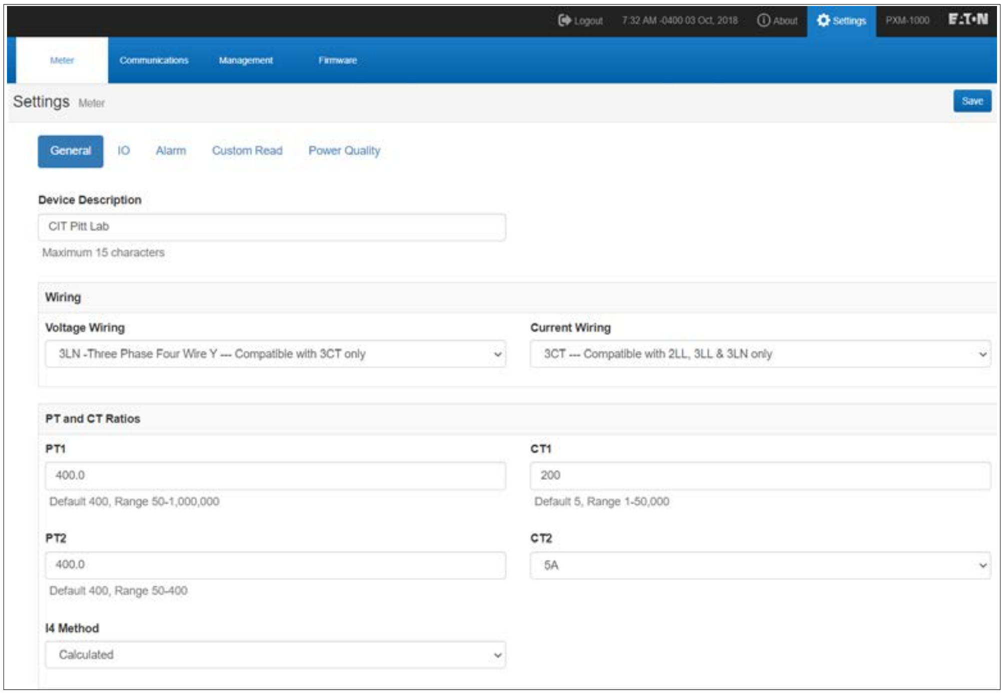
Group	DI1 Status	DI2 Status	DI3 Status	DI4 Status	DI5 Status	DI6 Status	Timestamp
Group 1	On	Off	Off	On	On	On	2018-10-02 16:45:08.771
Group 2	On	Off	Off	On	On	Off	2018-10-02 16:45:08.774
Group 3	On	Off	Off	Off	On	Off	2018-10-02 16:45:08.776
Group 4	Off	Off	Off	Off	On	Off	2018-10-02 16:45:08.908
Group 5	Off	Off	Off	On	On	On	2018-10-02 16:45:10.495
Group 6	Off	Off	Off	On	On	On	2018-10-02 16:45:10.495
Group 7	Off	Off	Off	On	Off	On	2018-10-02 16:45:10.500
Group 8	On	Off	Off	On	Off	On	2018-10-02 16:45:10.682
Group 9	Off	Off	Off	Off	Off	Off	2000-00-00 00:00:00.000
Group 10	Off	Off	Off	Off	Off	Off	2000-00-00 00:00:00.000
Group 11	Off	Off	Off	Off	Off	Off	2000-00-00 00:00:00.000
Group 12	Off	Off	Off	Off	Off	Off	2000-00-00 00:00:00.000
Group 13	Off	Off	Off	Off	Off	Off	2000-00-00 00:00:00.000
Group 14	Off	Off	Off	Off	Off	Off	2000-00-00 00:00:00.000
Group 15	Off	Off	Off	Off	Off	Off	2000-00-00 00:00:00.000
Group 16	Off	Off	Off	Off	Off	Off	2000-00-00 00:00:00.000
Group 17	Off	Off	Off	Off	Off	Off	2000-00-00 00:00:00.000
Group 18	Off	Off	Off	Off	Off	Off	2000-00-00 00:00:00.000
Group 19	Off	Off	Off	Off	Off	Off	2000-00-00 00:00:00.000
Group 20	Off	Off	Off	Off	Off	Off	2000-00-00 00:00:00.000

5.2.9.5 Settings Web Page

Click on the “Settings” tab to visit the parameter setting web pages that can be configured from the PXM 1000 Ethernet Module module. There are four parameter settings that can be configured. They are “Meter”, “Communications”, “Management”, and “Firmware” settings. Each settings web page will require the PXM 1000 Ethernet Module module to be rebooted from the Management web page after any configuration is saved, so the saved changes can take effect.

Note: The Settings web page will only be accessible at Admin level.

Figure 120. Settings Page.



Device Description: CIT Pitt Lab
Maximum 15 characters

Wiring

Voltage Wiring: 3LN -Three Phase Four Wire Y --- Compatible with 3CT only

Current Wiring: 3CT --- Compatible with 2LL, 3LL & 3LN only

PT and CT Ratios

PT1: 400.0
Default 400, Range 50-1,000,000

CT1: 200
Default 5, Range 1-50,000

PT2: 400.0
Default 400, Range 50-400

CT2: 5A

I4 Method: Calculated

Meter Setting:

The meter setting web page will allow user to configure basic meter settings in order for the meter to measure the voltage and current and display it correctly.

Voltage Wiring: Select how the meter's voltage input terminal is wired by selecting a configuration from the drop down list - i.e. - for a three-phase three-wire configuration without a neutral, select 3LL.

Current Wiring: Select the number of CT's that are connected to the meter's current input terminal by selecting a number from the drop down list.

PT1: Enter the rated input of the potential transformer that is connected to the meter. Possible range is from 50 to 1,000,000V.

CT1: Enter the rated input of the current transformer that is used with the meter. Possible ranges for the CT1 are from 1 to 50,000 A.

CT41: Enter the rated input of the neutral current transformer that is used with the meter. Possible ranges for the CT41 is from 1 to 50,000 A. If the Neutral current transformer is present, by default the PX1000 calculates. The selection can also be changed to measure and then the appropriate CT41 setting can be entered.

Note: CT41 Setting is available only with the Rev B Meters without Ring Terminals.

PT2: Enter the rated output of the potential transformer. Possible range is from 50 to 400 V.

CT2: Select the rated output of the current transformer from the drop down list. By default this setting is already configured.

CT42: Enter the rated input of the neutral current transformer that is used with the meter. Possible ranges for the CT42 are 1A or 5A. If the Neutral current transformer is present, by default the PX1000 calculates. The selection can also be changed to measure and then the appropriate CT42 setting can be entered.

Note: CT42 Setting is available only with the Rev B Meters without Ring Terminals.

Real time Reading: Select the mode of the readings for the meter when it is polled through Modbus. By default the meter is in secondary mode which will require some parameters to be scaled by a relationship. Configuring the meter in primary mode does not require any scaling.

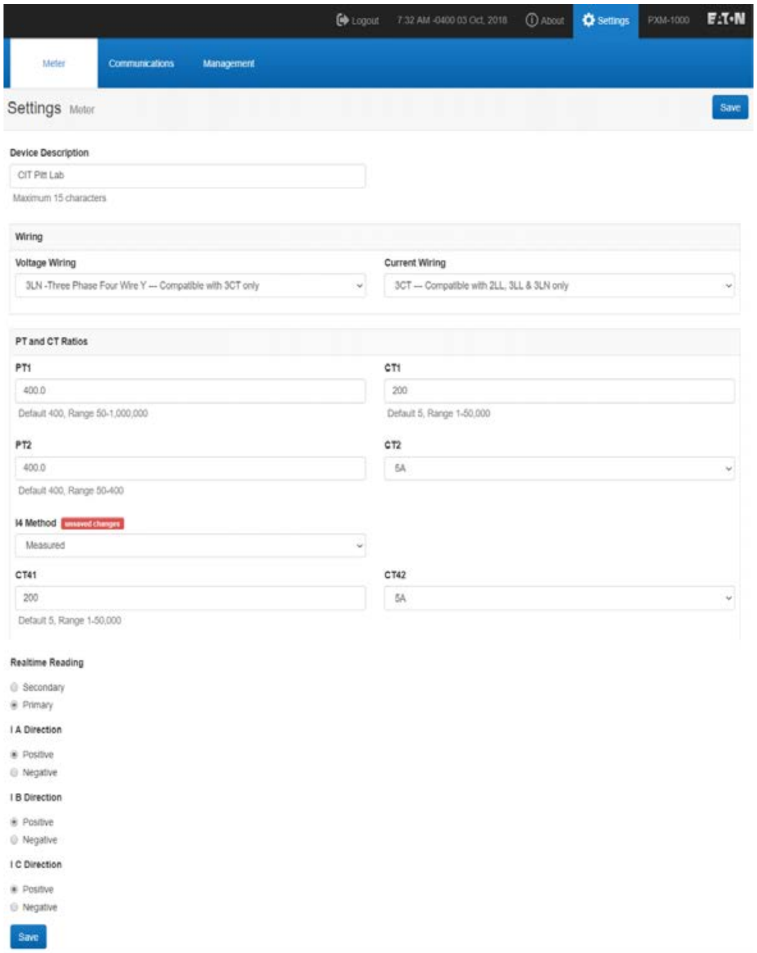
I A Direction: Represents the flow of direction for the Phase A current being measured. Configure this setting to troubleshoot issues related to incorrect polarity of readings such as real power, Power Factor, etc.

I B Direction: Represents the flow of direction for the Phase B current being measured. Configure this setting to troubleshoot issues related to incorrect polarity of readings such as real power, Power Factor, etc.

I C Direction: Represents the flow of direction for the Phase C current being measured. Configure this setting to troubleshoot issues related to incorrect polarity of readings such as real power, Power Factor, etc.

Click "Save" after changing any settings.

Figure 121. Meter Settings Page.



Settings Meter

Device Description

CIT Pitt Lab

Maximum 15 characters

Wiring

Voltage Wiring: 3LN -Three Phase Four Wire Y — Compatible with 3CT only

Current Wiring: 3CT — Compatible with 2LL, 3LL & 3LN only

PT and CT Ratios

PT1: 400.0
Default 400, Range 50-1,000,000

CT1: 200
Default 5, Range 1-50,000

PT2: 400.0
Default 400, Range 50-400

CT2: 5A

I4 Method: Measured

CT41: 200
Default 5, Range 1-50,000

CT42: 5A

Realtime Reading
○ Secondary
● Primary

I A Direction
● Positive
○ Negative

I B Direction
● Positive
○ Negative

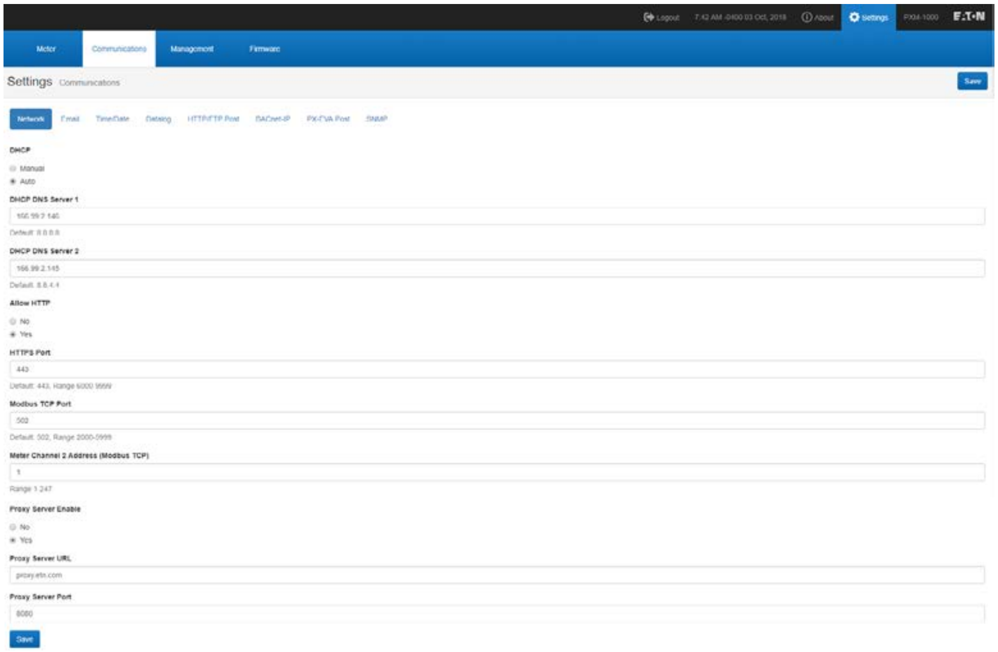
I C Direction
● Positive
○ Negative

Communication:

The communication setting web page will allow the user to configure settings related to the

Ethernet network. The functions that the PXM 1000 Ethernet Module support can be configured from this web page by selecting the corresponding tab such as Emails, Time/Date, Datalog, HTTP/FTP Post and SNMP.

Figure 122. Communications Settings Page.



DHCP

○ Manual
● Auto

DHCP DNS Server 1

166.99.2.140

Default: 8.8.8.8

DHCP DNS Server 2

166.99.2.145

Default: 8.8.4.4

Allow HTTP

○ No
● Yes

HTTPS Port

443

Default: 443, Range 6000-9999

Modbus TCP Port

502

Default: 502, Range 2000-5999

Meter Channel 2 Address (Modbus TCP)

1

Range 1-247

Proxy Server Enable

○ No
● Yes

Proxy Server URL

proxy.etn.com

Proxy Server Port

8080

Network:

DHCP: Select "Manual" to manually configure the IP address to access the meter. If set to "Manual", you will also need to set the Subnet Mask and Gateway.

Select "Auto" to have the meter assigned a IP address automatically. With this selection the Subnet Mask, Gateway and DNS servers will also be automatically assigned.

Note: After changing DHCP to Auto, check the display of the meter to obtain the new IP address that has been assigned after the PXM 1000 Ethernet Module has completed its reboot and the router has assigned the meter with an IP address.

IP Address: If the DHCP is configured to Manual, the IP address can be configured from this page.

Subnet Mask: If the DHCP is configured to Manual, the Subnet Mask can be configured from this page.

Gateway: If the DHCP is configured to Manual, the Gateway can be configured from this web page.

DHCP DNS Server 1: Enter the address of the DNS 1 server in this page.

DHCP DNS Server 2: Enter the address of the DNS 2 server in this page.

Allow HTTP: Enable this setting so that the PXM 1000 Ethernet Module can be accessed through HTTP at port 80.

HTTPS Port: Enter the HTTPS port number of the meter. By default, this setting is configured to 443. The range can be from 6000 to 9,999.

Note: This setting should never be configured to 80.

Modbus TCP Port: Enter the Modbus port number of the meter. By default, this setting is configuredo 502. The range can be from 2,000 to 5,999.

Proxy Server Enabled: Enable this setting so that the PXM 1000 Ethernet Module can act as an intermediary to communicate with another server.

Click “Save” after changing any settings. Users will be prompted to reboot the PXM 1000 Ethernet Module immediately or later. If later is chosen the PXM 1000 Ethernet Module will need to be rebooted from the “Management” page.

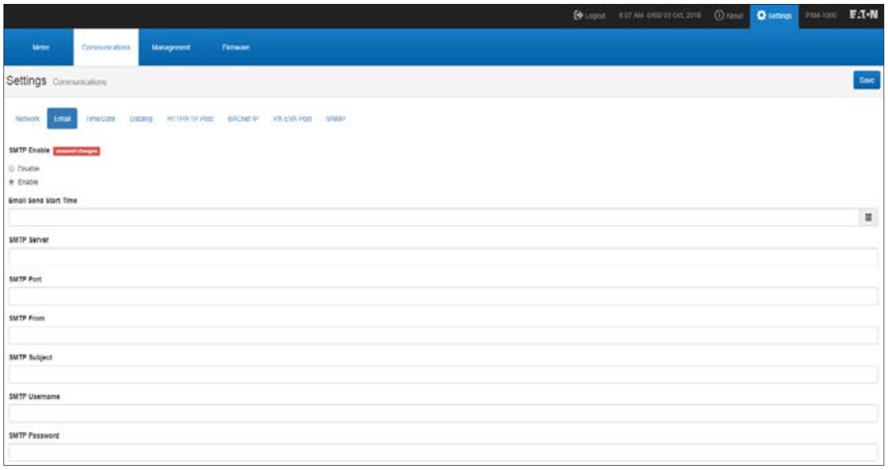
Emails:

The PXM 1000 Ethernet Module supports the SMTP protocol so users can setup the email function on the PXM 1000 Ethernet Module to enable the meter to send emails based on a time interval or when there is an alarm or SOE event or a combination of both. Users must know their SMTP server provider and details regarding their SMTP server, which can be provided by users’ IT personal.

There are three modes available for sending emails that the user can enable. The first mode is "Triggered Sending" where emails are sent immediately when there is a new alarm or SOE event. The second mode is "Timed Sending". Users can receive emails at a certain period of time based on the time interval configured and the email will include the data that is selected to be sent. The third mode is when both of the above are enabled.

Users can configure the mail function for their needs by clicking on the “Settings” tab and selecting “Communications”. Once redirected to the Communications web page, select “Email”.

Figure 123. Email Settings Page.



SMTP Enable

○ Disable

● Enable

Email Send Start Time

SMTP Server

SMTP Port

SMTP From

SMTP Subject

SMTP Username

SMTP Password

To use this function the following settings need to be configured.

SMTP Enable: Select “Enable” to further configure the settings related to the SMTP function.

Email Send Start Time: Use the calendar date picker to select the date and time to begin sending email notifications.

SMTP Server: Enter the URL of a valid SMTP server - i.e. - mail.eaton.com or smtp.gmail.com.

SMTP Port: Enter the port number associated with the SMTP server.

SMTP From: Enter a name or phrase which will appear to let you know who the mail is from - i.e. - "Technical Support".

SMTP Username: Enter the SMTP user name for the SMTP server set above.

SMTP Password: Enter the SMTP user password for the user set above.

SMTP To Address 1; 2; 3: Enter up to three recipients that you wish to have the email sent to in “SMTP To Address 1”, “SMTP To Address 2”, and “SMTP To Address 3”.

After configuring the above settings, the next step is to select the content for the emails.

To enable emails to be sent based on a new Alarm or SOE Event, select “Yes” under "SMTP Triggered Sending Alarm Event" or "SMTP Triggered Sending SOE Event".

Figure 124. SMTP Triggered Page.

SMTP Triggered Sending Alarm Event

○ No

● Yes

SMTP Triggered Sending SOE Event

○ No

● Yes

To receive email reports at timed intervals, configure the following settings:

SMTP Timed Sending Interval: Configure this setting with a value between 5-1440 minutes. This represents how often the emails will be sent.

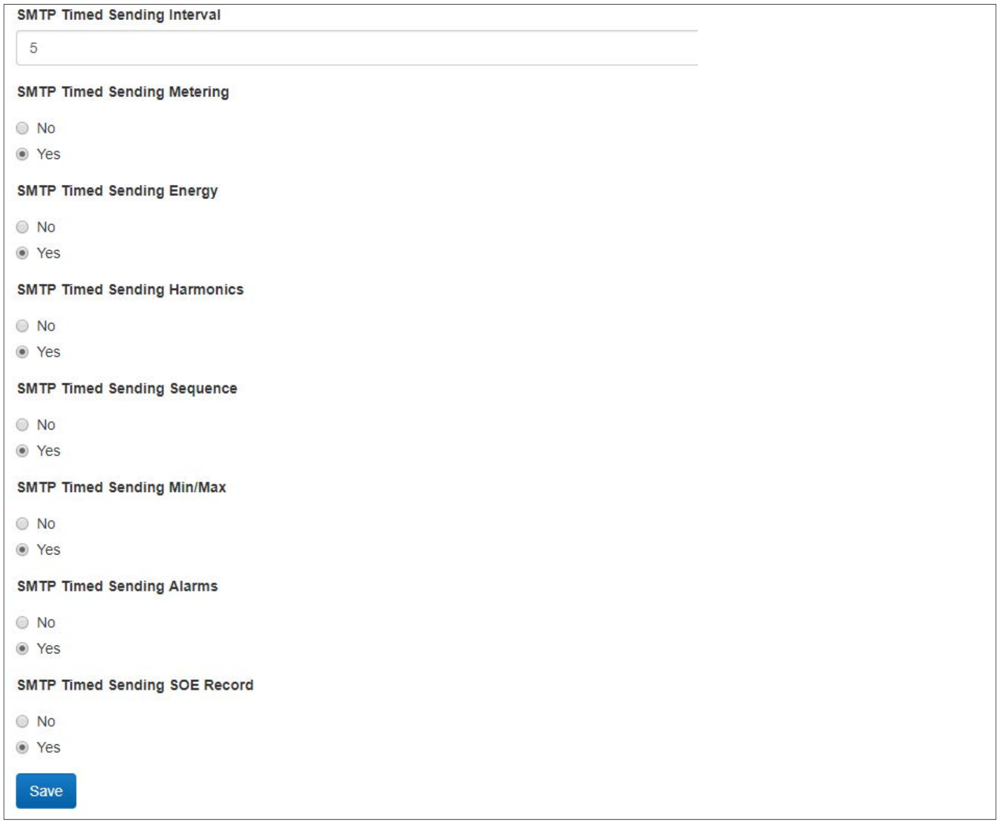
To receive emails on specific groups of parameters select “Yes” under "SMTP Timed Sending xxx".

Where xxx can be for receiving emails on:

- **Metering:** Report on real time voltage, current, power, etc.;
- **Energy:** Report on energy parameters;
- **Harmonics:** Report on the voltage and current harmonics from 2nd to 63rd;
- **Sequence:** Report on the positive, negative, and zero components of the voltage and current waveform;
- **Min/Max:** Report on the maximum and minimum statistics that the meter has recorded since the lifetime of the meter or from the last reset of the min/max statistics;
- **Alarm:** Report of the alarm log;
- **SOE Record:** Report of the SOE log.

Click “Save” after changing any settings. Users will be prompted to reboot the PXM 1000 Ethernet Module immediately or later. If later is chosen the PXM 1000 Ethernet Module will need to be rebooted from the “Management” page.

Figure 125. Receive Email Page.



SMTP Timed Sending Interval

5

SMTP Timed Sending Metering

○ No
● Yes

SMTP Timed Sending Energy

○ No
● Yes

SMTP Timed Sending Harmonics

○ No
● Yes

SMTP Timed Sending Sequence

○ No
● Yes

SMTP Timed Sending Min/Max

○ No
● Yes

SMTP Timed Sending Alarms

○ No
● Yes

SMTP Timed Sending SOE Record

○ No
● Yes

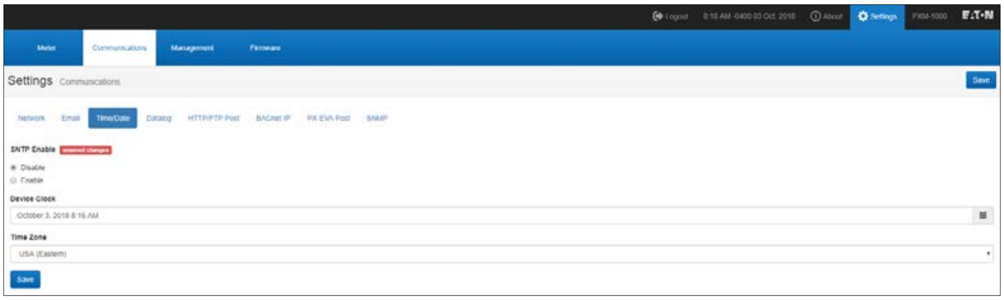
Time/Date:

The device clock of the PXM 1000 series meter can be set through the web interface of the PXM 1000 Ethernet Module module. The PXM 1000 Ethernet Module module also supports the Simple Network Time Protocol (SNTP) protocol so that the module can update the meter's device clock by synchronizing with a time server.

The PXM 1000 Ethernet Module can sync with up to three time servers. If a time server is down, the module will synchronize with the second or third time server if they are configured.

The settings for the time and date can be found by clicking on the "Settings" tab and selecting "Communications". Click "Time/Date" to access the web page.

Figure 126. Time/Date Settings Page.



SNTP Enable

● Disable
○ Enable

Device Clock

October 3, 2018 8:16 AM

Time Zone

USA (Eastern)

SNTP Enable: Select “Yes” to enable the function and to further configure the settings related to the SNTP function.

Device Clock: The device clock of the PXM 1000 series can be configured from this setting.

Time Zone: Select the time zone the meter is in or the time zone in which you would like the meter’s time to be synchronized to from the drop down list.

SNTP Interval: Enter a number from 1 min to 6,000 minutes to configure how often the meter will synchronize it’s time with the time server.

SNTP Server 1; 2; 3: Enter up to three SNTP servers in the "SNTP Server 1", "SNTP Server 2", and "SNTP Server 3" fields.

Examples of North American SNTP servers are:

0.us.pool.ntp.org

1.us.pool.ntp.org

2.us.pool.ntp.org

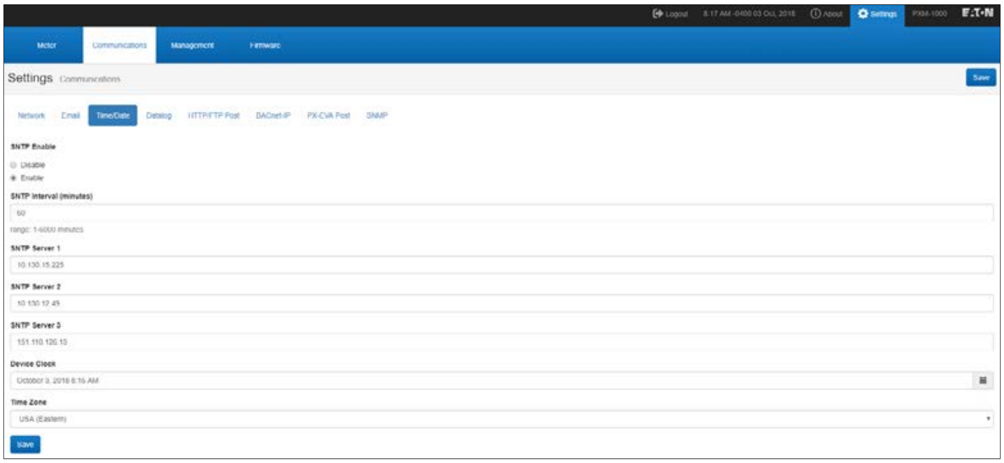
3.us.pool.ntp.org

For more NTP servers based on region, visit the following site:

http://www.pool.ntp.org/en/

Click “Save” after changing any settings. Users will be prompted to reboot the PXM 1000 Ethernet Module immediately or later. If later is chosen the PXM 1000 Ethernet Module will need to be rebooted from the “Management” page.

Figure 127. Time/Date Servers Page.



SNTP Enable

○ Disable

● Enable

SNTP Interval (minutes)

60

range: 1-6000 minutes

SNTP Server 1

10.130.15.225

SNTP Server 2

10.130.12.45

SNTP Server 3

151.110.126.15

Device Clock

October 3, 2018 8:16 AM

Time Zone

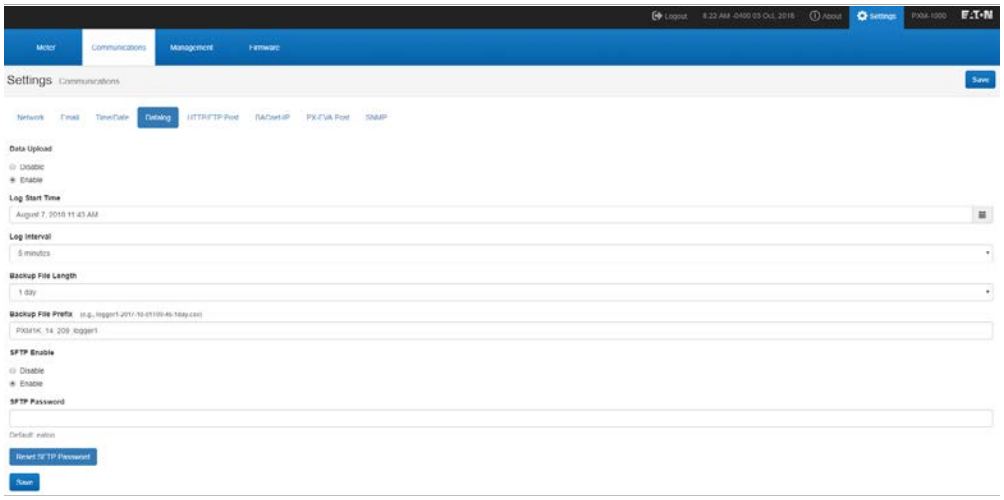
USA (Eastern)

Datalog:

The PXM 1000 Ethernet Module supports logging data onto its memory. Once enabled, the module can log up to a day or month of data. The data can be downloaded as a .csv file using a FTP client.

The PXM 1000 Ethernet Module can log data at intervals of time ranging from 15 seconds to 1 month.

Figure 128. Datalog Settings Page.



Data Upload
○ Disable
● Enable

Log Start Time
August 7, 2018 11:43 AM

Log Interval
5 minutes

Backup File Length
1 day

Backup File Prefix
PXM1K_14_209_logger1

SFTP Enable
○ Disable
● Enable

SFTP Password

Default: eaton

Data Upload: To use the datalog function to log the data onto the module, select the Enable option to view and configure the settings that are applicable.

Once enabled, the following settings related to when the logging of the data will begin. How often the data should be logged, the format and prefix of the file name, and how the time stamp will be represented need to be configured:

Log Start Time: Select a valid time for the meter to start logging the data.

Note: The device clock of the meter should be correctly configured and up to date.

Log Interval: Select how frequently the module will log data to the file from the drop down list. The logging interval can be from 15 seconds to 1 month.

Backup File Length: Select the length of the log file, as either 1 day or 1 month of data, from the drop down list.

Backup File Prefix: Provide a name for the log file which will be appended to the beginning of the log file. By default "logger1" will be appended to the beginning of the log file.

SFTP Enable: To download the logged data from the module using a FTP client, select Enable. The log file will then be available to be downloaded using a FTP client using the following credentials:

Host: sftp://IPaddressofthemeter

Username: sftpuser

SFTP Password: eaton

Port: 22

By default, the password for retrieving the backup log files is “eaton”. The user can configure any password or can reset to the default of eaton by clicking on the "Reset SFTP Password".

Note: After enabling the SFTP function, the user must reboot the communication module in order to access the data logs with the default password of “eaton”.

Click “Save” after changing any settings. Users will be prompted to reboot the PXM 1000 Ethernet Module immediately or later. If later is chosen the PXM 1000 Ethernet Module will need to be rebooted from the “Management” page.

HTTP/FTP Post:

The PXM 1000 Ethernet Module supports the HTTP and FTP Post functions to send data from the meter to a HTTP/FTP server. The PXM 1000 Ethernet Module can post .csv files to two different web servers using HTTP Post and can also send the same .csv file to a server using FTP Post.

In the case when there is no connection to the server, the PXM 1000 Ethernet Module will store the posts and send it out after the connection is restored.

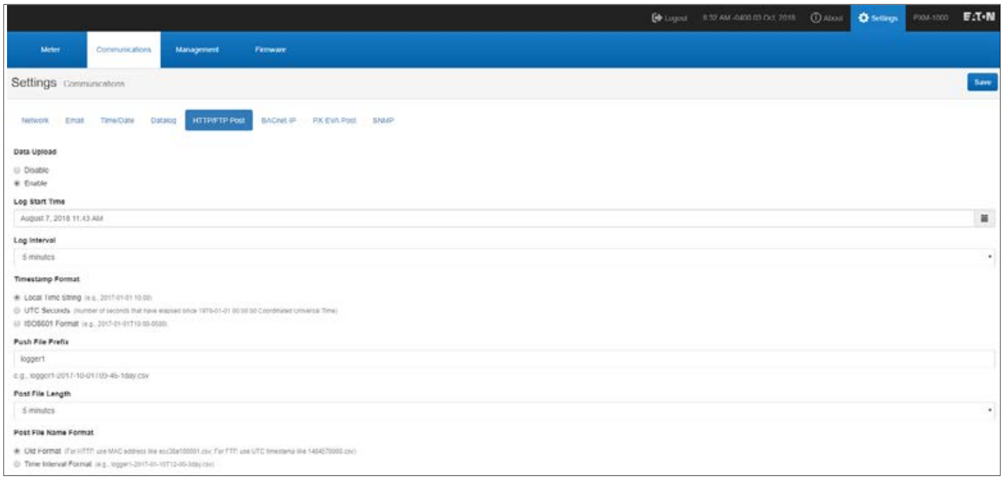
The PXM 1000 Ethernet Module can post data to a server at intervals of time ranging from 15 seconds to 1 month.

The settings for the data log function can be found by clicking on the “Settings” tab and selecting “Communications”. Click "Datalog" to access the data log web page.

The settings for the HTTP/FTP Post function can be found by clicking on the “Settings” tab and selecting “Communications”. Click "HTTP/FTP Post" to access the HTTP/FTP Post web page.

Data Upload: To use the HTTP/FTP post function to send data to the appropriate server, select the Enable option to view and configure the settings that are applicable.

Figure 129. HTTP/FTP Post Settings Page.



Data Upload
○ Disable
● Enable

Log Start Time
August 7, 2018 11:43 AM

Log Interval
5 minutes

Timestamp Format
● Local Time String
○ UTC Seconds
○ ISO8601 Format

Push File Prefix
logger1

Post File Length
5 minutes

Post File Name Format
● Old Format
○ Time Interval Format

Once enabled, the following settings related to when the uploading of the data should begin, how often the data should be logged and uploaded, the format of the file name, and how the time stamp will be represented.

Log Start Time: Select a valid time for the meter to start logging the data to be posted.

Note: The device clock of the meter should be correctly configured and up to date.

Log Interval: Select how frequently the meter will log data to the file that will be uploaded to the server from the drop down list. The logging interval can be from 15 seconds to 1 month.

Time Stamp Format: Select the format of the time stamp for the data that is logged. The format for the time stamp can be based on the Local Time, UTC seconds, or based on ISO8601 format.

Push File Prefix: Provide a name for the log file which will be appended to the beginning of the logfile if "Time Interval Format" is selected as the Post File Name Format. By default "logger1" will be appended to the beginning of the log file.

Post File Length: Select how frequently the log file will be uploaded to the server from the drop down list, The log file length can be from 15 seconds to 1 month.

With the above settings configured the following settings need to be configured depending on which protocol will be used.

HTTP Push Channel 1 Enable: Select "Yes" to enable and to further configure the HTTP Push 1 settings.

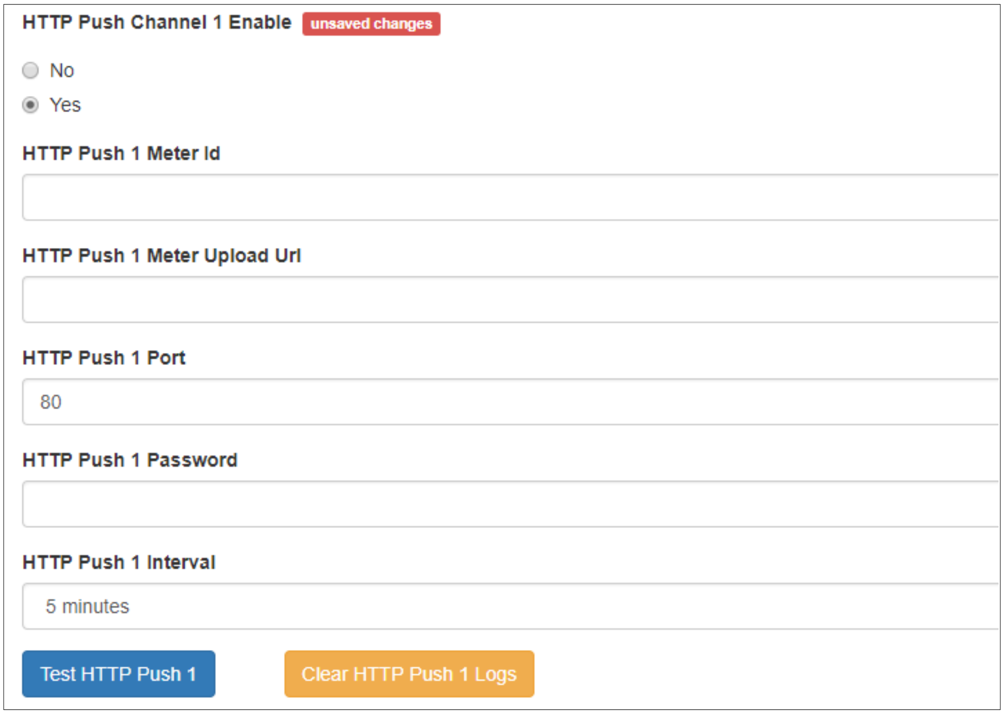
HTTP Push 1 Meter Upload Url: Enter the Url of the HTTP server that will receive the data from the meter.

HTTP Push 1 Port: Enter the port number for the server that will receive the data.

HTTP Push 1 Password: Enter the password to send data to the receiving server if applicable. Otherwise, leave blank.

HTTP Push 1 Interval: Select how frequently the data should be uploaded to the HTTP server. The data can be posted in intervals from 15 seconds to 1 month.

Figure 130. Uploading HTTP Data Settings Page.



HTTP Push Channel 1 Enable

○ No
● Yes

HTTP Push 1 Meter Id

HTTP Push 1 Meter Upload Url

HTTP Push 1 Port: 80

HTTP Push 1 Password

HTTP Push 1 Interval: 5 minutes

Note: The "TEST HTTP Push1" button should only be utilized after clicking the "Save" button otherwise a fail response will be observed. If a fail response occurs after clicking "Save", the settings should be double checked or troubleshooting on the server side may be required.

In the case the network is down and the module cannot send the data to the server, it will accumulate all the failed posts and send them out when the network is up. These failed posts can be cleared by clicking the "Clear HTTP Push Logs".

HTTP Push Channel 2 Enable: Select "Yes" to enable and to further configure the HTTP Push 2 settings.

HTTP Push 2 Meter Upload Url: Enter the Url of the HTTP server that will receive the data from the meter.

HTTP Push 2 Port: Enter the port number for the server that will receive the data.

HTTP Push 2 Password: Enter the password to send data to the receiving server if applicable. Otherwise, leave blank.

HTTP Push 2 Interval: Select how frequently the data should be uploaded to the HTTP server. The data can be posted in intervals from 15 seconds to 1 month.

FTP Push Enable: Select "Yes" to enable and further configure the FTP Push settings.

FTP Push Meter Upload Url: Enter the Url of the FTP server that will receive the data from the meter.

FTP Push Port: Enter the port number for the server that will receive the data.

FTP Push Username: Enter a valid username to send the data to the FTP server. An incorrect username could result in no data being received by the server.

FTP Push Password: Enter a valid password for the username above to send data to the receiving FTP server.

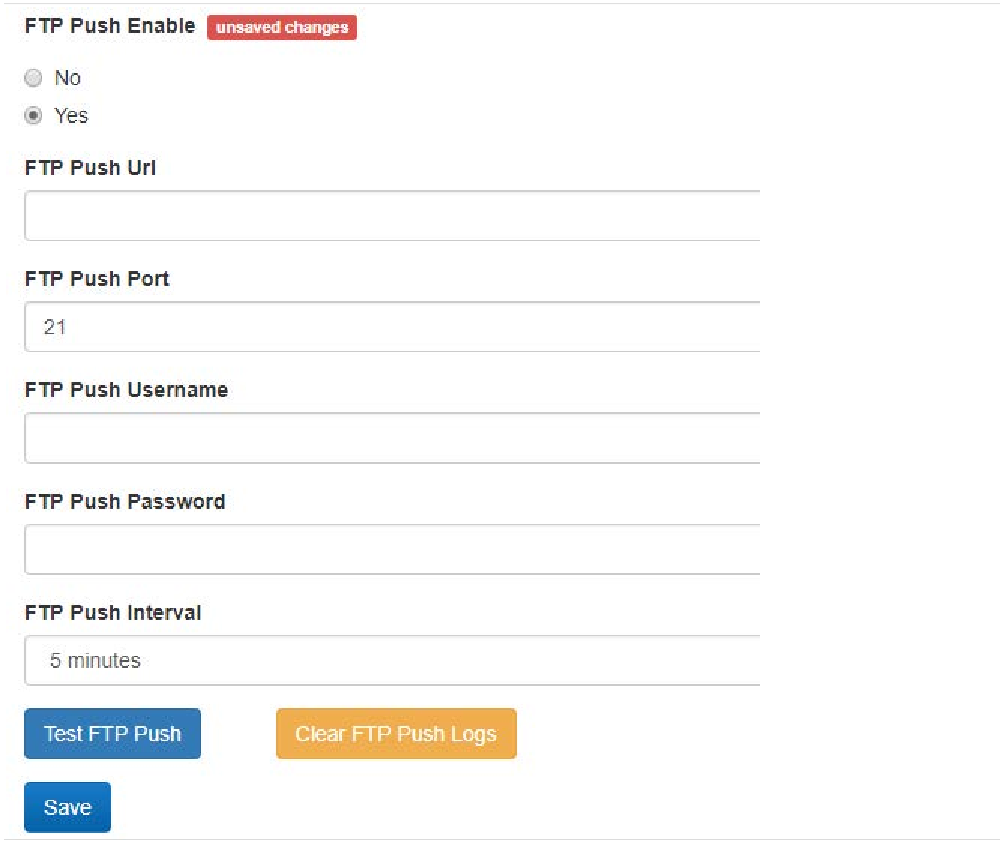
FTP Push Interval: Select how frequently the data should be uploaded to the FTP server. The data can be posted in intervals from 15 seconds to 1 month.

Note: The "TEST FTP Push" button should only be utilized after clicking the "Save" button, otherwise a fail response will be observed. If a fail response occurs after clicking "Save", the settings should be double checked or troubleshooting on the server side may be required.

In the case the network or FTP server is down and the module cannot send the data to the server, it will accumulate all the failed posts and send them out when the network is up. These failed posts can be cleared by clicking the "Clear FTP Push Logs".

Click "Save" after changing any settings. Users will be prompted to reboot the PXM 1000 Ethernet Module immediately or later. If later is chosen, the PXM 1000 Ethernet Module will need to be rebooted from the "Management" page.

Figure 131. Uploading FTP Data Settings Page.



FTP Push Enable

○ No
● Yes

FTP Push Url

FTP Push Port
21

FTP Push Username

FTP Push Password

FTP Push Interval
5 minutes

SNMP:

The PXM 1000 Ethernet Module module supports the Simple Network Management Protocol (SNMP) for reporting the metering data to the management station. The PXM 1000 Ethernet Module uses a public community string for read-only access. By default, the module will communicate using SNMP port 161. The PXM 1000 Ethernet Module also supports traps to send unsolicited messages to up to four management stations.

The settings for the SNMP protocol can be found by clicking on the “Settings” tab and selecting “Communications”. Select "SNMP" to access the settings to configure the PXM 1000 Ethernet Module to communicate with a SNMP management station.

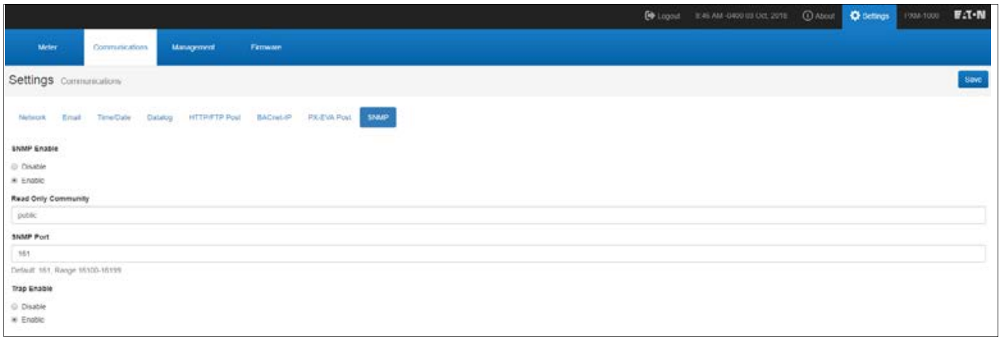
SNMP Enable: Select “Enable” to enable the function and to further configure the settings related to the SNMP protocol.

Read Only Community: By default, the community string is public, this configuration is similar to a password which allows only authorized users to access the meters data.

SNMP Port: By default, the SNMP Port is configured to 161. The SNMP Port can be any value from 16,100 to 16,199.

Trap Enable: Select “Enable” so that the meter will send a message to the management station when an event is triggered. The event could be a change in digital input status (DIS). The notification can then be sent to up to four stations.

Figure 132. SNMP Settings Page.



Settings Communications

SNMP Enable
○ Disable
● Enable

Read Only Community
public

SNMP Port
161
Default: 161, Range 16100-16199

Trap Enable
○ Disable
● Enable

Trap Target 1: Enter the IP address and port number of station number 1 that should be notified when there is an event.

Trap Target 2: Enter the IP address and port number of station number 2 that should be notified when there is an event.

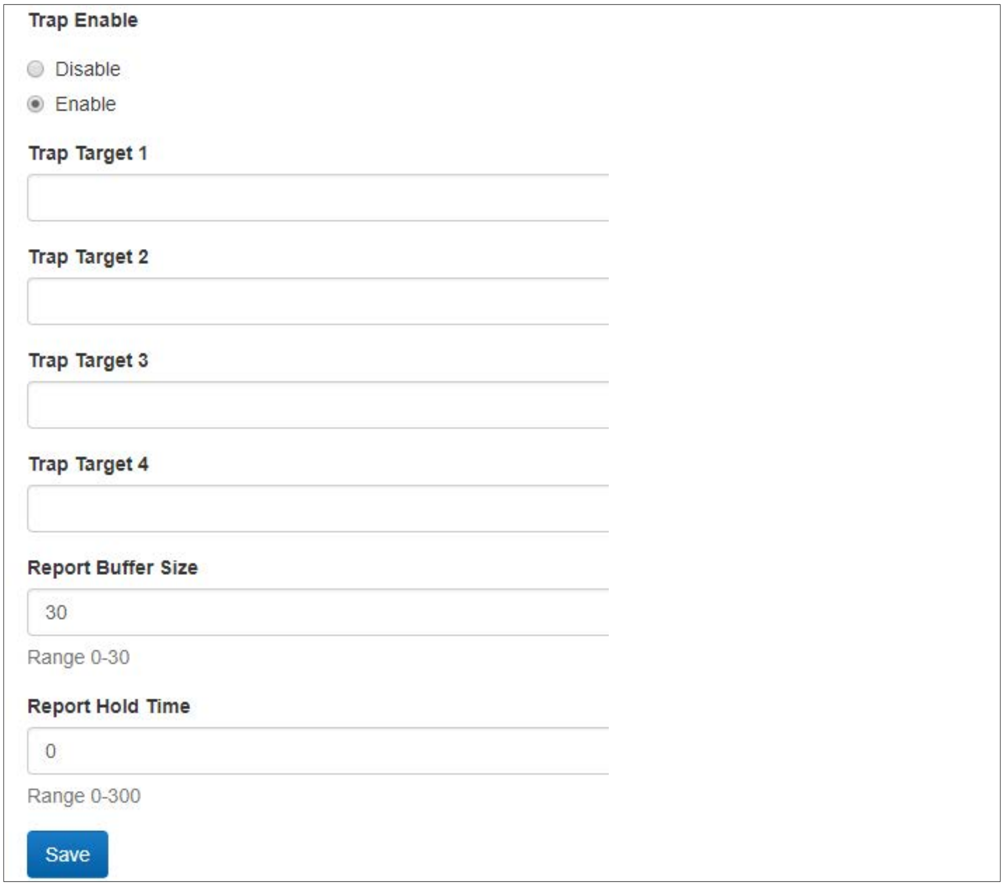
Trap Target 3: Enter the IP address and port number of station number 3 that should be notified when there is an event.

Trap Target 4: Enter the IP address and port number of station number 4 that should be notified when there is an event.

Report Buffer Size: Enter the size of the buffer for the amount of notifications will be stored before being sent to the management station. A maximum of 30 notifications can be stored.

Report Hold Time: Enter the time in seconds for how long the notification will be in queue before it gets sent to the management station. By default, this setting is configured to 0 so the notification will be sent immediately after an event occurs. This setting could be configured from 0-300 seconds.

Figure 133. Trap Settings Page.



Trap Enable

○ Disable

● Enable

Trap Target 1

Trap Target 2

Trap Target 3

Trap Target 4

Report Buffer Size: 30

Range 0-30

Report Hold Time: 0

Range 0-300

Management:

The Management web page can be used to reset parameters such as the demand, energy, max/min, and the alarm records, reboot the web module, as well as setting or changing the password for the access levels. The user can also download the network log file for the module from this page which can be used for diagnostics of the module.

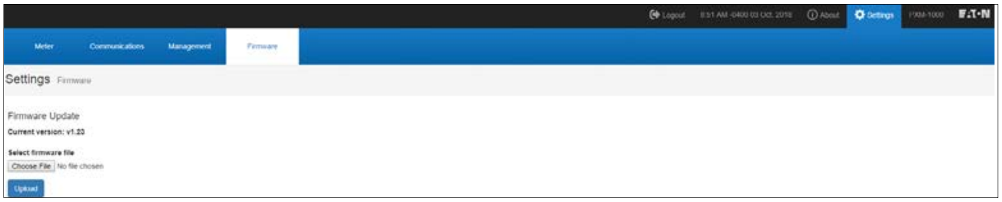
Note: Please send the log file to Eaton's Customer Integrity Team (mrsupport@eaton.com) for analysis.

This page is where the PXM 1000 Ethernet Module can be rebooted so that all changes and configurations can take effect. This can be done by clicking on "Reboot Communication Module".

Firmware:

The Firmware web page is used for updating the firmware version on the PXM 1000 Ethernet Module. The user can update the module if needed or they can contact Technical Support with the current firmware version of the PXM 1000 Ethernet Module which can be found from the Device Information page.

Figure 134. Firmware Settings Page.



Settings Firmware

Firmware Update

Current version: v1.23

Select firmware file

No file chosen

Note: There are two PXM1000 Hardware Revisions – Rev A and Rev B. Each of these Hardware Revisions would require a specific compatible firmware.

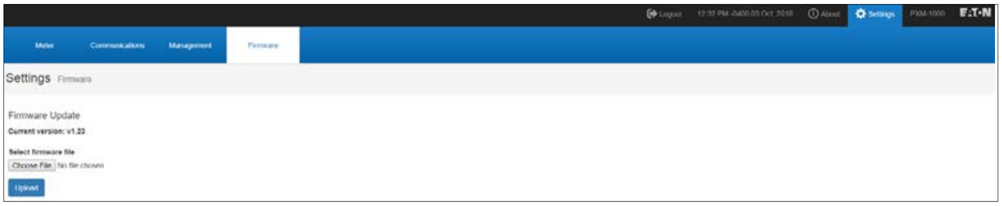
Hardware Rev A - Power Xpert Meter 1000 Meter Base (MA) firmware version

Hardware Rev B - Power Xpert Meter 1000 Meter Base (MB) firmware version 6.12

To update the module using the Select Firmware File option:

1. Click on "Choose File" and select the firmware file to update from your computer. Then click on "Upload".

Figure 135. Select the Firmware and Upload Page.



Settings Firmware

Firmware Update

Current version: v1.23

Select firmware file

No file chosen

Once the upload was successfully uploaded you will see the following page confirming that the file was uploaded.

2. Click "Process" to begin the update.

Figure 136. Upload Successful and Process Page.

Settings Firmware

Firmware Update

Current version: v1.23

Firmware file ready for processing

Ready to update

Your file was successfully uploaded. Click Process to begin update

The update will begin and you will see the following message: "Firmware update in progress."

Figure 137. Firmware Update in Progress Page.

Firmware Update

Current version: v1.23

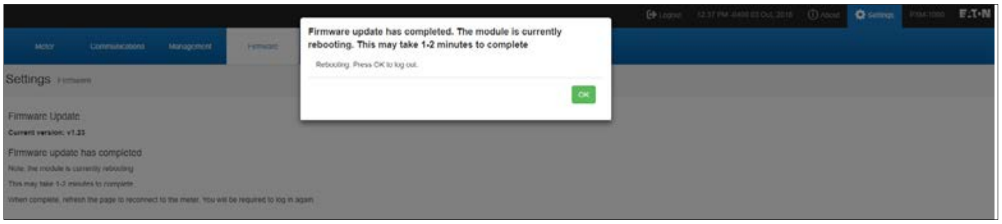
Updating firmware, please wait...

Firmware update in progress

Please note, this may take several minutes to complete

Once the update is complete, you will see the following page.

Figure 138. Firmware Update Successful Page.



Firmware update has completed. The module is currently rebooting. This may take 1-2 minutes to complete

Rebooting. Press OK to log out.

Firmware Update

Current version: v1.23

Firmware update has completed

Note: the module is currently rebooting

This may take 1-2 minutes to complete

When complete, refresh the page to reconnect to the meter. You will be required to log in again

Note: The module is currently rebooting. This may take 1-2 minutes to complete. When complete, refresh the page to reconnect to the meter. You will be required to log in again.

5.3 BACnet Communications

5.3.1 BACnet Overview

The Building Automation and Control Network (BACnet), described in the ANSI/ASHRAE Standard 135-1995, is one of the most widely used building management systems protocols. BACnet was designed to allow communication of building automation and control systems for applications such as heating, ventilating, and air-conditioning control, lighting control, access control, and fire detection systems and their associated equipment. The BACnet protocol provides mechanisms for computerized building automation devices to exchange information, regardless of the particular building service they perform.

5.3.2 Introduction

The PXM 1000 BACnet module supports BACnet communication using BACnet IP communication. It communicates in native BACnet IP over Ethernet to seamlessly integrate with most building automation/control systems. The PXM 1000 meter's BACnet IP protocol supports 106 objects which lets you track up 78 measurements and 28 I/O parameters.

The PXM 1000 meter supports native BACnet/IP that lets it act as a BACnet server in any BACnet application. The PXM 1000 meter's BACnet IP also comes with a web interface that allows users to configure the BACnet related parameters and read measurements by using a standard browser.

5.3.3 About BACnet Protocol

The BACnet protocol operates in a client-server environment. A client machine sends a service request (message) to a server machine. Once the service is performed, the results are reported back to the client machine. BACnet defines 5 groups (or classes) of 35 message types. For example, one class contains messages for retrieving and manipulating the object properties described above. An example of a common service request in this class is "ReadProperty." When the server machine receives this message from a client machine, it locates the requested property of the requested object and sends the value to the client.

The BACnet protocol consists of objects that contain different kinds of information. Each object has properties that contain data related to it.

Below is an example from the PXM1K-BIPP (BACnet/IP protocol) of an object for Total Active Power:

- Object instance: 18
- Object name: Total Active Power
- Object type: Analog Input
- Object unit: kW

For more detailed information, visit the BACnet website at www.bacnet.org.

5.3.4 Using the PXM 1000 Meter's BACnet Protocol

There are different Ethernet based-versions of BACnet. The dominant Ethernet version is BACnet/IP.

BACnet/IP has been developed to allow the BACnet protocol to use TCP/IP networks. You could say that BACnet/IP is a way of hooking BACnet up to the Internet and communicating with different Local Area Networks (LANs). This enables system owners, facility managers, or even external suppliers to access BACnet networks and manage their devices and systems remotely.

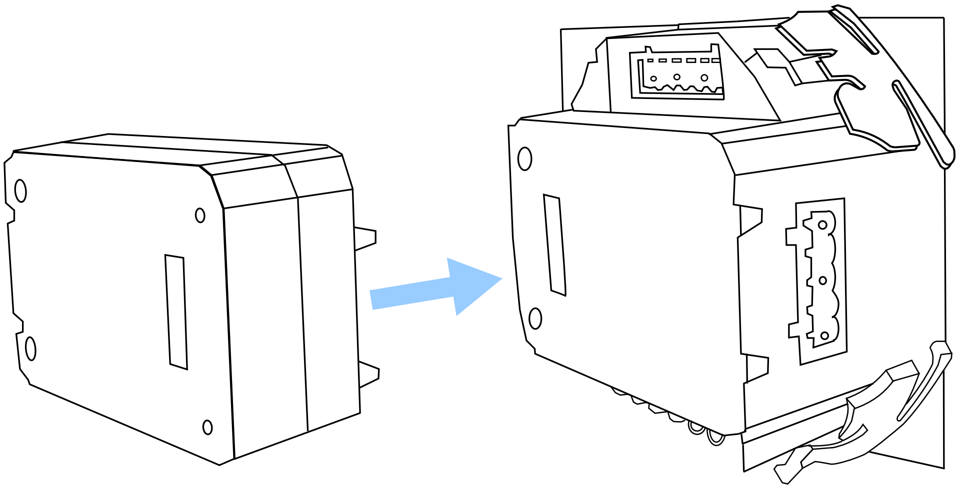
Table 27. BACnet/IP Characteristics.

Network type	Ethernet based network using UDP for data transfer.
Topology	Line or star topology (standard ethernet topology)
Installation	Ethernet twisted pair cables with RJ45 connectors
Speed	10/100 Mbit/s full duplex
Max. station	No network limitation of number of nodes.
Data	Up to 1,476 bytes per frame

5.3.5 Using the BACnet Module (PXM1K-BIPP)

5.3.5.1 Installation Method

Figure 139. BACnet Module Installation.



The BACnet module is linked to the PXM 1000 meter by a communication plug. It can also be linked to other extended modules like I/O modules.

1. Insert the installation clips to the counterpart of the meter, and then press the BACnet module lightly until linking is established.
2. Tighten the installation screws.

Notes:

- Install the BACnet module carefully to avoid damage;
- Under no circumstances should any installation be done with the meter powered on. Failure to do so may result in injury or death.

5.3.5.2 Definition of RJ45 Interface and 485 Interface

The BACnet/IP module uses a standard RJ45 connector to access the network.

Figure 140. BACnet Module Electrical Characteristics.

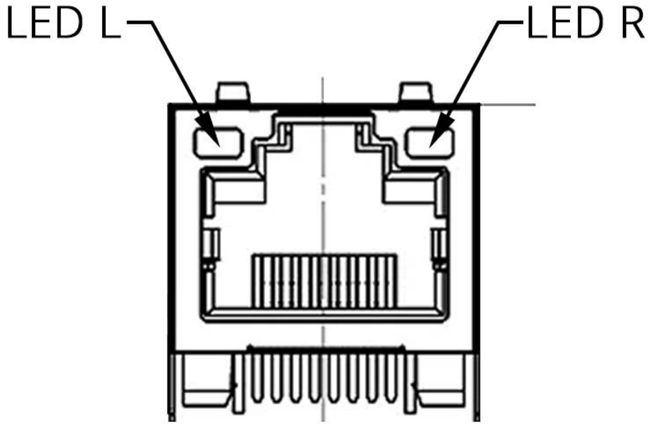


Figure 141. BACnet Module Electrical Characteristics of the Connectors.

Pin	Signal	Description
1	TX+	Tranceived Data+
2	TX-	Tranceived Data-
3	RX+	Received Data+
4	n/c	Not Connected
5	n/c	Not Connected
6	RX-	Received Data-
7	n/c	Not Connected
8	n/c	Not Connected

5.3.6 Initializing the BACnet Modules

5.3.6.1 BACnet/IP Module (PXM1K-BIPP)

PXM1K-BIPP module's default settings are as follows:

IP address (192.168.1.254); subnet mask (255.255.255.0); gateway (192.168.1.1); DNS1 (8.8.8.8); DNS2 (8.8.4.4).

The PXM 1000 will need to be configured in order to communicate with the PXM1K-BIPP.

The following process shows how to configure BACnet module settings by using the keys on the display.

- Pressing “H” key and “V/A” key simultaneously on the meter will go to the menu selecting mode. The “Meter” cursor flashes in this mode.
- Press the "P" or “E” key to move the cursor to "Setting". Press the “V/A” key to go into the meter parameter setting mode. Device address page is the first page of

“Setting”mode. It shows the Modbus address of the device for several seconds, before changing to the Password Setting Page and prompting for the password on the device. Press the “V/A” button to confirm the password and enter the Parameter Settings menu. Press the "V/A” key to enter the "SYS" System Setting page.

Figure 142. The Password Page.

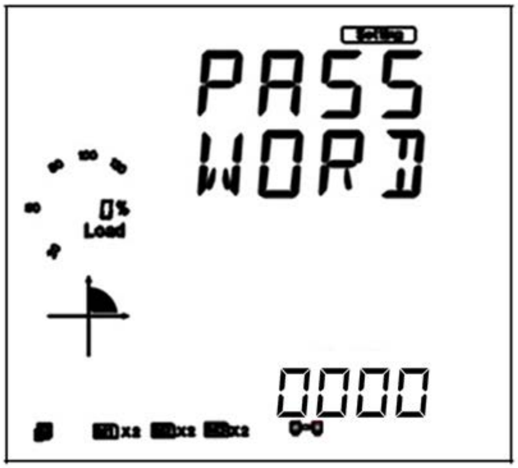
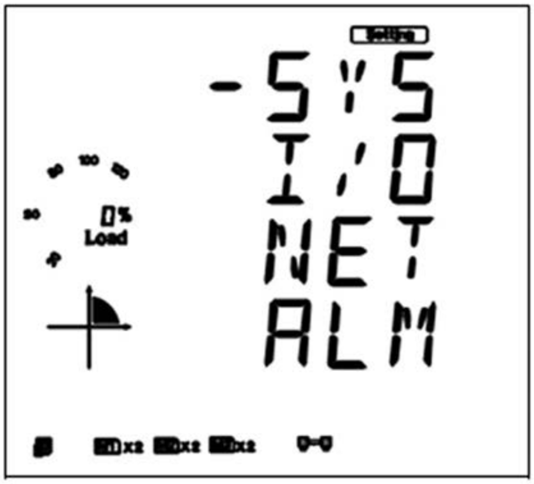


Figure 143. The System Settings Page.



- Once in the System Settings menu, the initial page is S01 ADDR, the meters RS485 address page. Press the "P" key to go to the S02 BPS2 page. The baud rate should be at 38,400.
- Press the "V/A" key to enter the edit mode to configure the desired baud rate using the "P" or "E" key. Select 38,400. Press the "V/A" key to confirm.
- Scroll through the settings using the "P” or “E” key until you reach the S31 Parity2 page. Press the "V/A" key to enter edit mode.
- Press the "P” or “E” key to change the setting to "1NO" and press the "V/A" key to confirm the setting.

- Press the "P” or “E” key to move to the page S34 PROTOCOL 2 page. Press the "V/A" key to enter edit mode.
- Press the "P” or “E” key to change the setting to "Other" and press the "V/A" key to confirm the setting.
- Press the "H" key to back out of the system settings and press the "E" key to move the cursor to "NET".
- Press"V/A" key to enter the BACnet module settings page to configure the IP address of the PXM1K-BIPP.
- Press the "P” key to move to N02 IP page. If you would like to change it, press the "V/A" key to enter edit mode.
- Press “V/A” to modify; the first digit will begin to flash.
- Press the “P” or “E” key to change the number of the flashing digit.
- Press “H” to switch the flashing digit.
- Press “V/A” to confirm the setting.
- Press the "P” key to move to the N03 SUBMASK page. If you would like to change it, press the "V/A" key to enter edit mode and follow the procedure for changing the IP address above.
- Press the "P” key to move to the N04 GATEWAY page. If you would like to change it, press the "V/A" key to enter edit mode and follow the procedure for changing the IP address above.
- Press the "P” key to move to the N05 DNS1 page. If you would like to change it, press the "V/A" key to enter edit mode and follow the procedure for changing the IP address above.
- .Press the "P” key to move to the N06 DNS2 page. If you would like to change it, press the "V/A" key to enter edit mode and follow the procedure for changing the IP address above.

After making any changes to the settings above, the PXM1K-BIPP will require a reset in order for the setting to take effect.

- Press the "P” key to move to N09 NET REST page.
- Press "V/A" key to modify; “NO” should begin to flash.
- Press "P" key to change “NO” to “RESET”.
- Press "V/A" key to reset the module. “NO” will be displayed on the screen and the PXM1K-BIPP module settings should now take effect.

5.3.7 BACnet Objects

5.3.7.1 PXM1K-BIPP Reading Objects

The PXM1K-BIPP module for the PXM 1000 meter supports 78 predefined objects based on the meters real-time measurement parameters. There is no programming or mapping necessary to use the BACnet objects. The object’s name easily identifies the measurement they contain.

The following objects have the object type as Analog Inputs. The following table lists each of the objects with their instance number and the units of measurement.

Table 28. Analog Inputs (Continued).

Instance	Object Type	Name	Object Data Type	Units
1	Analog Input	Frequency	Float	Hz
2	Analog Input	Phase A Voltage	Float	V
3	Analog Input	Phase B Voltage	Float	V
4	Analog Input	Phase C Voltage	Float	V
5	Analog Input	Average Line Voltage	Float	V
6	Analog Input	Line Voltage AB	Float	V
7	Analog Input	Line Voltage BC	Float	V
8	Analog Input	Line Voltage CA	Float	V
9	Analog Input	Average Line Voltage	Float	V
10	Analog Input	Phase A Current	Float	A
11	Analog Input	Phase B Current	Float	A
12	Analog Input	Phase C Current	Float	A
13	Analog Input	Average Current	Float	A
14	Analog Input	Neutral Current	Float	A
15	Analog Input	Phase A Active Power	Float	kW
16	Analog Input	Phase B Active Power	Float	kW
17	Analog Input	Phase C Active Power	Float	kW
18	Analog Input	Total Active Power	Float	kW
19	Analog Input	Phase A Reactive Power	Float	kvar
20	Analog Input	Phase B Reactive Power	Float	kvar
21	Analog Input	Phase C Reactive Power	Float	kvar
22	Analog Input	Total Reactive Power	Float	kvar
23	Analog Input	Phase A Apparent Power	Float	kVA
24	Analog Input	Phase B Apparent Power	Float	kVA
25	Analog Input	Phase C Apparent Power	Float	kVA
26	Analog Input	Total Apparent Power	Float	kVA
27	Analog Input	Phase A Power Factor	Float	
28	Analog Input	Phase B Power Factor	Float	
29	Analog Input	Phase C Power Factor	Float	
30	Analog Input	Total Power Factor	Float	
31	Analog Input	Voltage Unbalance Factor	Float	%
32	Analog Input	Current Unbalance Factor	Float	%
33	Analog Input	Load Type	Float	
34	Analog Input	Active Power Demand	Float	kW
35	Analog Input	Reactive Power Demand	Float	kvar
36	Analog Input	Apparent Power Demand	Float	kVA
37	Analog Input	Phase A Current Demand	Float	A
38	Analog Input	Phase B Current Demand	Float	A
39	Analog Input	Phase C Current Demand	Float	A
40	Analog Input	Import Active Energy	Float	kWh
41	Analog Input	Export Active Energy	Float	kWh
42	Analog Input	Import Reactive Energy	Float	kWh
43	Analog Input	Export Reactive Energy	Float	kWh
44	Analog Input	Energy Total	Float	kWh

Table 28. Analog Inputs.

Instance	Object Type	Name	Object Data Type	Units
45	Analog Input	Energy Net	Float	kWh
46	Analog Input	Reactive Energy Total	Float	kvarh
47	Analog Input	Reactive Energy Net	Float	kvarh
48	Analog Input	Apparent Energy	Float	kVAh
49	Analog Input	Phase A Import Active Energy	Float	kWh
50	Analog Input	Phase A Export Active Energy	Float	kWh
51	Analog Input	Phase B Export Active Energy	Float	kWh
52	Analog Input	Phase B Export Active Energy	Float	kWh
53	Analog Input	Phase C Import Active Energy	Float	kWh
54	Analog Input	Phase C Export Active Energy	Float	kWh
55	Analog Input	Phase A Import Reactive Energy	Float	kvarh
56	Analog Input	Phase A Export Reactive Energy	Float	kvarh
57	Analog Input	Phase B Import Reactive Energy	Float	kvarh
58	Analog Input	Phase B Export Reactive Energy	Float	kvarh
59	Analog Input	Phase C Import Reactive Energy	Float	kvarh
60	Analog Input	Phase C Export Reactive Energy	Float	kvarh
61	Analog Input	Phase A Apparent Energy	Float	kVAh
62	Analog Input	Phase B Apparent Energy	Float	kVAh
63	Analog Input	Phase C Apparent Energy	Float	kVAh
64	Analog Input	Phase A Voltage THD	Float	%
65	Analog Input	Phase B Voltage THD	Float	%
66	Analog Input	Phase C Voltage THD	Float	%
67	Analog Input	Average Voltage THD	Float	%
68	Analog Input	Phase A Current THD	Float	%
69	Analog Input	Phase B Current THD	Float	%
70	Analog Input	Phase C Current THD	Float	%
71	Analog Input	Average Current THD	Float	%

Table 29. Binary Inputs (Continued).

Instance	Object Type	Name	Object Data Type
1	Binary Input	IO11-DI1	Bit
2	Binary Input	IO11-DI2	Bit
3	Binary Input	IO11-DI3	Bit
4	Binary Input	IO11-DI4	Bit
5	Binary Input	IO11-DI5	Bit
6	Binary Input	IO11-DI6	Bit
7	Binary Input	IO21-DI1	Bit
8	Binary Input	IO21-DI2	Bit
9	Binary Input	IO21-DI3	Bit
10	Binary Input	IO21-DI4	Bit
11	Binary Input	IO31-DI1	Bit
12	Binary Input	IO31-DI2	Bit
13	Binary Input	IO31-DI3	Bit
14	Binary Input	IO31-DI4	Bit

Table 29. Binary Inputs (Continued).

Instance	Object Type	Name	Object Data Type
15	Binary Input	IO12-DI1	Bit
16	Binary Input	IO12-D2	Bit
17	Binary Input	IO12-DI3	Bit
18	Binary Input	IO12-DI4	Bit
19	Binary Input	IO12-DI5	Bit
20	Binary Input	IO12-DI6	Bit
21	Binary Input	IO22-DI1	Bit
22	Binary Input	IO22-DI2	Bit
23	Binary Input	IO22-DI3	Bit
24	Binary Input	IO22-DI4	Bit
25	Binary Input	IO32-DI1	Bit
26	Binary Input	IO32-DI2	Bit
27	Binary Input	IO32-DI3	Bit
28	Binary Input	IO32-DI4	Bit

Table 30. Analog Inputs: I/O Module.

Instance	Object Type	Name	Object Data Type	Units
1001	Analog Input	IO21-AI1	Float	mA/Volts
1002	Analog Input	IO21-AI2	Float	mA/Volts
1003	Analog Input	IO22-AI3	Float	mA/Volts
1004	Analog Input	IO22-AI4	Float	mA/Volts
1005	Analog Input	IO31-AI1	Float	mA/Volts
1006	Analog Input	IO31-AI2	Float	mA/Volts
1007	Analog Input	IO32-AI3	Float	mA/Volts
1008	Analog Input	IO32-AI4	Float	mA/Volts

Table 31. Analog Inputs: DI Counter (Continued).

Instance	Object Type	Name
2001	Analog Input	IO11-DI1-Counter
2002	Analog Input	IO11-DI2-Counter
2003	Analog Input	IO11-DI3-Counter
2004	Analog Input	IO11-DI4-Counter
2005	Analog Input	IO11-DI5-Counter
2006	Analog Input	IO11-DI6-Counter
2007	Analog Input	IO21-DI1-Counter
2008	Analog Input	IO21-DI2-Counter
2009	Analog Input	IO21-DI3-Counter
2010	Analog Input	IO21-DI4-Counter
2011	Analog Input	IO31-DI1-Counter
2012	Analog Input	IO31-DI2-Counter
2013	Analog Input	IO31-DI3-Counter
2014	Analog Input	IO31-DI4-Counter
2015	Analog Input	IO12-DI1-Counter
2016	Analog Input	IO12-D2-Counter

Table 31. Analog Inputs: DI Counter (Continued).

Instance	Object Type	Name
2017	Analog Input	IO12-DI3-Counter
2018	Analog Input	IO12-DI4-Counter
2019	Analog Input	IO12-DI5-Counter
2020	Analog Input	IO12-DI6-Counter
2021	Analog Input	IO22-DI1-Counter
2022	Analog Input	IO22-DI2-Counter
2023	Analog Input	IO22-DI3-Counter
2024	Analog Input	IO22-DI4-Counter
2025	Analog Input	IO32-DI1-Counter
2026	Analog Input	IO32-DI2-Counter
2027	Analog Input	IO32-DI3-Counter
2028	Analog Input	IO32-DI4-Counter

5.3.8 PXM1K-BIPP through the Web Server

5.3.8.1 Configuring the BACnet-IP Settings

To configure the BACnet related setting on the PXM1K-BIPP, users must use the built in web server. Ensure the network settings related to the PXM1K-BIPP are configured correctly so it can be accessed by a computer within the LAN.

- Open an Internet browser and enter the IP address of the meter.
- Login in with "Admin" access.

Note: The default password for the Admin user access is "admin".

- Click on "Settings" and select the "Communications" tab.

Figure 144. Opening the Communications Tab.

Select the "BACnet-IP" tab to configure the settings related to BACnet-IP protocol.

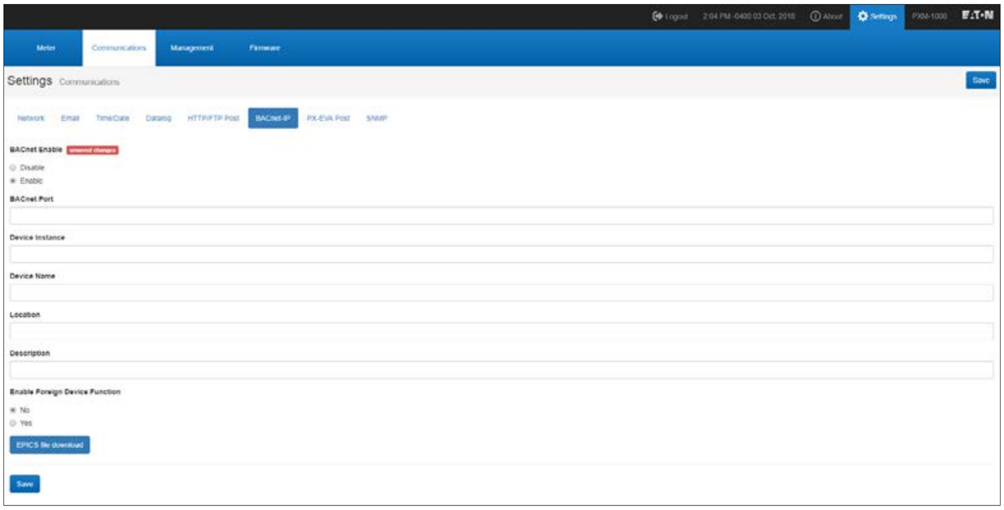
Figure 145. The BACnet Tab.

BACnet Enable

● Disable
○ Enable

Under "BACnet Enabled", select “Enable” to enable the BACnet protocol.

Figure 146. Enabling the BACnet Protocol.



BACnet Enable
○ Disable
● Enable

BACnet Port

Device Instance

Device Name

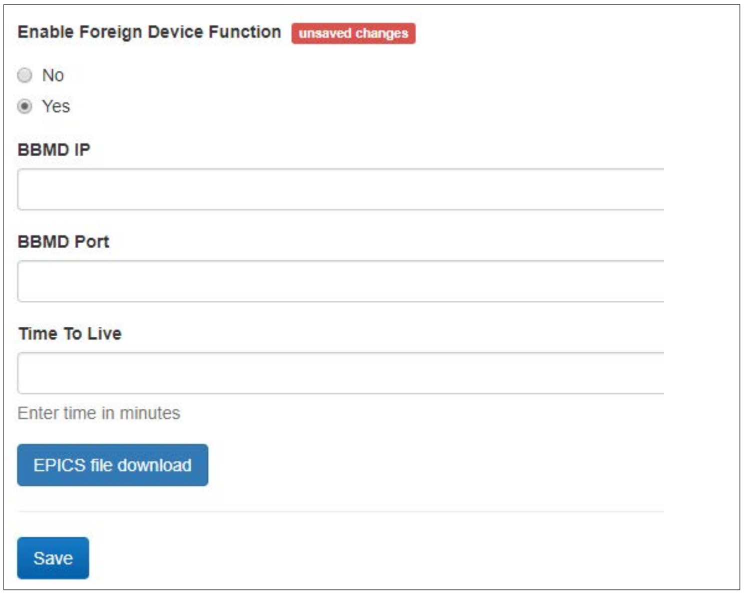
Location

Description

Enable Foreign Device Function
● No
○ Yes

- Enter the "BACnet Port" or the UDP port number. The default port is 47808.
- Enter a "Device Instance" for the device which is the instance number for the device object in the BACnet system. It must be unique within the system.
- Enter the "Network ID" number for the BACnet IP network in which the device resides. The Network ID would need to be the same for the BACnet devices to communicate with each other.
- Enter a "Device Name" for the device to distinguish it from other devices within the network.
- Under the "Enable Foreign Device Function", select “Enable” to communicate with a BACnet device from another subnet.
- Enter the IP of the BACnet Broadcast Management Device (BBMD) under the “BBMD IP” field for the device which will receive broadcast messages on one subnet and forward them to another subnet.
- Enter BACnet Port of the BBMD in "BBMD Port"
- Enter a value between 5-1440 min. in the "Time To Live" for how often the foreign device will register in the BBMD’s foreign device table.

Figure 147. Entering the "Time To Live" Value.



Enable Foreign Device Function unsaved changes

○ No
● Yes

BBMD IP

BBMD Port

Time To Live

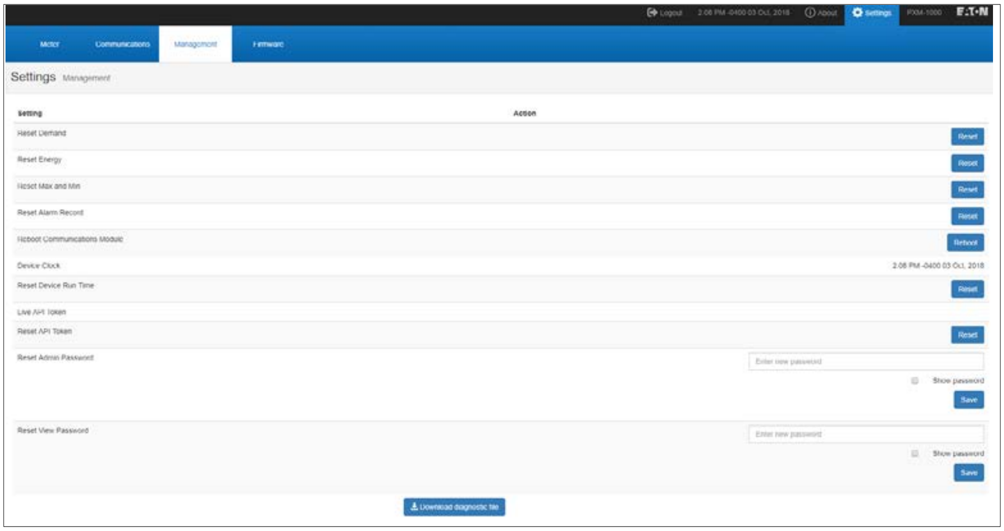
Enter time in minutes

- Click “Save” to save all settings to the module.

The module will require a reboot in order for the settings to take effect.

- Click on “Settings” and select “Management”.
- Click on the “Reboot” button on the "Reboot Communications Module" option.

Figure 148. Resetting the Communications Module.



Settings Management

Setting	Action
Reset Demand	Reset
Reset Energy	Reset
Reset Max and Min	Reset
Reset Alarm Record	Reset
Reboot Communications Module	Reboot
Device Clock	2:06 PM -0400 03 Oct, 2018
Reset Device Run Time	Reset
Live API Token	
Reset API Token	Reset
Reset Admin Password	Enter new password ☐ Show password Save
Reset View Password	Enter new password ☐ Show password Save

5.3.8.2 BACnet Protocol Implementation Conformity Statement

The EPICS document for the PXM1K-BIPP can be found on the Eaton website at www.eaton.com. The PICS document for the PXM1K-BIPP can be downloaded from the following URL:

http://www.eaton.com/us/en-us/catalog/low-voltage-power-distribution-controls-systems/power-xpert-meter-1000.html

6. Communication

This chapter will mainly discuss how to handle the meter via the communication port using

This chapter will mainly discuss how to communicate using the Modbus protocol. It is highly recommended that previous chapters be read before moving onto Chapter 6, a familiarity with Modbus would also be helpful.

6.1 Modbus Protocol Introduction

Modbus RTU is the communication protocol used in PXM 1000 meters. Data format and error check methods are defined in the Modbus protocol. The half duplex query and respond mode is adopted in the Modbus protocol. There is only one master device in the communication network. The others are slave devices, waiting for the query of the master.

Transmission Mode

The mode of transmission defines the data structure within a frame and the rules used to transmit data. The mode is defined in the following which is compatible with Modbus RTU mode.

Framing

Table 32. Data Framing

Address	Function	Data	Check
8-Bits	8-Bits	Nx8-Bits	16-Bits

Coding System	8-Bit Binary
Start Bit	1
Data Bits	8
Parity	No parity, odd parity, even parity
Stop Bit	1 or 2
Error Checking	CC check

Address Field

The address field of a message frame contains eight bits. Valid slave device addresses are in the range of 0~247 decimal. A master addresses a slave by placing the slave address in the address field of the message. When the slave sends its response, it places its own address in this address field of the response to let the master know which slave is responding.

Function Field

The function code field of a message frame contains eight bits. Valid codes are in the range of 1~255 decimal. When a message is sent from a master to a slave device the function code field tells the slave what kind of action to perform.

Table 33. Function Code Transmission

Code	Meaning	Action
01	Read Relay Output Status	Obtain current status of Relay Output
02	Read Digital Input (DI) Status	Obtain current status of Digital Input
03	Read Data	Obtain current binary value from one or more registers
05	Control Relay Output	Force relay state to “ON” or “OFF”
16	Press Multiple-Register	Place specific binary values into a series of consecutive Multiple-Registers

Data Field

The data field is constructed using sets of two hexadecimal digits, in the range of 00 to FF hexadecimal. The data field of messages sent from a master to slave devices contains additional information which the slave must use to take the action defined by the function code. This can include items such as register addresses, the quantity of items to be handled, and the count of actual data bytes in the field. For example, if the master writes to a group of registers in the slave (function code 10 hexadecimal), the data field specifies the starting register, how many registers to write, the count of data bytes to follow 234 in the data field, and the data to be written into the registers.

If no error occurs, the data field of a response from a slave to a master contains the data requested. If an error occurs, the field contains an exception code that the master application can use to determine the next action to be taken. The data field can be non existent if there is zero length in certain kinds of messages.

Error Check Field

Every message includes an error checking field which is based on the Cyclical Redundancy Check (CRC) method. The CRC field checks the contents of the entire message. It is applied regardless of any parity check method used for the individual characters of the message. The CRC field is two bytes long, containing a 16-bit binary value. The CRC value is calculated by the transmitting device, and is appended to the message. The receiving device recalculates the CRC value during reception of the message, and compares the calculated value to the actual value it received in the CRC field. If the two values are not equal, an error will be reported. CRC calculation is first started by preloading the whole 16-bit register to 1's. The process begins by applying successive 8-bit bytes of the message to the current contents of the register. Only the eight bits of data in each character are used for generating the CRC. Start and stop bits and the parity bit do not apply to the CRC. When generating the CRC, each 8-bit character is exclusive "ORed" with the register contents. The result is shifted towards the least significant bit (LSB), with a zero filled into the most significant bit (MSB) position. The LSB is extracted and examined, if the LSB equals to 1, the register is exclusive "ORed" with a preset, fixed value; if the LSB equals to 0, no action will be taken. This process is repeated until eight shifts have been performed. After the last (eighth) shift, the next 8-bit byte is exclusive ORed with the register's current value, and the process repeats for eight more shifts as described above. After all the bytes of the message have been applied, the final contents of the register, which should exchange the high-byte and the low-byte, is the CRC value. When the CRC is appended to the message, the low-order byte is appended first, followed by the high-order byte.

6.2 Communication Format

Table 34. Explanation of Frame

Address	Function	Data start register HI	Data start register LO	Number of data start registers HI	Number of data start registers LO	CRC 16 HI	CRC 16 LO
06H	03H	00H	00H	00H	21H	84H	65H

1. Reading Relay Status

Function Code 01

This function code is used to read the status of the relay in the meter.

1=On, 0=Off, Relay1's address is 0000H,

Relay2's address is 0001H and so on.

The following query is to read the relay status for the meter with communication address 17.

Query:

Table 35. Read the Status of Relay1 and Relay2 Query Message

Address	Function	Data start register HI	Data start register LO	Number of data start reg-isters HI	Number of data start reg-isters LO	CRC 16 HI	CRC 16 LO
11H	01H	00H	00H	00H	02H	BFH	SBH

Response:

The PXM 1000 meter response includes the meter address, function code, quantity of data byte, the data, and error checking. An example response to read the status of Relay1 and Relay2 is shown as Table 6-5. The status of Relay1 and Relay2 are responding to the last 2 bits of the data.

Relay1: bit0, Relay2: bit1

Table 36. Relay Status Response

Address	Function	Byte Count	Data	CRC 16 HI	CRC 16 LO
11H	01H	01H	02H	D4H	89H

The content of the data is:

7	6	5	4	3	2	1	0
0	0	0	0	0	0	1	0
MSB							**LSB**

Relay1 = OFF (LSB), Relay2 = ON (Left to LSB)

2. Read Status of DI

Function Code 02 1=ON, 0=OFF

DI’s address is 0000H, D12’s address is 0001H, and so on.

The following query is to read the status of 4 DI’s of PXM 1000 meter with communication address 17.

Query:

Table 37. Read the Status of Relay1 and Relay2 Query Message

Address	Function	Data start register HI	Data start register LO	Number of data start reg-isters HI	Number of data start reg-isters LO	CRC 16 HI	CRC 16 LO
11H	02H	00H	00H	00H	04H	7BH	59H

Response:

The PXM 1000 meter response includes the meter address, function code, quantity of data characters, the actual data characters and error checking. An example response to read the status of 4 DIs are shown in Table 6-7. The DI status corresponds to the last 4 bits of the data.

DI1: bit0; DI2: bit1; DI3: bit2; DI4: bit3

Table 38. Relay Status Response

DI1: bit0		DI2: bit1		DI3: bit2		DI4: bit3
Transaction Identifier HI	Transaction Identifier LO	Protocol Identifier Hi	Protocol Identifier LO	Length HI	Length LO	Unit Identifier
11H	02H	00H	00H	00H	04H	7BH

Function	Byte Count	Data
02H	01H	0FH

The content of the data is:

7	6	5	4	3	2	1	0
0	0	0	0	1	1	1	1
MSB							LSB

3. Read Data (Function Code 03)

Query:

This function allows the master to obtain the measurement results from the PXM 1000 meter. Table 6-8 is an example of reading the measured data (F, V1 and V2) from slave device number 17, the data address of F is 4000H, 4001H; V1's address is 4002H, 4003 and V2's address is 4004H, 4005H.

Table 39. Read F, V1, V2 Query Message

Address	Function	Data start register HI	Data start register LO	Number of data start registers HI	Number of data start registers LO	CRC 16 HI	CRC 16 LO
11H	03H	40H	00H	00H	06H	D2H	98H

Response:

The PXM 1000 meter response includes the meter address, function code, quantity of data bytes, data and error checking. An example response to read F, V1 and V2 (F=42480000H (50.00Hz), V1=42C7CCCDH (99.9V), V2=42C83333H (100.1V)) is shown:

Table 40. Read F, V1 and V2 Message

Address	Function	Byte Count	Data1 HI	Data1 LO	Data2 HI	Data2 LO	Data3 HI	Data3 LO	Data4 HI	Data4 LO
11H	3H	0CH	42H	48H	00H	00H	42H	C7H	CCH	CDH

Data5 HI	Data5 LO	Data6 HI	Data6 LO	Data16 HI	Data16 LO
42H	C8H	33H	33H	CAH	7FH

4. Control Relay (Function Code 05)

Query:

This message forces a relay to either turn “ON” or “OFF”. Any relay that exists within PXM 1000 meter can be forced to either “ON” or “OFF” status. The data value FF00H will set the relay on and the value 0000H will turn it off; all other values are invalid and will not affect that relay.

The example below is a request to the PXM 1000 meter with the address of 17 to turn on Relay1.

Table 41. Control Relay Query Message

Address	Function	DO Address HI	DO Address LO	Value HI	Value LO	CRC 16 HI	CRC 16 LO
11H	05H	00H	00H	FFH	00H	8EH	AAH

Response:

The normal response to the command request is to re-transmit the message as received after the relay status has been altered.

Table 42. Control Relay Response Message

Address	Function	Relay Address HI	Relay Address LO	Value HI	Value LO	CRC 16 HI	CRC 16 LO
11H	05H	00H	00H	FFH	00H	8EH	AAH

5. Preset/Reset Multi-Register (Function Code 16)

Query:

Function 16 allows the user to modify the contents of a multi-register. Some registers of PXM 1000 meter can have their contents changed by this message. The example below is a request to an PXM 1000 meter with the address of 17 to preset Ep_imp as “17807783.3kWh”, while its HEX value is 0A9D4089H. Ep_imp data address is 4048H and 4049H.

Table 43. Preset Multi-Registers Query Message

Address	Function	Data start register HI	Data start register LO	Number of data start registers HI	Number of data start registers LO	Byte Count
11H	10H	40H	48H	00H	02H	04H

Value	Value LO	Value LO	Value LO	CRC HI	CRC LO
0AH	9DH	40H	89H	F1H	6AH

Response:

The normal response to a preset multi-register request includes the PXM 1000 meter address, function code, data start register, the number of registers, and error checking.

Table 44. Preset Multi-Register Response Message

Address	Function	Data start register HI	Data start register LO	Number of data start registers HI	Number of data start registers LO	CRC 16 HI	CRC 16 LO
11H	10H	40H	48H	00H	02H	D6H	8EH

6.3 Data Address Table and Application Details

There are several rules to follow in using the meter:

6.3.1 Data Type

"word" refers to 16-bit unsigned integer using one data address and 2 bytes of memory, it varies from 0 to 65535.

"int" refers to 16-bit integer using one data address and 2 bytes of memory, it varies from -32768 to 32767.

"dword" refers to 32-bit unsigned integer using two data addresses and 4 bytes of memory with high word at the front and low word at the end, it varies from 0 to 4294967295. Rx=high word*65536+low word.

"float" refers to 32-bit single value using two data addresses and 4 bytes of memory, it varies from -1.175494E-38 to 3.402823E+38.

6.3.2 Relationship between communication value and numerical value.

It is important to note that the numerical value may not be the same as the communication value. The following table shows how they respond to each other.

When current output CTs are selected, the value of CT2 is 1A or 5A, and when using the relationship listed below to count primary value, the value of CT2 should be original 1 or 5.

When a CT has a voltage output, the value of CT2 is 333mV, and when using the relationship listed below to count primary value, the value of CT2 should not be 333, but 1.

When using Rogowski Coil CTs (output 100mV/50Hz or 120mV/60Hz), the value of CT2 is 100. When using the relationship listed below to count the primary value, the value of CT2 should not be 100, but 1.

When you select a 80/100/200 mA CT, the value of CT2 is 80, 100 or 200, and use the relationship listed below to count primary value, the value of CT2 should not be 80, 100 or 200, but 1.

Table 45. Relationship of Parameters

Parameters	Relationship	Unit	Format Code
System parameters	Numerical value equals to communication value	No unit	F1
Run-time	T=Rx/100	Hour	F2
Clock	Numerical value equals to communication value	Unit of time	F3
Energy (primary)	Ep=Rx/10	kWh	F4
Reactive energy (primary)	Ep=Rx/10	kvarh	F5
Apparent energy (primary)	Ep=Rx/10	kVA	F6
Energy (secondary)	Ep=Rx/1000	kWh	F7
Reactive energy (secondary)	Ep=Rx/1000	kvarh	F8
Apparent energy (secondary)	Ep=Rx/1000	kVA	F9

Frequency	Ep=Rx/100	Hz	F10
Voltage	U=Rx×(PT1/PT2)/10	V	F11
Current, current demand	I=Rx×(CT1/CT2)/1000	A	F12
Power, demand	P=Rx×(PT1/PT2)×(CT1/CT2)	W	F13
Reactive power, demand	Q=Rx×(PT1/PT2)×(CT1/CT2)	Var	F14
Apparent power, demand	S=Rx×(PT1/PT2)×(CT1/CT2)	VA	F15
Power factor	PF=Rx/100	No unit	F16
Unbalance factor	Unbl=(Rx/1000)×100%	No unit	F17
THD	THD=(Rx/10000)×100%	No unit	F18
Harmonics	HDn=(Rx/10000)×100%	No unit	F19
Total odd HD	HDo=(Rx/10000)×100%	No unit	F20
Total even HD	HDe=(Rx/10000)×100%	No unit	F21
Crest factor	CF=Rx/1000	No unit	F22
K factor	KF=Rx/10	No unit	F23
THFF	THFF=(Rx/10000)×100%	No unit	F24
Phase angle	Phase angle=Rx/10	Degree	F25

IMPORTANT NOTE: Regions from “System parameters settings” to “Data logging 3 settings” are the regions that can be set and modified. Please follow these guidelines when communicating with the meter.

When function code 10H is used, one communication command can only modify contents in one region, such as “System parameters settings,” “System status parameter,” “Date and time table,” “Over/under limit alarming-Global settings,” “Over/under limit alarming-settings,” I/O Modules settings,” or “Data logging 1 settings, Data logging 2 settings, Data logging 3 settings.” Modification of the contents in both of two or more regions above cannot be accomplished in a single communication.

When function code 03H is used, the rules and limitations described above will not be applied.

6.3.3 System Parameter Setting

System parameters determine how the meter works. Please refer to Chapter 3 and Chapter 4 for more details.

Function code: 03H for reading, 10H for writing.

Data type: word

Table 46.

System Status 03H Read, 10H Write						
Address(H)	**Address(D)**	**Parameter**	**Range**	**Default**	**Data Type**	**Access Property**
0FFDH	4093	Frequency	0: 50Hz 1: 60Hz 2: 400Hz	0	Word	R/W
0FFEH	4094	First Communication Protocol	0: Modbus 1: DNP3.0	0	Word	R/W
0FFFH	4095	Parity for Communication Protocol 1	0: Even 1: Odd 2: Non2 3: Non1	3	Word	R/W
1000H	4096	Password	0~9999	0	Word	R/W

System Status 03H Read, 10H Write

Address(H)	Address(D)	Parameter	Range	Default	Data Type	Access Property
1001H	4097	Communication Address 1	1~247 (Modbus) 0~65534 (DNP3.0)	1	Word	R/W
1002H	4098	Baud Rate for Communication Protocol 1	1200~38400	19200	Word	R/W
1003H	4099	Voltage Input Wiring Type	0: 3LN 1: 1LN 2: 2LL 3: 3LL 4: 1LL	0	Word	R/W
1004H	4100	Current Input Wiring Type	0: 3CT 1: 1CT 2: 2CT	0	Word	R/W
1005H	4101	PT1 (High 16 bit)	50.0~500000.0	0	Word	R/W
1006H	4102	PT2 (Low 16 bit)		400	Word	R/W
1007H	4103	PT2	50.0~400.0	400	Word	R/W
1008H	4104	CT1	1~50000	CT1 = 5 , for 5A CT1 = 1 , for 333mV CT1 = 1 , for 80/100/200mA CT1 = 1000 , for RCT	Word	R/W
1009H	4105	CT2	1(A), 5(A), 333 (333mV), 80, 100, 200 (mA)	CT2 = 5, for 5A CT2 = 333, for 333mV CT2 = 100 , for 80/100/200mA CT2 = 120/60 or 100/50 , for RCT	Word	R/W
100AH	4106	kWh Pulse Constant	1~60000	5000	Word	R/W
100BH	4107	kvarh Pulse Constant	1~60000	5000	Word	R/W
100CH	4108	LCD Backlight Time	0-120	1	Word	R/W
100DH	4109	Demand Sliding Window Time	1~30	15	Word	R/W
100EH	4110	Demand Calculation Mode	0: Fixed Window 1: Sliding Window 2: Thermal 3: Rolling Window	1	Word	R/W
100FH	4111	Clear Demand	Only 1 works	0	Word	R/W
1010H	4112	Max/Min Clear	Only 1 works	0	Word	R/W
1011H	4113	Run Time Clear	Only 1 works	0	Word	R/W
1012H	4114	Current I1 Direction	0: Positive 1: Negative	0	Word	R/W
1013H	4115	Current I2 Direction	0: Positive 1: Negative	0	Word	R/W

System Status 03H Read, 10H Write

Address(H)	Address(D)	Parameter	Range	Default	Data Type	Access Property
1014H	4116	Current I3 Direction	0: Positive 1: Negative	0	Word	R/W
1015H	4117	VAR/PF Convention	0: IEC 1: IEEE	0	Word	R/W
1016H	4118	Clear Energy	Only 1 works	0	Word	R/W
1017H	4119	Energy Calculation Mode	0: Fundamental 1: Full wave	1	Word	R/W
1018H	4120	Reactive Power Measurement Mode	0: Real 1: General	0	Word	R/W
1019H	4121	Energy Display Mode	0: Primary 1: Secondary	0	Word	R/W
101AH	4122	Reset Ethernet Module	0: None 1: Reset 2: Default	0	Word	R/W
101BH	4123	Enable SOE	0: None 1: AXM-IO11 2: AXM-IO21 3: AXM-IO31 4: AXM-IO12 5: AXM-IO22 6: AXM-IO32	0	Word	R/W
101CH	4124	Clear Pulse Counter	0: None 1: AXM-IO11 2: AXM-IO21 3: AXM-IO31 4: AXM-IO12 5: AXM-IO22 6: AXM-IO32	0	Word	R/W
101DH	4125	Basic Parameter Mode	0: Secondary 1: Primary	0	Word	R/W
1020H	4128	Demand Calculation Slipping Time	1~30	1	Word	R/W
1021H	4129	Clear Alarm Records	1: Clear Alarm 0: No Clear	0	Word	R/W
1022H	4130	CT41	1-50000	1	Word	R/W
1023H	4131	CT42	1: 1A (5A Model) 5: 5A (5A Model) 333: 333mV (MV Model)) 100: RCT (MV Model)	5 (5A Model) 333 (MV Model)	Word	R/W

Note: When register 0FFEH is 0, the first communication protocol is set to MODBUS. When register 0FFEH is 1, the first communication protocol is set to DNP3.0. At this time, special DNP3.0 software is needed.

Additional MODBUS Registry details are available under Technical data sheets at: https://www.eaton.com/us/en-us/catalog/low-voltage-power-distribution-controls-systems/power-xpert-meter-1000.resources.html

100AH, 100BH setting method: 1000 * 3600 / (U * I * n * pulse constant) = pulse period (S), pulse period calculated by the pulse constant must be greater than the pulse width (20ms ~ 1000ms) of IO module DO setting, wherein n is applied with the user, and if the three-phase signals are added, then n is 3. U and I generally equal to user settings PT2 and CT2, i.e., rated voltage and rated current.

0x1017H: When selecting 400Hz type; supports full-wave only.

6.3.4 System Status Parameters

The "System status" indicates the events that have occurred in the meter, what kinds of flags are read by the user, and the index of the storage events. Flags should be cleared after being read by the controller; otherwise, new data will not be stored properly.

Function code: 03H for reading, 10H for writing. Data type: word

Table 47.

System Status 03H Read, 10H Write						
Address(H)	**Address(D)**	**Parameter**	**Range**	**Default**	**Data Type**	**Access Property**
101EH	4126	Sealed Non Standard Parameters	Bit0: 1st communication parameters Bit1: 2nd communication parameters Bit2: Clear Run time Bit3: DI Pulse count Bit4: TOU		Word	R/W
101FH	4127	Seal Status	0x0A: Sealed Other: Seal opened		Word	R/W
1020H	4128	Reserved			Word	R/W
1021H	4129	Clear Alarm Record	0x0A: Clear Other: Not Clear		Word	R/W
1022H-102DH	4130-4141	Reserved			Word	R/W
102EH	4142	System Status	Bit0: New alarm record Bit1: New SOE record		Word	R/W
102FH	4143	Baud Rate 2	4800~38400	38400	Word	R/W
1030H	4144	Parity 2	0: Even 1: Odd 2: Non2 3: Non1	3	Word	R/W
1031H	4145	Communication Address 2	1~247	1	Word	R/W
1032H	4146	Alarm Record Number	0: No alarming record 1~16: Last alarm record number		Word	R/W
1033H	4147	SOE Record Number	0: No SOE record 1~20: Last SOE record number		Word	R/W
1034H	4148	Run Time (High)	0~999999999		Word	R/W
1035H	4149	Run Time (Low)			Word	R/W

System Status 03H Read, 10H Write						
Address(H)	Address(D)	Parameter	Range	Default	Data Type	Access Property
1036H	4150	Expansion IO Modules Status	Bit0: AXM-IO11 Bit1: AXM-IO12 Bit2: AXM-IO21 Bit3: AXM-IO22 Bit4: AXM-IO31 Bit5: AXM-IO32 0: Disconnected 1: Connected		Word	R/W
1037H	4151	Reserved			Word	R/W
1038H	4152	2nd Communication Selection	0: Other Protocol 1: BACnet Protocol 2: Mesh Protocol 3: Wi-Fi	0	Word	R/W
1039H	4153	10 Year Holiday Setting Enable	1: Enable		Word	R/W
103AH	4154	Clear Sharp Tariff	0x0A: Clear Other: Not Clear		Word	R/W
103BH	4155	Clear Peak Tariff	0x0A: Clear Other: Not Clear		Word	R/W
103CH	4156	Clear Valley Tariff	0x0A: Clear Other: Not Clear		Word	R/W
103DH	4157	Clear Normal Tariff	0x0A: Clear Other: Not Clear		Word	R/W
103EH	4158	Clear Total	0x0A: Clear Other: Not Clear		Word	R/W

Note: Please refer to Chapter 3 and Chapter 4 for more details about parameter settings.

When register 1038H is 2, second communication is set to MESH, the baud rate should be set to "9600bps," and parity should be set to "NON1" for the second communication. When register 1038H is 1, the second communication protocol is set to BACnet protocol. When register 1038H is 0, the second communication protocol is set to other protocols, while second communication should select the second RS-485 module, PROFIBUS module, or Ethernet module. If the selected protocol does not match attached module, communication cannot process. If you use the Ethernet or PROFIBUS module, you should set 38400bps and NON1 for the second communication. While the Ethernet or PROFIBUS module will connect normally, the user cannot change the protocol, baud rate, or parity.

6.3.5 Date and Time Registers

Function code: 03H for reading, 10H for presetting.

Table 48.

Clock Settings: 03H Read, 10H Write					
Address(H)	**Address(D)**	**Parameter**	**Range**	**Data Type**	**Access Property**
103FH	4159	Week	0~6	Word	R/W
1040H	4160	Year	2000~2099	Word	R/W
1041H	4161	Month	1~12	Word	R/W
1042H	4162	Day	1~31	Word	R/W
1043H	4163	Hour	0-23	Word	R/W
1044H	4164	Minute	0-59	Word	R/W
1045H	4165	Second	0-59	Word	R/W

6.3.6 100ms Refresh Metering Parameters

Table 49.

Basic Measurements: 03H Read								
Address(H)	**Address(D)**	**Symbol**	**Parameter**	**Parameter Mode**		**Property**	**Data Type**	**Access Property**
				Primary Mode	**Secondary Mode**			
3000H-3001H	12288-12289	F	Frequency	F=Rx	F=Rx	Hz	Float	R
3002H-3003H	12290-12291	U1	Phase 1 Voltage	U=Rx	U=Rx*(PT1/PT2)	V	Float	R
3004H-3005H	12292-12293	U2	Phase 2 Voltage	U=Rx	U=Rx*(PT1/PT2)	V	Float	R
3006H-3007H	12294-12295	U3	Phase 3 Voltage	U=Rx	U=Rx*(PT1/PT2)	V	Float	R
3008H-3009H	12296-12297	Uavg	Average Phase Voltage	U=Rx	U=Rx*(PT1/PT2)	V	Float	R
300AH-300BH	12298-12299	U12	Line Voltage 1-2	U=Rx	U=Rx*(PT1/PT2)	V	Float	R
300CH-300DH	12300-12301	U23	Line Voltage 2-3	U=Rx	U=Rx*(PT1/PT2)	V	Float	R
300EH-300FH	12302-12303	U31	Line Voltage 3-1	U=Rx	U=Rx*(PT1/PT2)	V	Float	R
3010H-3011H	12304-12305	Ulavg	Average Line Voltage	U=Rx	U=Rx*(PT1/PT2)	V	Float	R
3012H-3013H	12306-12307	IL1	Total Phase A Current	I=Rx	I=Rx*(CT1/CT2)	A	Float	R
3014H-3015H	12308-12309	IL2	Total Phase B Current	I=Rx	I=Rx*(CT1/CT2)	A	Float	R
3016H-3017H	12310-12311	IL3	Total Phase C Current	I=Rx	I=Rx*(CT1/CT2)	A	Float	R
3018H-3019H	12312-12313	Iavg	Average Phase Current	I=Rx	I=Rx*(CT1/CT2)	A	Float	R

Basic Measurements: 03H Read

Address(H)	Address(D)	Symbol	Parameter	Parameter Mode		Property	Data Type	Access Property
				Primary Mode	Secondary Mode			
301AH-301BH	12314-12315	In	Neutral Current	I=Rx	I=Rx*(CT1/CT2)	A	Float	R
301CH-301DH	12316-12317	Pa	Phase A Power	P=Rx/1000	P=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kW	Float	R
301EH-301FH	12318-12319	Pb	Phase B Power	P=Rx/1000	P=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kW	Float	R
3020H-3021H	12320-12321	Pc	Phase C Power	P=Rx/1000	P=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kW	Float	R
3022H-3023H	12322-12323	Psum	Total System Power	P=Rx/1000	P=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kW	Float	R
3024H-3025H	12324-12325	Qa	Phase A Reactive Power	Q=Rx/1000	Q=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kvar	Float	R
3026H-3027H	12326-12327	Qb	Phase B Reactive Power	Q=Rx/1000	Q=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kvar	Float	R
3028H-3029H	12328-12329	Qc	Phase C Reactive Power	Q=Rx/1000	Q=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kvar	Float	R
302AH-302BH	12330-12331	Qsum	Total Reactive Power	Q=Rx/1000	Q=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kvar	Float	R
302CH-302DH	12332-12333	Sa	Phase A Apparent Power	S=Rx/1000	S=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kVA	Float	R
302EH-302FH	12334-12335	Sb	Phase B Apparent Power	S=Rx/1000	S=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kVA	Float	R
3030H-3031H	12336-12337	Sc	Phase C Apparent Power	S=Rx/1000	S=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kVA	Float	R
3032H-3033H	12338-12339	Ssum	Total Apparent Power	S=Rx/1000	S=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kVA	Float	R
3034H-3035H	12340-12341	PFa	Phase A Power Factor	PF=Rx	PF=Rx		Float	R
3036H-3037H	12342-12343	PFb	Phase B Power Factor	PF=Rx	PF=Rx		Float	R
3038H-3039H	12344-12345	PFc	Phase C Power Factor	PF=Rx	PF=Rx		Float	R
3403AH-303BH	12346-12347	PFsum	Total Power Factor	PF=Rx	PF=Rx		Float	R

6.3.7 Real Time Metering Parameters

There are two, different modes to read basic analog measurements. The first is secondary mode and the other is primary mode. In primary mode, the numerical value in the register of the meter is equal to the real, physical value. In secondary mode, the relationship between the numerical value in the register and the real physical value is shown in the following table. (Rx is the numerical value in the register of the PXM 1000 meter).

NOTE: The parameter mode Primary or Secondary corresponds to the Basic Parameter Mode (at address 101DH) in the system parameter settings. You can also configure the parameter mode from the 'S28 PARA MODE' in the system settings through the meter's display. The basic parameter mode of the meter is in Secondary Mode by default.

Table 50.

Energy Measurements: 03H Read, 10H Write								
Address(H)	Address(D)	Symbol	Parameter	Parameter Mode		Property	Data Type	Access Property
				Primary Mode	Secondary Mode			
4000H-4001H	16384-16385	F	Frequency	F=Rx	F=Rx	Hz	Float	R
4002H-4003H	16386-16387	U1	Phase 1 Voltage	U=Rx	U=Rx*(PT1/PT2)	V	Float	R
4004H-4005H	16388-16389	U2	Phase 2 Voltage	U=Rx	U=Rx*(PT1/PT2)	V	Float	R
4006H-4007H	16390-16391	U3	Phase 3 Voltage	U=Rx	U=Rx*(PT1/PT2)	V	Float	R
4008H-4009H	16392-16393	Uavg	Average Phase Voltage	U=Rx	U=Rx*(PT1/PT2)	V	Float	R
400AH-400BH	16394-16395	U12	Line Voltage 1-2	U=Rx	U=Rx*(PT1/PT2)	V	Float	R
400CH-400DH	16396-16397	U23	Line Voltage 2-3	U=Rx	U=Rx*(PT1/PT2)	V	Float	R
400EH-400FH	16398-16399	U31	Line Voltage 3-1	U=Rx	U=Rx*(PT1/PT2)	V	Float	R
4010H-4011H	16400-16401	Ulavg	Average Line Voltage	U=Rx	U=Rx*(PT1/PT2)	V	Float	R
4012H-4013H	16402-16403	IL1	Total Phase A Current	I=Rx	I=Rx*(CT1/CT2)	A	Float	R
4014H-4015H	16404-16405	IL2	Total Phase B Current	I=Rx	I=Rx*(CT1/CT2)	A	Float	R
4016H-4017H	16406-16407	IL3	Total Phase C Current	I=Rx	I=Rx*(CT1/CT2)	A	Float	R
4018H-4019H	16408-16409	Iavg	Average Phase Current	I=Rx	I=Rx*(CT1/CT2)	A	Float	R
401AH-401BH	16410-16411	In	Neutral Current	I=Rx	I=Rx*(CT1/CT2)	A	Float	R
401CH-401DH	16412-16413	Pa	Phase A Power	P=Rx/1000	P=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kW	Float	R
401EH-401FH	16414-16415	Pb	Phase B Power	P=Rx/1000	P=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kW	Float	R
4020H-4021H	16416-16417	Pc	Phase C Power	P=Rx/1000	P=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kW	Float	R

Energy Measurements: 03H Read, 10H Write								
Address(H)	Address(D)	Symbol	Parameter	Parameter Mode		Property	Data Type	Access Property
				Primary Mode	Secondary Mode			
4022H-4023H	16418-16419	Psum	Total System Power	P=Rx/1000	P=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kW	Float	R
4024H-4025H	16420-16421	Qa	Phase A Reactive Power	Q=Rx/1000	Q=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kvar	Float	R
4026H-4027H	16422-16423	Qb	Phase B Reactive Power	Q=Rx/1000	Q=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kvar	Float	R
4028H-4029H	16424-16425	Qc	Phase C Reactive Power	Q=Rx/1000	Q=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kvar	Float	R
402AH-402BH	16426-16427	Qsum	Total Reactive Power	Q=Rx/1000	Q=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kvar	Float	R
402CH-402DH	16428-16429	Sa	Phase A Apparent Power	S=Rx/1000	S=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kVA	Float	R
402EH-402FH	16430-16431	Sb	Phase B Apparent Power	S=Rx/1000	S=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kVA	Float	R
4030H-4031H	16432-16433	Sc	Phase C Apparent Power	S=Rx/1000	S=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kVA	Float	R
4032H-4033H	16434-16435	Ssum	Total Apparent Power	S=Rx/1000	S=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kVA	Float	R
4034H-4035H	16436-16437	PFa	Phase A Power Factor	PF=Rx	PF=Rx		Float	R
4036H-4037H	16438-16439	PFb	Phase B Power Factor	PF=Rx	PF=Rx		Float	R
4038H-4039H	16440-16441	PFc	Phase C Power Factor	PF=Rx	PF=Rx		Float	R
403AH-403BH	16442-16443	PFsum	Total Power Factor	PF=Rx	PF=Rx		Float	R
403CH-403DH	16444-16445	U_unbl	Voltage Unbalance	U=Rx*100%	U=Rx*100%	%	Float	R
403EH-403FH	16446-16447	I_unbl	Current Unbalance	I=Rx*100%	I=Rx*100%	%	Float	R
4040H-4041H	16448-16449	L/C/R	Load Characteristic	76.0(L) 67.0(C) 82.0(R)	76.0(L) 67.0(C) 82.0(R)		Float	R
4042H-4043H	16450-16451	P_Dmd	Power Demand	P=Rx/1000	P=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kW	Float	R
4044H-4045H	16452-16453	Q_Dmd	Reactive Power Demand	S=Rx/1000	S=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kVA	Float	R
4046H-4047H	16454-16455	S_Dmd	Apparent Power Demand	Q=Rx/1000	Q=[Rx*(PT1/PT2)*(CT1/CT2)]/1000	kvar	Float	R

Energy Measurements: 03H Read, 10H Write								
Address(H)	Address(D)	Symbol	Parameter	Parameter Mode		Property	Data Type	Access Property
				Primary Mode	Secondary Mode			
4600H-4601H	17920-17921	I1_Dmd	Phase A Current Demand	I=Rx	I=Rx*(CT1/CT2)	A	Float	R
4602H-4603H	17922-17923	I2_Dmd	Phase B Current Demand	I=Rx	I=Rx*(CT1/CT2)	A	Float	R
4604H-4605H	17924-17925	I3_Dmd	Phase C Current Demand	I=Rx	I=Rx*(CT1/CT2)	A	Float	R

6.3.8 Energy Parameters

NOTE: The Energy Display option of either Primary Mode or Secondary Mode corresponds to the Energy Display Mode (at address 1019H) in the system parameter settings. You can also configure the energy display mode from the 'S24 E SEL' in the system settings through the meters display. The energy display mode is in Primary Mode by default.

Table 51.

Energy Measurements: 03H Read, 10H Write								
Address(H)	Address(D)	Symbol	Parameter	Parameter Mode		Property	Data Type	Access Property
				Primary Mode	Secondary Mode			
4048H-4049H	16456-16457	Ep_Imp	Consumed Energy	Ep_ Imp=Rx/10	Ep_ Imp=Rx/1000	0~999999999	kWh	R/W
404AH-404BH	16458-16459	Ep_Exp	Generated Energy	Ep_ Exp=Rx/10	Ep_ Exp=Rx/1000	0~999999999	kWh	R/W
404CH-404DH	16460-16461	Eq_Imp	Consumed Reactive Energy	Eq_ Imp=Rx/10	Eq_ Imp=Rx/1000	0~999999999	kvarh	R/W
404EH-404FH	16462-16463	Eq_Exp	Generated Reactive Energy	Eq_ Exp=Rx/10	Eq_ Exp=Rx/1000	0~999999999	kvarh	R/W
4050H-4051H	16464-16465	Ep_sum	Total Energy	Ep_ sum=Rx/10	Ep_ sum=Rx/1000	0~999999999	kWh	R/W
4052H-4053H	16466-16467	Ep_net	Net Energy	Ep_ net=Rx/10	Ep_ net=Rx/1000	±999999999	kWh	R/W
4054H-4055H	16468-16469	Eq_sum	Total Reactive Energy	Eq_ sum=Rx/10	Eq_ sum=Rx/1000	0~999999999	kvarh	R/W
4056H-4057H	16470-16471	Eq_net	Net Reactive Energy	Eq_ net=Rx/10	Eq_ net=Rx/1000	±999999999	kvarh	R/W
4058H-4059H	16472-16473	Es	Apparent Energy	Es=Rx/10	Es=Rx/1000	0~999999999	kVAh	R/W
4620H-4621H	17952-17953	Epa_Imp	Phase A Consumed Energy	Epa_ Imp=Rx/10	Epa_ Imp=Rx/1000	0~999999999	kWh	R/W
4622H-4623H	17954-17955	Epa_Exp	Phase A Generated Energy	Epa_ Exp=Rx/10	Epa_ Exp=Rx/1000	0~999999999	kWh	R/W

Energy Measurements: 03H Read, 10H Write								
Address(H)	Address(D)	Symbol	Parameter	Parameter Mode		Property	Data Type	Access Property
				Primary Mode	Secondary Mode			
4624H-4625H	17956-17957	Epb_Imp	Phase B Consumed Energy	Epb_ Imp=Rx/10	Epb_ Imp=Rx/1000	0~999999999	kWh	R/W
4626H-4627H	17958-17959	Epb_Exp	Phase B Generated Energy	Epb_ Exp=Rx/10	Epb_ Exp=Rx/1000	0~999999999	kWh	R/W
4628H-4629H	17960-17961	Epc_Imp	Phase C Consumed Energy	Epc_ Imp=Rx/10	Epc_ Imp=Rx/1000	0~999999999	kWh	R/W
462AH-462BH	17962-17963	Epc_Exp	Phase C Generated Energy	Epc_ Exp=Rx/10	Epc_ Exp=Rx/1000	0~999999999	kWh	R/W
462CH-462DH	17964-17965	Eqa_Imp	Phase A Consumed Reactive Energy	Eqa_ Imp=Rx/10	Eqa_ Imp=Rx/1000	0~999999999	kvarh	R/W
462EH-462FH	17966-17967	Eqa_Exp	Phase A Generated Reactive Energy	Eqa_ Exp=Rx/10	Eqa_ Exp=Rx/1000	0~999999999	kvarh	R/W
4630H-4631H	17968-17969	Eqb_Imp	Phase B Consumed Reactive Energy	Eqb_ Imp=Rx/10	Eqb_ Imp=Rx/1000	0~999999999	kvarh	R/W
4632H-4633H	17970-17971	Eqb_Exp	Phase B Generated Reactive Energy	Eqb_ Exp=Rx/10	Eqb_ Exp=Rx/1000	0~999999999	kvarh	R/W
4634H-4635H	17972-17973	Eqc_Imp	Phase C Consumed Reactive Energy	Eqc_ Imp=Rx/10	Eqc_ Imp=Rx/1000	0~999999999	kvarh	R/W
4636H-4637H	17974-17975	Eqc_Exp	Phase C Generated Reactive Energy	Eqc_ Exp=Rx/10	Eqc_ Exp=Rx/1000	0~999999999	kvarh	R/W
4638H-4639H	17976-17977	Esa	Phase A Apparent Energy	Esa=Rx/10	Esa=Rx/1000	0~999999999	kVA	R/W
463AH-463BH	17978-17979	Esb	Phase B Apparent Energy	Esb=Rx/10	Esb=Rx/1000	0~999999999	kVA	R/W
463CH-463DH	17980-17981	Esc	Phase C Apparent Energy	Esc=Rx/10	Esc=Rx/1000	0~999999999	kVA	R/W

6.3.9 TOU (Time-of-Use) Registers

Current Month Accumulation TOU Energy

Table 52. Table 6-21

Current month accumulation TOU Energy: 03H Read, 10H Write							
Address(H)	**Address(D)**	**Symbol**	**Parameter**	**Range**	**Property**	**Data Type**	**Access Property**
Sharp							
7200H-7201H	29184-29185	Ep_Imp	Consumed Energy	0-999999999	kWh	Dword	R/W
7202H-7203H	29186-29187	Ep_Exp	Generated Energy	0-999999999	kWh	Dword	R/W
7204H-7205H	29188-29189	Eq_Imp	Consumed Reactive Energy	0-999999999	kvarh	Dword	R/W
7206H-7207H	29190-29191	Eq_Exp	Generated Reactive Energy	0-999999999	kvarh	Dword	R/W
7208H-7209H	29192-29193	Es	Apparent Energy	0-999999999	kVAh	Dword	R/W
Peak							
720AH-720BH	29194-29195	Ep_Imp	Consumed Energy	0-999999999	kWh	Dword	R/W
720CH-720DH	29196-29197	Ep_Exp	Generated Energy	0-999999999	kWh	Dword	R/W
720EH-720FH	29198-29199	Eq_Imp	Consumed Reactive Energy	0-999999999	kvarh	Dword	R/W
7210H-7211H	29200-29201	Eq_Exp	Generated Reactive Energy	0-999999999	kvarh	Dword	R/W
7212H-7213H	29202-29203	Es	Apparent Energy	0-999999999	kVAh	Dword	R/W
Valley							
7214H-7215H	29204-29205	Ep_Imp	Consumed Energy	0-999999999	kWh	Dword	R/W
7216H-7217H	29206-29207	Ep_Exp	Generated Energy	0-999999999	KWh	Dword	R/W
7218H-7219H	29208-29209	Eq_Imp	Consumed Reactive Energy	0-999999999	kvarh	Dword	R/W
721AH-721BH	29210-29211	Eq_Exp	Generated Reactive Energy	0-999999999	kvarh	Dword	R/W
721CH-721DH	29212-29213	Es	Apparent Energy	0-999999999	kVAh	Dword	R/W
Normal							
721EH-721FH	29214-29215	Ep_Imp	Consumed Energy	0-999999999	kWh	Dword	R/W
7220H-7221H	29216-29217	Ep_Exp	Generated Energy	0-999999999	kWh	Dword	R/W

Current month accumulation TOU Energy: 03H Read, 10H Write							
Address(H)	Address(D)	Symbol	Parameter	Range	Property	Data Type	Access Property
7222H-7223H	29218-29219	Eq_Imp	Consumed Reactive Energy	0-999999999	kvarh	Dword	R/W
7224H-7225H	29220-29221	Eq_Exp	Generated Reactive Energy	0-999999999	kvarh	Dword	R/W
7226H-7227H	29222-29223	Es	Apparent Energy	0-999999999	kVAh	Dword	R/W
Total							
7228H-7229H	29224-29225	Ep_Imp	Consumed Energy	0-999999999	kWh	Dword	R/W
722AH-722BH	29226-29227	Ep_Exp	Generated Energy	0-999999999	kWh	Dword	R/W
722CH-722DH	29228-29229	Eq_Imp	Consumed Reactive Energy	0-999999999	kvarh	Dword	R/W
722EH-722FH	29230-29231	Eq_Exp	Generated Reactive Energy	0-999999999	kvarh	Dword	R/W
7230H-7231H	29232-29233	Es	Apparent Energy	0-999999999	kVAh	Dword	R/W

Prior Month Accumulation TOU Energy

Table 53.

Prior Month Accumulation TOU Energy: 03H Read, 10H Write							
Address(H)	Address(D)	Symbol	Parameter	Range	Property	Data Type	Access Property
Sharp							
7232H-7233H	29234-29235	Ep_Imp	Consumed Energy	0-999999999	kWh	Dword	R/W
7234H-7235H	29236-29237	Ep_Exp	Generated Energy	0-999999999	kWh	Dword	R/W
7236H-7237H	29238-29239	Eq_Imp	Consumed Reactive Energy	0-999999999	kvarh	Dword	R/W
7238H-7239H	29240-29241	Eq_Exp	Generated Reactive Energy	0-999999999	kvarh	Dword	R/W
723AH-723BH	29242-29243	Es	Apparent Energy	0-999999999	kVAh	Dword	R/W
Peak							
723CH-723DH	29244-29245	Ep_Imp	Consumed Energy	0-999999999	kWh	Dword	R/W
723EH-723FH	29246-29247	Ep_Exp	Generated Energy	0-999999999	kWh	Dword	R/W

Prior Month Accumulation TOU Energy: 03H Read, 10H Write							
Address(H)	**Address(D)**	**Symbol**	**Parameter**	**Range**	**Property**	**Data Type**	**Access Property**
7240H-7241H	29248-29249	Eq_Imp	Consumed Reactive Energy	0-999999999	kvarh	Dword	R/W
7242H-7243H	29250-29251	Eq_Exp	Generated Reactive Energy	0-999999999	kvarh	Dword	R/W
7244H-7245H	29252-29253	Es	Apparent Energy	0-999999999	kVAh	Dword	R/W
Valley							
7246H-7247H	29254-29255	Ep_Imp	Consumed Energy	0-999999999	kWh	Dword	R/W
7248H-7249H	29256-29257	Ep_Exp	Generated Energy	0-999999999	kWh	Dword	R/W
724AH-724BH	29258-29259	Eq_Imp	Consumed Reactive Energy	0-999999999	kvarh	Dword	R/W
724CH-724DH	29260-29261	Eq_Exp	Generated Reactive Energy	0-999999999	kvarh	Dword	R/W
724EH-724FH	29262-29263	Es	Apparent Energy	0-999999999	kVAh	Dword	R/W
Normal							
7250H-7251H	29264-29265	Ep_Imp	Consumed Energy	0-999999999	kWh	Dword	R/W
7252H-7253H	29266-29267	Ep_Exp	Generated Energy	0-999999999	kWh	Dword	R/W
7254H-7255H	29268-29269	Eq_Imp	Consumed Reactive Energy	0-999999999	kvarh	Dword	R/W
7256H-7257H	29270-29271	Eq_Exp	Generated Reactive Energy	0-999999999	kvarh	Dword	R/W
7258H-7259H	29272-29273	Es	Apparent Energy	0-999999999	kVAh	Dword	R/W
Total							
725AH-725BH	29274-29275	Ep_Imp	Consumed Energy	0-999999999	kWh	Dword	R/W
725CH-725DH	29276-29277	Ep_Exp	Generated Energy	0-999999999	kWh	Dword	R/W
725EH-725FH	29278-29279	Eq_Imp	Consumed Reactive Energy	0-999999999	kvarh	Dword	R/W
7260H-7261H	29280-29281	Eq_Exp	Generated Reactive Energy	0-999999999	kvarh	Dword	R/W
7262H-7263H	29282-29283	Es	Apparent Energy	0-999999999	kVAh	Dword	R/W

Current Month Incremental TOU Energy

Table 54.

Current Month Incremental TOU Energy: 03H Read, 10H Write							
Address(H)	**Address(D)**	**Symbol**	**Parameter**	**Range**	**Property**	**Data Type**	**Access Property**
Sharp							
7300H-7301H	29440-29441	Ep_Imp	Consumed Energy	0-999999999	kWh	Dword	R/W
7302H-7303H	29442-29443	Ep_Exp	Generated Energy	0-999999999	kWh	Dword	R/W
7304H-7305H	29444-29445	Eq_Imp	Consumed Reactive Energy	0-999999999	kvarh	Dword	R/W
7306H-7307H	29446-29447	Eq_Exp	Generated Reactive Energy	0-999999999	kvarh	Dword	R/W
7308H-7309H	29448-29449	Es	Apparent	0-999999999	kVAh	Dword	R/W
Peak							
730AH-730BH	29450-29451	Ep_Imp	Consumed Energy	0-999999999	kWh	Dword	R/W
730CH-730DH	29452-29453	Ep_Exp	Generated Energy	0-999999999	kWh	Dword	R/W
730EH-730FH	29454-29455	Eq_Imp	Consumed Reactive Energy	0-999999999	kvarh	Dword	R/W
7310H-7311H	29456-29457	Eq_Exp	Generated Reactive Energy	0-999999999	kvarh	Dword	R/W
7312H-7313H	29458-29459	Es	Apparent Energy	0-999999999	kVAh	Dword	R/W
Valley							
7314H-7315H	29460-29461	Ep_Imp	Consumed Energy	0-999999999	kWh	Dword	R/W
7316H-7317H	29462-29463	Ep_Exp	Exported Energy	0-999999999	kWh	Dword	R/W
7318H-7319H	29464-29465	Eq_Imp	Consumed Reactive Energy	0-999999999	kvarh	Dword	R/W
731AH-731BH	29466-29467	Eq_Exp	Generated Reactive Energy	0-999999999	kvarh	Dword	R/W
731CH-731DH	29468-29469	Es	Apparent Energy	0-999999999	kVAh	Dword	R/W
Normal							
731EH-731FH	29470-29741	Ep_Imp	Consumed Energy	0-999999999	kWh	Dword	R/W
7320H-7321H	29472-29473	Ep_Exp	Generated Energy	0-999999999	kWh	Dword	R/W

Table 66. Harmonics (continued).

Current Month Incremental TOU Energy: 03H Read, 10H Write							
Address(H)	Address(D)	Symbol	Parameter	Range	Property	Data Type	Access Property
7322H-7323H	29474-29475	Eq_Imp	Consumed Reactive Energy	0-999999999	kvarh	Dword	R/W
7324H-7325H	29476-29477	Eq_Exp	Generated Reactive Energy	0-999999999	kvarh	Dword	R/W
7326H-7327H	29478-29479	Es	Apparent Energy	0-999999999	kVAh	Dword	R/W
Total							
7328H-7329H	29480-29481	Ep_Imp	Consumed Energy	0-999999999	kWh	Dword	R/W
732AH-732BH	29482-29483	Ep_Exp	Exported Energy	0-999999999	kWh	Dword	R/W
732CH-732DH	29484-29485	Eq_Imp	Consumed Reactive Energy	0-999999999	kvarh	Dword	R/W
732EH-732FH	29486-29487	Eq_Exp	Generated Reactive Energy	0-999999999	kvarh	Dword	R/W
7330H-7331H	29488-29489	Es	Apparent Energy	0-999999999	kVAh	Dword	R/W

Prior Month Incremental TOU Energy

Table 55.

Prior Month Incremental TOU Energy: 03H Read, 10H Write							
Address(H)	Address(D)	Symbol	Parameter	Range	Property	Data Type	Access Property
Sharp							
7332H-7333H	29490-29491	Ep_Imp	Consumed Energy	0-999999999	kWh	Dword	R/W
7334H-7335H	29492-29493	Ep_Exp	Generated Energy	0-999999999	kWh	Dword	R/W
7336H-7337H	29494-29495	Eq_Imp	Consumed Reactive Energy	0-999999999	kvarh	Dword	R/W
7338H-7339H	29496-29497	Eq_Exp	Generated Reactive Energy	0-999999999	kvarh	Dword	R/W
733AH-733BH	29498-29499	Es	Apparent Energy	0-999999999	kVAh	Dword	R/W
Peak							
733CH-733DH	29500-29501	Ep_Imp	Consumed Energy	0-999999999	kWh	Dword	R/W
733EH-733FH	29502-29503	Ep_Exp	Generated Energy	0-999999999	kWh	Dword	R/W
7340H-7341H	29504-29505	Eq_Imp	Consumed Reactive Energy	0-999999999	kvarh	Dword	R/W

Prior Month Incremental TOU Energy: 03H Read, 10H Write							
Address(H)	Address(D)	Symbol	Parameter	Range	Property	Data Type	Access Property
7342H-7343H	29506-29507	Eq_Exp	Generated Reactive Energy	0-999999999	kvarh	Dword	R/W
7344H-7345H	29508-29509	Es	Apparent Energy	0-999999999	kVAh	Dword	R/W
Valley							
7346H-7347H	29510-29511	Ep_Imp	Consumed Energy	0-999999999	kWh	Dword	R/W
7348H-7349H	29512-29513	Ep_Exp	Generated Energy	0-999999999	kWh	Dword	R/W
734AH-734BH	29514-29515	Eq_Imp	Consumed Reactive Energy	0-999999999	kvarh	Dword	R/W
734CH-734DH	29516-29517	Eq_Exp	Generated Reactive Energy	0-999999999	kvarh	Dword	R/W
734EH-734FH	29518-29519	Es	Apparent Energy	0-999999999	kVA	Dword	R/W
Normal							
7350H-7351H	29520-29521	Ep_Imp	Consumed Energy	0-999999999	kWh	Dword	R/W
7352H-7353H	29522-29523	Ep_Exp	Generated Energy	0-999999999	kWh	Dword	R/W
7354H-7355H	29524-29525	Eq_Imp	Consumed Reactive Energy	0-999999999	kvarh	Dword	R/W
7356H-7357H	29526-29527	Eq_Exp	Generated Reactive Energy	0-999999999	kvarh	Dword	R/W
7358H-7359H	29528-29529	Es	Apparent Energy	0-999999999	kVAh	Dword	R/W
Total							
735AH-735BH	29530-29531	Ep_Imp	Consumed Energy	0-999999999	kWh	Dword	R/W
735CH-735DH	29532-29533	Ep_Exp	Generated Energy	0-999999999	kWh	Dword	R/W
735EH-735FH	29534-29535	Eq_Imp	Consumed Reactive Energy	0-999999999	kvarh	Dword	R/W
7360H-7361H	29536-29537	Eq_Exp	Generated Reactive Energy	0-999999999	kvarh	Dword	R/W
7363H-7363H	29538-29539	Es	Apparent Energy	0-999999999	kVAh	Dword	R/W

Current Month Maximum Demand TOU

Table 56.

Current Month Maximum Demand TOU Energy: 03H Read, 10H Write							
Address(H)	**Address(D)**	**Symbol**	**Parameter**	**Relationship**	**Range**	**Data Type**	**Access Property**
Sharp							
7500H	29952	Ep_Imp	Max Demand	Rx/10	32768~32767	Int	R
7501H-7503H	29956		Timestamp	YY/MM; DD/HH; Min/Sec			
7504H	29956	Ep_Exp	Max Demand	Rx/10	32768~32767	Int	R
7505H-7507H	29957-29959		Timestamp	YY/MM; DD/HH; Min/Sec			
7508H	29960	Eq_Imp	Max Demand	Rx/10	32768~32767	Int	R
7509H-750BH	29961-29963		Timestamp	YY/MM; DD/HH; Min/Sec			
750CH	29964	Eq_Exp	Max Demand	Rx/10	32768~32767	Int	R
750DH-750FH	29965-29967		Timestamp	YY/MM; DD/HH; Min/Sec			
7510H	29968	Es	Max Demand	Rx/10	32768~32767	Int	R
7511H-7513H	29969-29971		Timestamp	YY/MM; DD/HH; Min/Sec			
7514H	29972	Ia	Max Demand	Rx*(CT1/CT2)/1000	32768~32767	Int	R
7515H-7517H	29973-29975		Timestamp	YY/MM; DD/HH; Min/Sec			
7518H	29976	Ib	Max Demand	Rx*(CT1/CT2)/1000	32768~32767	Int	R
7519H-751BH	29977-29979		Timestamp	YY/MM; DD/HH; Min/Sec			
751CH	29980	Ic	Max Demand	Rx*(CT1/CT2)/1000	32768~32767	Int	R
751DH-751FH	29981-29983		Timestamp	YY/MM; DD/HH; Min/Sec			
Peak							
7520H	29984	Ep_Imp	Max Demand	Rx/10	32768~32767	Int	R
7521H-7523H	29985-29987		Timestamp	YY/MM; DD/HH; Min/Sec			
7524H	29988	Ep_Exp	Max Demand	Rx/10	32768~32767	Int	R

Current Month Maximum Demand TOU Energy: 03H Read, 10H Write							
Address(H)	Address(D)	Symbol	Parameter	Relationship	Range	Data Type	Access Property
7525H-7527H	29989-29991		Timestamp	YY/MM; DD/HH; Min/Sec			
7528H	29992	Eq_Imp	Max Demand	Rx/10	32768~32767	Int	R
7529H-752BH	29993-29995		Timestamp	YY/MM; DD/HH; Min/Sec			
752CH	29996	Eq_Exp	Max Demand	Rx/10	32768~32767	Int	R
752DH-752FH	29997-29999		Timestamp	YY/MM; DD/HH; Min/Sec			
7530H	30000	Es	Max Demand	Rx/10	32768~32767	Int	R
7531H-7533H	30001-30003		Timestamp	YY/MM; DD/HH; Min/Sec			
7534H	30004	Ia	Max Demand	Rx*(CT1/CT2)/1000	32768~32767	Int	R
7535H-7537H	30005-30007		Timestamp	YY/MM; DD/HH; Min/Sec			
7538H	30008	Ib	Max Demand	Rx*(CT1/CT2)/1000	32768~32767	Int	R
7539H-753BH	30009-30011		Timestamp	YY/MM; DD/HH; Min/Sec			
753CH	30012	Ic	Max Demand	Rx*(CT1/CT2)/1000	32768~32767	Int	R
753DH-753FH	30013-30015		Timestamp	YY/MM; DD/HH; Min/Sec			
Valley							
7540H	30016	Ep_Imp	Max Demand	Rx/10	32768~32767	Int	R
7541H-7543H	30017-30019		Timestamp	YY/MM; DD/HH; Min/Sec			
7544H	30020	Ep_Exp	Max Demand	Rx/10	32768~32767	Int	R
7545H-7547H	30021-30023		Timestamp	YY/MM; DD/HH; Min/Sec			
7548H	30024	Eq_Imp	Max Demand	Rx/10	32768~32767	Int	R
7549H-754BH	30025-30026		Timestamp	YY/MM; DD/HH; Min/Sec			

Note: Max and min values are always in secondary, so relationship must be applied.

Current Month Maximum Demand TOU Energy: 03H Read, 10H Write							
Address(H)	Address(D)	Symbol	Parameter	Relationship	Range	Data Type	Access Property
754CH	30027	Eq_Exp	Max Demand	Rx/10	32768~32767	Int	R
754DH-754FH	30028-30031		Timestamp	YY/MM; DD/HH; Min/Sec			
7550H	30032	Es	Max Demand	Rx/10	32768~32767	Int	R
7551H-7553H	30033-30035		Timestamp	YY/MM; DD/HH; Min/Sec			
7554H	30036	Ia	Max Demand	Rx*(CT1/CT2)/1000	32768~32767	Int	R
7555H-7557H	30037-30039		Timestamp	YY/MM; DD/HH; Min/Sec			
7558H	30040	Ib	Max Demand	Rx*(CT1/CT2)/1000	32768~32767	Int	R
7559H-755BH	30041-30043		Timestamp	YY/MM; DD/HH; Min/Sec			
755CH	30044	Ic	Max Demand	Rx*(CT1/CT2)/1000	32768~32767	Int	R
755DH-755FH	30045-30047		Timestamp	YY/MM; DD/HH; Min/Sec			
Normal							
7560H	30048	Ep_Imp	Max Demand	Rx/10	32768~32767	Int	R
7561H-7563H	30049-30051		Timestamp	YY/MM; DD/HH; Min/Sec			
7564H	30052	Ep_Exp	Max Demand	Rx/10	32768~32767	Int	R
7565H-7567H	30053-30055		Timestamp	YY/MM; DD/HH; Min/Sec			
7568H	30056	Eq_Imp	Max Demand	Rx/10	32768~32767	Int	R
7569H-756BH	30057-30059		Timestamp	YY/MM; DD/HH; Min/Sec			
756CH	30060	Eq_Exp	Max Demand	Rx/10	32768~32767	Int	R
756DH-756FH	30061-30063		Timestamp	YY/MM; DD/HH; Min/Sec			
7570H	30064	Es	Max Demand	Rx/10	32768~32767	Int	R

Current Month Maximum Demand TOU Energy: 03H Read, 10H Write							
Address(H)	Address(D)	Symbol	Parameter	Relationship	Range	Data Type	Access Property
7571H-7573H	30065-30067		Timestamp	YY/MM; DD/HH; Min/Sec			
7574H	30068	Ia	Max Demand	Rx*(CT1/CT2)/1000	32768~32767	Int	R
7575H-7577H	30069-30071		Timestamp	YY/MM; DD/HH; Min/Sec			
7578H	30072	Ib	Max Demand	Rx*(CT1/CT2)/1000	32768~32767	Int	R
7579H-757BH	30073-30075		Timestamp	YY/MM; DD/HH; Min/Sec			
757CH	30076	Ic	Max Demand	Rx*(CT1/CT2)/1000	32768~32767	Int	R
757DH-757FH	30077-30079		Timestamp	YY/MM; DD/HH; Min/Sec			
Total							
7580H	30080	Ep_Imp	Max Demand	Rx/10	32768~32767	Int	R
7581H-7583H	30081-30083		Timestamp	YY/MM; DD/HH; Min/Sec			
7584H	30084	Ep_Exp	Max Demand	Rx/10	32768~32767	Int	R
7585H-7587H	30085-30087		Timestamp	YY/MM; DD/HH; Min/Sec			
7588H	30088	Eq_Imp	Max Demand	Rx/10	32768~32767	Int	R
7589H-758BH	30089-30091		Timestamp	YY/MM; DD/HH; Min/Sec			
758CH	30092	Eq_Exp	Max Demand	Rx/10	32768~32767	Int	R
758DH-758FH	30093-30095		Timestamp	YY/MM; DD/HH; Min/Sec			
7590H	30096	Es	Max Demand	Rx/10	32768~32767	Int	R
7591H-7593H	30097-30099		Timestamp	YY/MM; DD/HH; Min/Sec			
7594H	30100	Ia	Max Demand	Rx*(CT1/CT2)/1000	32768~32767	Int	R

Current Month Maximum Demand TOU Energy: 03H Read, 10H Write							
Address(H)	Address(D)	Symbol	Parameter	Relationship	Range	Data Type	Access Property
7595H-7597H	30101-30103		Timestamp	YY/MM; DD/HH; Min/Sec			
7598H	30104	Ib	Max Demand	Rx*(CT1/CT2)/1000	32768~32767	Int	R
7599H-759BH	30105-30107		Timestamp	YY/MM; DD/HH; Min/Sec			
759CH	30108	Ic	Max Demand	Rx*(CT1/CT2)/1000	32768~32767	Int	R
759DH-759FH	30109-30111		Timestamp	YY/MM; DD/HH; Min/Sec			

Prior Month Maximum Demand

Table 57.

Previous Month Maximum Demand TOU Energy: 03H, 10H Write							
Address(H)	Address(D)	Symbol	Parameter	Relationship	Range	Data Type	Access Property
Sharp							
7600H	30208	Ep_Imp	Max Demand	Rx/10	32768~32767	Int	R
7601H-7603H	30209-30211		Timestamp	YY/MM; DD/HH; Min/Sec			
7604H	30212	Ep_Exp	Max Demand	Rx/10	32768~32767	Int	R
7605H-7607H	30213-30215		Timestamp	YY/MM; DD/HH; Min/Sec			
7608H	30216	Eq_Imp	Max Demand	Rx/10	32768~32767	Int	R
7609H-760BH	30217-30219		Timestamp	YY/MM; DD/HH; Min/Sec			
760CH	30220	Ep_Exp	Max Demand	Rx/10	32768~32767	Int	R
760DH-760FH	30221-30223		Timestamp	YY/MM; DD/HH; Min/Sec			
7610H	30224	Es	Max Demand	Rx/10	32768~32767	Int	R
7611H-7613H	30225-30227		Timestamp	YY/MM; DD/HH; Min/Sec			
7614H	30228	Ia	Max Demand	Rx*(CT1/CT2)/1000	32768~32767	Int	R

Previous Month Maximum Demand TOU Energy: 03H, 10H Write							
Address(H)	Address(D)	Symbol	Parameter	Relationship	Range	Data Type	Access Property
7615H-7617H	30229-30231		Timestamp	YY/MM; DD/HH; Min/Sec			
7618H	30232	Ib	Max Demand	Rx*(CT1/ CT2)/1000	32768~32767	Int	R
7619H-761BH	30233-30235		Timestamp	YY/MM; DD/HH; Min/Sec			
761CH	30236	Ic	Max Demand	Rx*(CT1/ CT2)/1000	32768~32767	Int	R
761DH-761FH	30237-30239		Timestamp	YY/MM; DD/HH; Min/Sec			
Peak							
7620H	30240	Ep_Imp	Max Demand	Rx/10	32768~32767	Int	R
7621H-7623H	30241-30243		Timestamp	YY/MM; DD/HH; Min/Sec			
7624H	30244	Ep_Exp	Max Demand	Rx/10	32768~32767	Int	R
7625H-7627H	30245-30247		Timestamp	YY/MM; DD/HH; Min/Sec			
7628H	30248	Eq_Imp	Max Demand	Rx/10	32768~32767	Int	R
7629H-762BH	30249-30251		Timestamp	YY/MM; DD/HH; Min/Sec			
762CH	30252	Eq_Exp	Max Demand	Rx/10	32768~32767	Int	R
762DH-762FH	30253-30255		Timestamp	YY/MM; DD/HH; Min/Sec			
7630H	30256	Es	Max Demand	Rx/10	32768~32767	Int	R
7631H-7633H	30257-30259		Timestamp	YY/MM; DD/HH; Min/Sec			
7634H	30260	Ia	Max Demand	Rx*(CT1/ CT2)/1000	32768~32767	Int	R
7635H-7637H	30261-30263		Timestamp	YY/MM; DD/HH; Min/Sec			
7638H	30264	Ib	Max Demand	Rx*(CT1/ CT2)/1000	32768~32767	Int	R

Previous Month Maximum Demand TOU Energy: 03H, 10H Write							
Address(H)	**Address(D)**	**Symbol**	**Parameter**	**Relationship**	**Range**	**Data Type**	**Access Property**
7639H-763BH	30265-30267		Timestamp	YY/MM; DD/HH; Min/Sec			
763CH	30268	Ic	Max Demand	Rx*(CT1/ CT2)/1000	32768~32767	Int	R
763DH-763FH	30269-30271		Timestamp	YY/MM; DD/HH; Min/Sec			
Valley							
7640H	30272	Ep_Imp	Max Demand	Rx/10	32768~32767	Int	R
7641H-7643H	30273-30275		Timestamp	YY/MM; DD/HH; Min/Sec			
7644H	30276	Ep_Exp	Max Demand	Rx/10	32768~32767	Int	R
7645H-7647H	30277-30279		Timestamp	YY/MM; DD/HH; Min/Sec			
7648H	30280	Eq_Imp	Max Demand	Rx/10	32768~32767	Int	R
7649H-764BH	30281-30283		Timestamp	YY/MM; DD/HH; Min/Sec			
764CH	30284	Eq_Exp	Max Demand	Rx/10	32768~32767	Int	R
764DH-764FH	30285-30287		Timestamp	YY/MM; DD/HH; Min/Sec			
7650H	30288	Es	Max Demand	Rx/10	32768~32767	Int	R
7651H-7653H	30289-30291		Timestamp	YY/MM; DD/HH; Min/Sec			
7654H	30292	Ia	Max Demand	Rx*(CT1/ CT2)/1000	32768~32767	Int	R
7655H-7657H	30293-30295		Timestamp	YY/MM; DD/HH; Min/Sec			
7658H	30296	Ib	Max Demand	Rx*(CT1/ CT2)/1000	32768~32767	Int	R
7659H-765BH	30297-30299		Timestamp	YY/MM; DD/HH; Min/Sec			
765CH	30300	Ic	Max Demand	Rx*(CT1/ CT2)/1000	32768~32767	Int	R

Previous Month Maximum Demand TOU Energy: 03H, 10H Write							
Address(H)	**Address(D)**	**Symbol**	**Parameter**	**Relationship**	**Range**	**Data Type**	**Access Property**
765DH-765FH	30301-30303		Timestamp	YY/MM; DD/HH; Min/Sec			
Normal							
7660H	30304	Ep_Imp	Max Demand	Rx/10	32768~32767	Int	R
7661H-7663H	30305-30307		Timestamp	YY/MM; DD/HH; Min/Sec			
7664H	30308	Ep_Exp	Max Demand	Rx/10	32768~32767	Int	R
7665H-7667H	30309-30311		Timestamp	YY/MM; DD/HH; Min/Sec			
7668H	30312	Eq_Imp	Max Demand	Rx/10	32768~32767	Int	R
7669H-766BH	30313-30315		Timestamp	YY/MM; DD/HH; Min/Sec			
766CH	30316	Eq_Exp	Max Demand	Rx/10	32768~32767	Int	R
766DH-766FH	30317-30319		Timestamp	YY/MM; DD/HH; Min/Sec			
7670H	30320	Es	Max Demand	Rx/10	32768~32767	Int	R
7671H-7673H	30321-30323		Timestamp	YY/MM; DD/HH; Min/Sec			
7674H	30324	Ia	Max Demand	Rx*(CT1/CT2)/1000	32768~32767	Int	R
7675H-7677H	30325-30327		Timestamp	YY/MM; DD/HH; Min/Sec			
7678H	30328	Ib	Max Demand	Rx*(CT1/CT2)/1000	32768~32767	Int	R
7679H-767BH	30329-30331		Timestamp	YY/MM; DD/HH; Min/Sec			
767CH	30332	Ic	Max Demand	Rx*(CT1/CT2)/1000	32768~32767	Int	R
767DH-767FH	30333-30334		Timestamp	YY/MM; DD/HH; Min/Sec			
Total							
7680H	30336	Ep_Imp	Max Demand	Rx/10	32768~32767	Int	R

Previous Month Maximum Demand TOU Energy: 03H, 10H Write							
Address(H)	**Address(D)**	**Symbol**	**Parameter**	**Relationship**	**Range**	**Data Type**	**Access Property**
7681H-7683H	30337-30339		Timestamp	YY/MM; DD/HH; Min/Sec			
7684H	30340	Ep_Exp	Max Demand	Rx/10	32768~32767	Int	R
7685H-7687H	30341-30343		Timestamp	YY/MM; DD/HH; Min/Sec			
7688H	30344	Eq_Imp	Max Demand	Rx/10	32768~32767	Int	R
7689H-768BH	30345-30347		Timestamp	YY/MM; DD/HH; Min/Sec			
768CH	30348	Eq_Exp	Max Demand	Rx/10	32768~32767	Int	R
768DH-768FH	30349-30351		Timestamp	YY/MM; DD/HH; Min/Sec			
7690H	30352	Es	Max Demand	Rx/10	32768~32767	Int	R
7691H-7693H	30353-30355		Timestamp	YY/MM; DD/HH; Min/Sec			
7694H	30356	Ia	Max Demand	Rx*(CT1/ CT2)/1000	32768~32767	Int	R
7695H-7697H	30357-30359		Timestamp	YY/MM; DD/HH; Min/Sec			
7698H	30360	Ib	Max Demand	Rx*(CT1/ CT2)/1000	32768~32767	Int	R
7699H-769BH	30361-30363		Timestamp	YY/MM; DD/HH; Min/Sec			
769CH	30364	Ic	Max Demand	Rx*(CT1/ CT2)/1000	32768~32767	Int	R
769DH-769FH	30365-30366		Timestamp	YY/MM; DD/HH; Min/Sec			

6.3.10 Power Quality Parameters

THD, Harmonics, odd HD, Crest Factor, THFF, K factor, etc. are all stored here where the data type is “Word.”

NOTE: Voltage parameters refer to line voltage when it is set to “2LL/3LL” and phase voltage for others.

THD Parameters

Table 58.

Power Quality: 03H Read							
Address(H)	**Address(D)**	**Parameter**	**Relationship**	**Property**	**Range**	**Data Type**	**Access Property**
405AH	16474	THD_V1(V12)	THD=Rx/100	%	≥0	Word	R
405BH	16475	THD_V2(V31)	THD=Rx/100	%	≥0	Word	R
405CH	16476	THD_V3(V23)	THD=Rx/100	%	≥0	Word	R
405DH	16477	THD_avg	THD=Rx/100	%	≥0	Word	R
405EH	16478	THD_I1	THD=Rx/100	%	≥0	Word	R
405FH	16479	THD_I2	THD=Rx/100	%	≥0	Word	R
4060H	16480	THD_I3	THD=Rx/100	%	≥0	Word	R
4061H	16481	THD_Iavg	THD=Rx/100	%	≥0	Word	R

Voltage V1 (V12) Harmonics

Table 59.

Voltage Harmonics, Even & Odd Harmonics, Crest Factor: 03H Read							
Address(H)	**Address(D)**	**Parameter**	**Relationship**	**Property**	**Range**	**Data Type**	**Access Property**
4062H	16482	V1(V12) 2nd Harmonic	THD=Rx/100	%	≥0	Word	R
4063H	16483	V1(V12) 3rd Harmonic	THD=Rx/100	%	≥0	Word	R
4064H	16484	V1(V12) 4th Harmonic	THD=Rx/100	%	≥0	Word	R
4065H	16485	V1(V12) 5th Harmonic	THD=Rx/100	%	≥0	Word	R
4066H	16486	V1(V12) 6th Harmonic	THD=Rx/100	%	≥0	Word	R
4067H	16487	V1(V12) 7th Harmonic	THD=Rx/100	%	≥0	Word	R
4068H	16488	V1(V12) 8th Harmonic	THD=Rx/100	%	≥0	Word	R
4069H	16489	V1(V12) 9th Harmonic	THD=Rx/100	%	≥0	Word	R
406AH	16490	V1(V12) 10th Harmonic	THD=Rx/100	%	≥0	Word	R
406BH	16491	V1(V12) 11th Harmonic	THD=Rx/100	%	≥0	Word	R
406CH	16492	V1(V12) 12th Harmonic	THD=Rx/100	%	≥0	Word	R
406DH	16493	V1(V12) 13th Harmonic	THD=Rx/100	%	≥0	Word	R
406EH	16494	V1(V12) 14th Harmonic	THD=Rx/100	%	≥0	Word	R
406FH	16495	V1(V12) 15th Harmonic	THD=Rx/100	%	≥0	Word	R
4070H	16496	V1(V12) 16th Harmonic	THD=Rx/100	%	≥0	Word	R
4071H	16497	V1(V12) 17th Harmonic	THD=Rx/100	%	≥0	Word	R
4072H	16498	V1(V12) 18th Harmonic	THD=Rx/100	%	≥0	Word	R
4073H	16499	V1(V12) 19th Harmonic	THD=Rx/100	%	≥0	Word	R
4074H	16500	V1(V12) 20th Harmonic	THD=Rx/100	%	≥0	Word	R
4075H	16501	V1(V12) 21st Harmonic	THD=Rx/100	%	≥0	Word	R
4076H	16502	V1(V12) 22nd Harmonic	THD=Rx/100	%	≥0	Word	R
4077H	16503	V1(V12) 23rd Harmonic	THD=Rx/100	%	≥0	Word	R
4078H	16504	V1(V12) 24th Harmonic	THD=Rx/100	%	≥0	Word	R

Voltage Harmonics, Even & Odd Harmonics, Crest Factor: 03H Read							
Address(H)	**Address(D)**	**Parameter**	**Relationship**	**Property**	**Range**	**Data Type**	**Access Property**
4079H	16505	V1(V12) 25th Harmonic	THD=Rx/100	%	≥0	Word	R
407AH	16506	V1(V12) 26th Harmonic	THD=Rx/100	%	≥0	Word	R
407BH	16507	V1(V12) 27th Harmonic	THD=Rx/100	%	≥0	Word	R
407CH	16508	V1(V12) 28th Harmonic	THD=Rx/100	%	≥0	Word	R
407DH	16509	V1(V12) 29th Harmonic	THD=Rx/100	%	≥0	Word	R
407EH	16510	V1(V12) 30th Harmonic	THD=Rx/100	%	≥0	Word	R
407FH	16511	V1(V12) 31st Harmonic	THD=Rx/100	%	≥0	Word	R
4500H	17664	V1(V12) 32nd Harmonic	THD=Rx/100	%	≥0	Word	R
4501H	17665	V1(V12) 33rd Harmonic	THD=Rx/100	%	≥0	Word	R
4502H	17666	V1(V12) 34th Harmonic	THD=Rx/100	%	≥0	Word	R
4503H	17667	V1(V12) 35th Harmonic	THD=Rx/100	%	≥0	Word	R
4504H	17668	V1(V12) 36th Harmonic	THD=Rx/100	%	≥0	Word	R
4505H	17669	V1(V12) 37th Harmonic	THD=Rx/100	%	≥0	Word	R
4506H	17670	V1(V12) 38th Harmonic	THD=Rx/100	%	≥0	Word	R
4507H	17671	V1(V12) 39th Harmonic	THD=Rx/100	%	≥0	Word	R
4508H	17672	V1(V12) 40th Harmonic	THD=Rx/100	%	≥0	Word	R
4509H	17673	V1(V12) 41st Harmonic	THD=Rx/100	%	≥0	Word	R
450AH	17674	V1(V12) 42nd Harmonic	THD=Rx/100	%	≥0	Word	R
450BH	17675	V1(V12) 43rd Harmonic	THD=Rx/100	%	≥0	Word	R
450CH	17676	V1(V12) 44th Harmonic	THD=Rx/100	%	≥0	Word	R
450DH	17677	V1(V12) 45th Harmonic	THD=Rx/100	%	≥0	Word	R
450EH	17678	V1(V12) 46th Harmonic	THD=Rx/100	%	≥0	Word	R
450FH	17679	V1(V12) 47th Harmonic	THD=Rx/100	%	≥0	Word	R
4510H	17680	V1(V12) 48th Harmonic	THD=Rx/100	%	≥0	Word	R
4511H	17681	V1(V12) 49th Harmonic	THD=Rx/100	%	≥0	Word	R

Voltage Harmonics, Even & Odd Harmonics, Crest Factor: 03H Read							
Address(H)	Address(D)	Parameter	Relationship	Property	Range	Data Type	Access Property
4512H	17682	V1(V12) 50th Harmonic	THD=Rx/100	%	≥0	Word	R
4513H	17683	V1(V12) 51st Harmonic	THD=Rx/100	%	≥0	Word	R
4514H	17684	V1(V12) 52nd Harmonic	THD=Rx/100	%	≥0	Word	R
4515H	17685	V1(V12) 53rd Harmonic	THD=Rx/100	%	≥0	Word	R
4516H	17686	V1(V12) 54th Harmonic	THD=Rx/100	%	≥0	Word	R
4517H	17687	V1(V12) 55th Harmonic	THD=Rx/100	%	≥0	Word	R
4518H	17688	V1(V12) 56th Harmonic	THD=Rx/100	%	≥0	Word	R
4519H	17689	V1(V12) 57th Harmonic	THD=Rx/100	%	≥0	Word	R
451AH	17690	V1(V12) 58th Harmonic	THD=Rx/100	%	≥0	Word	R
451BH	17691	V1(V12) 59th Harmonic	THD=Rx/100	%	≥0	Word	R
451CH	17692	V1(V12) 60th Harmonic	THD=Rx/100	%	≥0	Word	R
451DH	17693	V1(V12) 61st Harmonic	THD=Rx/100	%	≥0	Word	R
451EH	17694	V1(V12) 62nd Harmonic	THD=Rx/100	%	≥0	Word	R
451FH	17695	V1(V12) 63rd Harmonic	THD=Rx/100	%	≥0	Word	R
4080H	16512	Odd THD_V1(V12)	THD=Rx/100	%	≥0	Word	R
4081H	16513	Even THD_V1(V12)	THD=Rx/100	%	≥0	Word	R
4082H	16514	Crest Factor V1(V12)	CF=Rx/100	%	0~65535	Word	R
4083H	16515	THFF_V1(V12)	THFF=Rx/100	%	≥0	Word	R

Voltage V2(V31) Harmonics

Table 60.

Voltage Harmonics, Even & Odd Harmonics, Crest Factor: 03H Read							
Address(H)	Address(D)	Parameter	Relationship	Property	Range	Data Type	Access Property
4084H	16516	V2(V31) 2nd Harmonic	THD=Rx/100	%	≥0	Word	R
4085H	16517	V2(V31) 3rd Harmonic	THD=Rx/100	%	≥0	Word	R
4086H	16518	V2(V31) 4th Harmonic	THD=Rx/100	%	≥0	Word	R

Voltage Harmonics, Even & Odd Harmonics, Crest Factor: 03H Read							
Address(H)	Address(D)	Parameter	Relationship	Property	Range	Data Type	Access Property
4087H	16519	V2(V31) 5th Harmonic	THD=Rx/100	%	≥0	Word	R
4088H	16520	V2(V31) 6th Harmonic	THD=Rx/100	%	≥0	Word	R
4089H	16521	V2(V31) 7th Harmonic	THD=Rx/100	%	≥0	Word	R
408AH	16522	V2(V31) 8th Harmonic	THD=Rx/100	%	≥0	Word	R
408BH	16523	V2(V31) 9th Harmonic	THD=Rx/100	%	≥0	Word	R
408CH	16524	V2(V31) 10th Harmonic	THD=Rx/100	%	≥0	Word	R
408DH	16525	V2(V31) 11th Harmonic	THD=Rx/100	%	≥0	Word	R
408EH	16526	V2(V31) 12th Harmonic	THD=Rx/100	%	≥0	Word	R
408FH	16527	V2(V31) 13th Harmonic	THD=Rx/100	%	≥0	Word	R
4090H	16528	V2(V31) 14th Harmonic	THD=Rx/100	%	≥0	Word	R
4091H	16529	V2(V31) 15th Harmonic	THD=Rx/100	%	≥0	Word	R
4092H	16530	V2(V31) 16th Harmonic	THD=Rx/100	%	≥0	Word	R
4093H	16531	V2(V31) 17th Harmonic	THD=Rx/100	%	≥0	Word	R
4094H	16532	V2(V31) 18th Harmonic	THD=Rx/100	%	≥0	Word	R
4095H	16533	V2(V31) 19th Harmonic	THD=Rx/100	%	≥0	Word	R
4096H	16534	V2(V31) 20th Harmonic	THD=Rx/100	%	≥0	Word	R
4097H	16535	V2(V31) 21th Harmonic	THD=Rx/100	%	≥0	Word	R
4098H	16536	V2(V31) 22th Harmonic	THD=Rx/100	%	≥0	Word	R
4099H	16537	V2(V31) 23rd Harmonic	THD=Rx/100	%	≥0	Word	R
409AH	16538	V2(V31) 24th Harmonic	THD=Rx/100	%	≥0	Word	R
409BH	16539	V2(V31) 25th Harmonic	THD=Rx/100	%	≥0	Word	R
409CH	16540	V2(V31) 26th Harmonic	THD=Rx/100	%	≥0	Word	R
409DH	16541	V2(V31) 27th Harmonic	THD=Rx/100	%	≥0	Word	R
409EH	16542	V2(V31) 28th Harmonic	THD=Rx/100	%	≥0	Word	R
409FH	16543	V2(V31) 29th Harmonic	THD=Rx/100	%	≥0	Word	R

Voltage Harmonics, Even & Odd Harmonics, Crest Factor: 03H Read							
Address(H)	**Address(D)**	**Parameter**	**Relationship**	**Property**	**Range**	**Data Type**	**Access Property**
40A0H	16544	V2(V31) 30th Harmonic	THD=Rx/100	%	≥0	Word	R
40A1H	16545	V2(V31) 31st Harmonic	THD=Rx/100	%	≥0	Word	R
4520H	17696	V2(V31) 32nd Harmonic	THD=Rx/100	%	≥0	Word	R
4521H	17697	V2(V31) 33rd Harmonic	THD=Rx/100	%	≥0	Word	R
4522H	17698	V2(V31) 34th Harmonic	THD=Rx/100	%	≥0	Word	R
4523H	17699	V2(V31) 35th Harmonic	THD=Rx/100	%	≥0	Word	R
4524H	17700	V2(V31) 36th Harmonic	THD=Rx/100	%	≥0	Word	R
4525H	17701	V2(V31) 37th Harmonic	THD=Rx/100	%	≥0	Word	R
4526H	17702	V2(V31) 38th Harmonic	THD=Rx/100	%	≥0	Word	R
4527H	17703	V2(V31) 39th Harmonic	THD=Rx/100	%	≥0	Word	R
4528H	17704	V2(V31) 40th Harmonic	THD=Rx/100	%	≥0	Word	R
4529H	17705	V2(V31) 41st Harmonic	THD=Rx/100	%	≥0	Word	R
452AH	17706	V2(V31) 42nd Harmonic	THD=Rx/100	%	≥0	Word	R
452BH	17707	V2(V31) 43rd Harmonic	THD=Rx/100	%	≥0	Word	R
452CH	17708	V2(V31) 44th Harmonic	THD=Rx/100	%	≥0	Word	R
425DH	17709	V2(V31) 45th Harmonic	THD=Rx/100	%	≥0	Word	R
452EH	17710	V2(V31) 46th Harmonic	THD=Rx/100	%	≥0	Word	R
452FH	17711	V2(V31) 47th Harmonic	THD=Rx/100	%	≥0	Word	R
4530H	17712	V2(V31) 48th Harmonic	THD=Rx/100	%	≥0	Word	R
4531H	17713	V2(V31) 49th Harmonic	THD=Rx/100	%	≥0	Word	R
4532H	17714	V2(V31) 50th Harmonic	THD=Rx/100	%	≥0	Word	R
4533H	17715	V2(V31) 51st Harmonic	THD=Rx/100	%	≥0	Word	R
4534H	17716	V2(V31) 52nd Harmonic	THD=Rx/100	%	≥0	Word	R
4535H	17717	V2(V31) 53rd Harmonic	THD=Rx/100	%	≥0	Word	R
4536H	17718	V2(V31) 54th Harmonic	THD=Rx/100	%	≥0	Word	R

Voltage Harmonics, Even & Odd Harmonics, Crest Factor: 03H Read							
Address(H)	**Address(D)**	**Parameter**	**Relationship**	**Property**	**Range**	**Data Type**	**Access Property**
4537H	17719	V2(V31) 55th Harmonic	THD=Rx/100	%	≥0	Word	R
4538H	17720	V2(V31) 56th Harmonic	THD=Rx/100	%	≥0	Word	R
4539H	17721	V2(V31) 57th Harmonic	THD=Rx/100	%	≥0	Word	R
453AH	17722	V2(V31) 58th Harmonic	THD=Rx/100	%	≥0	Word	R
453BH	17723	V2(V31) 59th Harmonic	THD=Rx/100	%	≥0	Word	R
453CH	17724	V2(V31) 60th Harmonic	THD=Rx/100	%	≥0	Word	R
453DH	17725	V2(V31) 61st Harmonic	THD=Rx/100	%	≥0	Word	R
453EH	17726	V2(V31) 62nd Harmonic	THD=Rx/100	%	≥0	Word	R
453FH	17727	V2(V31) 63rd Harmonic	THD=Rx/100	%	≥0	Word	R
40A2H	16546	Odd THD_V2(V31)	THD=Rx/100	%	≥0	Word	R
40A3H	16547	Even THD_V2(V31)	THD=Rx/100	%	≥0	Word	R
40A4H	16548	Crest Factor V2(V31)	THD=Rx/100	%	≥0	Word	R
40A5H	16549	THFF_V2(V31)	THFF=Rx/100	%	≥0	Word	R

Voltage V3(V23) Harmonics

Table 61.

Voltage Harmonics, Even & Odd Harmonics, Crest Factor: 03H							
Address(H)	**Address(D)**	**Parameter**	**Relationship**	**Property**	**Range**	**Data Type**	**Access Property**
40A6H	16550	V3(V23) 2nd Harmonic	THD=Rx/100	%	≥0	Word	R
40A7H	16551	V3(V23) 3rd Harmonic	THD= Rx/100	%	≥0	Word	R
40A8H	16552	V3(V23) 4th Harmonic	THD=Rx/100	%	≥0	Word	R
40A9H	16553	V3(V23) 5th Harmonic	THD=Rx/100	%	≥0	Word	R
40AAH	16554	V3(V23) 6th Harmonic	THD=Rx/100	%	≥0	Word	R
40ABH	16555	V3(V23) 7th Harmonic	THD=Rx/100	%	≥0	Word	R
40ACH	16556	V3(V23) 8th Harmonic	THD=Rx/100	%	≥0	Word	R
40ADH	16557	V3(V23) 9th Harmonic	THD=Rx/100	%	≥0	Word	R

Voltage Harmonics, Even & Odd Harmonics, Crest Factor: 03H							
Address(H)	**Address(D)**	**Parameter**	**Relationship**	**Property**	**Range**	**Data Type**	**Access Property**
40AEH	16558	V3(V23) 10th Harmonic	THD=Rx/100	%	≥0	Word	R
40AFH	16559	V3(V23) 11th Harmonic	THD=Rx/100	%	≥0	Word	R
40B0H	16560	V3(V23) 12th Harmonic	THD=Rx/100	%	≥0	Word	R
40B1H	16561	V3(V23) 13th Harmonic	THD=Rx/100	%	≥0	Word	R
40B2H	16562	V3(V23) 14th Harmonic	THD=Rx/100	%	≥0	Word	R
40B3H	16563	V3(V23) 15th Harmonic	THD=Rx/100	%	≥0	Word	R
40B4H	16564	V3(V23) 16th Harmonic	THD=Rx/100	%	≥0	Word	R
40B5H	16565	V3(V23) 17th Harmonic	THD=Rx/100	%	≥0	Word	R
40B6H	16566	V3(V23) 18th Harmonic	THD=Rx/100	%	≥0	Word	R
40B7H	16567	V3(V23) 19th Harmonic	THD=Rx/100	%	≥0	Word	R
40B8H	16568	V3(V23) 20th Harmonic	THD=Rx/100	%	≥0	Word	R
40B9H	16569	V3(V23) 21st Harmonic	THD=Rx/100	%	≥0	Word	R
40BAH	16570	V3(V23) 22nd Harmonic	THD=Rx/100	%	≥0	Word	R
40BBH	16571	V3(V23) 23rd Harmonic	THD=Rx/100	%	≥0	Word	R
40BCH	16572	V3(V23) 24th Harmonic	THD=Rx/100	%	≥0	Word	R
40BDH	16573	V3(V23) 25th Harmonic	THD=Rx/100	%	≥0	Word	R
40BEH	16574	V3(V23) 26th Harmonic	THD=Rx/100	%	≥0	Word	R
40BFH	16575	V3(V23) 27th Harmonic	THD=Rx/100	%	≥0	Word	R
40C0H	16576	V3(V23) 28th Harmonic	THD=Rx/100	%	≥0	Word	R
40C1H	16577	V3(V23) 29th Harmonic	THD=Rx/100	%	≥0	Word	R
40C2H	16578	V3(V23) 30th Harmonic	THD=Rx/100	%	≥0	Word	R
40C3H	16579	V3(V23) 31st Harmonic	THD=Rx/100	%	≥0	Word	R
4540H	17728	V3(V23) 32nd Harmonic	THD=Rx/100	%	≥0	Word	R
4541H	17729	V3(V23) 33rd Harmonic	THD=Rx/100	%	≥0	Word	R

Voltage Harmonics, Even & Odd Harmonics, Crest Factor: 03H

Address(H)	Address(D)	Parameter	Relationship	Property	Range	Data Type	Access Property
4542H	17730	V3(V23) 34th Harmonic	THD=Rx/100	%	≥0	Word	R
4543H	17731	V3(V23) 35th Harmonic	THD=Rx/100	%	≥0	Word	R
4544H	17732	V3(V23) 36th Harmonic	THD=Rx/100	%	≥0	Word	R
4545H	17733	V3(V23) 37th Harmonic	THD=Rx/100	%	≥0	Word	R
4546H	17734	V3(V23) 38th Harmonic	THD=Rx/100	%	≥0	Word	R
4547H	17735	V3(V23) 39th Harmonic	THD=Rx/100	%	≥0	Word	R
4548H	17736	V3(V23) 40th Harmonic	THD=Rx/100	%	≥0	Word	R
4549H	17737	V3(V23) 41st Harmonic	THD=Rx/100	%	≥0	Word	R
454AH	17738	V3(V23) 42nd Harmonic	THD=Rx/100	%	≥0	Word	R
454BH	17739	V3(V23) 43rd Harmonic	THD=Rx/100	%	≥0	Word	R
454CH	17740	V3(V23) 44th Harmonic	THD=Rx/100	%	≥0	Word	R
454DH	17741	V3(V23) 45th Harmonic	THD=Rx/100	%	≥0	Word	R
454EH	17742	V3(V23) 46th Harmonic	THD=Rx/100	%	≥0	Word	R
454FH	17743	V3(V23) 47th Harmonic	THD=Rx/100	%	≥0	Word	R
4550H	17744	V3(V23) 48th Harmonic	THD=Rx/100	%	≥0	Word	R
4551H	17745	V3(V23) 49th Harmonic	THD=Rx/100	%	≥0	Word	R
4552H	17746	V3(V23) 50th Harmonic	THD=Rx/100	%	≥0	Word	R
4553H	17747	V3(V23) 51st Harmonic	THD=Rx/100	%	≥0	Word	R
4554H	17748	V3(V23) 52nd Harmonic	THD=Rx/100	%	≥0	Word	R
4555H	17749	V3(V23) 53rd Harmonic	THD=Rx.100	%	≥0	Word	R
4556H	17750	V3(V23) 54th Harmonic	THD=Rx/100	%	≥0	Word	R
4557H	17751	V3(V23) 55th Harmonic	THD=Rx/100	%	≥0	Word	R
4558H	17752	V3(V23) 56th Harmonic	THD=Rx/100	%	≥0	Word	R
4559H	17753	V3(V23) 57th Harmonic	THD=Rx/100	%	≥0	Word	R

Voltage Harmonics, Even & Odd Harmonics, Crest Factor: 03H							
Address(H)	Address(D)	Parameter	Relationship	Property	Range	Data Type	Access Property
455AH	17754	V3(V23) 58th Harmonic	THD=Rx/100	%	≥0	Word	R
455BH	17755	V3(V23) 59th Harmonic	THD=Rx/100	%	≥0	Word	R
455CH	17756	V3(V23) 60th Harmonic	THD=Rx/100	%	≥0	Word	R
455DH	17757	V3(V23) 61st Harmonic	THD=Rx/100	%	≥0	Word	R
455EH	17758	V3(V23) 62nd Harmonic	THD=Rx/100	%	≥0	Word	R
455FH	17759	V3(V23) 63rd Harmonic	THD=Rx/100	%	≥0	Word	R
40C4H	16580	Odd THD_V3(V23)	THD=Rx/100	%	≥0	Word	R
40C5H	16581	Even THD_V3(V23)	THD=Rx/100	%	≥0	Word	R
40C6H	16582	Crest Factor V3(V23)	CF=Rx/100	%	0~65535	Word	R
40C7H	16583	THDD_V3(V23)	THFF=Rx/100	%	≥0	Word	R

I1 Current Harmonics

Table 62.

Current Harmonics, Even & Odd Harmonics, K Factor: 03H Read							
Address(H)	Address(D)	Parameter	Relationship	Property	Range	Data Type	Access Property
40C8H	16584	I1 2nd Harmonic	THD=Rx/100	%	≥0	Word	R
40C9H	16585	I1 3rd Harmonic	THD=Rx/100	%	≥0	Word	R
40CAH	16586	I1 4th Harmonic	THD=Rx/100	%	≥0	Word	R
40CBH	16587	I1 5th Harmonic	THD=Rx/100	%	≥0	Word	R
40CCH	16588	I1 6th Harmonic	THD=Rx/100	%	≥0	Word	R
40CDH	16589	I1 7th Harmonic	THD=Rx/100	%	≥0	Word	R
40CEH	16590	I1 8th Harmonic	THD=Rx/100	%	≥0	Word	R
40CFH	16591	I1 9th Harmonic	THD=Rx/100	%	≥0	Word	R
40D0H	16592	I1 10th Harmonic	THD=Rx/100	%	≥0	Word	R
40D1H	16593	I1 11th Harmonic	THD=Rx/100	%	≥0	Word	R
40D2H	16594	I1 12th Harmonic	THD=Rx/100	%	≥0	Word	R
40D3H	16595	I1 13th Harmonic	THD=Rx/100	%	≥0	Word	R
40D4H	16596	I1 14th Harmonic	THD=Rx/100	%	≥0	Word	R
40D5H	16597	I1 15th Harmonic	THD=Rx/100	%	≥0	Word	R
40D6H	16598	I1 16th Harmonic	THD=Rx/100	%	≥0	Word	R
40D7H	16599	I1 17th Harmonic	THD=Rx/100	%	≥0	Word	R
40D8H	16600	I1 18th Harmonic	THD=Rx/100	%	≥0	Word	R
40D9H	16601	I1 19th Harmonic	THD=Rx/100	%	≥0	Word	R
40DAH	16602	I1 20th Harmonic	THD=Rx/100	%	≥0	Word	R

Current Harmonics, Even & Odd Harmonics, K Factor: 03H Read							
Address(H)	**Address(D)**	**Parameter**	**Relationship**	**Property**	**Range**	**Data Type**	**Access Property**
40DBH	16603	I1 21st Harmonic	THD=Rx/100	%	≥0	Word	R
40DCH	16604	I1 22nd Harmonic	THD=Rx/100	%	≥0	Word	R
40DDH	16605	I1 23rd Harmonic	THD=Rx/100	%	≥0	Word	R
40DEH	16606	I1 24th Harmonic	THD=Rx/100	%	≥0	Word	R
40DFH	16607	I1 25th Harmonic	THD=Rx/100	%	≥0	Word	R
40E0H	16608	I1 26th Harmonic	THD=Rx/100	%	≥0	Word	R
40E1H	16609	I1 27th Harmonic	THD=Rx/100	%	≥0	Word	R
40E2H	16610	I1 28th Harmonic	THD=Rx/100	%	≥0	Word	R
40E3H	16611	I1 29th Harmonic	THD=Rx/100	%	≥0	Word	R
40E4H	16612	I1 30th Harmonic	THD=Rx/100	%	≥0	Word	R
40E5H	16613	I1 31st Harmonic	THD=Rx/100	%	≥0	Word	R
4560H	17760	I1 32nd Harmonic	THD=Rx/100	%	≥0	Word	R
4561H	17762	I1 33rd Harmonic	THD=Rx/100	%	≥0	Word	R
4562H	17763	I1 34th Harmonic	THD=Rx/100	%	≥0	Word	R
4563H	17764	I1 35th Harmonic	THD=Rx/100	%	≥0	Word	R
4564H	17765	I1 36th Harmonic	THD=Rx/100	%	≥0	Word	R
4565H	17765	I1 37th Harmonic	THD=Rx/100	%	≥0	Word	R
4566H	17766	I1 38th Harmonic	THD=Rx/100	%	≥0	Word	R
4567H	17767	I1 39th Harmonic	THD=Rx/100	%	≥0	Word	R
4568H	17768	I1 40th Harmonic	THD=Rx/100	%	≥0	Word	R
4569H	17769	I1 41st Harmonic	THD=Rx/100	%	≥0	Word	R
456AH	17770	I1 42nd Harmonic	THD=Rx/100	%	≥0	Word	R
456BH	17771	I1 43rd Harmonic	THD=Rx/100	%	≥0	Word	R
456CH	17772	I1 44th Harmonic	THD=Rx/100	%	≥0	Word	R
456DH	17773	I1 45th Harmonic	THD=Rx/100	%	≥0	Word	R
456EH	17774	I1 46th Harmonic	THD=Rx/100	%	≥0	Word	R
456FH	17775	I1 47th Harmonic	THD=Rx/100	%	≥0	Word	R
4570H	17776	I1 48th Harmonic	THD=Rx/100	%	≥0	Word	R
4571H	17777	I1 49th Harmonic	THD=Rx/100	%	≥0	Word	R
4572H	17778	I1 50th Harmonic	THD=Rx/100	%	≥0	Word	R
4573H	17779	I1 51st Harmonic	THD=Rx/100	%	≥0	Word	R
4574H	17780	I1 52nd Harmonic	THD=Rx/100	%	≥0	Word	R
4575H	17781	I1 53rd Harmonic	THD=Rx/100	%	≥0	Word	R
4576H	17782	I1 54th Harmonic	THD=Rx/100	%	≥0	Word	R
4577H	17783	I1 55th Harmonic	THD=Rx/100	%	≥0	Word	R
4578H	17784	I1 56th Harmonic	THD=Rx/100	%	≥0	Word	R
4579H	17785	I1 57th Harmonic	THD=Rx/100	%	≥0	Word	R
457AH	17786	I1 58th Harmonic	THD=Rx/100	%	≥0	Word	R
457BH	17787	I1 59th Harmonic	THD=Rx/100	%	≥0	Word	R
457CH	17788	I1 60th Harmonic	THD=Rx/100	%	≥0	Word	R
457DH	17789	I1 61st Harmonic	THD=Rx/100	%	≥0	Word	R

Current Harmonics, Even & Odd Harmonics, K Factor: 03H Read							
Address(H)	Address(D)	Parameter	Relationship	Property	Range	Data Type	Access Property
457EH	17790	I1 62nd Harmonic	THD=Rx/100	%	≥0	Word	R
457FH	17791	I1 63rd Harmonic	THD=Rx/100	%	≥0	Word	R
40E6H	16614	Odd THD_I1	THD=Rx/100	%	≥0	Word	R
40E7H	16615	Even_THD_I1	THD=Rx/100	%	≥0	Word	R
40E8H	16616	K Factor of I1	CF=Rx/100	%	≥0	Word	R

I2 Current Harmonics

Table 63.

Current Harmonics, Even & Odd Harmonics, K Factor: 03H Read							
Address(H)	Address(D)	Parameter	Relationship	Property	Range	Data Type	Access Property
40E9H	16617	I2 2nd Harmonic	THD=Rx/100	%	≥0	Word	R
40EAH	16618	I2 3rd Harmonic	THD=Rx/100	%	≥0	Word	R
40EBH	16619	I2 4th Harmonic	THD=Rx/100	%	≥0	Word	R
40ECH	16620	I2 5th Harmonic	THD=Rx/100	%	≥0	Word	R
40EDH	16621	I2 6th Harmonic	THD=Rx/100	%	≥0	Word	R
40EEH	16622	I2 7th Harmonic	THD=Rx/100	%	≥0	Word	R
40EFH	16623	I2 8th Harmonic	THD=Rx/100	%	≥0	Word	R
40F0H	16624	I2 9th Harmonic	THD=Rx/100	%	≥0	Word	R
40F1H	16625	I2 10th Harmonic	THD=Rx/100	%	≥0	Word	R
40F2H	16626	I2 11th Harmonic	THD=Rx/100	%	≥0	Word	R
40F3H	16627	I2 12th Harmonic	THD=Rx/100	%	≥0	Word	R
40F4H	16628	I2 13th Harmonic	THD=Rx/100	%	≥0	Word	R
40F5H	16629	I2 14th Harmonic	THD=Rx/100	%	≥0	Word	R
40F6H	16630	I2 15th Harmonic	THD=Rx/100	%	≥0	Word	R
40F7H	16631	I2 16th Harmonic	THD=Rx/100	%	≥0	Word	R
40F8H	16632	I2 17th Harmonic	THD=Rx/100	%	≥0	Word	R
40F9H	16633	I2 18th Harmonic	THD=Rx/100	%	≥0	Word	R
40FAH	16634	I2 19th Harmonic	THD=Rx/100	%	≥0	Word	R
40FBH	16635	I2 20th Harmonic	THD=Rx/100	%	≥0	Word	R
40FCH	16636	I2 21st Harmonic	THD=Rx/100	%	≥0	Word	R
40FDH	16637	I2 22nd Harmonic	THD=Rx/100	%	≥0	Word	R
40FEH	16638	I2 23rd Harmonic	THD=Rx/100	%	≥0	Word	R
40FFH	16639	I2 24th Harmonic	THD=Rx/100	%	≥0	Word	R
4100H	16640	I2 25th Harmonic	THD=Rx/100	%	≥0	Word	R
4101H	16641	I2 26th Harmonic	THD=Rx/100	%	≥0	Word	R
4102H	16642	I2 27th Harmonic	THD=Rx/100	%	≥0	Word	R
4103H	16643	I2 28th Harmonic	THD=Rx/100	%	≥0	Word	R
4104H	16644	I2 29th Harmonic	THD=Rx/100	%	≥0	Word	R

Current Harmonics, Even & Odd Harmonics, K Factor: 03H Read							
Address(H)	Address(D)	Parameter	Relationship	Property	Range	Data Type	Access Property
4105H	16645	I2 30th Harmonic	THD=Rx/100	%	≥0	Word	R
4106H	16646	I2 31st Harmonic	THD=Rx/100	%	≥0	Word	R
4580H	17792	I2 32nd Harmonic	THD=Rx/100	%	≥0	Word	R
4581H	17793	I2 33rd Harmonic	THD=Rx/100	%	≥0	Word	R
4582H	17794	I2 34th Harmonic	THD=Rx/100	%	≥0	Word	R
4583H	17795	I2 35th Harmonic	THD=Rx/100	%	≥0	Word	R
4584H	17796	I2 36th Harmonic	THD=Rx/100	%	≥0	Word	R
4585H	17797	I2 37th Harmonic	THD=Rx/100	%	≥0	Word	R
4586H	17798	I2 38th Harmonic	THD=Rx/100	%	≥0	Word	R
4587H	17799	I2 39th Harmonic	THD=Rx/100	%	≥0	Word	R
4588H	17800	I2 40th Harmonic	THD=Rx/100	%	≥0	Word	R
4589H	17801	I2 41st Harmonic	THD=Rx/100	%	≥0	Word	R
458AH	17802	I2 42nd Harmonic	THD=Rx/100	%	≥0	Word	R
458BH	17803	I2 43rd Harmonic	THD=Rx/100	%	≥0	Word	R
458CH	17804	I2 44th Harmonic	THD=Rx/100	%	≥0	Word	R
458DH	17805	I2 45th Harmonic	THD=Rx/100	%	≥0	Word	R
458EH	17806	I2 46th Harmonic	THD=Rx/100	%	≥0	Word	R
458FH	17807	I2 47th Harmonic	THD=Rx/100	%	≥0	Word	R
4590H	17808	I2 48th Harmonic	THD=Rx/100	%	≥0	Word	R
4591H	17809	I2 49th Harmonic	THD=Rx/100	%	≥0	Word	R
4592H	17810	I2 50th Harmonic	THD=Rx/100	%	≥0	Word	R
4593H	17811	I2 51st Harmonic	THD=Rx/100	%	≥0	Word	R
4594H	17812	I2 52nd Harmonic	THD=Rx/100	%	≥0	Word	R
4595H	17813	I2 53rd Harmonic	THD=Rx/100	%	≥0	Word	R
4596H	17814	I2 54th Harmonic	THD=Rx/100	%	≥0	Word	R
4597H	17815	I2 55th Harmonic	THD=Rx/100	%	≥0	Word	R
4598H	17816	I2 56th Harmonic	THD=Rx/100	%	≥0	Word	R
4599H	17817	I2 57th Harmonic	THD=Rx/100	%	≥0	Word	R
459AH	17818	I2 58th Harmonic	THD=Rx/100	%	≥0	Word	R
459BH	17819	I2 59th Harmonic	THD=Rx/100	%	≥0	Word	R
459CH	17820	I2 60th Harmonic	THD=Rx/100	%	≥0	Word	R
459DH	17821	I2 61st Harmonic	THD=Rx/100	%	≥0	Word	R
459EH	17822	I2 62nd Harmonic	THD=Rx/100	%	≥0	Word	R
459FH	17823	I2 63rd Harmonic	THD=Rx/100	%	≥0	Word	R
4107H	16647	Odd THD_I2	THD=Rx/100	%	≥0	Word	R
4108H	16648	Even THD_I2	THD=Rx/100	%	≥0	Word	R
4109H	16649	K Factor of I2	CF=Rx/100	%	≥0	Word	R

I3 Current Harmonics

Table 64.

Current Harmonics, Even & Odd Harmonics, K Factor: 03H Read							
Address(H)	Address(D)	Parameter	Relationship	Property	Range	Data Type	Access Property
410AH	16650	I3 2nd Harmonic	THD=Rx/100	%	≥0	Word	R
410BH	16551	I3 3rd Harmonic	THD=Rx/100	%	≥0	Word	R
410CH	16652	I3 4th Harmonic	THD=Rx/100	%	≥0	Word	R
410DH	16553	I3 5th Harmonic	THD=Rx/100	%	≥0	Word	R
410EH	16554	I3 6th Harmonic	THD=Rx/100	%	≥0	Word	R
410FH	16555	I3 7th Harmonic	THD=Rx/100	%	≥0	Word	R
4110H	16556	I3 8th Harmonic	THD=Rx/100	%	≥0	Word	R
4111H	16657	I3 9th Harmonic	THD=Rx/100	%	≥0	Word	R
4112H	16558	I3 10th Harmonic	THD=Rx/100	%	≥0	Word	R
4113H	16559	I3 11th Harmonic	THD=Rx/100	%	≥0	Word	R
4114H	16660	I3 12th Harmonic	THD=Rx/100	%	≥0	Word	R
4115H	16661	I3 13th Harmonic	THD=Rx/100	%	≥0	Word	R
4116H	16662	I3 14th Harmonic	THD=Rx/100	%	≥0	Word	R
4117H	16663	I3 15th Harmonic	THD=Rx/100	%	≥0	Word	R
4118H	16664	I3 16th Harmonic	THD=Rx/100	%	≥0	Word	R
4119H	16665	I3 17th Harmonic	THD=Rx/100	%	≥0	Word	R
411AH	16666	I3 18th Harmonic	THD=Rx/100	%	≥0	Word	R
411BH	16667	I3 19th Harmonic	THD=Rx/100	%	≥0	Word	R
411CH	16668	I3 20th Harmonic	THD=Rx/100	%	≥0	Word	R
411DH	16669	I3 21st Harmonic	THD=Rx/100	%	≥0	Word	R
411EH	16670	I3 22nd Harmonic	THD=Rx/100	%	≥0	Word	R
411FH	16671	I3 23rd Harmonic	THD=Rx/100	%	≥0	Word	R
4120H	16672	I3 24th Harmonic	THD=Rx/100	%	≥0	Word	R
4121H	16673	I3 25th Harmonic	THD=Rx/100	%	≥0	Word	R
4122H	16674	I3 26th Harmonic	THD=Rx/100	%	≥0	Word	R
4123H	16675	I3 27th Harmonic	THD=Rx/100	%	≥0	Word	R
4124H	16676	I3 28th Harmonic	THD=Rx/100	%	≥0	Word	R
4125H	16677	I3 29th Harmonic	THD=Rx/100	%	≥0	Word	R
4126H	16678	I3 30th Harmonic	THD=Rx/100	%	≥0	Word	R
4127H	16679	I3 31st Harmonic	THD=Rx/100	%	≥0	Word	R
45A0H	17824	I3 32nd Harmonic	THD=Rx/100	%	≥0	Word	R
45A1H	17825	I3 33rd Harmonic	THD=Rx/100	%	≥0	Word	R
45A2H	17826	I3 34th Harmonic	THD=Rx/100	%	≥0	Word	R
45A3H	17827	I3 35th Harmonic	THD=Rx/100	%	≥0	Word	R
45A4H	17828	I3 36th Harmonic	THD=Rx/100	%	≥0	Word	R
45A5H	17829	I3 37th Harmonic	THD=Rx/100	%	≥0	Word	R
45A6H	17830	I3 38th Harmonic	THD=Rx/100	%	≥0	Word	R
45A7H	17831	I3 39th Harmonic	THD=Rx/100	%	≥0	Word	R

Current Harmonics, Even & Odd Harmonics, K Factor: 03H Read							
Address(H)	Address(D)	Parameter	Relationship	Property	Range	Data Type	Access Property
45A8H	17832	I3 40th Harmonic	THD=Rx/100	%	≥0	Word	R
45A9H	17833	I3 41st Harmonic	THD=Rx/100	%	≥0	Word	R
45AAH	17834	I3 42nd Harmonic	THD=Rx/100	%	≥0	Word	R
45ABH	17835	I3 43rd Harmonic	THD=Rx/100	%	≥0	Word	R
45ACH	17836	I3 44th Harmonic	THD=Rx/100	%	≥0	Word	R
45ADH	17837	I3 45th Harmonic	THD=Rx/100	%	≥0	Word	R
45AEH	17838	I3 46th Harmonic	THD=Rx/100	%	≥0	Word	R
45AFH	17839	I3 47th Harmonic	THD=Rx/100	%	≥0	Word	R
45B0H	17840	I3 48th Harmonic	THD=Rx/100	%	≥0	Word	R
45B1H	17841	I3 49th Harmonic	THD=Rx/100	%	≥0	Word	R
45B2H	17842	I3 50th Harmonic	THD=Rx/100	%	≥0	Word	R
45B3H	17843	I3 51st Harmonic	THD=Rx/100	%	≥0	Word	R
45B4H	17844	I3 52nd Harmonic	THD=Rx/100	%	≥0	Word	R
45B5H	17845	I3 53rd Harmonic	THD=Rx/100	%	≥0	Word	R
45B6H	17846	I3 54th Harmonic	THD=Rx/100	%	≥0	Word	R
45B7H	17847	I3 55th Harmonic	THD=Rx/100	%	≥0	Word	R
45B8H	17848	I3 56th Harmonic	THD=Rx/100	%	≥0	Word	R
45B9H	17849	I3 57th Harmonic	THD=Rx/100	%	≥0	Word	R
45BAH	17850	I3 58th Harmonic	THD=Rx/100	%	≥0	Word	R
45BBH	17851	I3 59th Harmonic	THD=Rx/100	%	≥0	Word	R
45BCH	17852	I3 60th Harmonic	THD=Rx/100	%	≥0	Word	R
45BDH	17853	I3 61st Harmonic	THD=Rx/100	%	≥0	Word	R
45BEH	17854	I3 62nd Harmonic	THD=Rx/100	%	≥0	Word	R
45BFH	17855	I3 63rd Harmonic	THD=Rx/100	%	≥0	Word	R
4128H	16680	Odd THD_I3	THD=Rx/100	%	≥0	Word	R
4129H	16681	Even THD_I3	THD=Rx/100	%	≥0	Word	R
412AH	16682	K Factor of I3	CF=Rx/100	%	≥0	Word	R

Note: When selecting 400Hz type, harmonics support 2nd~15th.

6.3.11 Max & Min Values

Records MAX/MIN value and timestamp.

Maximum Values

Table 65.

MAX: 03H Read							
Address(H)	**Address(D)**	**Parameter**	**Relationship**	**Property**	**Range**	**Data Type**	**Access Property**
4136H	16694	Max of V1	(Rx*(PT1/PT2))/10	V	32768~ 32767	int	R
4137H-413CH	16695-16700	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
413DH	16701	Max of V2	(Rx*(PT1/PT2))/10	V	32768~ 32767	int	R
413EH-4143H	16702-16707	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
4144H	16708	Max of V3	(Rx*(PT1/PT2))/10	V	32768~ 32767	int	R
4145H-414AH	16709-16714	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
414BH	16715	Max of V12	(Rx*(PT1/PT2))/10	V	32768~ 32767	int	R
414CH-4151H	16716-16721	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
4152H	16722	Max of V23	(Rx*(PT1/PT2))/10	V	32768~ 32767	int	R
4153H-4158H	16723-16728	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
4159H	16729	Max of V31	(Rx*(PT1/PT2))/10	V	32768~ 32767	int	R
415AH-415FH	16730-16735	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
4160H	16736	Max of I1	(Rx*(CT1/CT2))/1000	A	32768~ 32767	int	R
4161H-4166H	16737-16742	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
4167H	16743	Max of I2	(Rx*(CT1/CT2))/1000	A	32768~ 32767	int	R
4168H-416DH	16744-16749	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
416EH	16750	Max of I3	(Rx*(CT1/CT2))/1000	A	32768~ 32767	int	R
416FH-4174H	16751-16756	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
4175H	16757	Max of System Power	(Rx*(CT1/CT2)*(PT1/PT2))/1000	kW	32768~ 32767	int	R
4176H-417BH	16758-16763	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
417CH	16764	Max of Reactive Power	(Rx*(CT1/CT2)*(PT1/PT2))/1000	kvar	32768~ 32767	int	R

MAX: 03H Read							
Address(H)	Address(D)	Parameter	Relationship	Property	Range	Data Type	Access Property
417DH-4182H	16765-16770	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
4183H	16771	Max of Apparent Power	(Rx*(CT1/CT2)*(PT1/PT2))/1000	kVA	32768~32767	int	R
4184H-4189H	16772-16777	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
418AH	16778	Max of Power Factor	Rx/1000		32768~32767	int	R
418BH-4190H	16779-16784	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
4191H	16785	Max of Frequency	Rx/1000	Hz	32768~32767	int	R
4192H-4197H	16786-16791	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
4198H	16792	Max of Power Demand	(Rx*(CT1/CT2)*(PT1/PT2))/1000	kW	32768~32767	int	R
4199H-419EH	16793-16798	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
419FH	16799	Max of Reactive Power Demand	(Rx*(CT1/CT2)*(PT1/PT2))/1000	kvar	32768~32767	int	R
41A0H-41A5H	16800-16805	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
41A6H	16806	Max of Apparent Power Demand	(Rx*(CT1/CT2)*(PT1/PT2))/1000	kVA	32768~32767	int	R
41A7H-41ACH	16807-16812	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
4606H	17926	Max of Phase A Current Demand	(Rx*(CT1/CT2))/1000	A	32768~32767	int	R
4607H-460CH	17927-17932	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
460DH	17933	Max of Phase B Current Demand	(Rx*(CT1/CT2))/1000	A	32768~32767	int	R
460EH-4613H	17934-17939	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
4614H	17940	Max of Phase C Current Demand	(Rx*(CT1/CT2))/1000	A	32768~32767	int	R
4615H-461AH	17941-17946	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
41ADH	16813	Max of Voltage Unbalance	Rx/10	%	32768~32767	int	R
41AEH-41B3H	16814-16819	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
41B4H	16820	Max of Current Unbalance	Rx/10	%	32768~32767	int	R

MAX: 03H Read							
Address(H)	Address(D)	Parameter	Relationship	Property	Range	Data Type	Access Property
41B5H-41BAH	16821-16826	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
41BBH	16827	Max of THD_V1(V12)		%	32768~32767	int	R
41BCH-41C1H	16828-16833	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
41C2H	16834	Max of THD_V2(V31)	Rx/100	%	32768~32767	int	R
41C3H-41C8H	16835-16840	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
41C9H	16841	Max of THD_V3(V23)	Rx/100	%	32768~32767	int	R
41CAH-41CFH	16842-16847	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
41D0H	16848	Max of THD_I1	Rx/100	%	32768~32767	int	R
41D1H-41D6H	16849-16854	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
41D7H	16855	Max of THD_I2	Rx/100	%	32768~32767	int	R
41D8H-41DDH	16856-16861	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
41DEH	16862	Max of THD_I3	Rx/100	%	32768~32767	int	R
41DFH-41E4H	16863-16868	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R

Minimum Values

Table 66.

MIN: 03H Read							
Address(H)	Address(D)	Parameter	Relationship	Property	Range	Data Type	Access Property
41E5H	16869	Min of V1	(Rx*(PT1/PT2))/10	V	32768~32767	int	R
41E6H-41EBH	16870-16875	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
41ECH	16876	Min of V2	(Rx*(PT1/PT2))/10	V	32768~32767	int	R
41EDH-41F2H	16877-16882	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
41F3H	16883	Min of V3	(Rx*(PT1/PT2))/10	V	32768~32767	int	R
41F4H-41F9H	16884-16889	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
41FAH	16890	Min of V12	(Rx*(PT1/PT2))/10	V	32768~32767	int	R

MIN: 03H Read							
Address(H)	**Address(D)**	**Parameter**	**Relationship**	**Property**	**Range**	**Data Type**	**Access Property**
41FBH-4200H	16891-16896	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
4201H	16897	Min of V23	(Rx*(PT1/PT2))/10	V	32768~32767	int	R
4202H-4207H	16898-16903	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
4208H	16904	Min of V31	(Rx*(PT1/PT2))/10	V	32768~32767	int	R
4209H-420EH	16905-16910	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
420FH	16911	Min of I1	(Rx*(CT1/CT2))/1000	A	32768~32767	int	R
4210H-4215H	16912-16917	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
4216H	16918	Min of I2	(Rx*(CT1/CT2))/1000	A	32768~32767	int	R
4217H-421CH	16919-16924	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
421DH	16925	Min of I3	(Rx*(CT1/CT2))/1000	A	32768~32767	int	R
421EH-4223H	16926-16931	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
4224H	16932	Min of System Power	(Rx*(CT1/CT2)*(PT1/PT2))/1000	kW	32768~32767	int	R
4225H-422AH	16933-16938	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
422BH	16939	Min of Reactive Power	(Rx*(CT1/CT2)*(PT1/PT2))/1000	kvar	32768~32767	int	R
422CH-4231H	16940-16945	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
4232H	16946	Max of Apparent Power	(Rx*(CT1/CT2)*(PT1/PT2))/1000	kVA	32768~32767	int	R
4233H-4238H	16947-16952	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
4239H	16953	Min of Power Factor	Rx/1000		32768~32767	int	R
423AH-423FH	16954-16959	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
4240H	16960	Max of Frequency	Rx/1000	Hz	32768~32767	int	R
4241H-4246H	16961-16966	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
4247H	16967	Min of Power Demand	(Rx*(CT1/CT2)*(PT1/PT2))/1000	kW	32768~32767	int	R
4248H-424DH	16968-16973	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R

MIN: 03H Read							
Address(H)	**Address(D)**	**Parameter**	**Relationship**	**Property**	**Range**	**Data Type**	**Access Property**
424EH	16974	Max of Reactive Power Demand	(Rx*(CT1/CT2)*(PT1/ PT2))/1000	kvar	32768~ 32767	int	R
424FH-4254H	16975-16980	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
4255H	16981	Max of Apparent Power Demand	(Rx*(CT1/CT2)*(PT1/ PT2))/1000	kVA	32768~ 32767	int	R
4256H-425BH	16982-16987	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
425CH	16988	Min of Voltage Unbalance	Rx/10	%	32768~ 32767	int	R
425DH-4262H	16989-16994	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
4263H	16995	Min of Current Unbalance	Rx/10	%	32768~ 32767	int	R
4264H-4269H	16996-17001	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
426AH	17002	Min of THD_ V1 (V12)	Rx/100	%	32768~ 32767	int	R
426BH-4270H	17003-17008	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
4271H	17009	Min of THD_ V2 (V31)	Rx/100	%	32768~ 32767	int	R
4272H-4277H	17010-17015	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
4278H	17016	Min of THD_ V3(V23)	Rx/100	%	32768~ 32767	int	R
4279H-427EH	17017-17022	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
427FH	17023	Min of THD_I1	Rx/100	%	32768~ 32767	int	R
4280H-4285H	17024-17029	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
4286H	17030	Min of THD_I2	Rx/100	%	32768~ 32767	int	R
4287H-428CH	17031-17036	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R
428DH	17037	Min of THD_I3	Rx/100	%	32768~ 32767	int	R
428EH-4293H	17038-17043	Timestamp	YYYY:MM:DD:hh:mm:ss			int	R

Note: NOTE: The MAX and MIN frequency value should use word data type (0~65535).

6.3.12 Phase Angles

All voltage and current phase angles corresponding to V1 (V120) are stored here. You can find out the phase sequence according to them. Data type is “Word”.

Table 67.

Phase Angles: 03H Read						
Address(H)	Address(D)	Parameter	Relationship	Range	Data Type	Access Property
42A0H	17056	Phase Angle of V2 to V1	V2=Rx/10	0~3600	Word	R
42A1H	17057	Phase Angle of V3 to V1	V3=Rx/10	0~3600	Word	R
42A2H	17058	Phase Angle of I1 to V1	I1=Rx/10	0~3600	Word	R
42A3H	17059	Phase Angle of I2 to V1	I2=Rx/10	0~3600	Word	R
42A4H	17060	Phase Angle of I3 to V1	I3=Rx/10	0~3600	Word	R

6.3.13 Sequence Component

U1 (U12), I1 consist of a real part and complex part. They have positive sequence, negative sequence, and zero sequence. Data type is “Int.”

Table 68.

Sequence Component: 03H Read							
Address(H)	Address(D)	Parameter	Relationship	Property	Range	Data Type	Access Property
4294H	17044	Positive Sequence real part of V1	THD=Rx/100	%	-32768~32768	Word	R
4295H	17045	Positive Sequence complex part of V1	THD=Rx/100	%	-32768~32768	Word	R
4296H	17046	Negative Sequence real part of V1	THD=Rx/100	%	-32768~32768	Word	R
4297H	17047	Negative Sequence complex part of V1	THD=Rx/100	%	-32768~32768	Word	R
4298H	17048	Zero Sequence real part of V1	THD=Rx/100	%	-32768~32768	Word	R
4299H	17049	Zero Sequence complex part of V1	THD=Rx/100	%	-32768~32768	Word	R
429AH	17050	Positive Sequence real part of I1	THD=Rx/100	%	-32768~32768	Word	R
429BH	17051	Positive Sequence complex part of I1	THD=Rx/100	%	-32768~32768	Word	R
429CH	17052	Negative Sequence real part of I1	THD=Rx/100	%	-32768~32768	Word	R
429DH	17053	Negative Sequence complex part of I1	THD=Rx/100	%	-32768~32768	Word	R
429EH	17054	Zero Sequence real part of I1	THD=Rx/100	%	-32768~32768	Word	R
29FH	17055	Zero Sequence complex part of I1	THD=Rx/100	%	-32768~32768	Word	R

6.3.14 I/O Module Settings

I/O module setting changes will be made only if the corresponding I/O modules are installed, otherwise no changes will be made. Please check the I/O module connection status before doing any settings. Function code: 03H for reading, 10H for writing. Please refer to Chapter 5 Extended Modules for details.

AXM-IO11

Table 69.

AXM-IO1-1 Settings: 03H Read, 10H Write					
Address	**Parameters**	**Default**	**Range**	**Data Type**	**Property**
109EH	DI1~6 type	0	Bit0: DI1, Bit1: DI2, Bit2: DI3, Bit3: DI4 Bit4: DI5, Bit5: DI6, 0: DI, 1: Pulse counter	Word	R/W
109FH	DI pulse constant	0	1~65535	Word	R/W
10A0H	Working mode of relay 1 and 2	0	0: Control output, 1: Alarming output	Word	R/W
10A1H	Output mode of relay 1 and 2	0	0: Latch, 1: Pulse	Word	R/W
10A2H	Pulse width	50	50~3000ms	Word	R/W

AXM-IO21

Table 70.

AXM-IO2-1 Settings, 10H Write					
Address	**Parameters**	**Default**	**Range**	**Data Type**	**Property**
10A3H	DI11~14 type	0	Bit0: DI7, Bit1: DI8, Bit2: DI9, Bit3: DI10 0: DI, 1: Pulse counter	Word	R/W
10A4H	DI pulse constant	0	1~65535	Word	R/W
10A5H	Working mode of relay 3 and 4	0	0: Pulse output, 1: Alarming output	Word	R/W
10A6H	Output mode of relay 3 and 4	0	20~1000ms	Word	R/W
10A7H	Pulse width	50	0: None, 1: Consumption power 2: Generating power 3: Absorption reactive power 4: Generating reactive power	Word	R/W
10A8H	AI1, 2 type	1 or 2	0: None, 1: Consumption power 2: Generating power 3: Absorption reactive power 4: Generating reactive power	Word	R/W
10A9H	Pulse width	50	0: 0~20mA, 1: 4~20mA, 2: 0~5V, 3: 1~5V	Word	R/W

AXM-IO31

Table 71.

AXM-IO3-1 Settings: 03H Read, 10H Write					
Address	**Parameters**	**Default**	**Range**	**Data Type**	**Property**
10AAH	DI11~14 type	0	Bit0: DI11, Bit1: DI12, Bit2: DI13, Bit3: DI14 0: DI, 1: Pulse counter	Word	R/W
10ABH	DI pulse constant	0	1~65535	Word	R/W
10ACH	Working mode of relay 3 and 4	0	0: Control output, 1: Alarming output	Word	R/W
10ADH	Output mode of relay 3 and 4	0	0: Latch, 1: Pulse	Word	R/W
10AEH	Pulse width	50	50~3000ms	Word	R/W
10AFH	AI1, 2 type	1 or 2	0: 0~20mA, 1: 4~20mA, 2: 0~5V, 3: 1~5V	Word	R/W

AXM-IO12

Table 72.

AXM-IO1-2 Settings: 03H Read, 10H Write					
Address	**Parameters**	**Default**	**Range**	**Data Type**	**Property**
10B0H	DI15~20 type	0	Bit0: DI15, Bit1: DI16	Word	R/W
10B1H	DI pulse constant (high)	0	1~65535	Word	R/W
10B2H	Working mode of relay 5 and 6	0	0: Control output, 1: Alarming output	Word	R/W
10B3H	Output mode of relay 5 and 6	0	0: Latch, 1: Pulse	Word	R/W
10B4H	Pulse width	50	50~3000ms	Word	R/W

AXM-IO22

Table 73. Table 6-42

AXM-IO2-2 Settings: 03H Read, 10H Write					
Address	**Parameters**	**Default**	**Range**	**Data Type**	**Property**
10B5H	DI21~24 type	0	Bit0: DI21, Bit1: DI22, Bit2: DI23, Bit3: DI24, 0: DI, 1: Pulse counter	Word	R/W
10B6H	DI pulse constant	0	1~65535	Word	R/W
10B7H	Working mode of DO3, 4	0	0: Pulse output, 1: Alarming output	Word	R/W
10B8H	DO pulse width	20	20~1000ms	Word	R/W

AXM-IO2-2 Settings: 03H Read, 10H Write					
Address	Parameters	Default	Range	Data Type	Property
10B9H	DO3 output	0	0: None, 1: Consumption power 2: Generating power 3: Absorption reactive power 4: Generating reactive power	Word	R/W
10BAH	DO4 output	0	0: None, 1: Consumption power 2: Generating power 3: Absorption reactive power 4: Generating reactive power	Word	R/W
10BBH	AO3, 4 type	1 or 2	0: 0~20mA, 1: 4~20mA, 2: 0~5V, 3: 1~5V	Word	R/W

AXM-IO32

Table 74.

AXM-IO3-2 Settings: 03H Read, 10H Write					
Address	Parameters	Default	Range	Data Type	Property
10BCH	DI25~28 type	0	Bit0: DI25, Bit1: DI26, Bit2: DI27, Bit3: DI28 0: DI, 1: Pulse constant	Word	R/W
10BDH	DI pulse constant	0	1~65535	Word	R/W
10BEH	Working mode of relay 7 and 8	0	0: Control output, 1: Alarming output	Word	R/W
10BFH	Output mode of relay 7 and 8	0	0: Latch, 1: Pulse	Word	R/W
10C0H	Pulse width	50	50~3000	Word	R/W
10C1H	AI3, 4 type	1 or 2	0: 0~20mA, 1: 4~20mA, 2: 0~5V, 3: 1~5V	Word	R/W

AO Parameter Selection

Table 75.

AO Parameter Selection: 03H Read, 10H Write					
Address	Parameters	Default	Range	Data Type	Property
10C2H	AO1 parameter	0	Refer to the table 6-45 below	Word	R/W
10C3H	AO2 parameter	0	Refer to the table 6-45 below	Word	R/W
10C4H	AO3 parameter	0	Refer to the table 6-45 below	Word	R/W
10C5H	AO4 parameter	0	Refer to the table 6-45 below	Word	R/W

AO Parameter Translation Table

Table 76.

AO Parameter Selection					
Setting Value	**Transforming Object**	**Setting Value**	**Transforming Object**	**Setting Value**	**Transforming Object**
0	Frequency	1	Va	2	Vb
3	Vc	4	Average phase voltage	5	Uab
6	Ubc	7	Uca	8	Average line voltage
9	Current of phase A	10	Current of phase B	11	Current of phase C
12	Average current	13	Neutral current	14	Power of phase A
15	Power of phase B	16	Power of phase C	17	Power of all
18	Reactive power of A	19	Reactive power of phase B	20	Reactive power of phase C
21	Reactive power of all	22	Apparent power of phase A	23	Apparent power of phase B
24	Apparent power of phase C	25	Apparent power of all	26	PF of A
27	PF of B	28	PF of C	29	PF

AO Range Configuration

Table 77.

AO Parameter Selection: 03H Read, 10H Write					
Address	**Parameters**	**Default**	**Range**	**Data Type**	**Property**
10D0H	AO1 Gradient Number selection of input/output transfer curve	1	1: 1 Gradient 2: 2 Gradient 3: 3 Gradient	INT	R/W
10D1H	AO1 following value range setting start point		Please see note	INT	R/W
10D2H	AO1 following value range setting point 2			INT	R/W
10D3H	AO1 following value range setting point 3			INT	R/W
10D4H	AO1 following value range setting end point			INT	R/W
10D5H	AO1 output range setting start point		AO type of 0~24A or 0~6: 0~4915 AO type of 4~24A or 1~6: 819~4915	INT	R/W
10D6H	AO1 output range setting point 2			INT	R/W
10D7H	AO1 output range setting point 3			INT	R/W
10D8H	AO1 output range setting end point			INT	R/W

AO Parameter Selection: 03H Read, 10H Write					
Address	**Parameters**	**Default**	**Range**	**Data Type**	**Property**
109H-10E1H	AO2 Gradient Setting (same as AO1)		Same as AO1	INT	R/W
10E2H-10EAH	AO3 Gradient Setting (same as AO1)		Same as AO1	INT	R/W
10EBH-10F3H	AO4 Gradient Setting (same as AO1)		Same as AO1	INT	R/W

Note: NOTE: 1. AO Gradient Number Selection of input/output transfer curve

When the number is 1, only the AO following value range setting start point, AO following value range setting end point, AO1 output range setting start point, and AO1 output range setting endpoint should be set.

When number is 2, only the AO following value range setting start point, AO1 following value range setting point 2, AO following value range setting end point, AO1 output range setting start point, AO1 output range setting point 2, and AO1 output range setting endpoint should be set.

When number is 3, only the AO following value range setting start point, AO1 following value range setting point 2, AO1 following value range setting point 3, and AO following value range setting end point should be set. At the same time, the AO1 output range setting start point, AO1 output range setting point 2, AO1 output range setting point 3, and AO1 output range setting end point should be set.

Following value range setting:

The AO following value range setting start point, AO1 following value range setting point 2, AO1 following value range setting point 3, and AO following value range setting end point are increasing value, while they should be within range of the AO following value. Otherwise, the function of the AO will be affected.

Frequency: When selecting 50Hz or 60Hz type, the frequency range is 45Hz ~ 65Hz and the real setting value is 4500 ~ 6500. When selecting 400Hz type, the frequency range is 300Hz ~ 500Hz and the real setting value is 30000~50000.

Phase voltage V1, V2, V3 and average phase voltage: 0~480V, real setting value is 0~4800.

Line voltage V12, V23, V31 and average line voltage: 0~831V, real setting value is 0~8310.

Current I1, I2, I3 and average current: 0~10A, real setting value is 0~10000.

Power Pa, Pb and Pc: -4800~4800W, real setting value is -4800~4800.

System power: -14400~14400W, real setting value is -14400~14400.

Reactive power Qa, Qb and Qc: -4800~4800 Var, real setting value is-4800~4800.

System reactive power: -14400~14400 Var.

Apparent power Sa, Sb and Sc: 0~4800VA, real setting value is 0~4800.

System apparent power: 0~14400VA, real setting value is 0~14400.

Power factor PFa, PFb, PFc and System power factor: -1~1, real setting value is -1000~1000.

AO output range setting:

The AO output value range setting start point, AO1 output value range setting point 2, AO1 output value range setting point 3, and AO output value range setting end point are increasing value, while they should be within range of the AO output value.

When the AO type is 0~20mA, the setting value range is 0~ 4915, and the relationship is mA=setting value*20/4096.

When the AO type is 4~20mA, the setting value range is 819~ 4915, and the relationship is mA=setting value*20/4096.

When the AO type is 0~5V, the setting value range is 0~ 4915, and the relationship is V=setting value*5/4096.

When the AO type is 1~5V, the setting value range is 819~ 4915, and the relationship is V=setting value*5/4096.

Counting Pulses on DI

DI are arranged according to expanded I/O module addresses, user can check on the counting number of DI along with those modules. The DI counting record are stored in a non-volatile memory and will not be erased during power off. They can be reset via communication and panel. Data type is "Dword".

6.3.15 I/O Module Readings Settings

DI Counter

Table 78.

DI Counter: 03H Read						
Address(H)	**Address(D)**	**Symbol**	**Parameter**	**Range**	**Data Type**	**Access Property**
AXM-I01-1						
4349H-434AH	17225-17226	DI_111	DI1 Pulse Counter Number	0~4294967295	Dword	R
434BH-434CH	17227-17228	DI_112	DI2 Pulse Counter Number	0~4294967295	Dword	R
434DH-434EH	17229-17230	DI_113	DI3 Pulse Counter Number	0~4294967295	Dword	R
434FH-4350H	17231-17232	DI_114	DI4 Pulse Counter number	0~4294967295	Dword	R
4351H-4352H	17233-17234	DI_115	DI5 Pulse Counter Number	0~4294967295	Dword	R
4353H-4354H	17235-17236	DI_116	DI6 Pulse Counter Number	0~4294967295	Dword	R
AXM-I02-1						
4355H-4356H	17237-17238	DI_211	DI7 Pulse Counter Number	0~4294967295	Dword	R
4357H-4358H	17239-17240	DI_212	DI8 Pulse Counter Number	0~4294967295	Dword	R
4359H-435AH	17241-17242	DI_213	DI9 Pulse Counter Number	0~4294967295	Dword	R

DI Counter: 03H Read						
Address(H)	**Address(D)**	**Symbol**	**Parameter**	**Range**	**Data Type**	**Access Property**
435BH-435CH	17243-17244	DI_214	DI10 Pulse Counter Number	0~4294967295	Dword	R
AXM-IO3-1						
435DH-435EH	17245-17246	DI_311	DI11 Pulse Counter Number	0~4294967295	Dword	R
435FH-4360H	17247-17248	DI_312	DI12 Pulse Counter Number	0~4294967295	Dword	R
4361H-4362H	17249-17250	DI_313	DI13 Pulse Counter Number	0~4294967295	Dword	R
4363H-4364H	17251-17252	DI_314	DI14 Pulse Counter Number	0~4294967295	Dword	R
AXM-IO1-2						
4365H-4366H	17253-17254	DI_121	DI15 Pulse Counter Number	0~4294967295	Dword	R
4367H-4368H	17255-17256	DI_122	DI16 Pulse Counter Number	0~4294967295	Dword	R
4369H-436AH	17257-17258	DI_123	DI17 Pulse Counter Number	0~4294967295	Dword	R
436BH-436CH	17259-17260	DI_124	DI18 Pulse Counter Number	0~4294967295	Dword	R
436DH-436EH	17261-17262	DI_125	DI19 Pulse Counter Number	0~4294967295	Dword	R
436FH-4370H	17263-17264	DI_126	DI20 Pulse Counter Number	0~4294967295	Dword	R
AXM-IO2-2						
4371H-4372H	17265-17266	DI_221	DI21 Pulse Counter Number	0~4294967295	Dword	R
4373H-4374H	17267-17268	DI_222	DI22 Pulse Counter Number	0~4294967295	Dword	R
4375H-4376H	17269-17270	DI_223	DI23 Pulse Counter Number	0~4294967295	Dword	R
4377H-4378H	17271-17272	DI_224	DI24 Pulse Counter Number	0~4294967295	Dword	R
AXM-IO3-2						
4371H-4372H	17265-17266	DI_221	DI21 Pulse Counter Number	0~4294967295	Dword	R
4373H-4374H	17267-17268	DI_222	DI22 Pulse Counter Number	0~4294967295	Dword	R
4375H-4376H	17269-17270	DI_223	DI23 Pulse Counter Number	0~4294967295	Dword	R
4377H-4378H	17271-17272	DI_224	DI24 Pulse Counter Number	0~4294967295	Dword	R

DI Status

Table 79. Table 6-48

DI Status: 02H Read						
Address(H)	**Address(D)**	**Symbol**	**Parameter**	**Range**	**Data Type**	**Access Property**
AXM-101-1						
0000H	0	DI_111	DI1 Status	0: OFF 1: ON	Bit	R
0001H	1	DI_112	DI2 Status	0: OFF 1: ON	Bit	R
0002H	2	DI_113	DI3 Status	0: OFF 1: ON	Bit	R
0003H	3	DI_114	DI4 Status	0: OFF 1: ON	Bit	R
0004H	4	DI_115	DI5 Status	0: OFF 1: ON	Bit	R
0005H	5	DI_116	DI6 Status	0: OFF 1: ON	Bit	R
AXM-I02-1						
0006H	6	DI_211	DI7 Status	0: OFF 1: ON	Bit	R
0007H	7	DI_212	DI8 Status	0: OFF 1: ON	Bit	R
0008H	8	DI_213	DI9 Status	0: OFF 1: ON	Bit	R
0009H	9	DI_214	DI10 Status	0: OFF 1: ON	Bit	R
AXM-I03-1						
000AH	10	DI_311	DI11 Status	0: OFF 1: ON	Bit	R
000BH	11	DI_312	DI12 Status	0: OFF 1: ON	Bit	R
000CH	12	DI_313	DI13 Status	0: OFF 1: ON	Bit	R
000DH	13	DI_314	DI14 Status	0: OFF 1: ON	Bit	R
AXM-I01-2						
000EH	14	DI_121	DI15 Status	0: OFF 1: ON	Bit	R
000FH	15	DI_122	DI16 Status	0: OFF 1: ON	Bit	R
0010H	16	DI_123	DI17 Status	0: OFF 1: ON	Bit	R

DI Status: 02H Read						
Address(H)	Address(D)	Symbol	Parameter	Range	Data Type	Access Property
0011H	17	DI_124	DI18 Status	0: OFF 1: ON	Bit	R
0012H	18	DI_125	DI19 Status	0: OFF 1: ON	Bit	R
0013H	19	DI_126	DI20 Status	0: OFF 1: ON	Bit	R
AXM-IO2-2						
0014H	20	DI_221	DI21 Status	0: OFF 1: ON	Bit	R
0015H	21	DI_222	DI22 Status	0: OFF 1: ON	Bit	R
0016H	22	DI_223	DI23 Status	0: OFF 1: ON	Bit	R
0017H	23	DI_224	DI24 Status	0: OFF 1: ON	Bit	R
AXM-IO3-2						
0018H	24	DI_321	DI25 Status	0: OFF 1: ON	Bit	R
0019H	25	DI_322	DI26 Status	0: OFF 1: ON	Bit	R
001AH	26	DI_323	DI27 Status	0: OFF 1: ON	Bit	R
001BH	27	DI_324	DI28 Status	0: OFF 1: ON	Bit	R

Analog Input

The output of AI is mapped to the range of 0~4095 according to its sampling value using an algorithm. Data type is “Word”.

Table 80.

AI Input Value: 03H Read						
Address(H)	Address(D)	Symbol	Parameters	Range	Data Type	Access Property
4385H	17285	AI_311	AI1 Sampling value	0~4095	Dword	R
4386H	17286	AI_312	AI2 Sampling value	0~4095	Dword	R
4387H	17287	AI_321	AI3 Sampling value	0~4095	Dword	R
4388H	17288	AI_322	AI4 Sampling value	0~4095	Dword	R

Analog Output

The output of the AO is the actual value of output. There are 2 output options for AO: V or mA. Over/under limit or data type is "Float".

Table 81.

AO Output Value: 03H Read						
Address(H)	Address(D)	Symbol	Parameters	Range	Data Type	Access Property
4389H-438AH	17289-17290	AO_211	Value of AO1		Float	R
438BH-438CH	17291-17292	AO_212	Value of AO2		Float	R
438DH-438EH	17293-17294	AO_221	Value of AO3		Float	R
438FH-4390H	17295-17296	AO_222	Value of AO4		Float	R

Relay Output

Table 82.

DI Status: 02H Read						
Address(H)	Address(D)	Symbol	Parameters	Range	Data Type	Access Property
AXM-101-1						
0000H	0	RO_111	RO1	0:OFF 1:ON	Bit	R
0001H	1	RO_112	RO2	0:OFF 1:ON	Bit	R
AXM-I03-1						
0002H	2	RO_311	RO3	0: OFF 1: ON	Bit	R
0003H	3	RO_312	RO4	0: OFF 1: ON	Bit	R
AXM-I01-2						
0004H	4	RO_121	RO5	0: OFF 1: ON	Bit	R
0005H	5	RO_122	RO6	0: OFF 1: ON	Bit	R
AXM-I03-2						
0006H	6	RO_321	RO7	0: OFF 1: ON	Bit	R
0007H	7	RO_322	RO8	0: OFF 1: ON	Bit	R

SOE Records

There are 20 groups of records with the same format. Before gathering SOE records, the selected I/O module must be SOE enabled. If the SOE enabled I/O module is not connected, SOE record logs will not be collected.

Table 83.

Address	Parameters	Code	Range	Data Type	Property
4339H~439FH	First group: timestamp: yyyy:mm:dd:hh:mm:ms	F3		Word	R
43A0H	First group: DI status	F1		Word	R
43A1H~4438H	2nd to 20th group			Word	R
4439H	Value of A04	F1	0: None 1: AXM-IO11 2: AXM-IO21 3: AXM-IO31 4: AXM-IO12 5: AXM-IO22 6: AXM-IO32	Word	R

6.3.16 SunSpec Registers

Table 84.

SunSpec: 03H Read, 10H Write							
Address(H)	Address(D)	Parameters	Range	Default	Data Type	Access Property	Number of Registers
C350H-C351H	50000-50001	SunSpec_ID	0x53756e53			R	2
C352H	50002	ID	1		Uint16	R	1
C353H	50003	Length	65		String	R	1
C354H-C363H	50004-50019	Manufacturer		Eaton	String	R	16
C364H-C373H	50020-50035	Model	Manufacturer Specific Value (32 characters)	Acuvim II	String	R	16
C374H-C37BH	50036-50043	Options	Manufacturer Specific Value (16 characters)	Acuvim IIR/IIW	String	R	8
C37CH-C383H	50044-50051	Version	Manufacturer Specific Value (16 characters)	H: 2.31 S: 3.60	String	R	8
C384H-C393H	50052-50067	Serial Numsber	Manufacturer Specific Value (32 characters)		String	R	16
C394H	50068	Device Address	Modbus Device Address		Uint16	R	1

SunSpec: 03H Read, 10H Write							
Address(H)	**Address(D)**	**Parameters**	**Range**	**Default**	**Data Type**	**Access Property**	**Number of Registers**
C395H	50069	ID	Meter Configuration: Single Phase (AN or AB): 201 Split Single Phase (ABN): 202 WYE-Three Phase (ABCN): 203 Delta Three Phase (ABC): 204		Uint16	R	1
C396H	50070	Length	81		Uint16	R	1
C397H	50071	Current: Amps(Average)	0~32767 A		Int16	R	1
C398H	50072	Current: Phase A	0~32767 A		Int16	R	1
C399H	50073	Current: Phase B	0~32767 A		Int16	R	1
C39AH	50074	Current: Phase C	0~32767 A		Int16	R	1
C39BH	50075	Current SunSpec Scale Factor	0~32767 A		sunssf	R	1
C39CH	50076	Voltage: Average Phase	3~2 (used an exponent of a power of 10)		int16	R	1
C39DH	50077	Voltage: Phase A	0~9999 V		int16	R	1
C39EH	50078	Voltage: Phase B	0~9999 V		int16	R	1
C39FH	50079	Voltage: Phase C	0~9999 V		int16	R	1
C3A0H	50080	Voltage: Line-Line Average	0~9999 V		int16	R	1
C3A1H	50081	Voltage: Line AB	0~9999 V		int16	R	1
C3A2H	50082	Voltage: Line BC	0~9999V		int16	R	1
C3A3H	50083	Voltage: Line CA	0~9999 V		int16	R	1
C3A4H	50084	Voltage Scale Factor	2~4(used as an exponent of a power of 10)		sunssf	R	1
C3A5H	50085	Frequency	45-65Hz		int16	R	1
C3A6H	50086	Frequency Scale Factor	2(used as an exponent of a power of10)		sunssf	R	1
C3A7H	50087	Total Real Power	32768~32767 W		int16	R	1
C3A8H	50088	Real Power: Phase A Watts	32768~32767 W		int16	R	1
C3A9H	50089	Real Power: Phase B Watts	32768~32767 W		int16	R	1
C3AAH	50090	Real Power: Phase C Watts	32768~32767		int16	R	1

SunSpec: 03H Read, 10H Write							
Address(H)	**Address(D)**	**Parameters**	**Range**	**Default**	**Data Type**	**Access Property**	**Number of Registers**
C3ABH	50091	Real Power Scale Factor	1~8(used as an exponent of a power of 10)		sunssf	R	1
C3ACH	50092	Total Apparent Power	0~32367 VA		int16	R	1
C3ADH	50093	Apparent Power: Phase A VA	0~32367 VA		int16	R	1
C3AEH	50094	Apparent Power: Phase B VA	0~32367 VA		int16	R	1
C3AFH	50095	Apparent Power: Phase C VA	0~32767 VA		int16	R	1
C3B0H	50096	Apparent Power Scale Factor	1~8(used as an exponent of a power of 10)		sunssf	R	1
C3B1H	50097	Total Reactive Power	32768~32767 var		int16	R	1
C3B2H	50098	Reactive Power: Phase A var	32768~32767 var		int16	R	1
C3B3H	50099	Reactive Power: Phase B var	3278~32767 var		int16	R	1
C3B4H	50100	Reactive Power: Phase C var	32768~32767 var		int16	R	1
C3B5H	50101	Reactive Power Scale Factor	1~8(used as an exponent of a power of 10)		sunssf	R	1
C3B6H	50102	Power Factor	1000~1000		int16	R	1
C3B7H	50103	Power Factor: Phase A PF	1000~1000		int16	R	1
C3B8H	50104	Power Factor: Phase B PF	1000~1000		int16	R	1
C3B9H	50105	Power Factor: Phase C PF	1000~1000		int16	R	1
C3BAH	50106	Power Factor Scale Factor	3(used an exponent of a power of 10)		sunssf	R	1
C3BBH-C3BCH	50107-50108	Total Real Energy: Export	0~999999999 Wh		int32	R/W	2
C3BDH-C3BEH	50109-50110	Export Real Energy: Phase A	0~999999999 Wh		int32	R/W	2
C3BFH-C3C0H	50111-50112	Export Real Energy: Phase B	0~999999999 Wh		int32	R/W	2
C3C1H-C3C2H	50113-50114	Export Real Energy: Phase C	0~999999999 Wh		int32	R/W	2
C3C3H-C3C4H	50115-50116	Total Real Energy: Import	0~999999999 Wh		int32	R/W	2
C3C5H-C3C6H	50117-50118	Import Real Energy: Phase A	0~999999999 Wh		int32	R/W	2
C3C7H-C3C8H	50119-50120	Import Real Energy: Phase B	0~999999999 Wh		int32	R/W	2

SunSpec: 03H Read, 10H Write							
Address(H)	Address(D)	Parameters	Range	Default	Data Type	Access Property	Number of Registers
C3C9H-C3CAH	50121-50122	Import Real Energy: Phase C	0~999999999 Wh		int32	R/W	2
C3CBH	50123	Real Energy Scale Factor	0,2(used as an exponent of a power of 10)		sunssf	R	1
C3CCH-C3CDH	50124-50125	Total Apparent Energy	0~999999999 VAh		int32	R/W	2
C3CEH-C3CFH	50126-50127	Apparent Energy: Phase A	0~999999999 VAh		int32	R/W	2
C3D0H-C3D1H	50128-50129	Apparent Energy: Phase B	0~999999999 VAh		int32	R/W	2
C3D2H-C3D3H	50130-50131	Apparent Energy: Phase C	0~999999999 VAh		int32	R/W	2
C3D4H	50132	Apparent Energy Scale Factor	0,2(used as an exponent of a power of 10)		sunssf	R	1
C3D5H-C3D6H	50133-50134	Total Reactive Energy: Export	0~999999999 varh		int32	R/W	2
C3D7H-C3D8H	50135-50136	Export Reactive Energy: Phase A	0~999999999 varh		int32	R/W	2
C3D9H-C3DAH	50137-50138	Export Reactive Energy: Phase B	0~999999999 varh		int32	R/W	2
C3DBH-C3DCH	50139-50140	Export Reactive Energy: Phase C	0~999999999 varh		int32	R/W	2
C3DDH-C3DEH	50141-50142	Total Reactive Energy: Import	0~999999999 varh		int32	R/W	2
C3DFH-C3E0H	50143-50144	Import Reactive Energy: Phase A	0~999999999 varh		int32	R/W	2
C3E1H-C3E2H	50145-50146	Import Reactive Energy: Phase B	0~999999999 varh		int32	R/W	2
C3E3H-C3E4H	50174-50148	Import Reactive Energy: Phase C	0~999999999 varh		int32	R/W	2
C3E5H	50149	Reactive Power Scale Factor	0,2(used as an exponent of a power of 10)		sunssf	R	1
C3E6H-C3E7H	50150-50151	Meter Event Flags	0		Binary	R	2
C3E8H	50152	SunSpec_end_ID: Sunspec	FFFF		int16		1
C3E9H	50153	SunSpec_end_ID: Sunspec	0		int16		1

Chapter 6: Communication Part II

6.3.17 Over/Under Alarm Setting

This setting consists of alarm settings and single channel alarm settings. Alarm settings contain settings for all variables. There are 16 groups of records with the same format.

Function code: 03H for reading, 10H for writing.

Please refer to Chapter 4 for more details.

Alarm Settings

Table 85.

Alarm Settings: 03H Read, 10H Write					
Address(H)	**Address(D)**	**Parameters**	**Range**	**Data Type**	**Access Property**
1046H	4166	Alarm enable	0: Disable, 1: Enable	Word	R/W
1047H	4167	Alarm flash enable	0: Disable, 1: Enable	Word	R/W
1048H	4168	Alarm channel enable	0~65535 Bit0: Channel 1 1: Enable 0: Disable Bit1: Channel 2 .. Bit15: Channel 16	Word	R/W
1049H	4169	Logic “And” between alarm setting	0~255 Bit0: First logic switch Bit1: Second logic switch .. Bit7: Eighth logic switch	Word	R/W
104AH	4170	Alarming output to DO1 setting	0~65535 Bit0: Channel 1 output 1: Enable, 0: Disable Bit1: Channel 2 output .. Bit15: Channel 16 output	Word	R/W
104BH	4171	Alarming output to DO3 setting	0~65535 Bit0: Channel 1 output 1: Enable, 0: Disable Bit1: Channel 2 output .. Bit15: Channel 16 output	Word	R/W
104CH	4172	Alarming output to DO3 setting	0~65535 Bit0: Channel 1 output 1: Enable, 0: Disable Bit1: Channel 2 output .. Bit15: Channel 16 output	Word	R/W
104DH	4173	Alarming output to DO4 setting	0~65535 Bit0: Channel 1 output 1: Enable, 0: Disable Bit1: Channel 2 output .. Bit15: Channel 16 output	Word	R/W

Single Channel Alarm Settings

Table 86.

Single Channel Alarm Settings: 03H Read, 10H Write					
Address(H)	**Address(D)**	**Parameters**	**Range**	**Data Type**	**Access Property**
104EH	4174	1st group: parameter code	0~79	Word	R/W
104FH	4175	1st group: comparison mode	1: Greater than 2: Equal to 3: Less than	Word	R/W
1050H	4176	1st group: setpoint value	Related with parameters	Word	R/W
1051H	4177	1st group: delay	0~3000 (*10ms)	Word	R/W
1052H	4178	1st group: output to relay	0:none 1~8: related relay	Word	R/W
1053H	4179	2nd group: parameter code	0~79	Word	R/W
1054H	4180	2nd group: comparison mode	1: Greater than 2: Equal to 3: Less than	Word	R/W
1055H	4181	2nd group: setpoint value	Related with parameters	Word	R/W
1056H	4182	2nd group: delay	0~3000 (*10ms)	Word	R/W
1057H	4183	2nd group: output to relay	0:none 1~8: related relay	Word	R/W
1058H	4184	3rd group: parameter code	0~79	Word	R/W
1059H	4185	3rd group: comparison mode	1: Greater than 2: Equal to 3: Less than	Word	R/W
105AH	4186	3rd group: setpoint value	Related with parameters	Word	R/W
105BH	4187	3rd group: delay	0~3000 (*10ms)	Word	R/W
105CH	4188	3rd group: output to relay	0:none 1~8: related relay	Word	R/W
105DH	4189	4th group: parameter code	0~79	Word	R/W
105EH	4190	4th group: comparison mode	1: Greater than 2: Equal to 3: Less than	Word	R/W
105FH	4191	4th group: setpoint value	Related with parameters	Word	R/W
1060H	4192	4th group: delay	0~3000 (*10ms)	Word	R/W
1061H	4193	4th group: output to relay	0:none 1~8: related relay	Word	R/W

Single Channel Alarm Settings: 03H Read, 10H Write					
Address(H)	**Address(D)**	**Parameters**	**Range**	**Data Type**	**Access Property**
1062H	4194	5th group: parameter code	0~79	Word	R/W
1063H	4195	5th group: comparison mode	1: Greater than 2: Equal to 3: Less than	Word	R/W
1064H	4196	5th group: setpoint value	Related with parameters	Word	R/W
1065H	4197	5th group: delay	0~3000 (*10ms)	Word	R/W
1066H	4198	5th group: output to relay	0:none 1~8: related relay	Word	R/W
1067H	4199	6th group: parameter code	0~79	Word	R/W
1068H	4200	6th group: comparison mode	1: Greater than 2: Equal to 3: Less than	Word	R/W
1069H	4201	6th group: setpoint value	Related with parameters	Word	R/W
106AH	4202	6th group: delay	0~3000 (*10ms)	Word	R/W
106BH	4203	6th group: output to relay	0:none 1~8: related relay	Word	R/W
106CH	4203	7th group: parameter code	0~79	Word	R/W
106DH	4204	7th group: comparison mode	1: Greater than 2: Equal to 3: Less than	Word	R/W
106EH	4205	7th group: setpoint value	Related with parameters	Word	R/W
106FH	4206	7th group: delay	0~3000 (*10ms)	Word	R/W
1070H	4207	7th group: output to relay	0:none 1~8: related relay	Word	R/W
1071H	4208	8th group: parameter code	0~79	Word	R/W
1072H	4209	8th group: comparison mode	1: Greater than 2: Equal to 3: Less than	Word	R/W
1073H	4210	8th group: setpoint value	Related with parameters	Word	R/W
1074H	4211	8th group: delay	0~3000 (*10ms)	Word	R/W
1075H	4212	8th group: output to relay	0:none 1~8: related relay	Word	R/W
1076H	4213	9th group: parameter code	0~79	Word	R/W
1078H	4214	9th group: comparison mode	1: Greater than 2: Equal to 3: Less than	Word	R/W

Single Channel Alarm Settings: 03H Read, 10H Write					
Address(H)	**Address(D)**	**Parameters**	**Range**	**Data Type**	**Access Property**
1079H	4215	9th group: setpoint value	Related with parameters	Word	R/W
107AH	4216	9th group: delay	0~3000 (*10ms)	Word	R/W
107BH	4217	9th group: output to relay	0:none 1~8: related relay	Word	R/W
107CH	4218	10th group: parameter code	0~79	Word	R/W
107DH	4219	10th group: comparison mode	1: Greater than 2: Equal to 3: Less than	Word	R/W
107EH	4220	10th group: setpoint value	Related with parameters	Word	R/W
107FH	4221	10th group: delay	0~3000 (*10ms)	Word	R/W
1080H	4222	10th group: output to relay	0:none 1~8: related relay	Word	R/W
1081H	4223	11th group: parameter code	0~79	Word	R/W
1081H	4224	11th group: comparison mode	1: Greater than 2: Equal to 3: Less than	Word	R/W
1082H	4225	11th group: setpoint value	Related with parameters	Word	R/W
1083H	4226	11th group: delay	0~3000 (*10ms)	Word	R/W
1084H	4227	11th group: output to relay	0:none 1~8: related relay	Word	R/W
1085H	4228	12th group: parameter code	0~79	Word	R/W
1086H	4229	12th group: comparison mode	1: Greater than 2: Equal to 3: Less than	Word	R/W
1087H	4230	12th group: setpoint value	Related with parameters	Word	R/W
1088H	4231	12th group: delay	0~3000 (*10ms)	Word	R/W
1089H	4232	12th group: output to relay	0:none 1~8: related relay	Word	R/W
108AH	4233	13th group: parameter code	0~79	Word	R/W
108BH	4234	13th group: comparison mode	1: Greater than 2: Equal to 3: Less than	Word	R/W
108CH	4235	13th group: setpoint value	Related with parameters	Word	R/W
108DH	4236	13th group: delay	0~3000 (*10ms)	Word	R/W
108EH	4237	13th group: output to relay	0:none 1~8: related relay	Word	R/W

Single Channel Alarm Settings: 03H Read, 10H Write					
Address(H)	Address(D)	Parameters	Range	Data Type	Access Property
108FH	4238	14th group: parameter code	0~79	Word	R/W
1090H	4239	14th group: comparison mode	1: Greater than 2: Equal to 3: Less than	Word	R/W
1091H	4240	14th group: setpoint value	Related with parameters	Word	R/W
1092H	4241	14th group: delay	0~3000 (*10ms)	Word	R/W
1093H	4242	14th group: output to relay	0:none 1~8: related relay	Word	R/W
1094H	4243	15th group: parameter code	0~79	Word	R/W
1095H	4244	15th group: comparison mode	1: Greater than 2: Equal to 3: Less than	Word	R/W
1096H	4245	15th group: setpoint value	Related with parameters	Word	R/W
1097H	4246	15th group: delay	0~3000 (*10ms)	Word	R/W
1098H	4247	15th group: output to relay	0:none 1~8: related relay	Word	R/W
1099H	4248	16th group: parameter code	0~79	Word	R/W
109AH	4249	16th group: comparison mode	1: Greater than 2: Equal to 3: Less than	Word	R/W
109BH	4250	16th group: setpoint value	Related with parameters	Word	R/W
109CH	4251	16th group: delay	0~3000 (*10ms)	Word	R/W
109DH	4252	16th group: output to relay	0:none 1~8: related relay	Word	R/W

Alarming Parameter Code Table

Table 87.

Alarming Parameter Code Table					
Setting Value	Alarming Object	Setting Value	Alarming Object	Setting Value	Alarming Object
0	Frequency	1	Va	2	Vb
3	Vc	4	Average phase voltage	5	Uab
6	Ubc	7	Uca	8	Average line voltage
9	Current of phase A	10	Current of phase B	11	Current of phase C
12	Average current	13	Neutral current	14	Power of phase A
15	Power of phase B	16	Power of phase C	17	Power of all

Alarming Parameter Code Table					
Setting Value	Alarming Object	Setting Value	Alarming Object	Setting Value	Alarming Object
18	Reactive power of phase A	19	Reactive power of phase B	20	Reactive power of phase C
21	Reactive power of all	22	Apparent power of phase A	23	Apparent power of phase B
24	Apparent power of phase C	25	Apparent power of all	26	PF of A
27	PF of B	28	PF of C	29	PF
30	Voltage unbalance factor Uunbl	31	Current unbalance factor Iunbl	32	Load characteristic (R/C/L)
33	THDV1(V1 or V12)	34	THDV2(V2 or V31)	35	THDV3(V3 or V23)
36	Average THDV	37	THDI1	38	THDI2
39	THDI3	40	Average THDI	41	AI1 sampling value
42	AI2 sampling value	43	AI3 sampling value	44	AI4 sampling value
45	Active power demand of all	46	Reactive power demand of all	47	Apparent power demand of all
48	Current demand of phase A	49	Current demand of phase B	50	Current demand of phase C

Note: NOTE: When reversed phase sequence (51) is selected, whether the value of comparison mode or setpoint value is set or not will not affect alarm result and the angle of Ub to Ua will be recorded.

When DI (52~79) is selected, whether the value of comparison mode is set or not will not affect alarm result as long as the setpoint value is set to 1, 2, or 3.

1: Stands for DI alarm is ON, recovery is OFF.

2: Stands for DI alarm is OFF, recovery is ON.

3: Stands for DI alarm is OFF, recovery is ON, and present DI status is recorded.

There are 16 groups of records with the same format. Please refer to Chapter 4 for more details.

Table 88.

Alarming Group Records: 03H Read					
Address(H)	Address(D)	Parameters	Range	Data Type	Access Property
42A9H	17065	1st group: alarming status	0-65535	Word	R
42AAH	17066	1st group: alarming parameter code	0-79	Word	R
42ABH	17067	1st group: over/under limit or reset value	Related to parameter chosen	Word	R
42ACH~42B2H	17068-17074	1st group: Timestamp: yyyy:mm:dd:hh:ss:ms		Word	R
42B3H	17075	2nd group: alarming status	0-65535	Word	R
42B4H	17076	2nd group: alarming parameter code	0-79	Word	R
42B5H	17077	2nd group: over/under limit or reset value	Related to parameter chosen	Word	R

Alarming Group Records: 03H Read					
Address(H)	**Address(D)**	**Parameters**	**Range**	**Data Type**	**Access Property**
42B6H-42BCH	17078-17084	2nd group: Timestamp: yyyy:mm:dd:hh:ss:ms		Word	R
42BDH	17085	3rd group: alarming status	0-65535	Word	R
42BEH	17086	3rd group: alarming parameter code	0-79	Word	R
42BFH	17087	3rd group: over/under limit or reset value	Related to parameter chosen	Word	R
42C0H-42C6H	17088-17094	3rd group: Timestamp: yyyy:mm:dd:hh:ss:ms		Word	R
42C7H	17095	4th group: alarming status	0-65535	Word	R
42C8H	17096	4th group: alarming parameter code	0-79	Word	R
42C9H	17097	4th group: over/under limit or reset value	Related to parameter chosen	Word	R
42CAH-42D0H	17098-17104	4th group: Timestamp: yyyy:mm:dd:hh:ss:ms		Word	R
42D1H	17105	5th group: alarming status	0-65535	Word	R
42D2H	17106	5th group: alarming parameter code	0-79	Word	R
42D3H	17107	5th group: over/under limit or reset value	Related to parameter chosen	Word	R
42D4H-42DAH	170108-17114	5th group: Timestamp: yyyy:mm:dd:hh:ss:ms		Word	R
42DBH	17115	6th group: alarming status	0-65535	Word	R
42DCH	170116	6th group: alarming parameter code	0-79	Word	R
42DDH	17117	6th group: over/under limit or reset value	Related to parameter chosen	Word	R
42DEH-42E4H	17118-17124	6th group: Timestamp: yyyy:mm:dd:hh:ss:ms		Word	R
42E5H	17125	7th group: alarming status	0-65535	Word	R
42E6H	17126	7th group: alarming parameter code	0-79	Word	R
42E7H	17127	7th group: over/under limit or reset value	Related to parameter chosen	Word	R
42E8H-42EEH	17128-17134	7th group: Timestamp: yyyy:mm:dd:hh:ss:ms		Word	R
42EFH	17135	8th group: alarming status	0-65535	Word	R
42F0H	17136	8th group: alarming parameter code	0-79	Word	R
42F1H	17137	8th group: over/under limit or reset value	Related to parameter chosen	Word	R
42F2H-42F8H	17138-17144	8th group: Timestamp: yyyy:mm:dd:hh:ss:ms		Word	R
42F9H	17145	9th group: alarming status	0-65535	Word	R
42FAH	17146	9th group: alarming parameter code	0-79	Word	R
42FBH	17147	9th group: over/under limit or reset value	Related to parameter chosen	Word	R
42FCH-4302H	17148-17154	9th group: Timestamp: yyyy:mm:dd:hh:ss:ms		Word	R
4303H	17155	10th group: alarming status	0-65535	Word	R

Alarming Group Records: 03H Read					
Address(H)	**Address(D)**	**Parameters**	**Range**	**Data Type**	**Access Property**
4304H	17156	10th group: alarming parameter code	0-79	Word	R
4305H	17157	10th group: over/under limit or reset value	Related to parameter chosen	Word	R
4306H-430CH	17158-17164	10th group: Timestamp: yyyy:mm:dd:hh:ss:ms		Word	R
430DH	17165	11th group: alarming status	0-65535	Word	R
430EH	17166	11th group: alarming parameter code	0-79	Word	R
430FH	17167	11th group: over/under limit or reset value	Related to parameter chosen	Word	R
4310H-4316H	17168-17174	11th group: Timestamp: yyyy:mm:dd:hh:ss:ms		Word	R
4317H	17175	12th group: alarming status	0-65535	Word	R
4318H	17176	12th group: alarming parameter code	0-79	Word	R
4319H	17177	12th group: over/under limit or reset value	Related to parameter chosen	Word	R
431AH-4320H	17178-17184	12th group: Timestamp: yyyy:mm:dd:hh:ss:ms		Word	R
4321H	17185	13th group: alarming status	0-65535	Word	R
4322H	17186	13th group: alarming parameter code	0-79	Word	R
4323H	17187	13th group: over/under limit or reset value	Related to parameter chosen	Word	R
4324H-432AH	17188-17194	13th group: Timestamp: yyyy:mm:dd:hh:ss:ms		Word	R
432BH	17195	14th group: alarming status	0-65535	Word	R
432CH	17196	14th group: alarming parameter code	0-79	Word	R
432DH	17197	14th group: over/under limit or reset value	Related to parameter chosen	Word	R
432EH-4334H	17198-17204	14th group: Timestamp: yyyy:mm:dd:hh:ss:ms		Word	R
4335H	17205	15th group: alarming status	0-65535	Word	R
4336H	17206	15th group: alarming parameter code	0-79	Word	R
4337H	17207	15th group: over/under limit or reset value	Related to parameter chosen	Word	R
4338H-433EH	17208-17214	15th group: Timestamp: yyyy:mm:dd:hh:ss:ms		Word	R
433FH	17215	16th group: alarming status	0-65535	Word	R
4340H	17216	16th group: alarming parameter code	0-79	Word	R
4341H	17217	16th group: over/under limit or reset value	Related to parameter chosen	Word	R
4342H-4348H	17218-17224	16th group: Timestamp: yyyy:mm:dd:hh:ss:ms		Word	R

6.3.18 Data Logging

Data Logging Setting

In order to generate historical logs for the selected parameters, users should program the meter so that selected parameters from the corresponding Modbus registers can be copied to the historical log record. Since certain parameters occupy two registers, the programmable settings for the historical logs contain a list of descriptors to supplement this. Each descriptor lists the number of Modbus registers for the specified parameter. By combining these two lists, the historical log record can be interpreted.

For example: Registers 4002H and 4003H are programmed to be recorded by the historical log. Since 2 registers are used, the corresponding descriptor is set as 2. These registers program the log to record "Volts AN".

The historical log programmable settings are comprised of 3 blocks, one for each log. Each log works in an identical fashion; therefore, only historical log 1 is described here. All register addresses in this section are shown within the address range of historical log 1.

1100H-11DFH (Historical Data Log 1)

11C0H-127FH (Historical Data Log 2)

1280H-133FH (Historical Data Log 3)

Block Size: 192 registers per log (384 bytes)

Data Log Setting's Address Map:

Table 89.

Address	1100H		1101H	
Byte	0 (low byte)	1 (high byte)	2 (low byte)	3 (high byte)
Value	Sectors	Registers	Interval	

Registers: The number of registers to log in the record range from {0-117}. The size of the record in memory is [12 +(Registers x 2)].

Sectors: The number of memory sectors allocated to this log, where each sector is 64kb in size. There are 100 sectors are available for allocation among the three historical logs, and the valid allocation range is from 0~100 (When the sector is set to 0, this log is disabled).

Interval: The data capture interval for historical log records. Valid time interval can be set from 0-1440 minutes. When the interval is set to 0, the log is disabled.

Note: When sectors or Register or Interval is zero, the log is disabled.

Register List

Registers: 1102H-1176H

Size: 1 or 2 register(s) per parameter, 117 available registers per historical log. The register list controls which Modbus registers are recorded in each historical log record. Since many parameters, such as Voltage, Energy, etc., take up more than 1 register, multiple registers are allocated for those parameters.

For example: In order to record "Volts AN" into the historical log, Volts AN's Modbus addresses (4002H and 4003H) are assigned and programmed to the log record list so that information can be stored into the historical log registers.

Each unused register item should be set to 0000H or FFFFH to indicate no parameters are associated with them.

The actual size of the record, and the number of items in the register list which are used, is determined by the registers in the header.

Valid register address ranges that can be recorded in the historical log registers are 4000H-412BH, 4294H-42A8H, 4349H-4398H, 4500H-461BH, 4620H-463DH.

Item Descriptor List

Registers: 1177H-11B1H

Size: 1 byte per item, 117 bytes (59 registers)

While the register list describes what to log, the item descriptor list describes how to interpret that information. Each descriptor describes how many Modbus addresses are used to describe a parameter. Either 1 or 2 addresses will be used for each parameter.

For example: If the first descriptor is 2, and the second descriptor is 1, then the first 2 register items belong to the 1st descriptor, and the 3rd register item belongs to the 2nd descriptor.

Note: As can be seen from the example above, it is not a 1-to-1 relationship between the register list and the descriptor list. A single descriptor may refer to two register items.

Logging Time Setting

If the data logging only records one period data, or only starts from one specific time, the corresponding time and logging mode should be set accordingly for the data log function to work.

Modbus address 11B2H is used as the logging mode select. The following describes the different logging modes:

When register 11B2H is set to 0, the logging mode is set to Mode 1 which starts logging immediately until the memory is full (First In, First Out).

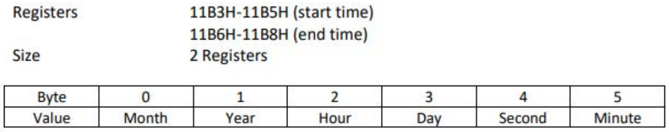
When register 11B2H is set to 1, the logging mode is set to Mode 2 which starts/ends logging based on the start/end time.

The start time is set in registers 11B3H-11B5H (start year, month, day, hour, minute, and second) and the end time is set in registers 11B6H-11B8H (end year, month, day, hour, minute, and second).

When register 11B2H is set to 2, the logging mode is set to Mode 3 which starts logging at a specific time until the memory is full.

Only the start time should be set, only registers 11B4H-11B5H (hour and minute).

Note: For more details regarding the data logging function, please refer to data logging section of Chapter 4.



Registers	11B3H-11B5H (start time) 11B6H-11B8H (end time)
Size	2 Registers

Byte	0	1	2	3	4	5
Value	Month	Year	Hour	Day	Second	Minute

Log Status Block

The Log Status Block describes the current status of the log in question.

Table 90.

Address(H)	Address(D)	Parameters	Range	Data Type	Property
6100H~6101H	24832~24833	Max records	0~468104	Dword	R
6102H~6103H	24834~24835	Used records	1~468104	Dword	R
6104H	24836	Record size	14~246	Word	R
6105H	24837	Reserved		Word	R
6106H~6108H	24838~24840	First record timestamp		Word	R
6109H~610BH	24841~24843	Last record timestamp		Word	R
6200H~620BH	25088~25099	Data Log 2 status	Same as the first group		
6300H~630BH	25344~25355	Data Log 3 status	Same as the first group		

Max Records: The maximum number of records the log can hold given the record size and sector allocation.

Used Records: The number of records stored in the log. This number will equal the Max Records when the log has filled. This value will be set to 1 when the log is reset.

Record Size: The number of bytes in this record, including the timestamp.

The record's format in the meter is: record number (4bytes) + timestamp (6bytes) + [data1~dataN](2Nbytes) + CRC(2bytes).

First Record Timestamp: Timestamp of the oldest record.

Last Record Timestamp: Timestamp of the newest record.

Log Retrieval Block

The log retrieval block consists of 2 parts: the header and the window. The header is used to verify the data shown within the requested log window. The window is a sliding block of data that can be used to access any record in the specified log.

Registers 6000H-6003H

Size 4 Registers

Table 91.

Address(H)	Address(D)	Parameters	Format	Property
6000H	24576	Log type	Nnnnnnnn	R/W
			ssssssss	
6001H	24577	Record number	Nnnnnnnn	R/W
		Status	wwwwwwww	
6002H~6003H	24578~24579	Offset		R/W
6004H~607EH	24580~24702	Window		R

Log type: The log to be retrieved. Write this value to set which log is being retrieved.

0 - Historical Log 1

1 - Historical Log 2

2 - Historical Log 3

Records Number: The number of records that fit within a window. This value is settable, and any number less than a full window may be used. This number tells the retrieving program how many records to expect to be fetched in the window. (Record number x Record Size) = bytes used in the window. This value should be ((123 x 2) / Record Size), rounded down. The greater the number, the faster the retrieval speed.

For example, with a record size of 50, the Records number = ((123 x 2) / 50) = 4.92 ≈ 4.

Status: The status of the current window. Since the time to prepare a window may exceed an acceptable Modbus delay (1 second), this acts as a ready status flag to notify when the window is ready for retrieval. When this value indicates that the window is not ready, the data in the window should be ignored.

Window Status is Read-only, any writes are ignored.

This value also indicates the memory erasing status when setting the date logging settings.

BH Window is Ready

FFH Window is Not Ready

AAH memory is erasing

BBH memory erasing is finished

CXH register list is set error

X:bit0 1, register list is set error in datalogging 1;

bit1 1, register list is set error in datalogging 2;

bit2 1, register list is set error in datalogging 3.

For example 0xC6H, register lists are error in datalogging 2 and 3

Offset: The offset of the record number of the first record in the data window and the record number of the "first record timestamp". Setting this value controls which records will be available in the data window. When the log is retrieved, the first (oldest) record is "latched." This means that offset 0 will always point to the oldest record at the time of latching.

Window: The actual data of the records, arranged according to the above settings.

NOTE: If the logging timer is disabled, the first recording sector will be erased when the log is full. Therefore, user should not read the whole log when the used record number is near to the max record number. Under this condition, user should read the "Used Records" field and compare it to the previous "Used Records" field from the last reading before retrieving the information and reading the window.

If the current "Used Records" field is greater than the "Used Records" field from the last reading and if the "Offset" field is less than the difference between the current and previous "Used Records" field, the first sector has been erased and the difference between the "Used Records" field should be subtracted from the recording number. If the "Offset" field is greater than the difference between the current and previous "Used Records" field, the "Offset" number should be subtracted from the recording number.

To avoid this situation, user should read the log before it is almost full.

For example: Data logging 1 has 3 sectors, each has 448 records, and the total records are 1344. If you press the "Read All" button when the "Used Records" number is at 1340, and if the first sector is erased before the information is transferred to the computer, the data stored in this sector is erased permanently and cannot be retrieved. If the records from the first sector can be retrieved before it gets erased, the new value of "Offset" will equal to the original "Offset" field minus the value of the difference between the current and previous "Used Records" field.

Data logging operation examples

The following example illustrates a data logging operation. The example makes the following assumptions:

The log is Historical Log 1.

The log contains VAN, VBN, VCN (12 bytes), the interval is 1min, the sectors is 10, the registers is 6, the logging timer function is disabled.

Retrieval is starting at record offset 0 (oldest record). 283

No new records are recorded to the log during the log retrieval process.

a) Data logging settings

Now set the data log 1 according to the assumptions:

Set the data log with VAN, VBN, VCN. Here we should set their Modbus address 0x4002,0 x4003,0x4004,0x4005,0x4006 and 0x4007 to 0x1102, 0x1103, 0x1104, 0x1105, 0x1106 and 0x1107. And the descriptor is 2, so set the 0x0202 and 0x0200 to 0x1177 and 0x1178.

The register is 6 and sector is 10, so we set 0x060A to 0x1100.

The interval is 1min, so set the 0x0001 to 0x1101.

The logging timer function is disabled, so set the 0 to 0x11B9.

b) Log Retrieval Procedure

The following procedure documents how to retrieve a single log from the oldest record to the newest record.

Compute the number of records per window, as follows:

RecordsPerWindow = (246\RecordSiz) = 246\24 = 10

Write the Records per window and Record offset, in this example set the 0x0A0B and 0x0000 to 0x6001d and 0x6002. This step tells the meter what data to return in the window.

Read the record window status from 0x6001.

If the Window Status is 0xFF, go to step 2.

If the Window Status is 0x0B, read the data window.

Read the data window and compute next Expected Record offset.

Compute the next expected record offset by adding Records Per Window and go to step 2.

If there are no remaining records after the current record window, stop reading.

6.3.19 Time-of-Use

Data Address of TOU Energy

The data address saves the parameter of energy, which includes Data address of last month TOU energy, Data address of current month TOU energy, Data address of TOU parameter setting and Data address of TOU default parameter. Except for the data address of TOU default parameter, the data address is read with 03 codes, preset with 16 code.

Figure 149. Division plan of TOU energy

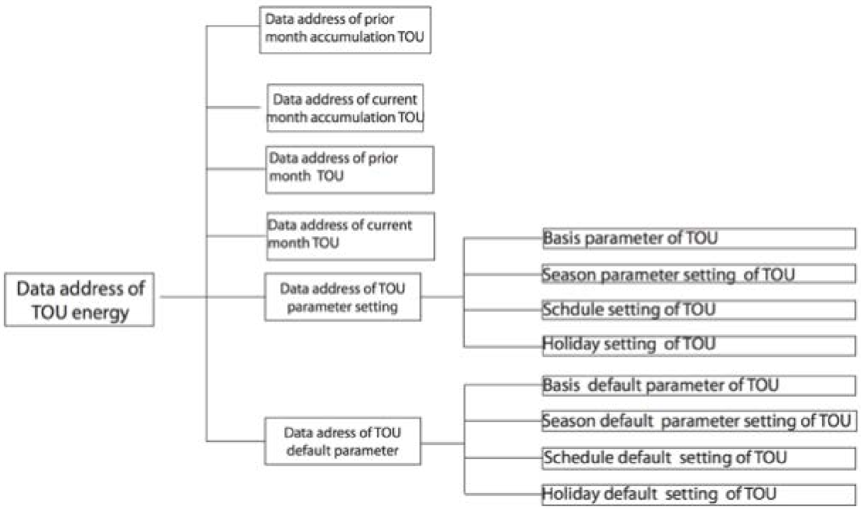


Table 92. Table 6-61

Address(H)	Address(D)	Parameters	Range	Data Type	Type of Access
Current month accumulation TOU energy					
7200H~7201H	29184~29185	Ep_imp (sharp)	0~999999999	Dword	R/W
7202H~7203H	29186~29187	Ep_exp (sharp)	0~999999999	Dword	R/W
7204H~7205H	29188~29189	Eq_imp (sharp)	0~999999999	Dword	R/W
7206H~7207H	29190~29191	Eq_exp (sharp)	0~999999999	Dword	R/W
7208H~7209H	29192~29193	Es (sharp)	0~999999999	Dword	R/W
720AH~720BH	29194~29195	Ep_imp (peak)	0~999999999	Dword	R/W
720CH~720DH	29196~29197	Ep_exp (peak)	0~999999999	Dword	R/W
720EH~720FH	29198~29199	Eq_imp (peak)	0~999999999	Dword	R/W
7210H~7211H	29200~29201	Eq_exp (peak)	0~999999999	Dword	R/W
7212H~7213H	29202~29203	Es (peak)	0~999999999	Dword	R/W
7214H~7215H	29204~29205	Ep_imp (valley)	0~999999999	Dword	R/W
7216H~7217H	29206~29207	Ep_exp (valley)	0~999999999	Dword	R/W
7218H~7219H	29208~29209	Eq_imp (valley)	0~999999999	Dword	R/W

Address(H)	Address(D)	Parameters	Range	Data Type	Type of Access
721AH~721BH	29210~29211	Eq_exp (valley)	0~999999999	Dword	R/W
721CH~721DH	29212~29213	Es (valley)	0~999999999	Dword	R/W
721EH~721FH	29214~29215	Ep_imp (normal)	0~999999999	Dword	R/W
7220H~7221H	29216~29217	Ep_exp (normal)	0~999999999	Dword	R/W
7222H~7223H	29218~29219	Eq_imp (normal)	0~999999999	Dword	R/W
7224H~7225H	29220~29221	Eq_exp (normal)	0~999999999	Dword	R/W
7226H~7227H	29222~29223	Es (normal)	0~999999999	Dword	R/W
7228H~7229H	29224~29225	Ep_imp (sum)	0~999999999	Dword	R/W
722AH~722BH	29226~29227	Ep_exp (sum)	0~999999999	Dword	R/W
722CH~722DH	29228~29229	Eq_imp (sum)	0~999999999	Dword	R/W
722EH~722FH	29230~29231	Eq_exp (sum)	0~999999999	Dword	R/W
7230H~7231H	29232~29233	Es (sum)	0~999999999	Dword	R/W
Current month accumulation TOU energy					
7232H~7233H	29234~29235	Ep_imp (sharp)	0~999999999	Dword	R/W
7234H~7235H	29236~29237	Ep_exp (sharp)	0~999999999	Dword	R/W
7236H~7237H	29238~29239	Eq_imp (sharp)	0~999999999	Dword	R/W
7238H~7239H	29240~29241	Eq_exp (sharp)	0~999999999	Dword	R/W
723AH~723BH	29242~29243	Es (sharp)	0~999999999	Dword	R/W
723CH~723DH	29244~29245	Ep_imp (peak)	0~999999999	Dword	R/W
723EH~723FH	29246~29247	Ep_exp (peak)	0~999999999	Dword	R/W
7240H~7241H	29248~29249	Eq_imp (peak)	0~999999999	Dword	R/W
7242H~7243H	29250~29251	Eq_exp (peak)	0~999999999	Dword	R/W
7244H~7245H	29252~29253	Es (peak)	0~999999999	Dword	R/W
7246H~7247H	29254~29255	Ep_imp (valley)	0~999999999	Dword	R/W
7248H~7249H	29256~29257	Ep_exp (valley)	0~999999999	Dword	R/W
724AH~724BH	29258~29259	Eq_imp (valley)	0~999999999	Dword	R/W
724CH~724DH	29260~29261	Eq_exp (valley)	0~999999999	Dword	R/W
724EH~724FH	29262~29263	Es (valley)	0~999999999	Dword	R/W
7250H~7251H	29264~29265	Ep_imp (normal)	0~999999999	Dword	R/W
7252H~7253H	29266~29267	Ep_exp (normal)	0~999999999	Dword	R/W
7254H~7255H	29268~29269	Eq_imp (normal)	0~999999999	Dword	R/W
7256H~7257H	29270~29271	Eq_exp (normal)	0~999999999	Dword	R/W
7258H~7259H	29272~29273	Es (normal)	0~999999999	Dword	R/W
725AH~725BH	29274~29275	Ep_imp (sum)	0~999999999	Dword	R/W
725CH~725DH	29276~29277	Ep_exp (sum)	0~999999999	Dword	R/W

Address(H)	Address(D)	Parameters	Range	Data Type	Type of Access
725EH~725FH	29278~29279	Eq_imp (sum)	0~999999999	Dword	R/W
7260H~7261H	20280~29281	Eq_exp (sum)	0~999999999	Dword	R/W
7262H~7263H	29282~29283	Es (sum)	0~999999999	Dword	R/W

Table 93. Table 6-62

Address(H)	Address(D)	Parameters	Range	Data Type	Type of Access
Current month TOU energy					
7300H~7301H	29440~29441	Ep_imp (sharp)	0~999999999	Dword	R/W
7302H~7303H	29442~29443	Ep_exp (sharp)	0~999999999	Dword	R/W
7304H~7305H	29444~29445	Eq_imp (sharp)	0~999999999	Dword	R/W
7306H~7307H	29446~29447	Eq_exp (sharp)	0~999999999	Dword	R/W
7308H~7309H	29448~29449	Es (sharp)	0~999999999	Dword	R/W
730AH~730BH	29450~29451	Ep_imp (peak)	0~999999999	Dword	R/W
730CH~730DH	29452~29453	Ep_exp (peak)	0~999999999	Dword	R/W
730EH~730FH	29454~29455	Eq_imp (peak)	0~999999999	Dword	R/W
7310H~7311H	29456~29457	Eq_exp (peak)	0~999999999	Dword	R/W
7312H~7313H	29458~29459	Es (peak)	0~999999999	Dword	R/W
7314H~7315H	29460~29461	Ep_imp (valley)	0~999999999	Dword	R/W
7316H~7317H	29462~29463	Ep_exp (valley)	0~999999999	Dword	R/W
7318H~7319H	29464~29465	Eq_imp (valley)	0~999999999	Dword	R/W
731AH~731BH	29466~29467	Eq_exp (valley)	0~999999999	Dword	R/W
731CH~731DH	29468~29469	Es (valley)	0~999999999	Dword	R/W
731EH~731FH	29470~29471	Ep_imp (normal)	0~999999999	Dword	R/W
7320H~7321H	29472~29473	Ep_exp (normal)	0~999999999	Dword	R/W
7322H~7323H	29474~29475	Eq_imp (normal)	0~999999999	Dword	R/W
7324H~7325H	29476~29477	Eq_exp (normal)	0~999999999	Dword	R/W
7326H~7327H	29478~29479	Es (normal)	0~999999999	Dword	R/W
7328H~7329H	29480~29481	Ep_imp (sum)	0~999999999	Dword	R/W
732AH~732BH	29482~29483	Ep_exp (sum)	0~999999999	Dword	R/W
732CH~732DH	29484~29485	Eq_imp (sum)	0~999999999	Dword	R/W
732EH~732FH	29486~29487	Eq_exp (sum)	0~999999999	Dword	R/W
7330H~7331H	29488~29489	Es (sum)	0~999999999	Dword	R/W
Prior month TOU energy					
7332H~7333H	29490~29491	Ep_imp (sharp)	0~999999999	Dword	R/W
7334H~7335H	29492~29493	Ep_exp (sharp)	0~999999999	Dword	R/W
7336H~7337H	29494~29495	Eq_imp (sharp)	0~999999999	Dword	R/W
7338H~7339H	29496~29497	Eq_exp (sharp)	0~999999999	Dword	R/W
733AH~733BH	29498~29499	Es (sharp)	0~999999999	Dword	R/W

Address(H)	Address(D)	Parameters	Range	Data Type	Type of Access
733CH~733DH	29500~29501	Ep_imp (sharp)	0~999999999	Dword	R/W
733EH~733FH	29502~29503	Ep_exp (sharp)	0~999999999	Dword	R/W
7340H~3241H	29504~29505	Eq_imp (sharp)	0~999999999	Dword	R/W
7342H~7343H	29506~29507	Eq_exp (sharp)	0~999999999	Dword	R/W
7344H~7345H	29508~29509	Es (sharp)	0~999999999	Dword	R/W
7346H~7347H	29510~29511	Ep_imp (sharp)	0~999999999	Dword	R/W
7348H~7349H	29512~29513	Ep_exp (sharp)	0~999999999	Dword	R/W
734AH~734BH	29514~25915	Eq_imp (sharp)	0~999999999	Dword	R/W
734CH~734DH	29516~29517	Eq_exp (sharp)	0~999999999	Dword	R/W
734EH~734FH	29518~29219	Es (sharp)	0~999999999	Dword	R/W
7350H~7351H	29220~29221	Ep_imp (sharp)	0~999999999	Dword	R/W
7352H~7353H	29222~29223	Ep_exp (sharp)	0~999999999	Dword	R/W
7354H~7355H	29224~29225	Eq_imp (sharp)	0~999999999	Dword	R/W
7356H~7357H	29226~29227	Eq_exp (sharp)	0~999999999	Dword	R/W
7358H~7359H	29228~292291	Es (sharp)	0~999999999	Dword	R/W
735AH~735BH	29230~29231	Ep_imp (sharp)	0~999999999	Dword	R/W
735CH~735DH	29232~29233	Ep_exp (sharp)	0~999999999	Dword	R/W
735EH~735FH	29234~29235	Eq_imp (sharp)	0~999999999	Dword	R/W
7360H~7361H	29236~29237	Eq_exp (sharp)	0~999999999	Dword	R/W
7362H~7363H	29538~29539	Es (sharp)	0~999999999	Dword	R/W

The address area includes the max of Ep_imp, Ep_exp, Eq_imp, Eq_exp, Es, Current demand, and timestamp, when tariff setting parameters are sharp, peak, valley, and normal. Function: 03H Read.

Table 94.

Address(H)	Address(D)	Parameters	Range	Data Type	Type of Access
7500H~7503H	29952~29955	Max of Ep_imp (sharp) demand and timestamp (format: power; year/mon; Day/Hour; Min/Sec)	-32768~32767	Int	R
7504H~7507H	29956~29959	Max of Ep_exp (sharp) demand and timestamp	-32768~32767	Int	R
7508H~750BH	29960~29963	Max of Eq_imp (sharp) demand and timestamp	-32768~32767	Int	R
750CH~750FH	29964~29967	Max of Eq_exp (sharp) demand and timestamp	-32768~32767	Int	R
7510H~7513H	29968~29971	Max of Es (sharp) demand and timestamp	-32768~32767	Int	R
7514H~7517H	29972~29975	Max of Ia (sharp) demand and timestamp	-32768~32767	Int	R
7518H~751BH	29976~29979	Max of Ib (sharp) demand and timestamp	-32768~32767	Int	R

Address(H)	Address(D)	Parameters	Range	Data Type	Type of Access
751CH~751FH	29980~29983	Max of Ic (sharp) demand and timestamp	-32768~32767	Int	R
7520H~7523H	29984~29987	Max of Ep_imp (peak) demand and timestamp	-32768~32767	Int	R
7524H~7527H	29988~29991	Max of Ep_exp (peak) demand and timestamp	-32768~32767	Int	R
7528H~752BH	29992~29995	Max of Eq_imp (peak) demand and timestamp	-32768~32767	Int	R
752CH~752FH	29996~29999	Max of Eq_exp (peak) demand and timestamp	-32768~32767	Int	R
7530H~7533H	30000~30003	Max of Es (peak) demand and timestamp	-32768~32767	Int	R
7534H~7537H	30004~30007	Max of Ia (peak) demand and timestamp	-32768~32767	Int	R
7538H~753BH	30008~30011	Max of Ib (peak) demand and timestamp	-32768~32767	Int	R
753CH~753FH	30012~30015	Max of Ic (peak) demand and timestamp	-32768~32767	Int	R
7540H~7543H	30016~30019	Max of Ep_imp (valley) demand and timestamp	-32768~32767	Int	R
7544H~7547H	30020~30023	Max of Ep_exp (valley) demand and timestamp	-32768~32767	Int	R
7548H~754BH	30024~30027	Max of Eq_imp (valley) demand and timestamp	-32768~32767	Int	R
754CH~754FH	30028~30031	Max of Eq_exp (valley) demand and timestamp	-32768~32767	Int	R
7550H~7553H	30032~30035	Max of Es (valley) demand and timestamp	-32768~32767	Int	R
7554H~7557H	30036~30039	Max of Ia (valley) demand and timestamp	-32768~32767	Int	R
7558H~755BH	30040~30043	Max of Ib (valley) demand and timestamp	-32768~32767	Int	R
755CH~755FH	30044~30047	Max of Ic (valley) demand and timestamp	-32768~32767	Int	R
7560H~7563H	30048~30051	Max of Ep_imp (normal) demand and timestamp	-32768~32767	Int	R
7564H~7567H	30052~30055	Max of Ep_exp (normal) demand and timestamp	-32768~32767	Int	R
7568H~756BH	30056~30059	Max of Eq_imp (normal) demand and timestamp	-32768~32767	Int	R
756CH~756FH	30060~30063	Max of Eq_exp (normal) demand and timestamp	-32768~32767	Int	R
7570H~7573H	30064~30067	Max of Es (normal) demand and timestamp	-32768~32767	Int	R
7574H~7577H	30068~30071	Max of Ia (normal) demand and timestamp	-32768~32767	Int	R
7578H~757BH	30072~30075	Max of Ib (normal) demand and timestamp	-32768~32767	Int	R
757CH~757FH	30076~30079	Max of Ic (normal) demand and timestamp	-32768~32767	Int	R

Address(H)	Address(D)	Parameters	Range	Data Type	Type of Access
7580H~7583H	30080~30083	Max of Ep_imp (all) demand and timestamp	-32768~32767	Int	R
7584H~7587H	30084~30087	Max of Ep_exp (all) demand and timestamp	-32768~32767	Int	R
7588H~758BH	30088~30091	Max of Eq_imp (all) demand and timestamp	-32768~32767	Int	R
758CH~758FH	30092~30095	Max of Eq_exp (all) demand and timestamp	-32768~32767	Int	R
7590H~7593H	30096~30099	Max of Es (all) demand and timestamp	-32768~32767	Int	R
7594H~7597H	30100~30103	Max of Ia (all) demand and timestamp	-32768~32767	Int	R
7598H~759BH	30104~30107	Max of Ib (all) demand and timestamp	-32768~32767	Int	R
759CH~759FH	30108~30111	Max of Ic (all) demand and timestamp	-32768~32767	Int	R

The address area includes Daylight savings time (DST) setting. Function: 03H Read, 10H Preset.

Table 95. Table 6-64

Address(H)	Address(D)	Parameters	Range	Data Type	Type of Access
7700H	30464	DST enable	0: Disable, 1: Enable	Word	R/W
7701H	30465	DST format	0: Format 1, 1: Format 2	Word	R/W
Format 1					
7702H	30466	DST start Mon	1~12	Word	R/W
7703H	30467	DST start Day	1~31	Word	R/W
7704H	30468	DST start Hour	0~23	Word	R/W
7705H	30469	DST start Min	0~59	Word	R/W
7706H	30470	DST start adjust time (Unit: Min)	1~120 (Default: 60)	Word	R/W
7707H	30471	DST ending Mon	1~12	Word	R/W
7708H	30472	DST ending Day	1~31	Word	R/W
7709H	30473	DST ending Hour	0~23	Word	R/W
770AH	30474	DST ending Min	0~59	Word	R/W
770BH	30475	DST ending adjust time (Unit: Min)	1~120 (Default: 60)	Word	R/W
Format 2					
770CH	30476	DST start Mon	1~12	Word	R/W
770DH	30477	DST start Week	0: Sunday 1~6, Monday to Saturday	Word	R/W
770EH	30478	DST start first few Weeks	1~5	Word	R/W

Address(H)	Address(D)	Parameters	Range	Data Type	Type of Access
770FH	30479	DST start Hour	0~23	Word	R/W
7710H	30480	DST start Min	0~59	Word	R/W
7711H	30481	DST start adjust time (Unit: Min)	1~120 (Default: 60)	Word	R/W
7712H	30482	DST ending Mon	1~12	Word	R/W
7713H	30483	DST ending Week	0: Sunday 1~6, Monday to Saturday	Word	R/W
7714H	30484	DST ending first few Weeks	1~5	Word	R/W
7715H	30485	DST ending Hour	0~23	Word	R/W
7716H	30486	DST ending Min	0~59	Word	R/W
7717H	30487	DST ending adjust time (Unit: Min)	1~120 (Default: 60)	Word	R/W

Data address of TOU parameter setting includes basis parameter of TOU, time zone setting parameter of TOU, timetable setting parameter of TOU, and holiday setting parameter of TOU. Function: 03 code, 10 reset.

Table 96.

Address(H)	Address(D)	Parameters	Range	Data Type	Type of Access
Basis parameter of TOU					
7800H	30720	Season number	0~12	Word	R/W
7801H	30721	Schedule number	0~14	Word	R/W
7802H	30722	Segment number	0~14	Word	R/W
7803H	30723	Tariff number	0~3	Word	R/W
7804H	30724	Weekend setting (bit0-Sunday; bit 1~bit6: Monday~Saturday bit=1 means using energy, bit=0 means not using energy)	0~127	Word	R/W
7805H	30725	Weekend schedule	0~14	Word	R/W
7806H	30726	Holiday number	0~30	Word	R/W
7807H	30727	TOU factory setting	1: Enable	Word	R/W
7808H	30728	Choice of calculation auto reset (0: End of Month)	1: Enable	Word	R/W
7809H	30729	TOU auto reset fixed date: day (default is 1)		Word	R/W
780AH	30730	TOU auto reset fixed date: hour (default is 0)	0~31	Word	R/W
780BH	30731	TOU auto reset fixed date: minute (default is 0)	0~23	Word	R/W
780CH	30732	TOU auto reset fixed date: second (default is 0)	0~59	Word	R/W

Address(H)	Address(D)	Parameters	Range	Data Type	Type of Access
780DH	30733	TOU auto reset fixed date: second (default is 0)	0~59	Word	R/W
780EH	30734	Error code (default is 0)	0: the setting of parameter is correct, 1: tariff setting error; 2: schedule setting error, 4: segment setting error; 8: season setting error; 16: parameter of season setting error; 32: holiday setting error; 64: parameter of holiday setting error; 256: tariff of schedule setting error; 512: time of schedule setting error; 1024: period of schedule setting error; 2048: period of weekend setting error; 4096: weekend setting error	Word	R/W
Season setting					
7820H~7822H	30752~30754	Data and season table of the 1st season		Word	R/W
7823H~7825H	30755~30757	Data and season table of the 2nd season		Word	R/W
7826H~7828H	30758~30760	Data and season table of the 3rd season		Word	R/W
7829H~782BH	30761~30763	Data and season table of the 4th season		Word	R/W
782CH~782EH	30764~30766	Data and season table of the 5th season		Word	R/W
782FH~7831H	30767~30769	Data and season table of the 6th season		Word	R/W
7832H~7834H	30770~30772	Data and season table of the 7th season		Word	R/W
7835H~7837H	30773~30775	Data and season table of the 8th season		Word	R/W
7838H~783AH	30776~30778	Data and season table of the 9th season		Word	R/W
783BH~783DH	30779~30781	Data and season table of the 10th season		Word	R/W
783EH~7840H	30782~30784	Data and season table of the 11th season		Word	R/W

Address(H)	Address(D)	Parameters	Range	Data Type	Type of Access
7841H~7843H	30785~30787	Data and season table of the 12th season		Word	R/W
Schedule setting					
7844H~7846H	30788~30790	1st segment and tariff number of the 1st schedule		Word	R/W
7847H~7849H	30791~30793	2nd segment and tariff number of the 1st schedule		Word	R/W
784AH~784CH	30794~30796	3rd segment and tariff number of the 1st schedule		Word	R/W
784DH~784FH	30797~30799	4th segment and tariff number of the 1st schedule		Word	R/W
7850H~7852H	30800~30802	5th segment and tariff number of the 1st schedule		Word	R/W
7853H~7855H	30803~30805	6th segment and tariff number of the 1st schedule		Word	R/W
7856H~7858H	30806~30808	7th segment and tariff number of the 1st schedule		Word	R/W
7859H~785BH	30809~30811	8th segment and tariff number of the 1st schedule		Word	R/W
785CH~785EH	30812~30814	9th segment and tariff number of the 1st schedule		Word	R/W
785FH~7861H	30815~30817	10th segment and tariff number of the 1st schedule		Word	R/W
7862H~7864H	30818~30820	11th segment and tariff number of the 1st schedule		Word	R/W
7865H~7867H	30821~30823	12th segment and tariff number of the 1st schedule		Word	R/W
7868H~786AH	30824~30826	13th segment and tariff number of the 1st schedule		Word	R/W
786BH~786DH	30827~30829	14th segment and tariff number of the 1st schedule		Word	R/W
786EH~7897H	30830~30871	From 1st to 14th segment and tariff number of the 2nd schedule	The same as the 1st schedule	Word	R/W
7898H~78C1H	30872~30913	From 1st to 14th segment and tariff number of the 3rd schedule	The same as the 1st schedule	Word	R/W
78C2H~78EBH	30914~30955	From 1st to 14th segment and tariff number of the 4th schedule	The same as the 1st schedule	Word	R/W
78ECH~7915H	30956~30997	From 1st to 14th segment and tariff number of the 5th schedule	The same as the 1st schedule	Word	R/W
7916H~793FH	30998~31039	From 1st to 14th segment and tariff number of the 6th schedule	The same as the 1st schedule	Word	R/W
7940H~7969H	31040~31081	From 1st to 14th segment and tariff number of the 7th schedule	The same as the 1st schedule	Word	R/W

Address(H)	Address(D)	Parameters	Range	Data Type	Type of Access
796AH~7993H	31082~31123	From 1st to 14th segment and tariff number of the 8th schedule	The same as the 1st schedule	Word	R/W
7994H~79BDH	31124~31165	From 1st to 14th segment and tariff number of the 9th schedule	The same as the 1st schedule	Word	R/W
79BEH~79E7H	31166~31207	From 1st to 14th segment and tariff number of the 10th schedule	The same as the 1st schedule	Word	R/W
79E8H~7A11H	31208~31249	From 1st to 14th segment and tariff number of the 11th schedule	The same as the 1st schedule	Word	R/W
7A12H~7A3BH	31250~31291	From 1st to 14th segment and tariff number of the 12th schedule	The same as the 1st schedule	Word	R/W
7A3CH~7A65H	31292~31333	From 1st to 14th segment and tariff number of the 13th schedule	The same as the 1st schedule	Word	R/W
7A66H~7A8FH	31334~31375	From 1st to 14th segment and tariff number of the 14th schedule	The same as the 1st schedule	Word	R/W
Holiday setting					
7A90H~7A92H	31376~31378	Data and the schedule of the 1st holiday		Word	R/W
7A93H~7A95H	31379~31381	Data and the schedule of the 2nd holiday		Word	R/W
7A96H~7A98H	31382~31384	Data and the schedule of the 3rd holiday		Word	R/W
7A99H~7A9BH	31385~31387	Data and the schedule of the 4th holiday		Word	R/W
7A9CH~7A9EH	31388~31390	Data and the schedule of the 5th holiday		Word	R/W
7A9FH~7AA1H	31391~31393	Data and the schedule of the 6th holiday		Word	R/W
7AA2H~7AA4H	31394~31396	Data and the schedule of the 7th holiday		Word	R/W
7AA5H~7AA7H	31397~31399	Data and the schedule of the 8th holiday		Word	R/W
7AA8H~7AAAH	31400~31402	Data and the schedule of the 9th holiday		Word	R/W
7AABH~7AADH	31403~31405	Data and the schedule of the 10th holiday		Word	R/W
7AAEH~7AB0H	31406~31408	Data and the schedule of the 11th holiday		Word	R/W
7AB1H~7AB3H	31409~31411	Data and the schedule of the 12th holiday		Word	R/W
7AB4H~7AB6H	31412~31414	Data and the schedule of the 13th holiday		Word	R/W
7AB7H~7AB9H	31415~31417	Data and the schedule of the 14th holiday		Word	R/W

Address(H)	Address(D)	Parameters	Range	Data Type	Type of Access
7ABAH~7ABCH	31418~31420	Data and the schedule of the 15th holiday		Word	R/W
7ABDH~7ABFH	31421~31423	Data and the schedule of the 16th holiday		Word	R/W
7AC0H~7AC2H	31424~31426	Data and the schedule of the 17th holiday		Word	R/W
7AC3H~7AC5H	31427~31429	Data and the schedule of the 18th holiday		Word	R/W
7AC6H~7AC8H	31430~31432	Data and the schedule of the 19th holiday		Word	R/W
7AC9H~7ACBH	31433~31435	Data and the schedule of the 20th holiday		Word	R/W
7ACCH~7ACEH	31436~31438	Data and the schedule of the 21st holiday		Word	R/W
7ACFH~7AD1H	31439~31441	Data and the schedule of the 22nd holiday		Word	R/W
7AD2H~7AD4H	31442~31444	Data and the schedule of the 23rd holiday		Word	R/W
7AD5H~7AD7H	31445~31447	Data and the schedule of the 24th holiday		Word	R/W
7AD8H~7ADAH	31448~31450	Data and the schedule of the 25th holiday		Word	R/W
7ADBH~7ADDH	31451~31453	Data and the schedule of the 26th holiday		Word	R/W
7ADEH~7AE0H	31454~31456	Data and the schedule of the 27th holiday		Word	R/W
7AE1H~7AE3H	31457~31459	Data and the schedule of the 28th holiday		Word	R/W
7AE4H~7AE6H	31460~31462	Data and the schedule of the 29th holiday		Word	R/W
7AE7H~7AE9H	31463~31465	Data and the schedule of the 30th holiday		Word	R/W
7AEAH	31466	Holiday setting enable		Word	R/W
7AEBH	31467	Start year holiday setting		Word	R/W
7AECH	31468	End year holiday setting		Word	R/W

The address area includes ten years holiday setting, Function: 03H Read 10H Preset.

Table 97.

The 1st Year Holiday Address Function: 03H Read 10H Preset				
Address(H)	**Address(D)**	**Parameters**	**Data Type**	**Type of Access**
7B00H~7B02H	31488~31490	The 1st holiday and schedule (format: month/day/schedule)	Word	R/W
7B03H~7B05H	31491~31493	The 2nd holiday and schedule	Word	R/W

The 1st Year Holiday Address Function: 03H Read 10H Preset				
Address(H)	**Address(D)**	**Parameters**	**Data Type**	**Type of Access**
7B06H~7B08H	31494~31496	The 3rd holiday and schedule	Word	R/W
7B09H~7B0BH	31497~31499	The 4th holiday and schedule	Word	R/W
7B0CH~7B0EH	31500~31502	The 5th holiday and schedule	Word	R/W
7B0FH~7B11H	31503~31505	The 6th holiday and schedule	Word	R/W
7B12H~7B14H	31506~31508	The 7th holiday and schedule	Word	R/W
7B15H~7B17H	31509~31511	The 8th holiday and schedule	Word	R/W
7B18H~7B1AH	31512~31514	The 9th holiday and schedule	Word	R/W
7B1BH~7B1DH	31515~31517	The 10th holiday and schedule	Word	R/W
7B1EH~7B20H	31518~31520	The 11th holiday and schedule	Word	R/W
7B21H~7B23H	31521~31523	The 12th holiday and schedule	Word	R/W
7B24H~7B26H	31524~31526	The 13th holiday and schedule	Word	R/W
7B27H~7B29H	31527~31529	The 14th holiday and schedule	Word	R/W
7B2AH~7B2CH	31530~31532	The 15th holiday and schedule	Word	R/W
7B2DH~7B2FH	31533~31535	The 16th holiday and schedule	Word	R/W
7B30H~7B32H	31536~31538	The 17th holiday and schedule	Word	R/W
7B33H~7B35H	31539~31541	The 18th holiday and schedule	Word	R/W
7B36H~7B38H	31542~31544	The 19th holiday and schedule	Word	R/W
7B39H~7B3BH	31545~31547	The 20th holiday and schedule	Word	R/W
7B3CH~7B3EH	31548~31550	The 21st holiday and schedule	Word	R/W
7B3FH~7B41H	31551~31553	The 22nd holiday and schedule	Word	R/W
7B42H~7B44H	31554~31556	The 23rd holiday and schedule	Word	R/W
7B45H~7B47H	31557~31559	The 24th holiday and schedule	Word	R/W
7B48H~7B4AH	31560~31562	The 25th holiday and schedule	Word	R/W
7B4BH~7B4DH	31563~31565	The 26th holiday and schedule	Word	R/W
7B4EH~7B50H	31566~31568	The 27th holiday and schedule	Word	R/W
7B51H~7B53H	31569~31571	The 28th holiday and schedule	Word	R/W
7B54H~7B56H	31572~31574	The 29th holiday and schedule	Word	R/W
7B57H~7B59H	31575~31577	The 30th holiday and schedule	Word	R/W
7B5AH	31578	The 1st setting year	Word	R/W
7b5BH	31579	Holiday number of the 1st year	Word	R/W

Table 98.

The 2nd Year Holiday Address Function: 03H Read 10H Preset				
Address(H)	**Address(D)**	**Parameters**	**Data Type**	**Type of Access**
7B5CH~7B5EH	31580~31582	The 1st holiday and schedule (format: month/day/schedule)	Word	R/W
7B5FH~7B61H	31583~31585	The 2nd holiday and schedule	Word	R/W
7B62H~7B64H	31586~31588	The 3rd holiday and schedule	Word	R/W
7B65H~7B67H	31589~31591	The 4th holiday and schedule	Word	R/W
7B68H~7B6AH	31592~31594	The 5th holiday and schedule	Word	R/W
7B6BH~7B6DH	31595~31597	The 6th holiday and schedule	Word	R/W

The 2nd Year Holiday Address Function: 03H Read 10H Preset				
Address(H)	**Address(D)**	**Parameters**	**Data Type**	**Type of Access**
7B6EH~7B70H	31598~31600	The 7th holiday and schedule	Word	R/W
7B71H~7B73H	31601~31603	The 8th holiday and schedule	Word	R/W
7B74H~7B76H	31604~31606	The 9th holiday and schedule	Word	R/W
7B77H~7B79H	31607~31609	The 10th holiday and schedule	Word	R/W
7B7AH~7B7CH	31610~31612	The 11th holiday and schedule	Word	R/W
7B7DH~7B7FH	31613~31615	The 12th holiday and schedule	Word	R/W
7B80H~7B82H	31616~31618	The 13th holiday and schedule	Word	R/W
7B83H~7B85H	31619~31621	The 14th holiday and schedule	Word	R/W
7B86H~7B88H	31622~31624	The 15th holiday and schedule	Word	R/W
7B89H~7B8BH	31625~31627	The 16th holiday and schedule	Word	R/W
7B8CH~7B8EH	31628~31630	The 17th holiday and schedule	Word	R/W
7B8FH~7B91H	31631~31633	The 18th holiday and schedule	Word	R/W
7B92H~7B94H	31634~31636	The 19th holiday and schedule	Word	R/W
7B95H~7B97H	31637~31639	The 20th holiday and schedule	Word	R/W
7B98H~7B9AH	31640~31642	The 21st holiday and schedule	Word	R/W
7B9BH~7B9DH	31643~31645	The 22nd holiday and schedule	Word	R/W
7B9EH~7BA0H	31646~31648	The 23rd holiday and schedule	Word	R/W
7BA1H~7BA3H	31649~31651	The 24th holiday and schedule	Word	R/W
7BA4H~7BA6H	31652~31654	The 25th holiday and schedule	Word	R/W
7BA7H~7BA9H	31655~31657	The 26th holiday and schedule	Word	R/W
7BAAH~7BACH	31658~31660	The 27th holiday and schedule	Word	R/W
7BADH~7BAFH	31661~31663	The 28th holiday and schedule	Word	R/W
7BB0H~7BB2H	31664~31666	The 29th holiday and schedule	Word	R/W
7BB3H~7BB5H	31667~31669	The 30th holiday and schedule	Word	R/W
7BB6H	31670	The 2nd setting year	Word	R/W
7BB7H	31671	Holiday number of the 2nd year	Word	R/W

Table 99.

The 3rd Year Holiday Address Function: 03H Read 10H Preset				
Address(H)	**Address(D)**	**Parameters**	**Data Type**	**Type of Access**
7BB8H~7BBAH	31672~31674	The 1st holiday and schedule (format: month/day/schedule)	Word	R/W
7BBBH~7BBDH	31675~31677	The 2nd holiday and schedule	Word	R/W
7BBEH~7BC0H	31678~31680	The 3rd holiday and schedule	Word	R/W
7BC1H~7BC3H	31681~31683	The 4th holiday and schedule	Word	R/W
7BC4H~7BC6H	31684~31686	The 5th holiday and schedule	Word	R/W
7BC7H~7BC9H	31687~31689	The 6th holiday and schedule	Word	R/W
7BCAH~7BCCH	31690~31692	The 7th holiday and schedule	Word	R/W
7BCDH~7BCFH	31693~31695	The 8th holiday and schedule	Word	R/W
7BD0H~7BD2H	31696~31698	The 9th holiday and schedule	Word	R/W

The 3rd Year Holiday Address Function: 03H Read 10H Preset				
Address(H)	**Address(D)**	**Parameters**	**Data Type**	**Type of Access**
7BD3H~7BD5H	31699~31701	The 10th holiday and schedule	Word	R/W
7BD6H~7BD8H	31702~31704	The 11th holiday and schedule	Word	R/W
7BD9H~7BDBH	31705~31707	The 12th holiday and schedule	Word	R/W
7BDCH~7BDEH	31708~31710	The 13th holiday and schedule	Word	R/W
7BDFH~7BE1H	31711~31713	The 14th holiday and schedule	Word	R/W
7BE2H~7BE4H	31714~31716	The 15th holiday and schedule	Word	R/W
7BE5H~7BE7H	31717~31719	The 16th holiday and schedule	Word	R/W
7BE8H~7BEAH	31720~31722	The 17th holiday and schedule	Word	R/W
7BEBH~7BEDH	31723~31725	The 18th holiday and schedule	Word	R/W
7BEEH~7BF0H	31726~31728	The 19th holiday and schedule	Word	R/W
7BF1H~7BF3H	31729~31731	The 20th holiday and schedule	Word	R/W
7BF4H~7BF6H	31732~31734	The 21st holiday and schedule	Word	R/W
7BF7H~7BF9H	31735~31737	The 22nd holiday and schedule	Word	R/W
7BFAH~7BFCH	31738~31740	The 23rd holiday and schedule	Word	R/W
7BFDH~7BFFH	31741~31743	The 24th holiday and schedule	Word	R/W
7C00H~7C02H	31744~31746	The 25th holiday and schedule	Word	R/W
7C03H~7C05H	31747~31749	The 26th holiday and schedule	Word	R/W
7C06H~7C08H	31750~31752	The 27th holiday and schedule	Word	R/W
7C09H~7C0BH	31753~31755	The 28th holiday and schedule	Word	R/W
7C0CH~7C0EH	31756~31758	The 29th holiday and schedule	Word	R/W
7C0FH~7C11H	31759~31761	The 30th holiday and schedule	Word	R/W
7C12H	31762	The 3rd setting year	Word	R/W
7C13H	31763	Holiday number of the 3rd year	Word	R/W

Table 100.

The 4th Year Holiday Address Function: 03H Read 10H Preset				
Address(H)	**Address(D)**	**Parameters**	**Data Type**	**Type of Access**
7C14H~7C16H	31764~31766	The 1st holiday and schedule (format: month/day/schedule)	Word	R/W
7C17H~7C19H	31767~31769	The 2nd holiday and schedule	Word	R/W
7C1AH~7C1CH	31770~31772	The 3rd holiday and schedule	Word	R/W
7C1DH~7C1FH	31773~31775	The 4th holiday and schedule	Word	R/W
7C20H~7C22H	31776~31778	The 5th holiday and schedule	Word	R/W
7C23H~7C25H	31779~31871	The 6th holiday and schedule	Word	R/W
7C26H~7C28H	31782~31874	The 7th holiday and schedule	Word	R/W
7C29H~7C2BH	31785~31787	The 8th holiday and schedule	Word	R/W
7C2CH~7C22H	31788~31790	The 9th holiday and schedule	Word	R/W
7C2FH~7C31H	31791~31793	The 10th holiday and schedule	Word	R/W
7C32H~7C34H	31794~31796	The 11th holiday and schedule	Word	R/W
7C35H~7C37H	31797~31799	The 12th holiday and schedule	Word	R/W

The 4th Year Holiday Address Function: 03H Read 10H Preset				
Address(H)	**Address(D)**	**Parameters**	**Data Type**	**Type of Access**
7C38H~7C3AH	31800~31802	The 13th holiday and schedule	Word	R/W
7C3BH~7C3DH	31803~31805	The 14th holiday and schedule	Word	R/W
7C3EH~7C40H	31806~31808	The 15th holiday and schedule	Word	R/W
7C41H~7C43H	31809~31811	The 16th holiday and schedule	Word	R/W
7C44H~7C46H	31812~31814	The 17th holiday and schedule	Word	R/W
7C47H~7C49H	31815~31817	The 18th holiday and schedule	Word	R/W
7C4AH~7C4CH	31818~31820	The 19th holiday and schedule	Word	R/W
7C4DH~7C4FH	31821~31823	The 20th holiday and schedule	Word	R/W
7C50H~7C52H	31824~31826	The 21st holiday and schedule	Word	R/W
7C53H~7C55H	31827~31829	The 22nd holiday and schedule	Word	R/W
7C56H~7C58H	31830~31832	The 23rd holiday and schedule	Word	R/W
7C59H~7C5BH	31833~31835	The 24th holiday and schedule	Word	R/W
7C5CH~7C5EH	31836~31838	The 25th holiday and schedule	Word	R/W
7C5FH~7C61H	31839~31841	The 26th holiday and schedule	Word	R/W
7C62H~7C64H	31842~31844	The 27th holiday and schedule	Word	R/W
7C65H~7C67H	31845~31847	The 28th holiday and schedule	Word	R/W
7C68H~7C6AH	31848~31850	The 29th holiday and schedule	Word	R/W
7C68H~7C6AH	31851~31853	The 30th holiday and schedule	Word	R/W
7C6EH	31854	The 4th setting year	Word	R/W
7C6FH	31855	Holiday number of the 4th year	Word	R/W

Table 101.

The 5th Year Holiday Address Function: 03H Read 10H Preset				
Address(H)	**Address(D)**	**Parameters**	**Data Type**	**Type of Access**
7C70H~7C72H	31856~31858	The 1st holiday and schedule (format: month/day/schedule)	Word	R/W
7C73H~7C75H	31859~31861	The 2nd holiday and schedule	Word	R/W
7C76H~7C78H	31862~31864	The 3rd holiday and schedule	Word	R/W
7C79H~7C7BH	31865~31867	The 4th holiday and schedule	Word	R/W
7C7CH~7C7EH	31868~31870	The 5th holiday and schedule	Word	R/W
7C7FH~7C81H	31871~31873	The 6th holiday and schedule	Word	R/W
7C82H~7C84H	31874~31876	The 7th holiday and schedule	Word	R/W
7C85H~7C87H	31877~31879	The 8th holiday and schedule	Word	R/W
7C88H~7C8AH	31880~31882	The 9th holiday and schedule	Word	R/W
7C8BH~7C8DH	31883~31885	The 10th holiday and schedule	Word	R/W
7C8EH~7C90H	31886~31888	The 11th holiday and schedule	Word	R/W
7C91H~7C93H	31889~31891	The 12th holiday and schedule	Word	R/W
7C94H~7C96H	31892~31894	The 13th holiday and schedule	Word	R/W
7C97H~7C99H	31895~31897	The 14th holiday and schedule	Word	R/W
7C3EH~7C40H	31898~31900	The 15th holiday and schedule	Word	R/W

The 5th Year Holiday Address Function: 03H Read 10H Preset				
Address(H)	**Address(D)**	**Parameters**	**Data Type**	**Type of Access**
7C9DH~7C9FH	31901~31903	The 16th holiday and schedule	Word	R/W
7CA0H~7CA2H	31904~31906	The 17th holiday and schedule	Word	R/W
7CA3H~7CA5H	31907~31909	The 18th holiday and schedule	Word	R/W
7CA6H~7CA8H	31910~31912	The 19th holiday and schedule	Word	R/W
7CA9H~7CABH	31913~31915	The 20th holiday and schedule	Word	R/W
7CACH~7CAEH	31916~31918	The 21st holiday and schedule	Word	R/W
7CAFH~7CB1H	31919~31921	The 22nd holiday and schedule	Word	R/W
7CB2H~7CB4H	31922~31924	The 23rd holiday and schedule	Word	R/W
7CB5H~7CB7H	31925~31927	The 24th holiday and schedule	Word	R/W
7CB8H~7CBAH	31928~31930	The 25th holiday and schedule	Word	R/W
7CBBH~7CBDH	31931~31933	The 26th holiday and schedule	Word	R/W
7CBEH~7CC0H	31934~31936	The 27th holiday and schedule	Word	R/W
7CC1H~7CC3H	31937~31939	The 28th holiday and schedule	Word	R/W
7CC4H~7CC6H	31940~31942	The 29th holiday and schedule	Word	R/W
7CC7H~7CC9H	31943~31945	The 30th holiday and schedule	Word	R/W
7CCAH	31946	The 5th setting year	Word	R/W
7CCBH	31947	Holiday number of the 5th year	Word	R/W

Table 102.

The 6th Year Holiday Address Function: 03H Read 10H Preset				
Address(H)	**Address(D)**	**Parameters**	**Data Type**	**Type of Access**
7CCCH~7CCEH	31948~31950	The 1st holiday and schedule (format: month/day/schedule)	Word	R/W
7CCFH~7CD1H	31951~31953	The 2nd holiday and schedule	Word	R/W
7CD2H~7CD4H	31954~31956	The 3rd holiday and schedule	Word	R/W
7CD5H~7CD7H	31957~31959	The 4th holiday and schedule	Word	R/W
7CD8H~7CDAH	31960~31962	The 5th holiday and schedule	Word	R/W
7CDBH~7CDDH	31963~31965	The 6th holiday and schedule	Word	R/W
7CDEH~7CE0H	31966~31968	The 7th holiday and schedule	Word	R/W
7CE1H~7CE3H	31969~31971	The 8th holiday and schedule	Word	R/W
7CD4H~7CE6H	31972~31974	The 9th holiday and schedule	Word	R/W
7CE7H~7CE9H	31975~31977	The 10th holiday and schedule	Word	R/W
7CEAH~7CECH	31978~31980	The 11th holiday and schedule	Word	R/W
7CEDH~7CEFH	31981~31983	The 12th holiday and schedule	Word	R/W
7CF0H~7CF2H	31984~31986	The 13th holiday and schedule	Word	R/W
7CF3H~7CF5H	31987~31989	The 14th holiday and schedule	Word	R/W
7CF6H~7CF8H	31990~31992	The 15th holiday and schedule	Word	R/W
7CF9H~7CFBH	31993~31995	The 16th holiday and schedule	Word	R/W
7CFCH~7CFEH	31996~31998	The 17th holiday and schedule	Word	R/W
7CFFH~7D01H	31999~32001	The 18th holiday and schedule	Word	R/W
7D02H~7D04H	32002~32004	The 19th holiday and schedule	Word	R/W
7D05H~7D07H	32005~32007	The 20th holiday and schedule	Word	R/W
7D08H~7D0AH	32008~32010	The 21st holiday and schedule	Word	R/W
7DOBH~7D0DH	32011~32013	The 22nd holiday and schedule	Word	R/W
7D0EH~7D10H	32014~32016	The 23rd holiday and schedule	Word	R/W
7D11H~7D13H	32017~32019	The 24th holiday and schedule	Word	R/W
7D14H~7D16H	32020~32022	The 25th holiday and schedule	Word	R/W
7D17H~7D19H	32023~32025	The 26th holiday and schedule	Word	R/W
7D1AH~7D1CH	32026~32028	The 27th holiday and schedule	Word	R/W
7D1DH~7D1FH	32029~32031	The 28th holiday and schedule	Word	R/W
7D20H~7D22H	32032~32034	The 29th holiday and schedule	Word	R/W
7D23H~7D25H	32035~32037	The 30th holiday and schedule	Word	R/W
7D26H	32038	The 6th setting year	Word	R/W
7D27H	32039	Holiday number of the 6th year	Word	R/W

Table 103.

The 7th Year Holiday Address Function: 03H Read 10H Preset				
Address(H)	**Address(D)**	**Parameters**	**Data Type**	**Type of Access**
7D28H~7D2AH	32040~32042	The 1st holiday and schedule (format: month/day/schedule)	Word	R/W
7D2BH~7D2DH	32043~32045	The 2nd holiday and schedule	Word	R/W

The 7th Year Holiday Address Function: 03H Read 10H Preset				
Address(H)	**Address(D)**	**Parameters**	**Data Type**	**Type of Access**
7D2EH~7D30H	32046~32048	The 3rd holiday and schedule	Word	R/W
7D31H~7D33H	32049~32051	The 4th holiday and schedule	Word	R/W
77D4H~7D36H	32052~32054	The 5th holiday and schedule	Word	R/W
7D37H~7D39H	32055~32057	The 6th holiday and schedule	Word	R/W
7D3AH~7D3CH	32058~32060	The 7th holiday and schedule	Word	R/W
7D3DH~7D3FH	32061~32063	The 8th holiday and schedule	Word	R/W
7D40H~7D42H	32064~32066	The 9th holiday and schedule	Word	R/W
7D43H~7D45H	32067~32069	The 10th holiday and schedule	Word	R/W
7D46H~D48H	32070~32072	The 11th holiday and schedule	Word	R/W
7D49H~D4BH	32073~32075	The 12th holiday and schedule	Word	R/W
7D4CH~D4EH	32076~32078	The 13th holiday and schedule	Word	R/W
7D4FH~D51H	32079~32081	The 14th holiday and schedule	Word	R/W
7D52H~7D54H	32082~32084	The 15th holiday and schedule	Word	R/W
7D55H~7D57H	32085~32087	The 16th holiday and schedule	Word	R/W
7D58H~7D5AH	32088~32090	The 17th holiday and schedule	Word	R/W
7D5BH~7D5DH	32091~32093	The 18th holiday and schedule	Word	R/W
7DFEH~7D60H	32094~32096	The 19th holiday and schedule	Word	R/W
7D61H~7D63H	32097~32099	The 20th holiday and schedule	Word	R/W
7D64H~7D66H	32100~32102	The 21st holiday and schedule	Word	R/W
7D67H~7D69H	32103~32105	The 22nd holiday and schedule	Word	R/W
7D6AH~7D6CH	32106~32108	The 23rd holiday and schedule	Word	R/W
7D6DH~7D6FH	32109~32111	The 24th holiday and schedule	Word	R/W
7D70H~7D72H	32112~32117	The 25th holiday and schedule	Word	R/W
7D73H~7D75H	32115~32117	The 26th holiday and schedule	Word	R/W
7D76H~7D78H	32118~32120	The 27th holiday and schedule	Word	R/W
7D79H~7D7BH	32121~32123	The 28th holiday and schedule	Word	R/W
7D7CH~7D7EH	32124~32126	The 29th holiday and schedule	Word	R/W
7D7FH~7D81H	32127~32129	The 30th holiday and schedule	Word	R/W
7D82H	32130	The 7th setting year	Word	R/W
7D83H	32131	Holiday number of the 7th year	Word	R/W

Table 104.

The 8th Year Holiday Address Function: 03H Read 10H Preset				
Address(H)	**Address(D)**	**Parameters**	**Data Type**	**Type of Access**
7D84H~7D86H	32132~32134	The 1st holiday and schedule (format: month/day/schedule)	Word	R/W
7D87H~7D89H	32135~32137	The 2nd holiday and schedule	Word	R/W
7D8AH~7D8CH	32138~32140	The 3rd holiday and schedule	Word	R/W
7D8DH~7D8FH	32141~32143	The 4th holiday and schedule	Word	R/W
7D90H~7D92H	32144~32146	The 5th holiday and schedule	Word	R/W

The 8th Year Holiday Address Function: 03H Read 10H Preset				
Address(H)	Address(D)	Parameters	Data Type	Type of Access
7D93H~7D95H	32147~32149	The 6th holiday and schedule	Word	R/W
7D96H~7D98H	32150~32152	The 7th holiday and schedule	Word	R/W
7D99H~7D9BH	32153~32155	The 8th holiday and schedule	Word	R/W
7D9CH~7D9EH	32156~32158	The 9th holiday and schedule	Word	R/W
7D9FH~7DA1H	32159~32161	The 10th holiday and schedule	Word	R/W
7DA2H~7DA4H	32162~32164	The 11th holiday and schedule	Word	R/W
7DA5H~7DA7H	32165~32167	The 12th holiday and schedule	Word	R/W
7DA8H~7DAAH	32168~32170	The 13th holiday and schedule	Word	R/W
7DABH~7DADH	32171~32173	The 14th holiday and schedule	Word	R/W
7DAEH~7DB0H	32174~32176	The 15th holiday and schedule	Word	R/W
7DB1H~7DB3H	32177~32179	The 16th holiday and schedule	Word	R/W
7DB4H~7DB6H	32180~32182	The 17th holiday and schedule	Word	R/W
7DB7H~7DB9H	32183~32185	The 18th holiday and schedule	Word	R/W
7DBAH~7DBCH	32186~32188	The 19th holiday and schedule	Word	R/W
7DBDH~7DBFH	32189~32191	The 20th holiday and schedule	Word	R/W
7DC0H~7DC2H	32192~32194	The 21st holiday and schedule	Word	R/W
7DC3H~7DC5H	32195~32197	The 22nd holiday and schedule	Word	R/W
7DC6H~7DC8H	32198~32200	The 23rd holiday and schedule	Word	R/W
7DC9H~7DCBH	32201~32203	The 24th holiday and schedule	Word	R/W
7DCCH~7DCEH	32204~32206	The 25th holiday and schedule	Word	R/W
7DCFH~7DD1H	32207~32209	The 26th holiday and schedule	Word	R/W
7DD2H~7DD4H	32210~32212	The 27th holiday and schedule	Word	R/W
7DD5H~7DD7H	32213~32215	The 28th holiday and schedule	Word	R/W
7DD8H~7DDAH	32216~32218	The 29th holiday and schedule	Word	R/W
7DDBH~7DDDH	32219~32221	The 30th holiday and schedule	Word	R/W
7DDEH	32222	The 8th setting year	Word	R/W
7DDFH	32223	Holiday number of the 8th year	Word	R/W

Table 105.

The 9th Year Holiday Address Function: 03H Read 10H Preset				
Address(H)	Address(D)	Parameters	Data Type	Type of Access
7DE0H~7DE2H	32224~32226	The 1st holiday and schedule (format: month/day/schedule)	Word	R/W
7DE3H~7DE5H	32227~32229	The 2nd holiday and schedule	Word	R/W
7DE6H~7DE8H	32230~32232	The 3rd holiday and schedule	Word	R/W
7DE9H~7DEBH	32233~32235	The 4th holiday and schedule	Word	R/W
7DECH~7DEEH	32236~32238	The 5th holiday and schedule	Word	R/W
7DEFH~7DF1H	32239~32241	The 6th holiday and schedule	Word	R/W
7DF2H~7DF4H	32242~32244	The 7th holiday and schedule	Word	R/W
7DF5H~7DF7H	32245~32247	The 8th holiday and schedule	Word	R/W

The 9th Year Holiday Address Function: 03H Read 10H Preset				
Address(H)	**Address(D)**	**Parameters**	**Data Type**	**Type of Access**
7DF8H~7DFAH	32248~32250	The 9th holiday and schedule	Word	R/W
7DFBH~7DFDH	32251~32253	The 10th holiday and schedule	Word	R/W
7DFEH~7E00H	32254~32256	The 11th holiday and schedule	Word	R/W
7E01H~7E03H	32257~32259	The 12th holiday and schedule	Word	R/W
7E04H~7E06H	32260~32262	The 13th holiday and schedule	Word	R/W
7E07H~7E09H	32263~32265	The 14th holiday and schedule	Word	R/W
7E0AH~7E0CH	32266~32268	The 15th holiday and schedule	Word	R/W
7E0DH~7E0FH	32269~32271	The 16th holiday and schedule	Word	R/W
7E10H~7E12H	32272~32274	The 17th holiday and schedule	Word	R/W
7E13H~7E15H	32275~32277	The 18th holiday and schedule	Word	R/W
7E16H~7E18H	32278~32280	The 19th holiday and schedule	Word	R/W
7E19H~7E1BH	32281~32283	The 20th holiday and schedule	Word	R/W
7E1CH~7E1EH	32284~32286	The 21st holiday and schedule	Word	R/W
7E1FH~7E21H	32287~32289	The 22nd holiday and schedule	Word	R/W
7E22H~7E24H	32290~32292	The 23rd holiday and schedule	Word	R/W
7E25H~7E27H	32293~32295	The 24th holiday and schedule	Word	R/W
7E28H~7E2AH	32296~32298	The 25th holiday and schedule	Word	R/W
7E2BH~7E2DH	32299~32301	The 26th holiday and schedule	Word	R/W
7E2EH~7E30H	32302~32304	The 27th holiday and schedule	Word	R/W
7E31H~7E33H	32305~32307	The 28th holiday and schedule	Word	R/W
7E34H~7E36H	32308~32310	The 29th holiday and schedule	Word	R/W
7E37H~7E39H	32311~32313	The 30th holiday and schedule	Word	R/W
7E3AH	32314	The 9th setting year	Word	R/W
7E3BH	32315	Holiday number of the 9th year	Word	R/W

Table 106.

The 10th Year Holiday Address Function: 03H Read 10H Preset				
Address(H)	**Address(D)**	**Parameters**	**Data Type**	**Type of Access**
7E3CH~7E3EH	32316~32318	The 1st holiday and schedule (format: month/day/schedule)	Word	R/W
7E3FH~7E41H	32319~32321	The 2nd holiday and schedule	Word	R/W
7E42H~7E44H	32322~32324	The 3rd holiday and schedule	Word	R/W
7E45H~7E47H	32325~32327	The 4th holiday and schedule	Word	R/W
7E48H~7E4AH	32328~32330	The 5th holiday and schedule	Word	R/W
7E4BH~7E4DH	32331~32333	The 6th holiday and schedule	Word	R/W
7E4EH~7E50H	32334~32336	The 7th holiday and schedule	Word	R/W
7E51H~7E53H	32337~32339	The 8th holiday and schedule	Word	R/W
7E54H~7E56H	32340~32342	The 9th holiday and schedule	Word	R/W
7E57H~7E59H	32343~32345	The 10th holiday and schedule	Word	R/W
7E5AH~7E5CH	32346~32348	The 11th holiday and schedule	Word	R/W

The 10th Year Holiday Address Function: 03H Read 10H Preset				
Address(H)	**Address(D)**	**Parameters**	**Data Type**	**Type of Access**
7E5DH~7E5FH	32349~32351	The 12th holiday and schedule	Word	R/W
7E60H~7E62H	32352~32354	The 13th holiday and schedule	Word	R/W
7E63H~7E65H	32355~32357	The 14th holiday and schedule	Word	R/W
7E66H~7E68H	32358~32360	The 15th holiday and schedule	Word	R/W
7E69H~7E6BH	32361~32363	The 16th holiday and schedule	Word	R/W
7E6CH~7E6EH	32364~32366	The 17th holiday and schedule	Word	R/W
7E6FH~7E71H	32367~32369	The 18th holiday and schedule	Word	R/W
7E72H~7E74H	32370~32372	The 19th holiday and schedule	Word	R/W
7E75H~7E77H	32373~32375	The 20th holiday and schedule	Word	R/W
7E78H~7E7AH	32376~32378	The 21st holiday and schedule	Word	R/W
7E7BH~7E7DH	32379~32381	The 22nd holiday and schedule	Word	R/W
7E7EH~7E80H	32382~32384	The 23rd holiday and schedule	Word	R/W
7E81H~7E83H	32385~32387	The 24th holiday and schedule	Word	R/W
7E84H~7E86H	32388~32390	The 25th holiday and schedule	Word	R/W
7E87H~7E89H	32391~32393	The 26th holiday and schedule	Word	R/W
7E8AH~7E8CH	32394~32396	The 27th holiday and schedule	Word	R/W
7E8DH~7E8FH	32397~32399	The 28th holiday and schedule	Word	R/W
7E90H~7E92H	32400~32402	The 29th holiday and schedule	Word	R/W
7E93H~7E95H	32403~32405	The 30th holiday and schedule	Word	R/W
7E96H	32406	The 10th setting year	Word	R/W
7E97H	32407	Holiday number of the 10th year	Word	R/W

Table 107.

Address(H)	Address(H)	Parameters	Data Type	Property	Range	Default	Factory Setting
8000H	32768	Manual triggering waveform	Word	R/W	0xAA: Enable 0: Disable	0	0
8001H	32769	D1 triggering – AXM-11	Word	R/W	bit1bit0: DI1, bit3bit2: DI2, bit5bit4: DI3, bit7bit6: DI4, bit9bit8: DI5, bit11bit10: DI6, 00: Disable; 00: From OFF to ON; 10: From ON to OFF; 11: Any DI state change	0	0
8002H	32770	DI triggering – AXM-21	Word	R/W	bit1bit0: DI7, bit3bit2: DI8, bit5bit4: DI9, bit7bit6: DI10; The same as above	0	0
8003H	32771	DI triggering – AXM-31	Word	R/W	Bit1bit0: DI11, bit3bit2: DI12, bit5bit4: DI13, bit7bit6: DI14; The same as above	0	0
8004H	32772	Voltage rated value	Word	R/W	50V-400V or 50V-690V (only in 3LL)	400	400
8005H	32773	Voltage sag triggering waveform	Word	R/W	1: Enable, 0: Disable	0	0
8006H	32774	Voltage sag threshold	Word	R/W	20-100%	10	10
8007H	32775	Voltage sag half cycle threshold	Word	R/W	4-200 half cycles	0	0
8008H	32776	Voltage swell triggering threshold	Word	R/W	1: Enable, 0: Disable	100	100
8009H	32777	Voltage swell threshold	Word	R/W	50-140%		
800AH	32778	Reserved	Word	R/W		5000	5000
800BH	32779	Current rated value	Word	R/W	1: Enable,0: Disable		
800CH	32780	Over-current triggering waveform	Word	R/W	1: Enable, 0: Disable	0	0
800DH	32781	Over-current threshold	Word	R/W	50-150%	100	100
800EH	32782	Clear waveform	Word	R/W	0x55 enable	0	0
800FH	32783	Clear power quality event	Word	R/W	0x55 enable	0	0

Note: In 3LL and 2LL, voltage rated value is line voltage; in 3LN, 1LN and 1LL, voltage rated value is phase voltage. Waveform Capture Data Retrieve Address

Waveform Capture includes timestamp, triggering condition, and waveform data. Every group uses the same data format. Only one group of waveforms is saved in the registers. When retrieving the waveform, first write 1-8 group number into 0X801FH, then read the registers after it to acquire the waveform corresponding to the written group number.

The relationship between voltage waveform value and real value:
Real Value (Unit: V) = Waveform Value / 37.59105

The relationship between current waveform value and real value:

1. 5A, 1A: Real Value (Unit: A) = Waveform Value/1683.153;
2. 333mV: Real Value (Unit: A) = Waveform Value/K (firmware above 3.21,K=14427.15; other: K = 15869.87);
3. 100mV(Rope-CT): Real Value(Unit: A) = Waveform Value/K (firmware above 3.21,K=20291.1; firmware 3.20, K=22068.8,other: K = 15869.87);
4. mA CT: Real Value(Unit: A) = Waveform Value/K (80mA CT: K=7414.289; 100mA: K=9267.440; 200mA: K=18514.68);

The voltage and current value obtained from the waveform are the PT or CT secondary side value.

Read: 03, Preset: 10. For more information, please refer to Chapter 4.7.

Table 108.

Address (H)	Address (D)	Parameter	Default	Range	Data Type	Property
8E00H	36352	Waveform group number for retrieving		1~100 When the value is smaller than or equal to newest waveform record group number, this value is valid	Word	R/W
8E01H	36353	Waveform group number		Waveform number 0-121	Word	R/W
8E02H	36354	Waveform record window status		0x0BH: Window data is valid 0xFF: Window data is invalid 0xAA: Waveform record memory is clearing (data is invalid)	Word	R/W
8E03H	36355	Newest waveform group number		1~100 0: No record	Word	R/W
8E04H~8E43	36356~36419	Waveform record data retrieving window		-32768~32767	Word	R/W

Power Quality Event Retrieve Address

Power quality event includes timestamp, triggering condition, and related settings. Every group uses the same data format. Only 10 groups of data are saved in the registers. When retrieving the event data, its parameters must be correctly set in order to get correct information.

Read: FC03, Preset: FC16. For more information, please refer to Chapter 4.7

Table 109.

Address(H)	Address(H)	Parameters	Data Type	Property	Range	Default	Factory Setting
8CFDH	36093	Newest event group number	Word	R	1-50000 0: No data	0	0
8CFEH	36094	Event for retrieving starting group number	Word	R/W	1-50000 Only valid smaller or equal to newest event group number	1	1
No. 1 Event							
8D00H	36096	Timestamp High byte – Year Low byte – Month	Word	R	Time		
8D01H	36097	Timestamp High byte – Day Low byte – Hour	Word	R	Time		
8D02H	36098	Timestamp High byte – Minute Low byte – Second	Word	R	Time		
8D03H	36099	Timestamp: Millisecond	Word	R	Time		
8D04H	36100	Voltage sag or voltage swell condition	Word	R	0: Disabled, 1: Voltage sag, 2: Voltage swell		
8D05H	36101	Rated value	Word	R	50V~400V or 50V~690V (only in 3LL)		
8D06H	36102	Threshold	Word	R	Voltage sag: 20-100%, Voltage swell: 50-140%		
8D07H	36103	Half cycle count	Word	R	Voltage sag event: 4~200; Voltage swell event: 0		
8D08H~ 8D0FH	36104~ 36111	No. 2 Event	Word	R			
8D10H~ 8D17H	36112~ 36119	No. 3 Event	Word	R			
8D18H~ 8D1FH	36120~ 36127	No. 4 Event	Word	R			
8D20H~ 8D27H	36128~ 36135	No. 5 Event	Word	R			
8D28H~ 8D2FH	36136~ 36143	No. 6 Event	Word	R			
8D30H~ 8D37H	36144~ 36151	No. 7 Event	Word	R			
8D38H~ 8D3FH	36152~ 36159	No. 8 Event	Word	R			
8D40H~ 8D47H	36160~ 36167	No. 9 Event	Word	R			
8D48H~ 8D4FH	36168~ 36175	No. 10 Event	Word	R			

Appendix A – Technical Data and Specification

Input Ratings

Energy Accuracy (PXM 1100)

Active Power	
(According to IEC 62053-22)	Class 0.2S
(According to ANSI C12.20)	Class 0.2
Reactive	
(According to IEC 62053-23)	Class 2

Harmonic Resolution

Metered Value	2nd ~ 63rd (50 or 60 Hz type) 2nd ~ 15th(400 Hz type)

Voltage Input

Nominal Full Scale	400 Vac L-N, 690 Vac L-L
Withstand	1,500 Vac continuous; 3,250 Vac, 50/60 Hz for 1 minute
Metering Frequency	45 ~ 65 Hz
Pickup Voltage	10 Vac
Burden	0.05 VA (typical) @ 5 Arms
Accuracy	0.2% full scale

Current inputs (each channel)

Nominal secondary sensor settings:

Current Sensor Input Options	5A	1A	333mV	100mV Rope CT	
Nominal Configuration Selection	5A	1A	1A	1A	
Metering range (%of nominal)	200%	200%	120%	120%	
Pickup current (%of nominal)	0.1%	0.1%	0.5%	0.5%	
Withstand	20 A rms continuous, 100 A rms for 1 second, non-recurring				
Burden	0.05 VA (typical) @ 5 A rms				
Accuracy	0.2% full scale				

Accuracy

Parameters		Accuracy	Resolution	Range
Voltage		0.2%	0.1 V	10 V ~ 1000 kV
Current		0.2%	0.001 A	5 mA ~ 50000 A
Power		0.2%	1 W	-9999 MW ~ 9999 MW
Reactive Power		0.2%	1 Var	-9999 MVar ~ 9999 MVar
Apparent Power		0.2%	1 VA	0 ~ 9999 MVA
Power Demand		0.2%	1 W	-9999 MW ~ 9999 MW
Reactive Power Demand		0.2%	1 Var	-9999 MVar ~ 9999 MVar
Apparent Power Demand		0.2%	1 VA	0 ~ 9999 MVA
Power Factor		0.2%	0.001	-1.000 ~ 1.000
Frequency		0.2%	0.01Hz	45.00 ~ 65.00 Hz (50Hz or 60Hz type) 300.00 ~ 500.00 (400 type)
Energy	Primary	0.2%	0.1 kWh	0 ~ 99999999.9 kWh
	Secondary	0.2%	0.001 kWh	0 ~ 999999.999 kWh
Reactive Energy	Primary	0.2%	0.1 kvarh	0 ~ 99999999.9 kvarh
	Secondary	0.2%	0.001 kvarh	0 ~ 999999.999 kvarh
Apparent Energy	Primary	0.2%	0.1 kVAh	0 ~ 99999999.9 kVAh
	Secondary	0.2%	0.001 kVAh	0 ~ 999999.999 kVAh
Harmonics		1.0%	0.1%	> = 0.0%
Phase Angle		2.0%	0.1°	0.0° ~ 359.9°
Imbalance Factor		2.0%	0.1%	0.0% ~ 100%
Running Time		<1 second/day	0.01 h	0 ~ 9999999.99 h
Temperature Drift		<100 ppm/°C		
		0.5‰/year		

Control Power

AC/DC Control Power

Operating Range	100 - 415 Vac, 50/60 Hz; 100 - 300 Vdc
Burden	5 W
Withstand	3250 Vac, 50/60 Hz 1 min
	Installation Category III (Distribution)

Low Voltage DC Control Power (Optional)

Operating Range	20 - 60 Vdc
Burden	5 W

I/O Options

Digital Input

Input Voltage Range	20 - 160 Vac/dc
Input Current (Max)	2 mA
Start Voltage	15 V
Stop Voltage	5 V
Pulse Frequency (Max)	100 Hz, 50% Duty Ratio
SOE Resolution	2 ms

Digital Output (DO) (Photo-MOS)

Voltage Range	0 - 250 Vac/dc
Load Current	100 mA (Max)
Output Frequency	25 Hz, 50% Duty Ratio
Isolation Voltage	2500 Vac

Relay Output (RO)

Switching Voltage (Max)	250 Vac, 30 Vdc
Load Current	5 A (resistive), 2 A (inductive)
Set Time	10 ms (Max)
Contact Resistance	30 mΩ (Max)
Isolation Voltage	2500 Vac
Mechanical Life	1.5×10^7

Analog Output (AO)

Output Range	0 - 5 V/1 - 5 V, 0 - 20 mA/4-20 mA (Optional)
Accuracy	0.5%
Temperature Drift	50 ppm/°C typical
Isolation Voltage	500 Vdc
Open Circuit Voltage	15 V

Analog Input (AI)

Input Range	0 - 5 V/1-5 V, 0 - 20 mA/4 - 20 mA (Optional)
Accuracy	0.2%
Temperature Drift	50 ppm/°C typical
Isolation Voltage	500 Vdc

Power Supply for DI (24Vdc)

Output Voltage	24 Vdc
Output Current	42 mA
Load (Max)	21 DIs

General Specifications

Product Specifications

Dimensions (mm)	96 x 96 x 51 (Cut-out 92 x 92 or 4-inch Round)
Protection Level	IP54 (Front), IP30 (Cover)
Weight (g) [oz]	350 g [11.25 oz]
Temperature	-25°C ~ 70°C (-13°F ~ 158°F), Metering -40°C~85°C (-40°F ~ 185°F), Storage
Humidity	5% ~ 95% Non-condensing
Power Supply	100 - 415 Vac, 50/60 Hz; 100 - 300 Vdc; Category III, Pollution Degree 2
Power Consumption	5 W

General Specificatons (Continued)

Standard Compliance

Measurement Standard	IEC 62053-22; ANSI C12.20
Environmental Standard	IEC 60068-2
Safety Standard	IEC 61010-1, UL 61010-1
EMC Standard	IEC 61000-4/-2-3-4-5-6-8-11, CISPR 22
Outlines Standard	DIN 43700, ANSI C39.1

Communication

RS-485 (Standard)	2-wire connection
	MODBUS RTU Protocol
	Up to 38400 baud rate
BACnet IP(Optional)	RJ45; BACnet Protocol
Ethernet (optional)	10M/100M BaseT
	MODBUS® TCP/IP
	BACnet-IP
	EtherNet/IP
	IPv6
	SNMP
	HTTP/HTTPs Webserver
	HTTP/HTTPs, FTP data post
	SMTP
	NTP

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Supersedes April 2021

Pow-R-Line Xpert and legacy panelboards


PRL1X


PRL2X


PRL3X


PRL4X


PRL1X/2X-LX


PRL4F


Pow-R-Command

Contents

PRL1X, PRL2X, PRL1a, PRL2a parts

PRL3X, PRL3a parts

PRL4X, PRL4 parts

Accessories

Powering Business Worldwide

Table 1. Product history time line

Product	1985	1990	1995	2019	Present
PRL1X, 2X, 3X, 4X					May 2020 ──►
PRL1a, 2a			◄──	Oct. 1996 ──►	
PRL3a		◄──	────	Mar. 1994 ──►	
PRL4B/F	◄──	────	────	Oct. 1987 ──►	
PRL1a, 2a-LX			◄──	Dec. 1997 ──►	
Pow-R-Command™			◄──	Mar. 1996 ──►	

Procedure for identifying panelboard type

The current line of Pow-R-Line C™ panelboards was introduced in 1993. The current line of Pow-R-Line Xpert™ panelboards was introduced in 2020.

A panelboard is identified by data found on the nameplate. Pow-R-Line C and Pow-R-Line Xpert panelboard nameplates are different in appearance, but all have the same critical information:

- Ampere rating of the main
- Ampere rating of the neutral
- Type of service (phase/wire)
- Manufacturing location
- Type of panel
- General order number

In the event the nameplate is missing, it may still be possible to identify the panel type by location of the neutral bar. **Figure 1** shows the position of the neutral in the panelboard.

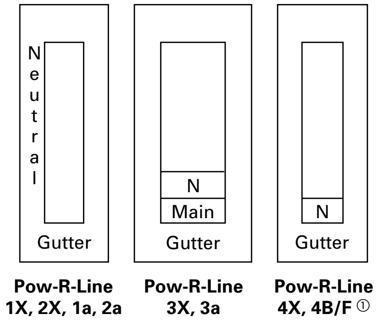


Figure 1. Position of the neutral in the panelboard

① PRL4F panels with vertical-mounted main switch will have the neutral mounted at the opposite end the main.

Box width may also help identify the panelboard type. Standard width for PRL1X, PRL2X, PRL3X, PRL1a, PRL2a, and PRL3a is 20.00 inches (508.0 mm). PRL4X and PRL4 standard widths are 24.00, 36.00, and 44.00 inches (609.6, 914.4, and 1117.6 mm).

⚠ WARNING

HAZARDOUS VOLTAGE WILL CAUSE SEVERE INJURY OR DEATH. TURN OFF POWER SUPPLY TO EQUIPMENT BEFORE WORKING ON IT.

Procedure for identifying renewal parts

1. Identify the type of panelboard, i.e., PRL1X, PRL2X, PRL3X, PRL4X, PRL1a, PRL2a, PRL3a, and PRL4 by reading the nameplate. Follow the procedure listed to the left.
2. Refer to the listing below and turn to the proper section in this document to identify standard parts.

3. This book identifies those replacement parts most frequently ordered and which are readily available from stock. These parts can be ordered by style or catalog number to speed up processing and delivery.

Distributor ordering instructions

1. Specify part by style/part number.
2. Turn to **page 3** to locate nearest satellite plant.
3. Enter the order via email to the nearest satellite plant.
4. Selling policy 25-000 applies.

Eaton satellite plants

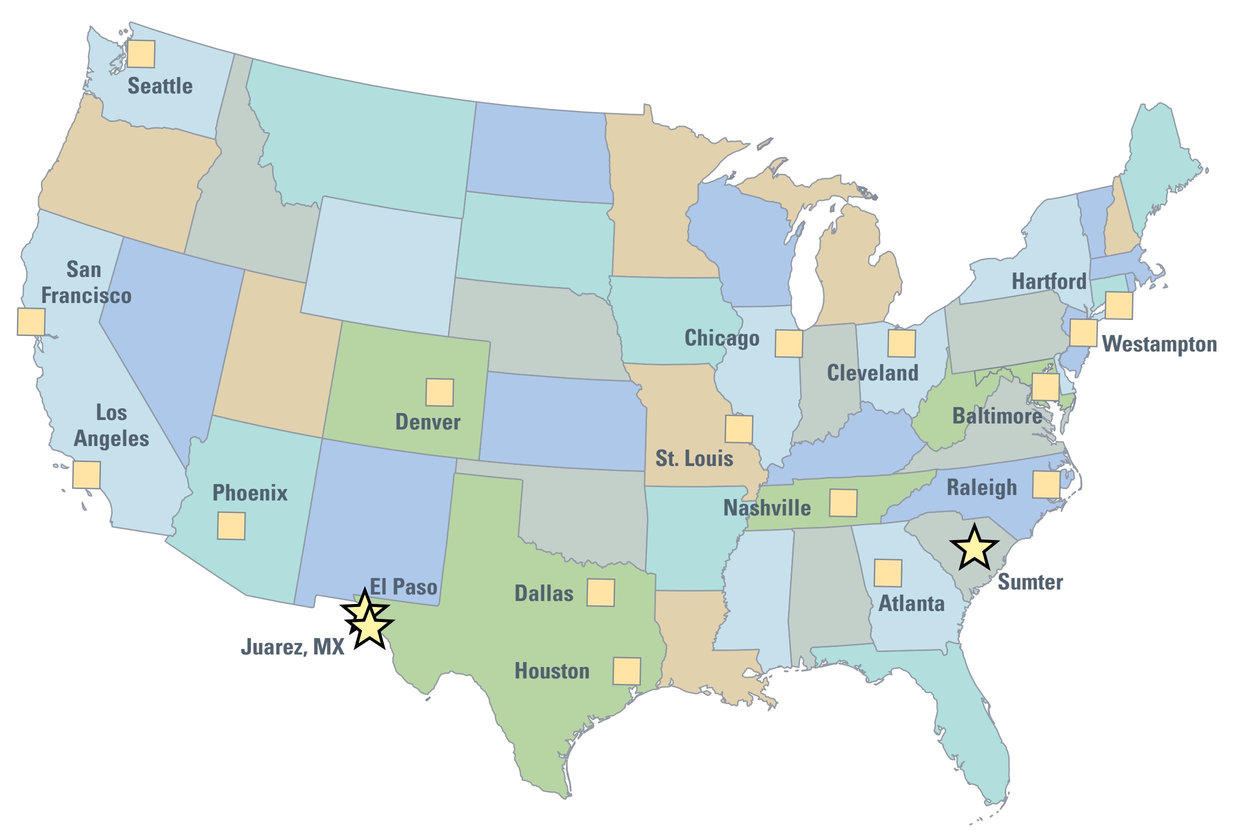


Figure 2. Satellite plants

For an unparalleled commitment to your specific needs, please visit your local Satellite facility.

Eaton Pow-R-Line Xpert panelboards and switchboards are built to your requirements at our world-class manufacturing plants in Sumter, SC, El Paso, TX, and Juarez, MX. In addition, Eaton has 16 regional Satellite facilities located across the country to meet your panelboard and switchboard service needs.

Atlanta
7000 Highlands Parkway SE
Suite 102
Smryna, GA 30082
678.309.4260

Baltimore
7451 Coca Cola Drive
Suite C
Hanover, MD 21076
410.796.7777

Chicago
230 Windy Point Drive
Glendale Heights, IL 60139
630.260.6303

Cleveland
12875 Corporate Drive
Unit E
Parma, OH 44130
216.265.3284

Dallas
631 Westport Parkway
Suite 100
Grapevine, TX 76051
817.251.6733

Denver
2450 Airport Road
Suite C
Aurora, CO 80011
303.366.2080

El Paso
45 Butterfield Circle
Suite C
El Paso, TX 79906
915.881.0259

Hartford
40A International Drive
Windsor, CT 06095
860.298.1305

Houston
14825 Northwest Freeway
Suite 100
Houston, TX 77040
713.744.7530

Juarez
Prolongacion Hermanos Escobar
#7014, Parque Industrial Omega
Adicion Oriental Cd.
Juarez, Chihuahua Mexico 32648

Los Angeles–P&S
13201 Dahlia Street
Suite 300
Fontana, CA 92337
919.428.8903

Nashville
1421 Gould Boulevard
Suite C
La Vergne, TN 37086
615.287.3200

Phoenix
560 N 54th Street
Suite 1
Chandler, AZ 85226
480.449.4222

Raleigh
9400 Globe Center Drive
Suite 121
Morrisville, NC 27560
919.544.7074

St. Louis
56 Soccer Park Road
Fenton, MO 63026
636.717.3500

Sumter
Main Manufacturing Plant
845 Corporate Circle
Sumter, SC 29154
803.481.3131

San Francisco
20923 Cabot Boulevard
Hayward, CA 94545
510.784.8981

Seattle
1604 15th Street SW
Suite 114
Auburn, WA 98001
253.833.5021

Westampton
96 Stemmers Lane
Westampton, NJ 08060
609.835.4230

PRL1X, PRL2X, PRL1a, PRL2a parts section

Description **Page**

PRL1X, PRL2X, PRL1a, PRL2a connector kits

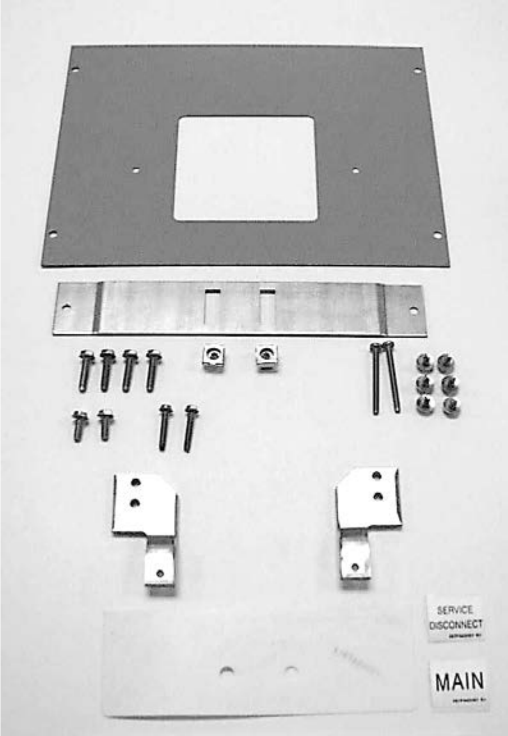
Table 2. PRL1X, PRL2X vertical breaker assemblies

		Three-phase		Single-phase	
		Tin-plated aluminum connector	Silver-plated copper connector	Tin-plated aluminum connector	Silver-plated copper connector
Device Type ①	Device mounting	Catalog number			
PD2 (100 A maximum)	Top fed	**KB13A2T**	**KB13S2T**	**KB11A2T**	**KB11S2T**
	Bottom fed	**KB13A2B**	**KB13S2B**	**KB11A2B**	**KB11S2B**
PD2 (225 A maximum)	Top fed	**KB23A2T**	**KB23S2T**	**KB21A2T**	**KB21S2T**
	Bottom fed	**KB23A2B**	**KB23S2B**	**KB21A2B**	**KB21S2B**
PD3A (400 A)	Top fed	**KB43A34T**	**KB43S34T**	**KB41A14T**	**KB41S14T**
	Bottom fed	**KB43A34B**	**KB43S34B**	**KB41A14B**	**KB41S14B**
PD3B (600 A)	Top fed	N/A	**KB63S36T**	N/A	**KB61S16T**
	Bottom fed	N/A	**KB63S36B**	N/A	**KB61S16B**

① Order main or sub-feed breaker separately when ordering above connector kits.

PD3A = Adjustable

PD3B = ETU (Electronic trip unit)



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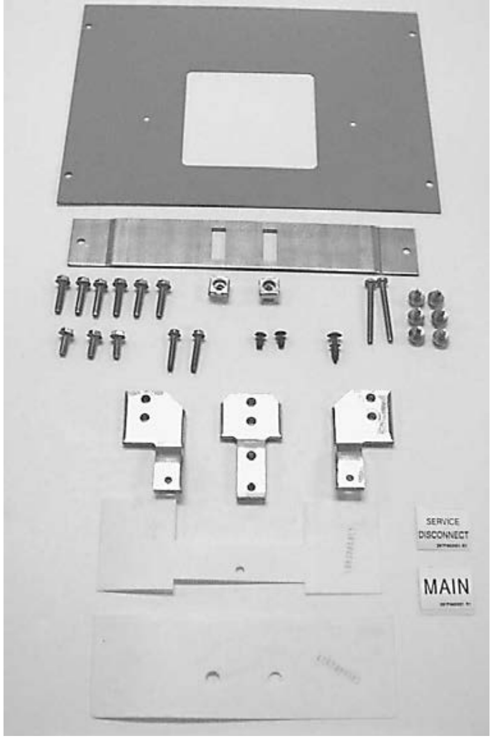


KB13AFT

Table 3. PRL1a, PRL2a vertical breaker assemblies

		Three-phase		Single-phase	
		Tin-plated aluminum connector	Silver-plated copper connector	Tin-plated aluminum connector	Silver-plated copper connector
Device type ①	**Device mounting**	**Catalog number**			
F-Frame ② (100 A maximum)	Top fed	**KB13AFT**	**KB13SFT**	**KB11AFT**	**KB11SFT**
	Bottom fed	**KB13AFB**	**KB13SFB**	**KB11AFB**	**KB11SFB**
F-Frame ③ (225 A maximum)	Top fed	**KB23AFT**	**KB23SFT**	**KB21AFT**	**KB21SFT**
	Bottom fed	**KB23AFB**	**KB23SFB**	**KB21AFB**	**KB21SFB**
J-Frame	Top fed	**KB43AJT**	**KB43SJT**	**KB41AJT**	**KB41SJT**
	Bottom fed	**KB43AJB**	**KB43SJB**	**KB41AJB**	**KB41SJB**
K-Frame	Top fed	**KB43AKT**	**KB43SKT**	**KB41AKT**	**KB41SKT**
	Bottom fed	**KB43AKB**	**KB43SKB**	**KB41AKB**	**KB41SKB**

① Order main or sub-feed breaker separately when ordering above connector kits.

② EHD, FD, HFD, FDC.

③ FD, HFD, FDC, ED, EDH, EDC.

Table 4. 100 A lug assemblies

				Three-phase		Single-phase	
				Tin-plated aluminum connector	Silver-plated copper connector	Tin-plated aluminum connector	Silver-plated copper connector
Lug type	**Panel lug options** ①	**Wire size range**	**Quantity per phase**	**Catalog number**			
Aluminum/copper mechanical	STD	#14–1/0	1	**KL13AMS**	**KL13SMS**	**KL11AMS**	**KL11SMS**
	SFL	#14–1/0	2	**KL13AMF**	**KL13SMF**	**KL11AMF**	**KL11SMF**
	OVS	#6–300 kcmil	1	**KL13AMO**	**KL13SMO**	**KL11AMO**	**KL11SMO**
Crimp	STD	#1–1/0	1	**KL13AVS**	**KL13SVS**	**KL11AVS**	**KL11SVS**
	SFL	#1–1/0	2	**KL13AVF**	**KL13SVF**	**KL11AVF**	**KL11SVF**
	OVS	2/0–300 kcmil	1	**KL13AVO**	**KL13SVO**	**KL11AVO**	**KL11SVO**
Copper mechanical	STD	#14–1/0	1	—	**KL13SCS**	—	**KL11SCS**
	SFL	#14–1/0	2	—	**KL13SCF**	—	**KL11SCF**
	OVS	#6–250 kcmil	1	—	**KL13SCO**	—	**KL11SCO**

① STD = Standard lugs. Use for main or through-feed.
SFL = Sub-feed lugs.
OVS = Oversize lugs. Use for main or through-feed.

KL13AMS

KL11AVS

Table 5. 225 A lug assemblies

Lug type	Panel lug options ①	Wire size range	Quantity per phase	Three-phase		Single-phase	
				Tin-plated aluminum connector	Silver-plated copper connector	Tin-plated aluminum connector	Silver-plated copper connector
				Catalog number			
Aluminum/copper mechanical	STD	#6–300 kcmil	1	**KL23AMS**	**KL23SMS**	**KL21AMS**	**KL21SMS**
	SFL	#6–300 kcmil	2	**KL23AMF**	**KL23SMF**	**KL21AMF**	**KL21SMF**
	OVS	4/0–500 kcmil	1	**KL23AMO**	**KL23SMO**	**KL21AMO**	**KL21SMO**
Crimp	STD	2/0–300 kcmil	1	**KL23AVS**	**KL23SVS**	**KL21AVS**	**KL21SVS**
	SFL	2/0–300 kcmil	2	**KL23AVF**	**KL23SVF**	**KL21AVF**	**KL21SVF**
	OVS	4/0–500 kcmil	1	**KL23AVO**	**KL23SVO**	**KL21AVO**	**KL21SVO**
Copper mechanical	STD	#6–250 kcmil	1	—	**KL23SCS**	—	**KL21SCS**
	SFL	#6–250 kcmil	2	—	**KL23SCF**	—	**KL21SCF**
	OVS	1/0–600 kcmil	1	—	**KL23SCO**	—	**KL21SCO**

① STD = Standard lugs. Use for main or through-feed.
SFL = Sub-feed lugs.
OVS = Oversize lugs. Use for main or through-feed.

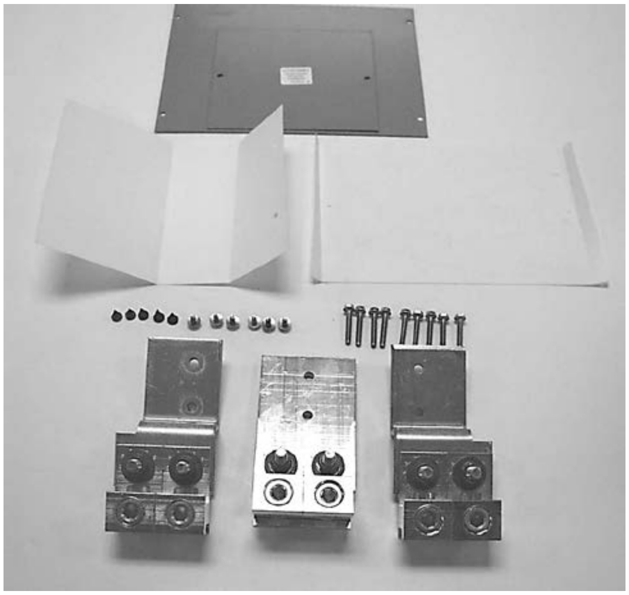
KL23AMS

KL21AVS

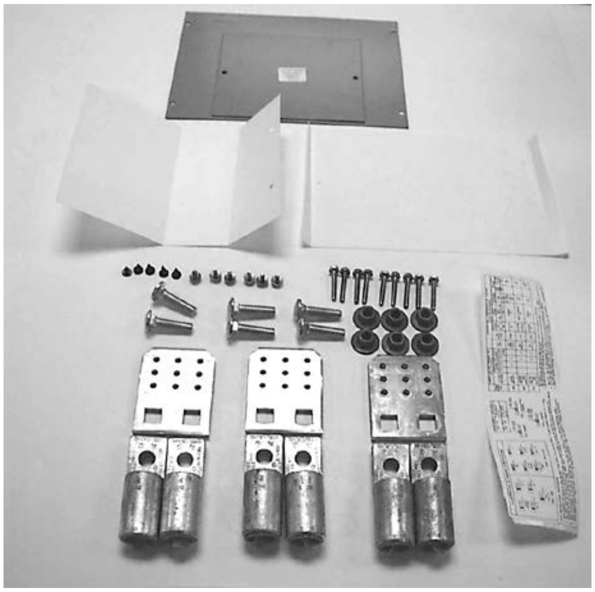
Table 6. 400 A lug assemblies

				Three-phase		Single-phase	
				Tin-plated aluminum connector	Silver-plated copper connector	Tin-plated aluminum connector	Silver-plated copper connector
Lug type	Panel lug options ①	Wire size range	Quantity per phase	Catalog number			
Aluminum/copper mechanical	STD	4/0–500 kcmil	2	**KL43AMS**	**KL43SMS**	**KL41AMS**	**KL41SMS**
	SFL	—	—	—	—	—	—
	OVS	3/0–750 kcmil	2	**KL43AMO**	**KL43SMO**	**KL41AMO**	**KL41SMO**
Crimp	STD	4/0–500 kcmil	2	**KL43AVS**	**KL43SVS**	**KL41AVS**	**KL41SVS**
	SFL	—	—	—	—	—	—
	OVS	500–750 kcmil	2	**KL43AVO**	**KL43SVO**	**KL41AVO**	**KL41SVO**
Copper mechanical	STD	1/0–600 kcmil	1	—	—	—	—
	SFL	—	—	—	—	—	—
	OVS	1/0–600 kcmil	1	—	**KL43SCO**	—	**KL41SCO**

① STD = Standard lugs. Use for main or through-feed.
SFL = Sub-feed lugs.
OVS = Oversize lugs. Use for main or through-feed.



KL43AMS



KL43AVS

Table 7. 600 A lug assemblies

				Three-phase connectors				Single-phase connectors			
				Tin-plated aluminum	Bare copper	Silver-plated copper	Tin-plated copper	Tin-plated aluminum	Bare copper	Silver-plated copper	Tin-plated copper
Lug type	Panel lug options ①	Wire size range	Quantity per phase	Catalog number							
Aluminum/ copper mechanical	STD	4/0–500 kcmil	2	—	**KL63CMS**	**KL63SMS**	**KL63TMS**	—	**KL61CMS**	**KL61SMS**	**KL61TMS**
	SFL	—	—	—	—	—	—	—	—	—	—
	OVS	3/0–750 kcmil	2	—	**KL63CMO**	**KL63SMO**	**KL63TMO**	—	**KL61CMO**	**KL61SMO**	**KL61TMO**
Crimp	STD	4/0–500 kcmil	2	—	**KL63CVS**	**KL63SVS**	**KL63TVS**	—	**KL61CVS**	**KL61SVS**	**KL61TVS**
	SFL	—	—	—	—	—	—	—	—	—	—
	OVS	500–750 kcmil	2	—	**KL63CVO**	**KL63SVO**	**KL63TVO**	—	**KL61CVO**	**KL61SVO**	**KL61TVO**
Copper mechanical	STD	1/0–600 kcmil	1	—	—	—	—	—	—	—	—
	SFL	—	—	—	—	—	—	—	—	—	—
	OVS	1/0–600 kcmil	1	—	—	—	—	—	—	—	—

① STD = Standard lugs. Use for main or through-feed.
SFL = Sub-feed lugs.
OVS = Oversize lugs. Use for main or through-feed.

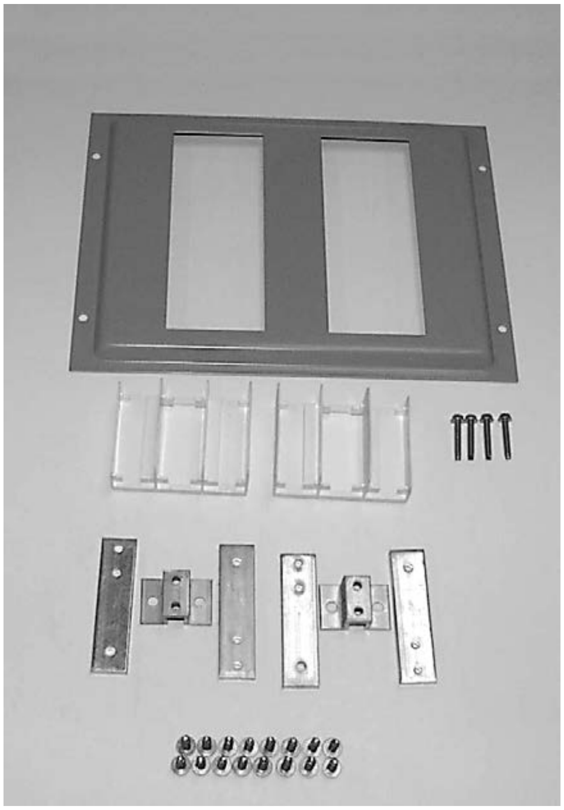
PRL1X, PRL1a horizontally mounted connector kit assemblies

Table 8. Bolt-on QUICKLAG® breaker assemblies

Breaker frame	Drawing number ①	Branch circuit quantity	Three-phase Tin-plated aluminum connector Item number	Three-phase Silver-plated copper connector	Single-phase Tin-plated aluminum connector	Single-phase Silver-plated copper connector
BA, BAB, QBH, QBGF, QBHGF, QBGFEP, QBHGFEP	1C96608	12	G01	G03	G05	G07
		18	G09	G11	G13	G15
		30	G17	G19	G21	G23
		42	G25	G27	G29	G31
		48	G33	G35	G37	G39
		54	G41	G43	G45	G47
		72	G49	G51	G53	G55
		96	G57	G59	G61	G63

① Order the basic drawing number, along with the equivalent G–number that's needed.

Note: When determining branch circuit quantity, remember:
1. QUICKLAG breakers with shunt trips require one additional circuit.
2. UL® listed lighting and appliance (CTL) panelboards **cannot** exceed 42 electrically connected circuits in a single enclosure.
3. When bare copper is specified, use the silver-plated groups.
4. **Order breakers separately with connector kit.**



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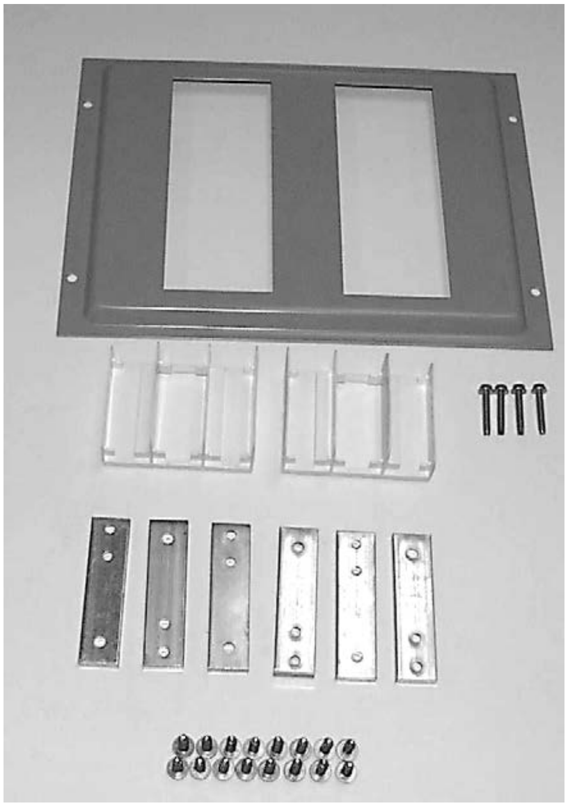


1C96608G05

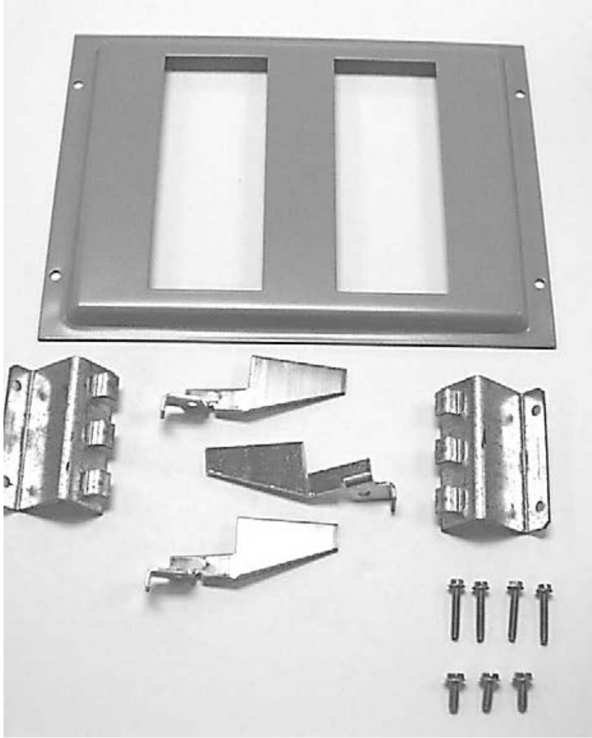
Table 9. Plug-in QUICKLAG breaker assemblies

Breaker frame	Drawing number ①	Branch circuit quantity	Three-phase Tin-plated aluminum connector Item number	Three-phase Silver-plated copper connector	Single-phase Tin-plated aluminum connector	Single-phase Silver-plated copper connector
HQP, QPHW, QHPX, QPGF, QPHGF, QPGFEP, QPHGFEP	2C11642	12	—	G03	—	G07
		18	—	G11	—	G15
		30	—	G19	—	G23
		42	—	G27	—	G31
		48	—	G35	—	G39
		54	—	G43	—	G47
		72	—	G51	—	G55
		96	—	G59	—	G63

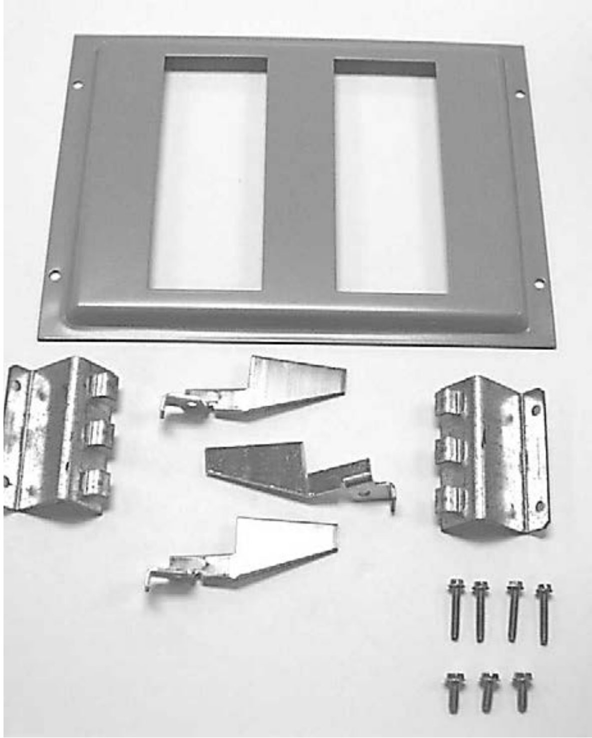
① Order the basic drawing number, along with the equivalent G–number that's needed.

Note: When determining branch circuit quantity, remember:

1. QUICKLAG breakers with shunt trips require one additional circuit.
2. UL listed lighting and appliance (CTL) panelboards **cannot** exceed 42 electrically connected circuits in a single enclosure.
3. When aluminum is specified, use the silver-plated groups.
4. The sum of the horizontally twin-mounted breakers **shall not exceed 140 A**.
5. **Order breakers separately with connector kit.**



2C11642G03



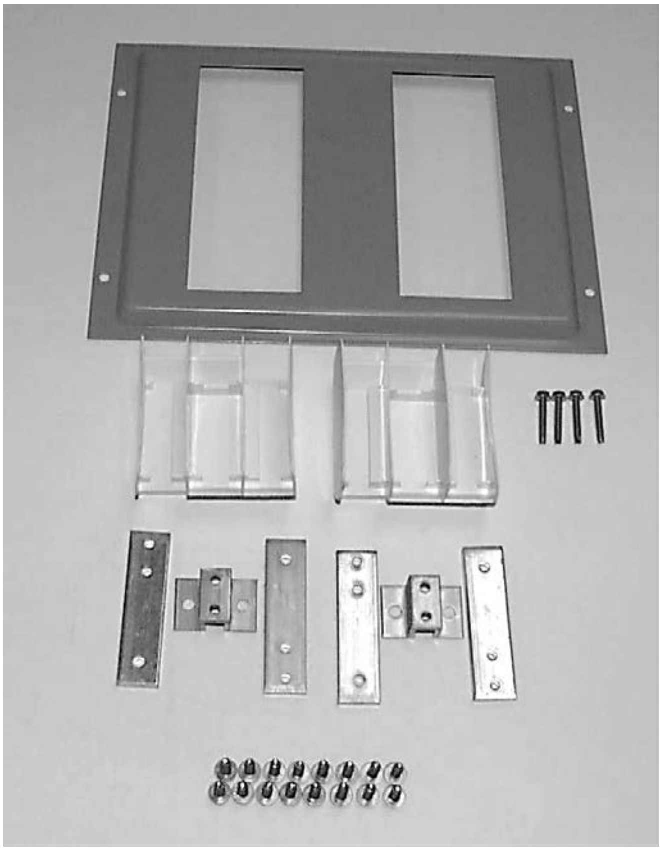
2C11642G07

Table 10. GB, GHB, GHQ, GHBS breaker assemblies

			Three-phase		Single-phase	
			Tin-plated aluminum connector	Silver-plated copper connector	Tin-plated aluminum connector	Silver-plated copper connector
Breaker frame	Drawing number ①	Branch circuit quantity	Item number			
GB, GHB, GHQ, GHBS	1C96609	12	G01	G03	G05	G07
		18	G09	G11	G13	G15
		30	G17	G19	G21	G23
		42	G25	G27	G29	G31
		48	G33	G35	G37	G39
		54	G41	G43	G45	G47
		72	G49	G51	G53	G55
		96	G57	G59	G61	G63

① Order the basic drawing number, along with the equivalent G–number that's needed.

Note: When determining branch circuit quantity, remember:
1. QUICKLAG breakers with shunt trips require one additional circuit.
2. UL listed lighting and appliance (CTL) panelboards **cannot** exceed 42 electrically connected circuits in a single enclosure.
3. When bare copper is specified, use the silver-plated groups.
4. **Order breakers separately with connector kit.**



1C96609G01

PRL1X, PRL2X, PRL1a, PRL2a neutral assemblies

Table 11. 100 A neutral assemblies ①

Panel main bus ampere rating	Neutral rating	Lug type	Drawing number ②	Panel lug options ③	Wire size range	Quantity	Tin-plated aluminum connector	Silver-plated copper connector
							Item number	
100	100%	Mechanical	1C96646	STD	#14–1/0	1	G02	G03
				SFL/TFL	#14–1/0	2	G05	G07
				OVS	#6–300 kcmil	1	G09	G11
		Crimp	42C4050	STD	#1–1/0	1	G01	G03
				SFL/TFL	#1–1/0	2	G05	G07
				OVS	2/0–300 kcmil	1	G09	G11
		Copper	1C96648	STD	#14–1/0	1	—	G03
				SFL/TFL	#14–1/0	2	—	G07
				OVS	#6–250 kcmil	1	—	G11
	200%	Mechanical	1C96649	STD	#6–300 kcmil	1	G02	G03
				SFL/TFL	#6–300 kcmil	2	G06	G07
				OVS	4/0–500 kcmil	1	G09	G11
		Crimp	42C4051	STD	2/0–300 kcmil	1	G01	G03
				SFL/TFL	2/0–300 kcmil	2	G05	G07
				OVS	4/0–500 kcmil	1	G09	G11
		Copper	1C96651	STD	#6–250 kcmil	1	—	G03
				SFL/TFL	#6–250 kcmil	2	—	G07
				OVS	1/0–600 kcmil	1	—	G11

① The assemblies shown on this page are for panelboards that mount in 30.00–90.00-inch (762.0–2286.0 mm) high enclosures only. Reference **page 14** for assemblies for panelboards that mount in 21.00–27.00-inch (533.4–685.8 mm) high enclosures.

② Order the basic drawing number, along with the equivalent G–number that's needed.

③ STD = Standard lugs.
SFL/TFL = Sub-feed and through-feed lugs.
OVS = Oversize lugs.

1C96646G01

Table 12. 225 A neutral assemblies ①

Panel main bus ampere rating	Neutral rating	Lug type	Drawing number ②	Panel lug options ③	Wire size range	Quantity	Tin-plated aluminum connector Item number	Silver-plated copper connector
225	100%	Mechanical	1C96649	STD	#6–300 kcmil	1	G02	G03
				SFL/TFL	#6–300 kcmil	2	G06	G07
				OVS	4/0–500 kcmil	1	G09	G11
		Crimp	42C4051	STD	2/0–300 kcmil	1	G01	G03
				SFL/TFL	2/0–300 kcmil	2	G05	G07
				OVS	4/0–500 kcmil	1	G09	G11
		Copper	1C96651	STD	#6–250 kcmil	1	—	G03
				SFL/TFL	#6–250 kcmil	2	—	G07
				OVS	1/0–600 kcmil	1	—	G11
	200%	Mechanical	1C96652	STD	4/0–500 kcmil	2	G01	G03
				SFL/TFL	—	—	G05	G07
				OVS	3/0–750 kcmil	2	G09	G11
		Crimp	42C4052	STD	4/0–500 kcmil	2	G01	G03
				SFL/TFL	—	—	G05	G07
				OVS	500–750 kcmil	2	G09	G11
		Copper	1C96654	STD	1/0–600 kcmil	1	—	G03
				SFL/TFL	—	—	—	G07
				OVS	1/0–600 kcmil	1	—	G11

① The assemblies shown on this page are for panelboards that mount in 30.00–90.00-inch (762.0–2286.0 mm) high enclosures.

② Order the basic drawing number, along with the equivalent G–number that's needed.

③ STD = Standard lugs.
SFL/TFL = Sub-feed and through-feed lugs.
OVS = Oversize lugs.

1C96649G01

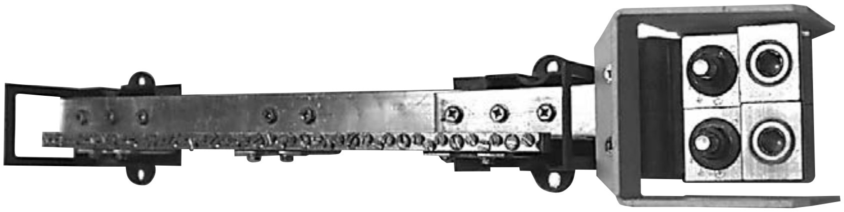
Table 13. 400 A neutral assemblies ①

Panel main bus ampere rating	Neutral rating	Lug type	Drawing number ②	Panel lug options ③	Wire size range	Quantity	Tin-plated aluminum connector	Silver-plated copper connector
							Item number	
400	100%	Mechanical	1C96652	STD	4/0–500 kcmil	2	G01	G03
				SFL/TFL	—	—	G05	G07
				OVS	3/0–750 kcmil	2	G09	G11
		Crimp	42C4052	STD	4/0–500 kcmil	2	G01	G03
				SFL/TFL	—	—	G05	G07
				OVS	500–750 kcmil	2	G09	G11
		Copper	1C96654	STD	1/0–600 kcmil	1	—	G03
				SFL/TFL	—	—	—	G07
				OVS	1/0–600 kcmil	1	—	G11

① The assemblies shown on this page are for panelboards that mount in 30.00–90.00-inch (762.0–2286.0 mm) high enclosures.

② Order the basic drawing number, along with the equivalent G–number that's needed.

③ STD = Standard lugs.
SFL/TFL = Sub-feed and through-feed lugs.
OVS = Oversize lugs.



1C96652G01

Table 14. 600 A neutral assemblies ①

Panel main bus ampere rating	Neutral rating	Lug type	Drawing number ②	Circuit quantity	Panel lug options ③	Tin-plated aluminum connector	Bare copper	Silver-plated copper connector	Tin-plated copper connector
						Item number			
600	100%	Mechanical	1C96652	42 or less	STD	—	G02	G03	G04
					TFL	—	G06	G07	G08
					OVS	—	G10	G11	G12
					OVS W/ TFL	—	G26	G27	G28
		Anderson	—	42 or less	STD	—	—	—	—
					TFL	—	—	—	—
					OVS	—	—	—	—
		Burndy	42C4052	42 or less	STD	—	G02	G03	G04
					TFL	—	G06	G07	G08
					OVS	—	G10	G11	G12
		Copper	—	42 or less	STD	—	—	—	—
					TFL	—	—	—	—
					OVS	—	—	—	—
				Greater than 42	STD	—	—	—	—
					TFL	—	—	—	—
					OVS	—	—	—	—

① The assemblies shown on this page are for panelboards that mount in 30.00–90.00-inch (762.0–2286.0 mm) high enclosures.

② Order the basic drawing number, along with the equivalent G–number that's needed.

③ STD = Standard lugs.
SFL/TFL = Sub-feed and through-feed lugs.
OVS = Oversize lugs.

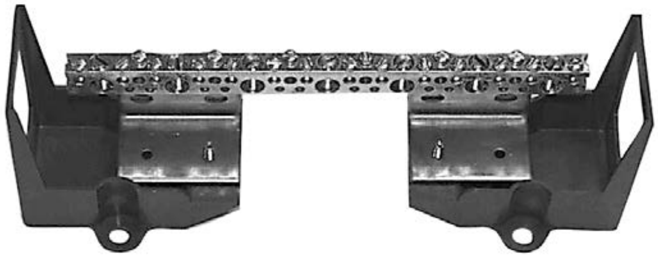
Table 15. 100 A neutral assemblies for 21.00–27.00-inch (533.4–685.8 mm) high enclosures only ①

Panel main bus ampere rating	Neutral rating	Lug type	Drawing number ②	Panel lug options ③	Wire size range	Quantity	Tin-plated aluminum connector	Silver-plated copper connector
							Item number	
100	100%	Mechanical	1C96645	STD	#14–1/0	1	G01	G03
				SFL/TFL	#14–1/0	2	G05	G07
				OVS	—	—	—	—
		Crimp	—	STD	—	—	—	—
				SFL/TFL	—	—	—	—
				OVS	—	—	—	—
		Copper	—	STD	—	—	—	—
				SFL/TFL	—	—	—	—
				OVS	—	—	—	—
	200%	Mechanical	1C97022	STD	#6–300 kcmil	1	G01	G03
				SFL/TFL	#6–300 kcmil	2	G05	G07
				OVS	—	—	—	—
		Crimp	—	STD	—	—	—	—
				SFL/TFL	—	—	—	—
				OVS	—	—	—	—
		Copper	—	STD	—	—	—	—
				SFL/TFL	—	—	—	—
				OVS	—	—	—	—

① The assemblies shown on this page are for panelboards that mount in 21.00–27.00-inch (533.4–685.8 mm) high enclosures only. Reference **page 11** for assemblies for panels that mount in 36.00, 48.00, 60.00, 72.00, and 90.00-inch (914.4, 1219.2, 1524.0, 1828.8, and 2286.0 mm) high enclosures.

② Order the basic drawing number, along with the equivalent G–number that's needed.

③ STD = Standard lugs.
SFL/TFL = Sub-feed and through-feed lugs.
OVS = Oversize lugs.



1C96645G01

PRL1X, PRL2X, PRL1a, PRL2a ground assemblies

Table 16. Standard ground

Drawing number ①	Enclosure height in inches (mm)	Bar material	Item number
5158C05	24.00 (609.6)	Aluminum/copper	G01
		Copper	G03
	36.00 (914.4), 48.00 (1219.2), 60.00 (1524.0), 72.00 (1828.8), 90.00 (2286.0)	Aluminum/copper	G02
		Copper	G04

① Order the basic drawing number, along with the equivalent G–number that's needed (example: 5158C05G01).

5158C05G01

5158C05G02

Table 17. Isolated ground

Drawing number ①	Enclosure height in inches (mm)	Bar material	Item number
2C11296	24.00 (609.6)	Aluminum/copper	G01
		Copper	G02
	36.00 (914.4), 48.00 (1219.2), 60.00 (1524.0), 72.00 (1828.8), 90.00 (2286.0)	Aluminum/copper	G03
		Copper	G04

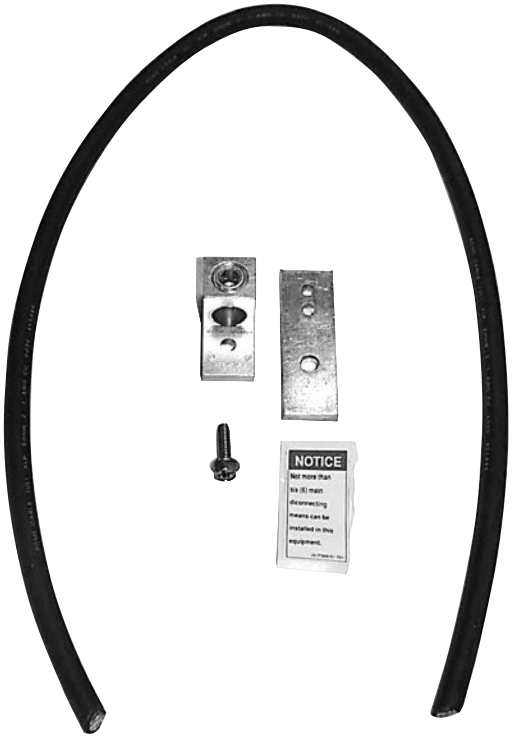
① Order the basic drawing number, along with the equivalent G–number that's needed (example: 5158C05G01).

PRL1X, PRL2X, PRL1a, PRL2a service entrance bonding jumper kits

Table 18. PRL1X, PRL2X, PRL1a, PRL2a service entrance bonding jumper kits

Drawing number ①	Panel ampere rating	Tin-plated aluminum	Bare copper	Silver-plated copper	Tin-plated copper
		Item number			
Mechanical main lugs or main breakers					
4180B62	100–225	G01	G02	G03	G04
4180B62	400–600	G05	G06	G07	G08
Compression (crimp) main lugs					
4180B62	100–225	G09	G10	G11	G12
4180B62	400–600	G13	G14	G15	G16
Copper main lugs					
4180B62	100–225	—	G18	G19	G20
4180B62	400–600	—	G22	G23	G24

① Order the basic drawing number, along with the equivalent G–number that's needed (example: 5158C05G01).



4180B62G01

PRL1X, PRL2X, PRL1a, PRL2a service entrance main breaker kits

Table 19. PRL1X, PRL2X service entrance main breaker kits

Description	Circuit breaker frame	Catalog number
Service entrance barrier for PD3	PD3	**PRLSEBLGKD**
Service entrance barrier for PD2	PD2	**PRLSEBFD**
Service entrance barrier for GHB	GHB	**PRLSEBGHB**

Table 20. PRL1a, PRL2a service entrance main breaker kits

Description	Circuit breaker frame	Catalog number
Service entrance barrier for LG and KD	LG/KD	**PRLSEBLGKD**
Service entrance barrier for JD	JD	**PRLSEBJD**
Service entrance barrier for FD	FD	**PRLSEBFD**
Service entrance barrier for GHB	GHB	**PRLSEBGHB**

SE barrier kit FD_016

PRL1X, PRL2X, PRL1a, PRL2a deadfront covers

Note: Does not apply to PRL4 sub-chassis.

Table 21. Assembly

Assembly drawing number ①	Standard enclosure height in inches (mm)						
	24.00 (609.6)	36.00 (914.4)	42.00 (1066.8)	48.00 (1219.2)	60.00 (1524.0)	72.00 (1828.8)	90.00 (2286.0)
1C96638	G01	G02	G07	G03	G04	G05	G06

① Order the basic drawing number, along with the equivalent G–number that's needed (example: 1C96638G01).

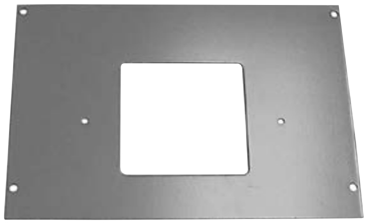
Table 22. PRL1X, PRL2X, PRL1a, PRL2a vertically mounted devices

Mounting arrangement	Device/frame	Drawing number ①	Mounting position	Item number
Vertical	100 A MLO, SFL, TFL or PD2 (100 A maximum)	42C8072	Top	H01
			Bottom	H02
	225 A MLO, SFL, TFL or PD2 (225 A maximum)	42C8073	Top	H01
			Bottom	H04
	400 A MLO, TFL or PD3	42C7982	Top	H01
			Bottom	H02
Blank covers in inches (mm)	1.00 (25.4)	4180B08	—	H01
	2.00 (50.8)		—	H02
	3.00 (76.2)		—	H03
	4.00 (101.6)		—	H04
	5.00 (127.0)		—	H05
	6.00 (152.4)		—	H06
	7.00 (177.8)		—	H07
	8.00 (203.2)		—	H08
	9.00 (228.6)		—	H09
	10.00 (254.0)		—	H10
	11.00 (279.4)		—	H11
	12.00 (304.8)		—	H12
	13.00 (330.2)		—	H13
	14.00 (355.6)		—	H14
	15.00 (381.0)		—	H15
	16.00 (406.4)		—	H16

① Order the basic drawing number, along with the equivalent H–number that's needed (example: 4180B03H01).

1C96638G01

4180B08H03



4180B03H01

Table 23. PRL1a, PRL2a vertically mounted devices

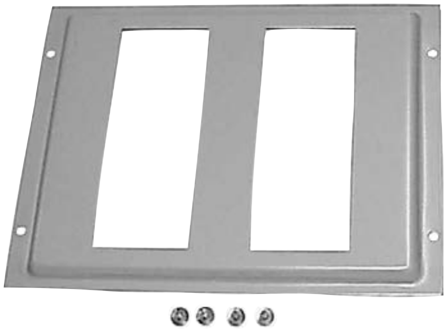
Mounting arrangement	Device/frame	Drawing number ①	Mounting position	Item number
Vertical	100 A MLO, SFL, TFL or F-Frame (100 A maximum)	42C8072	Top	H01
			Bottom	H02
	225 A MLO, SFL, TFL or F-Frame (225 A maximum)	42C8073	Top	H01
			Bottom	H04
	400 A MLO, SFL, TFL or J-Frame	4180B04	Top	H01
			Bottom	H02
	400 A MLO, TFL or K-Frame	4180B05	Top	H01
			Bottom	H02
Blank covers in inches (mm)	1.00 (25.4)	4180B08	—	H01
	2.00 (50.8)		—	H02
	3.00 (76.2)		—	H03
	4.00 (101.6)		—	H04
	5.00 (127.0)		—	H05
	6.00 (152.4)		—	H06
	7.00 (177.8)		—	H07
	8.00 (203.2)		—	H08
	9.00 (228.6)		—	H09
	10.00 (254.0)		—	H10
	11.00 (279.4)		—	H11
	12.00 (304.8)		—	H12
	13.00 (330.2)		—	H13
	14.00 (355.6)		—	H14
	15.00 (381.0)		—	H15
	16.00 (406.4)		—	H16

① Order the basic drawing number, along with the equivalent H–number that's needed (example: 4180B03H01).

Table 24. Horizontally mounted devices

Mounting arrangement	Device/frame	Drawing number ①	Branch circuit quantity	Item number	Quantity required
Horizontal	BA, BAB, QBH, QBGF, QBHGF, QBGFEP, QBHGFEP	1C96619	12	H01	1
			18	H02	1
			30	H04	1
			42	H06	1
			48	H03	2
			54	H03 and H04	1 each
			72	H05	2
			96	H07	2
	GB, GHB, GHQ, GHBS	1C96620	12	H01	1
			18	H02	1
			30	H04	1
			42	H06	1
			48	H03	2
			54	H03 and H04	1 each
			72	H05	2
			96	H07	2

① Order the basic drawing number, along with the equivalent H–number that's needed (example: 1C96619H01).



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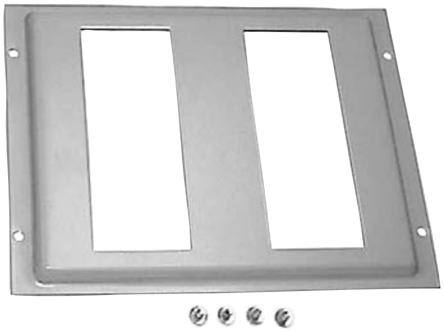


1C96620H01

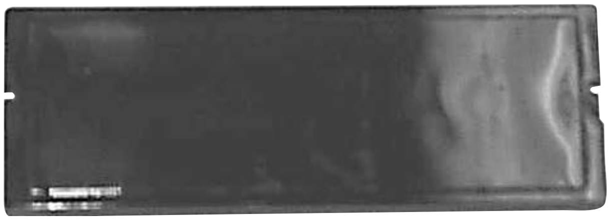
Table 25. Filler covers

Device/frame	Drawing number	Item number
F, J, K ①	4180B52	H01
QUICKLAG, GB, GHB ②	5155C62	H01

① Filler covers are required in addition to deadfront cover whenever MLO, SFL or TFL are specified.

② Filler covers are required in addition to deadfront cover whenever a branch provision is specified.

5155C62H01



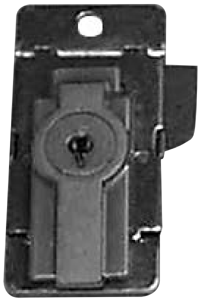
4180B52H01

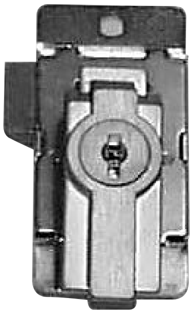
Panelboard special trim locks

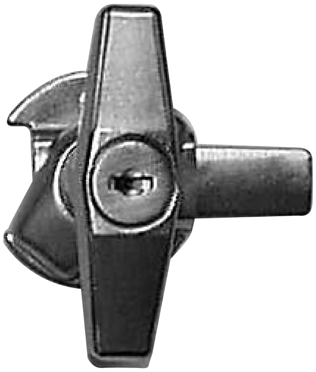
Panelboard trims use different trim locks. See pictures below for styles and part numbers. Contact your nearest satellite for availability on the styles listed below. See **page 3** for satellite listings.

Table 26. Panelboard special trim locks

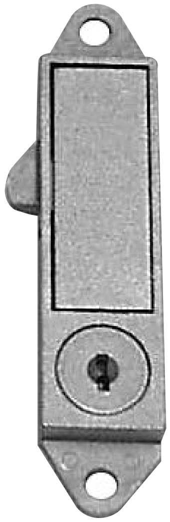
Description	Catalog number
For use on left-handed door (hinged on left side)	**K80522**
For use on right-handed door (hinged on right side)	**K80133**
T–Handle lock, at one time used on all trims over 48.00 inches (1219.2 mm) in height, also used on outdoor NEMA® 12/3R trims	**K80429**
Used on PRL4X and PRL4 lighting and power panels as standard	**1A32258H03**
Used on PRL1X, 2X, 3X, PRL1, 2, 3 and PRL1a, 2a, 3a lighting panels as standard; WEM 2 key	**5155C81G01**


K80522


K80133


K80429


5155C81G01


1A32258H03

Panelboard EZ Trim locks

Panelboard EZ Trim™ uses different trim locks. See **Table 27** and pictures below for styles and part numbers. Contact your nearest satellite for availability. See **page 3** for satellite listings.

Table 27. Panelboard EZ Trim locks

Description	**Size**	**Catalog number**
Lock	24–48 inches	**5155C81G03**
Lock and latch	54–60 inches	**5155C81G03/5155C81G05**
Lock and latch	72–90 inches	**5155C81G04/5155C81G06**

EZ Trim lock with key

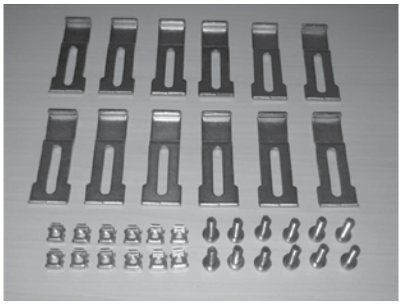
EZ Trim latch without key

Panelboard Fastrim clamps and screw-on hardware kits

For panelboard trim clamps, contact your nearest satellite for availability on the styles listed below. See **page 3** for satellite listings.

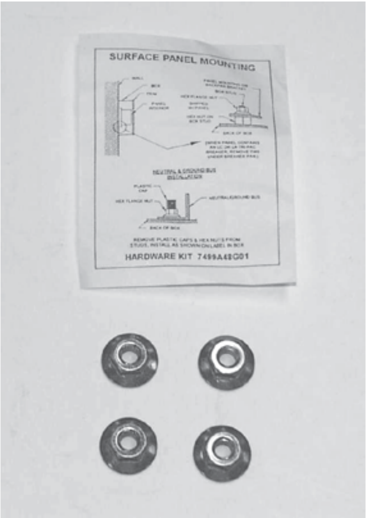
Table 28. Panelboard Fastrim clamps and screw-on hardware kits

Description	**Style number**
Trim clamps—used on PRL1X, PRL2X, PRL3X, PRL1a, PRL2a, PRL3a Fastrims (6 per bag)	**2C11641G02**
Trim screws—used on PRL1X, PRL2X, PRL3X, PRL1a, PRL2a, PRL3a, PRL4B standard trim (10 per bag)	**5157C83G06**
Chassis mounting hardware bag—PRL1X, PRL2X, PRL3X, PRL1a, PRL2a, PRL3a panels	**7499A48G04**



2C11641G02

5157C83G06



7499A48G04

PRL3X, PRL3a parts section

Description **Page**

PRL3X, PRL3a horizontally mounted connector kit assemblies

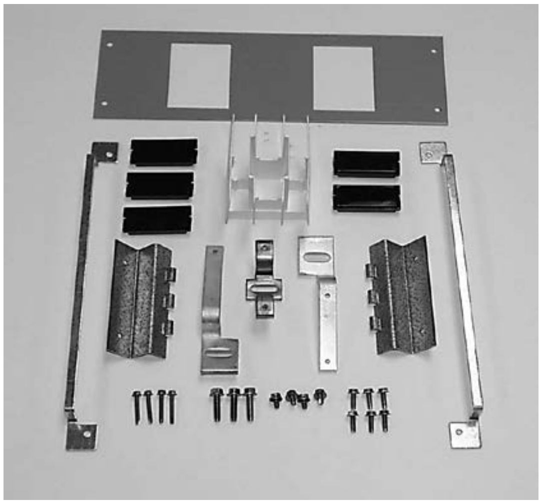
Three-phase kits contain A, B, and C phase connectors. Single-phase kits contain A and C phase connectors, deadfront cover, hardware and instructions to twin-mount breakers across from each other. **Maximum amperes connected to any one connector cannot exceed 200 A.**

Table 29. PRL3X horizontally mounted connector kit assemblies

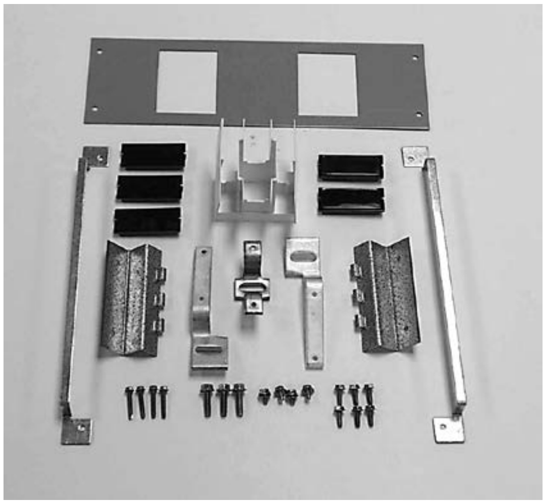
Devices	Circuits or poles	Three-phase Catalog number	Three-phase Phase	Single-phase Catalog number	Single-phase Phase	Notes
BA, BAB, QBGF, QBH, QBHGF, QBGFEP, QBHGFEP	6	**KPRL3XBA06**	A/B/C	**KPRL3XBA06-1**	A/C	(2) 100 A devices maximum
	12	**KPRL3XBA12**	A/B/C	**KPRL3XBA12-1**	A/C	
	18	**KPRL3XBA18**	A/B/C	**KPRL3XBA18-1**	A/C	
	24	**KPRL3XBA24**	A/B/C	**KPRL3XBA24-1**	A/C	
GB, GHB, GHQ, GHBS	6	**KPRL3XGB06**	A/B/C	**KPRL3XGB06-1**	A/C	
	12	**KPRL3XGB12**	A/B/C	**KPRL3XGB12-1**	A/C	
	18	**KPRL3XGB18**	A/B/C	**KPRL3XGB18-1**	A/C	
	24	**KPRL3XGB24**	A/B/C	**KPRL3XGB24-1**	A/C	

Table 30. PRL3a horizontally mounted connector kit assemblies

Devices	Circuits or poles	Three-phase Catalog number	Three-phase Phase	Single-phase Catalog number	Single-phase Phase	Notes
BA, BAB, QBGF, QBH, QBHGF, QBGFEP, QBHGFEP	6	**KPRL3ABA06**	A/B/C	**KPRL3ABA06-1**	A/C	(2) 100 A devices maximum
	12	**KPRL3ABA12**	A/B/C	**KPRL3ABA12-1**	A/C	
	18	**KPRL3ABA18**	A/B/C	**KPRL3ABA18-1**	A/C	
	24	**KPRL3ABA24**	A/B/C	**KPRL3ABA24-1**	A/C	
GB, GHB, GHQ, GHBS	6	**KPRL3AGB06**	A/B/C	**KPRL3AGB06-1**	A/C	
	12	**KPRL3AGB12**	A/B/C	**KPRL3AGB12-1**	A/C	
	18	**KPRL3AGB18**	A/B/C	**KPRL3AGB18-1**	A/C	
	24	**KPRL3AGB24**	A/B/C	**KPRL3XGB24-1**	A/C	



KPRL3ABA06



KPRL3AGB06

PRL3X, PRL3a, PD2, F-Frame horizontally mounted connector kit assemblies

Connector kits contain phase connectors, deadfront cover, hardware, and instructions to mount breakers.
Order breakers separately when ordering connector kit.

Table 31. PRL3X, PD2 Frame horizontally mounted connector kit assemblies

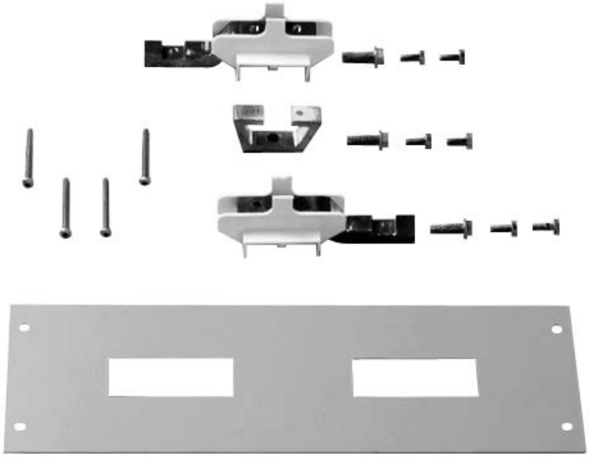
		Three-phase		Single-phase		
Devices	**Circuits or poles**	**Catalog number**	**Phase**	**Catalog number**	**Phase**	**Notes**
PD2 (175–225 A single mount) ①	Three-pole breaker	**KPRL3X23**	A/B/C	—	—	(1) 225 A maximum single mounted
	Two-pole breaker	**KPRL3X22**	A/C	**KPRL3X22**	A/C	
PD2 (150 A maximum twin mount)	Three-pole breaker	**KPRL3X23T**	A/B/C	—	—	(2) 150 A devices maximum
	Two-pole breaker	**KPRL3X22T**	A/C	**KPRL3X22T**	A/C	
	Single-pole breaker	**KPRL3X21T**	A/C	**KPRL3X21T**	A/C	

① PD2 Frame devices rated above 150 A must be single mounted. No twin mounting acceptable.

Table 32. PRL3a F-Frame horizontally mounted connector kit assemblies

		Three-phase		Single-phase		
Devices	**Circuits or poles**	**Catalog number**	**Phase**	**Catalog number**	**Phase**	**Notes**
EHD, FD, FDB, HFD, FDC (150 A maximum twin mount)	Three-pole breaker	**KPRL3AFD3**	A/B/C	—	—	(2) 150 A devices maximum
	Two-pole breaker	**KPRL3AFD2**	A/C	**KPRL3AFD2**	A/C	
	Single-pole breaker	**KPRL3AFD1**	A/C	**KPRL3AFD1**	A/C	
FD, HFD, FDC, ED, EDH, EDC (175–225 A single mount) ①	Three-pole breaker	**KPRL3AED3**	A/B/C	—	—	(1) 225 A maximum single mounted
	Two-pole breaker	**KPRL3AED2**	A/C	**KPRL3AED2**	A/C	

① PD2 Frame devices rated above 150 A must be single mounted. No twin mounting acceptable.

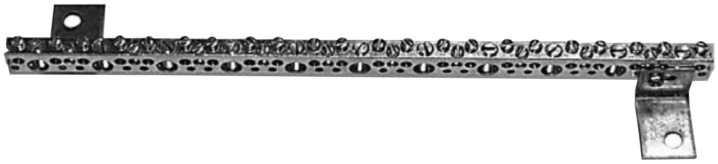


KPRL3AFD3

PRL3X, PRL3a ground assemblies

Table 33. PRL3X, PRL3a ground assemblies

	Standard	Isolated
Material	**Catalog number**	
Aluminum/copper	**5158C05G02**	**2C11296G02**
Copper only	**5158C05G04**	**2C11296G04**



5158C05G02

PRL3X, PRL3a service entrance bonding jumper kits

Table 34. PRL3X, PRL3a service entrance bonding jumper kits

		Tin-plated aluminum	Bare copper	Silver-plated copper	Tin-plated copper
Style number ①	**Panel ampere rating**	**Item number**			
Mechanical main lugs or main breakers					
5078A98	100	G01	G02	G03	G04
	250–600	G13	G14	G15	G16
Crimp main lugs					
5078A98	100	G05	G06	G07	G08
	250–600	G17	G18	G19	G20
Copper main lugs					
5078A98	100	G09	G10	G11	G12
	250–600	G21	G22	G23	G24

① When ordering, use complete style number (example: 100 A tin-plated aluminum 5078A98G01).

5078A98G01

PRL3X, PRL3a service entrance main breaker kits

Table 35. PRL3X service entrance main breaker kits

Description	Circuit breaker frame	Catalog number
Service entrance barrier for PD3	PD3	**PRLSEBPD3**
Service entrance barrier for PD2	PD2	**PRLSEBPD2**
Service entrance barrier for GHB	GHB	**PRLSEBGHB**

Table 36. PRL3a service entrance main breaker kits

Description	Circuit breaker frame	Catalog number
Service entrance barrier for LG and KD	LG/KD	**PRLSEBLGKD**
Service entrance barrier for JD	JD	**PRLSEBJD**
Service entrance barrier for FD	FD	**PRLSEBFD**
Service entrance barrier for GHB	GHB	**PRLSEBGHB**

SE Barrier Kit FD_016

PRL3X, PRL3a deadfront covers

Table 37. Assembly ①

	Chassis height/item number				
Style number ②	**14X**	**23X**	**31X**	**40X**	**53X**
6559C59	G01	G02	G03	G04	G05

① Assembly groups include the frame only (two rails and two end covers). Reference **page 29** for specific device covers. All connector kits ship with a deadfront cover for that device.

② When ordering, use complete style number (example: 14X high assembly 6559C59G01).

6559C59G01

PRL3X, PRL3a vertical devices deadfront covers

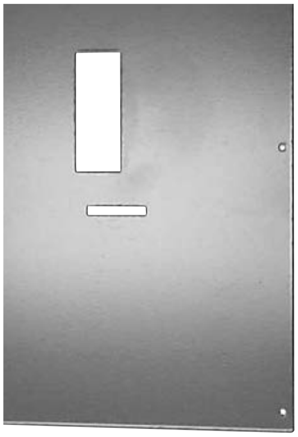
Table 38. PRL3X vertical devices deadfront covers

Device/frame	Trip unit type	Style number ①	"X" space required	Item number Without lock-offs ①	Item number With lock-offs ①
PD2 (top) ②	—	**42C8076**	7X	H01	H01
PD2 (bottom) ②	—	**42C8076**	7X	H02	H02
PD2 (top) ③	—	**42C8077**	10X	H01	H01
PD2 (bottom) ③	—	**42C8077**	10X	H02	H02
PD3 400 A (top)	Thermal-magnetic	**42C7980**	15X	H01	H01
PD3 400 A (bottom)	PXR	**42C7980**	15X	H02	H02
PD3 600 A (top)	Thermal-magnetic	**42C8055**	18X	H01	N/A
PD3 600 A (bottom)	PXR	**42C8055**	18X	H02	N/A
Neutral/blank cover	—	**4176B72**	1X	H01	—
			2X	H02	—
			3X	H03	—
			4X	H04	—
			5X	H05	—
			6X	H06	—
			7X	H07	—
			8X	H08	—
			9X	H09	—
			10X	H10	—
			11X	H11	—
			12X	H12	—

① When ordering covers, order complete style and item numbers (example: 4176B68H01).

② 4/0 maximum acceptable terminal size.

③ 300 kcmil maximum acceptable terminal size.



J main 4176B60H04

Neutral blank cover 4176B72H04

Table 39. PRL3a vertical devices deadfront covers

Device/frame	Trip unit type	Style number ①	"X" space required	Item number Without lock-offs ①	Item number With lock-offs ①
EHD, FD, FDB, HFD, FDC, ED, EDH, EDC (top) ②	—	**42C8076**	7X	H01	H01
EHD, FD, FDB, HFD, FDC, ED, EDH, EDC (bottom) ②	—	**42C8076**	7X	H02	H02
FD, HFD, FDC, ED, EDH (top) ③	—	**42C8077**	10X	H01	H01
FD, HFD, FDC, ED, EDH (bottom) ③	—	**42C8077**	10X	H02	H02
J-Frame (bottom)	—	**4176B60**	14X	H01	H02
J-Frame (top)	—	**4176B60**	14X	H03	H04
K-Frame (bottom)	Thermal-magnetic	**4176B61**	15X	H01	H02
K-Frame (bottom)	Electronic	**4176B61**	15X	H03	H04
K-Frame (top)	Thermal-magnetic	**4176B61**	15X	H05	H06
K-Frame (top)	Electronic	**4176B61**	15X	H07	H08
L-Frame (bottom)	Thermal-magnetic	**4176B51**	17X	H01	H02
L-Frame (bottom)	Electronic	**4176B51**	17X	H03	H04
L-Frame (top)	Thermal-magnetic	**4176B51**	17X	H05	H06
L-Frame (top)	Electronic	**4176B51**	17X	H07	H08
FB-P (top only)	—	**4176B70**	9X	H02	H02
LA-P (top only)	—	**4176B57**	21X	H01	H01
FCL	—	**4176B70**	9X	H01	H01
LCL (top)	—	**4176B56**	21X	H01	H02
LCL (bottom)	—	**4176B56**	21X	H03	H04
Neutral/blank cover	—	**4176B72**	1X	H01	—
	—	**4176B72**	2X	H02	—
	—	**4176B72**	3X	H03	—
	—	**4176B72**	4X	H04	—
	—	**4176B72**	5X	H05	—
	—	**4176B72**	6X	H06	—
	—	**4176B72**	7X	H07	—
	—	**4176B72**	8X	H08	—
	—	**4176B72**	9X	H09	—
	—	**4176B72**	10X	H10	—
	—	**4176B72**	11X	H11	—
	—	**4176B72**	12X	H12	—
J-Frame sub-feed twin bottom	—	**4176B79**	20X	H01	H02 (2 L/O)
	—	**4176B79**	20X	H01	H03 (1 L/O RT)
	—	**4176B79**	20X	H01	H04 (1 L/O LT)
J-Frame sub-feed twin top	—	**4176B79**	20X	H05	H05 (2 L/O)
	—	**4176B79**	20X	H05	H07 (1 L/O RT)
	—	**4176B79**	20X	H05	H08 (1 L/O LT)
Bolt switch					
PT363 (switch, pullout, 100 A maximum) (top)	—	**4180B79**	7X	H01	—
PT363 (switch, pullout, 100 A maximum) (bottom)	—	**4180B79**	7X	H02	—
PT364 (switch, pullout, 200 A maximum) (top)	—	**4180B79**	9X	H03	—
PT364 (switch, pullout, 200 A maximum) (bottom)	—	**4180B79**	9X	H04	—

① When ordering covers, order complete style and item numbers (example: 4176B68H01).

② 4/0 maximum acceptable terminal size.

③ 300 kcmil maximum acceptable terminal size.

PRL3X, PRL3a horizontal devices deadfront covers

Table 40. PRL3X horizontal mounting position

Device/frame	Device poles	Style number ①	Total circuit quantity	"X" space required	Item number
PD2 (twin mounted)	1, 2 or 3	**42C8078**	6	3X	H01
			12	6X	H02
			18	9X	H03
			24	12X	H04
			30	15X	H05
			36	18X	H06
			42	21X	H07
			48	24X	H08
PD2 (twin mounted)	1 or 2	**42C8079**	4	2X	H01
			8	4X	H02
			12	6X	H03
			16	8X	H04
			20	10X	H05
			24	12X	H06
			28	14X	H07
			32	16X	H08
PD2 (twin mounted)	1	**42C8080**	2	1X	H01
PD2 (single mounted)	2	**42C8081**	2	2X	H01
PD2 (single mounted)	3	**42C8082**	3	3X	H01
BA, BAB, BABRP, BABRSP, QBH, QBGF, QBGFEP, QBHGFEP	1, 2 or 3	**4176B67**	6	3X	H01
			12	5x	H02
			18	8x	H03
			24	10x	H04
GB, GHB, GHBS, GHBGFEP, HGHB, GHQ	1, 2 or 3	**4176B69**	6	3X	H01
			12	5x	H02
			18	8X	H03
			24	10X	H04
Pow-R-Command Controller	—	**4180B91**	—	5X	H01
Pow-R-Command Expansion	—	**4180B91**	—	7X	H02
			—	16X	H03

① When ordering covers, order complete style and item number (example: 4178B08H01).

Table 41. PRL3a horizontal mounting position

Device/frame	Device poles	Style number ①	Total circuit quantity	"X" space required	Item number
EHD, FD, FDB, HFD, FDC (twin mounted)	1, 2 or 3	**42C8078**	6	3X	H01
			12	6X	H02
			18	9X	H03
			24	12X	H04
			30	15X	H05
			36	18X	H06
			42	21X	H07
			48	24X	H08
EHD, FD, FDB, HFD, FDC (twin mounted)	1 or 2	**42C8079**	4	2X	H01
			8	4X	H02
			12	6X	H03
			16	8X	H04
			20	10X	H05
			24	12X	H06
			28	14X	H07
			32	16X	H08
EHD, FD, FDB, HFD, FDC (twin mounted)	1	**42C8080**	2	1X	H01
FD, HFD, FDC, ED, EDH, EDC (single mounted)	2	**42C8081**	2	2X	H01
FD, HFD, FDC, ED, EDH, EDC (single mounted)	3	**42C8082**	3	3X	H01
CA, CAH, HCA	3	**4176B66**	3	3X	H01
CA, CAH, HCA	2	**4176B80**	2	2X	H01
BA, BAB, BABRP, BABRSP, QBH, QBGF, QBGFEP, QBHGFEP	1, 2 or 3	**4176B67**	6	3X	H01
			12	5X	H02
			18	8X	H03
			24	10X	H04
GB, GHB, GHBS, GHBGFEP, HGHB, GHQ	1, 2 or 3	**4176B69**	6	3X	H01
			12	5X	H02
			18	8X	H03
			24	10X	H04
Pow-R-Command Controller	—	**4180B91**	—	5X	H01
Pow-R-Command Expansion	—	**4180B91**	—	7X	H02
				16X	H03

① When ordering covers, order complete style and item number (example: 4178B08H01).

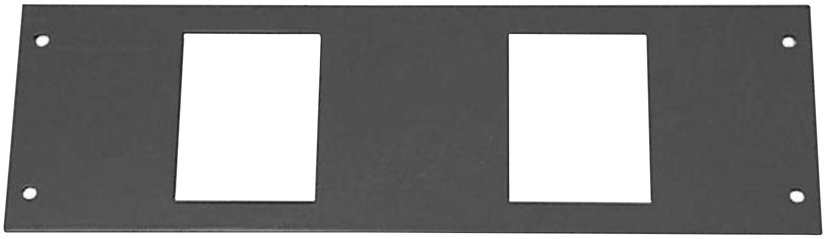
PRL3X, PRL3a deadfront cover blank fillers

Table 42. PRL3X deadfront cover blank fillers

Device/frame	Poles	Style number
PD2	1, 2 or 3	**42C8083H01**
QUICKLAG, GB, GHB, GHBS	1, 2 or 3	**5155C62H01**

Table 43. PRL3a deadfront cover blank fillers

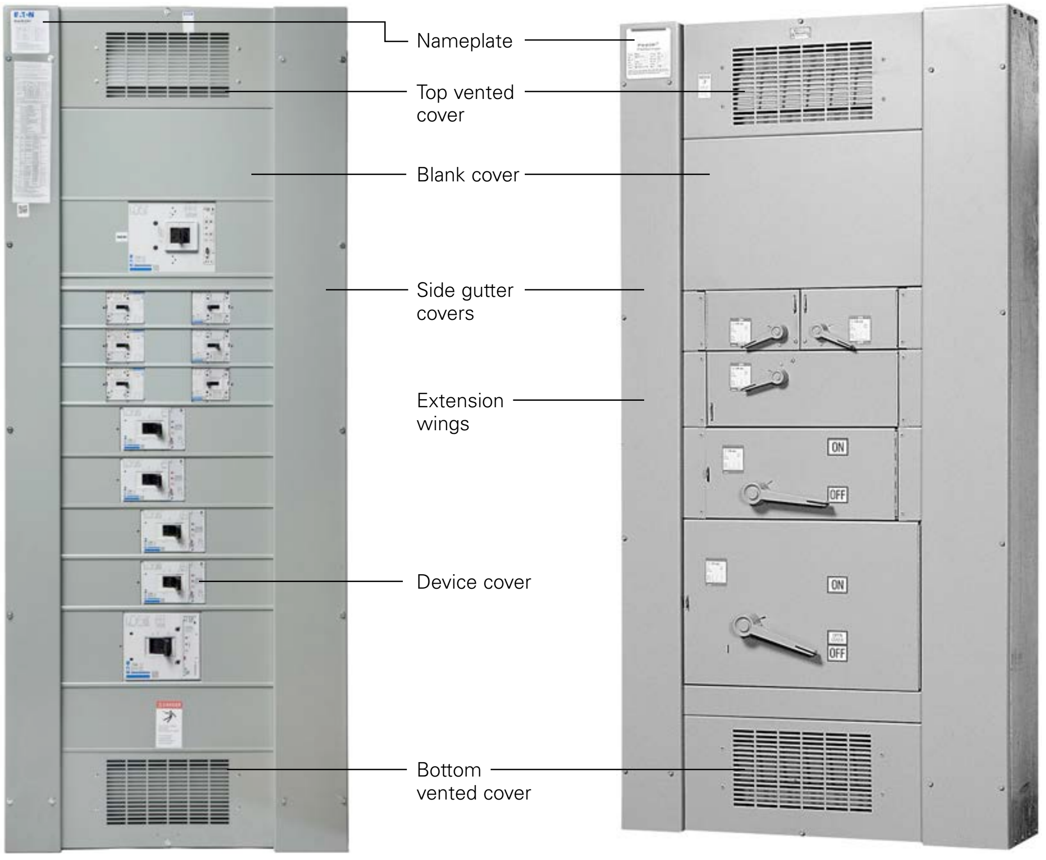
Device/frame	Poles	Style number
F-Frame	1, 2 or 3	**42C8083H01**
C-Frame	2	**6555C40H01**
C-Frame	3	**6555C41H01**
QUICKLAG, GB, GHB, GHBS	1, 2 or 3	**5155C62H01**



BAB Cover 4176B67H01

PRL4X, PRL4 parts section

PRL4 vented cover assemblies



PRL4X

PRL4F

Table 44. Vented cover assemblies and side gutter covers—dimensions in inches (mm)

NEMA 1 box					Side gutter covers			
					Left		Right	
Height	Width	Depth ①	Catalog number	Vented cover assembly ② style number	Size	Style number	Size	Style number
57.00 (1447.8)	24.00 (609.6)	10.40 (264.2)	**BX2457**	**6574C74G02**	5.00 (127.0) x 57.00 (1447.8)	**6555C20H01**	5.00 (127.0) x 57.00 (1447.8)	**6555C20H01**
73.00 (1854.2)	24.00 (609.6)		**BX2473**	**6574C74G03**	5.00 (127.0) x 73.00 (1854.2)	**6555C21H01**	5.00 (127.0) x 73.00 (1854.2)	**6555C21H01**
90.00 (2286.0)	24.00 (609.6)		**BX2490**	**6574C74G04**	5.00 (127.0) x 90.00 (2286.0)	**6555C25H01**	5.00 (127.0) x 90.00 (2286.0)	**6555C25H01**
73.00 (1854.2)	36.00 (914.4)		**BX3673**	**6574C74G05**	6.00 (152.4) x 73.00 (1854.2)	**6555C22H01**	8.00 (203.2) x 73.00 (1854.2)	**6555C23H01**
90.00 (2286.0)	36.00 (914.4)		**BX3690**	**6574C74G06**	6.00 (152.4) x 90.00 (2286.0)	**6555C26H01**	8.00 (203.2) x 90.00 (2286.0)	**6555C27H01**
73.00 (1854.2)	44.00 (1117.6)		**BX4473**	**6574C74G05**	8.00 (203.2) x 73.00 (1854.2)	**6555C23H01**	14.00 (355.6) x 73.00 (1854.2)	**6555C24H01**
90.00 (2286.0)	44.00 (1117.6)		**BX4490**	**6574C74G06**	8.00 (203.2) x 90.00 (2286.0)	**6555C27H01**	14.00 (355.6) x 90.00 (2286.0)	**6555C28H01**

① Covers add 0.90 inches (22.9 mm) to box depth for overall enclosure depth of 11.30 inches (287.0 mm).

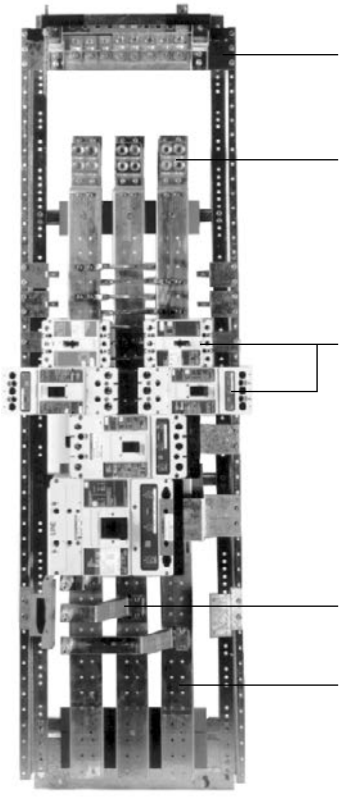
② Cover assembly consists of two side rails, top and bottom vented covers. **Important:** Order individual device covers and blanks separately.

PRL4 blank covers

Used to cover blank space on chassis. All PRL4X and PRL4 cover heights are measured in "X" units. 1X equals 1.38 inches (35.1 mm).

Table 45. PRL4 blank covers

Cover size	Style number 24.00-inch (609.6 mm) width box	36.00, 44.00-inch (914.4, 1117.6 mm) width box
1X	**6554C01H01**	**6554C02H01**
2X	**6554C01H02**	**6554C02H02**
3X	**6554C01H03**	**6554C02H03**
4X	**6554C01H13**	**6554C02H13**
5X	**6554C01H14**	**6554C02H14**
6X	**6554C01H04**	**6554C02H04**
7X	**6554C01H05**	**6554C02H05**
9X	**6554C01H06**	**6554C02H06**
10X	**6554C01H07**	**6554C02H07**
11X	**6554C01H08**	**6554C02H08**
12X	**6554C01H09**	**6554C02H09**
13X	**6554C01H10**	**6554C02H10**
15X	**6554C01H11**	**6554C02H11**
20X	**6554C01H12**	**6554C02H12**



PRL4B Interior

PRL4 breaker connector kits

Breaker connector kits

Each kit includes copper connectors, mounting brackets, covers, hardware, and instructions for mounting breaker(s) in a PRL4X and PRL4. **Breakers are not included.** Contact your local satellite plant for availability and application information (see **page 3**).

Connector kit

Each kit includes copper connectors mounting brackets, cover, hardware, and instructions.

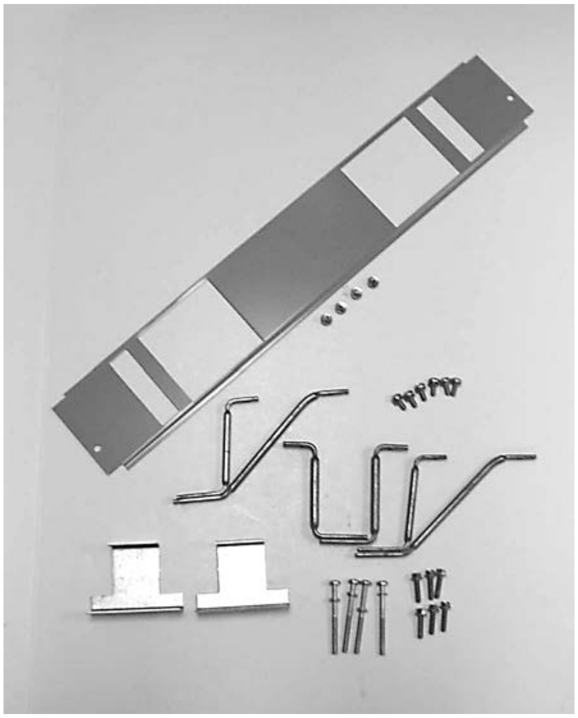
Table 46. PRL4 breaker connector kits

Breaker frame	Space required Inches (mm)	"X"	Number of poles	Mounting type	Connector kit catalog number
PD2	2.75 (69.9)	2X	1 ①	Twin	**KPRL4X12**
			2	Twin	**KPRL4X22**
PD2	4.13 (104.9)	3X	3	Twin	**KPRL4X32**
PD3 (400 A Frame)	5.50 (139.7)	4X	3	Single	**KPRL4X334S** ②
PD3 (400 A Frame)	5.50 (139.7)	4X	3	Twin	**KPRL4X334T** ③
PD3 (600 A Frame)	5.50 (139.7)	4X	3	Single	**KPRL4X336** ②
PD4	8.25 (209.6)	6X	3	Single	**KPRL4X34** ②
PD5	8.25 (209.6)	6X	3	Single	**KPRL4X35** ②

① Two sets of twin-mounted single-pole breakers.

② 36.00-inch (914.4 mm) minimum box width required.

③ 44.00-inch (1117.6 mm) box width required.



Connector kit

Table 47. PRL4 breaker connector kits

Breaker frame	Space required		Number of poles	Mounting type	Connector kit catalog number
	Inches (mm)	"X"			
EHD/FDB/FD/HFD/FDC	2.75 (69.9)	2X	1 ①	Twin	**KPRL4X12**
EHD/FDB/FD/HFD/FDC/ED/EDH/EDC/EHD/FDB/FD/HFD/FDC/FDB	2.75 (69.9)	2X	2	Twin	**KPRL4X22**
ED/EDH/EDC /FDE/HFDE/FDCE	4.13 (104.9)	3X	3	Twin	**KPRL4X32**
ED/EDH/EDC/EDB/EDS	4.13 (104.9)	3X	3	Twin	**KPRL4X32**
FD current limiter (available in single mounting only)	4.13 (104.9)	3X	3	Single	**KPRL4FDCL**
CA/CAH/HCA	2.75 (69.9)	2X	2	Twin	**KPRL4CA** ②
CA/CAH/HCA	4.13 (104.9)	3X	3	Twin	**KPRL4CA**
JD, JDB, HJD, JDC	4.13 (104.9)	3X	2, 3	Single	**KPRL4JDS**
JD, JDB, HJD, JDC	4.13 (104.9)	3X	2, 3	Twin	**KPRL4JDT** ②
FCL, FB-P, FD/LFD	4.13 (104.9)	3X	3	Twin	**KPRL4FBP**
DK, KD, KDB, HKD, KDC	5.50 (139.7)	4X	2, 3	Single	**KPRL4KDS** ②
DK, KD, KDB, HKD, KDC	5.50 (139.7)	4X	2, 3	Twin	**KPRL4KDT** ③
LC/LCY/HLC/LD/HLD/LDC/LDB [LA]	8.25 (209.6)	6X	3	Single	**KPRL4LC** ②
LGE/LGS/LGHLGC/LGU	8.25 (209.6)	6X	3	Single	**KPRL4X336** ②
LHH	5.50 (139.7)	4X	3	Single	**KPRL4LG** ②
MDS/MC/MCY/HMC [MA/HMA]	8.25 (209.6)	6X	3	Single	**KPRL4MC** ②
MDL/HMDL	8.25 (209.6)	6X	3	Single	**KPRL4X34** ②
LA-P	8.25 (209.6)	6X	3	Single	**KPRL4LAP** ②
LCL	8.25 (209.6)	6X	3	Single	**KPRL4LCL** ②
NB-P	8.25 (209.6)	6X	3	Single	**KPRL4NBP** ②
NC/NCY/HNC [NB/HNB]	8.25 (209.6)	6X	3	Single	**KPRL4NC** ②
ND/HND/NDC/NGS/NGH/NGC	8.25 (209.6)	6X	3	Single	**KPRL4X35** ②
NHH	8.25 (209.6)	6X	3	Single	**KPRL4ND** ②
100% rated breakers					
CKD/CHKD/CKDC	5.50 (139.7)	4X	3	Single	**KPRL4CKD** ③④
CLD/CHLD/CLDC	8.25 (209.6)	6X	3	Single	**KPRL4LC** ③④
LCC/HLCC	8.25 (209.6)	6X	3	Single	**KPRL4LC** ③④
MCC/HMCC	8.25 (209.6)	6X	3	Single	**KPRL4MC** ③④
MDSC	8.25 (209.6)	6X	3	Single	**KPRL4MC** ③④
CMDL/CHMDL	8.25 (209.6)	6X	3	Single	**KPRL4MD** ③④
CND/CHND/CNDC/NGS-C/NGH-C/NGC-C	8.25 (209.6)	6X	3	Single	**KPRL4CND** ③④

① Two sets of twin-mounted single-pole breakers.

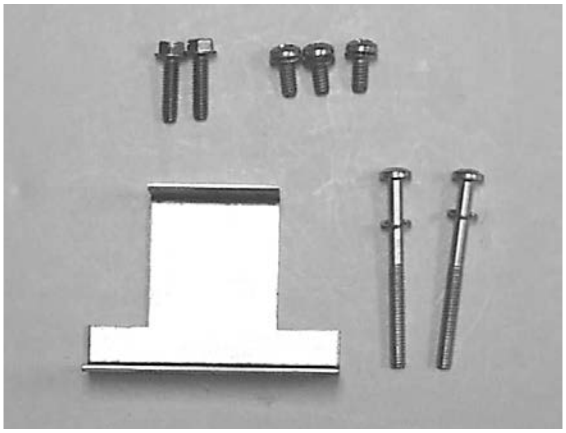
② 36.00-inch (914.4 mm) minimum box width required.

③ 44.00-inch (1117.6 mm) box width required.

④ Requires density rated bus in existing panel chassis.

Hardware kit

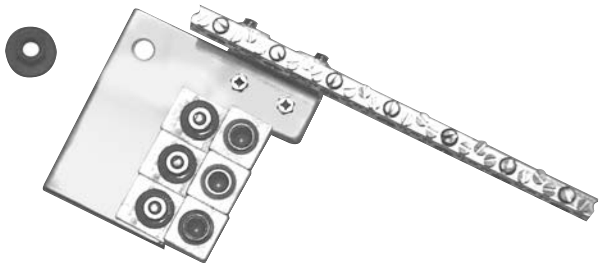
Each kit includes mounting bracket(s) and mounting hardware only. Use the appropriate connector kit catalog number and add an "H" to designate hardware only (example: KPRL4X32-H).



Hardware kit

Standard ground bus

Copper bus with (3) 6–300 kcmil lugs plus a 24-circuit terminal bar with #14–1/0 wire range.



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PRL4 fusible connector kits

Fusible switch connector kits

Each kit includes copper connectors, extension wings (when required), hardware, and instructions to mount a fusible switch. Switches are not included. Contact your local satellite plant for availability and application information (see **page 3**).

Table 48. Fusible switch connector kits

Switch height			Three-pole switch		
			240 V	600 V	
Inches (mm)	"X" space required	Switch ampere rating	Catalog number		Connector kit
5.50 (139.7)	4X	30–30	**FDPWT3211R**	**FDPWT3611R**	—
		60–60	**FDPWT3222R**	**FDPWT3622R**	**KPRL44X** ①
		100–100	**FDPWT3233R**	—	—
6.88 (174.8)	5X	100–100	—	**FDPWT3633R**	**KPRL45X1**
8.25 (209.6)	6X	200	**FDPBS324R**	**FDPBS364R**	**KPRL4B6XS**
		200–200	**FDPBT3244R**	**FDPBT3644R**	**KPRL4B6XT** ②
12.38 (314.5)	9X	400	**FDPW325R**	**FDPW365R**	**KPRL4W9X**
15.13 (384.3)	11X	600	**FDPW326R**	**FDPW366R**	**KPRL4W11X**
		800	**FDPW327**	**FDPW367**	**KPRL4W11X** ②
20.63 (524.0)	15X	1200	**FDPW328**	**FDPW368**	**KPRL4W15X** ②

① These connector kits will fit the FDP and FDPW switches.

② 44.00-inch (1117.6 mm) box width required for both R and J fuse applications.

PRL4 breaker and fusible switch retrofit kits

Breaker retrofit kits

Each kit includes one breaker, copper connectors, covers, hardware, and instructions to mount in a PRL4X and PRL4.

Table 49. PRL4X breaker retrofit kits

Breaker frame	Frame ampere rating	Trip range	Mounting type
PD2	100	15–100	Twin
PD2	150	110–150	Twin
PD2	225	110–225	Twin
PD3	400	100–400	Twin/single
PD3	600	300–600	Single
PD4	800	300–800	Single
PD5	1200	600–1200	Single

Table 50. PRL4 breaker retrofit kits

Breaker frame	Frame ampere rating	Trip range	Mounting type
EHD	100	15–100	Twin
FDB		15–100	Twin
FD		15–100	Twin
HFD		15–100	Twin
FDC		15–100	Twin
FCL		15–100	Twin
FB-P		15–100	Twin
FDB	150	110–150	Twin
FD	225	110–225	Twin
HFD		110–225	Twin
FDC		110–225	Twin
ED		100–225	Twin
EDH		100–225	Twin
EDC		100–225	Twin
JD	250	70–250	Twin/single
HJD		70–250	Twin/single
JDC		70–250	Twin/single
DK	400	100–400	Twin/single
KD		100–400	Twin/single
HKD		100–400	Twin/single
KDC		100–400	Twin/single
CKD		100–400	Single
LCL		125–400	Single
LA-P		70–400	Single
LD	600	300–600	Single
CLD		300–600	Single
HLD		300–600	Single
CHLD		300–600	Single
LDC		300–600	Single
CLDC		300–600	Single
MDL	800	300–800	Single
CMDL		300–800	Single
HMDL		300–800	Single
CHMDL		300–800	Single
ND	1200	600–1200	Single
CND		600–1200	Single
HND		600–1200	Single
CHND		600–1200	Single
NDC		600–1200	Single
CNDC		600–1200	Single

How to order a breaker retrofit kit by catalog number

Use "KPRL4" prefix and add catalog number of breaker as shown below. Use suffix "T" or "S" to denote twin or single mounting. Twin-mounting indicates that one set of connectors is required to mount two breakers (of similar frames) opposite one another. Retrofit kit includes one breaker only, for either single or twin-mounted applications.

Table 51. Catalog numbering system—breaker retrofit kit

KPRL4X PD3 3 G 400 S

Designates PRL4X connector kit

Breaker frame
- **PD**
- **PG**
- **PF**
- **2**
- **3**
- **4**
- **5**

Number of poles
- **2** = Two-pole
- **3** = Three-pole

Interrupting rating
- **F** = 240 V = 35 kA
480 V = 25 kA
- **G** = 240 V = 65 kA
480 V = 35 kA
- **M** = 240 V = 100 kA
480 V = 65 kA
- **P** = 240 V = 200 kA
480 V = 100 kA

Ampere rating

T = Twin
S = Single

Legend
PD = UL/CSA rated only to 240 V
PG = Globally rated/UL standard (600 V)
PF = Globally rated/UL 100% (600 V)
2, 3, 4, 5 = Frame type

Table 52. Catalog numbering system—legacy breaker retrofit kit

KPRL4 KD 3 400 S

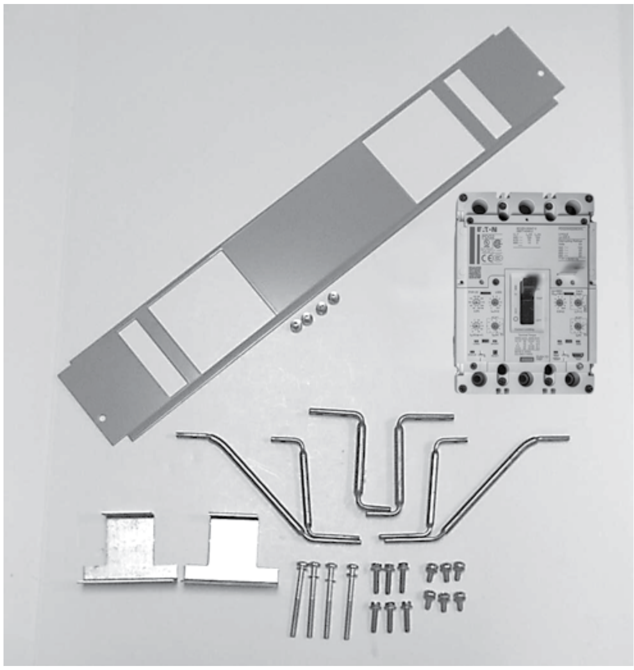
Designates KPRL4 connector kit

Breaker frame

Number of poles
- **2** = Two-pole
- **3** = Three-pole

Ampere rating

T = Twin
S = Single



PRL4 breaker retrofit kits

Fusible retrofit kits

Each kit includes a three-pole switch, copper connectors, extension wings (if required), hardware, and instructions to horizontally mount in a PRL4.

Table 53. Fusible retrofit kits

Switch ampere rating	Switch type	Mounting type
30–30	FDPW	Twin
60–60	FDPW	Twin
100–100	FDPW	Twin
100	FDPW	Single
200	FDPB	Single
200–200	FDPB	Twin
400	FDPW	Single
600	FDPW	Single
800	FDPW	Single
1200	FDPW	Single

How to order a fusible retrofit kit by catalog number

Use "KPRL4" prefix and add catalog number of appropriate switch (refer to **page 34** for three-pole switch catalog number).

Example: The retrofit kit catalog number for a 600 V, 100 A twin FDPW switch is:

Table 54. Catalog numbering system—fusible retrofit kit

KPRL4 FDPW T 3 6 33 R

Designates PRL4 connector

Switch type
- FDPW
- FDPB

T = Twin
S = Single

3 = Three-pole

Volts
- **2** = 240
- **6** = 600

11 = 30–30
22 = 60–60
33 = 100–100
44 = 200–200
4 = 200
5 = 400
6 = 600
7 = 800
8 = 1200

R = R fuse
J = J fuse
T = T fuse

Accessories

PRL1X, PRL2X, PRL3X, PRL1a, PRL2a, PRL3a EZ Trim and enclosures

EZ Trim

PRL1X, PRL2X, PRL3X, PRL1a, PRL2a, and PRL3a EZ Trim and EZ Box™ meet code requirements for both Type 1 standards. Features include a door-in-door standard with no exposed hardware and laser-cut trim with rounded corners. For EZ Box and EZ Trim, refer to **page 37**.

Example: EZT2048 and **EZB2048**.

EZ Trim

Table 55. EZ Trim

	Box				Trim							
	Unpainted		Painted		Unvented surface mounted		Unvented flush mounted		Vented surface mounted		Vented flush mounted	
Encl. height	Catalog number	Style number	Catalog number	Style number	Catalog number	Style number	Catalog number	Style number	Catalog number	Style number	Catalog number	Style number
24	**EZB2024R**	42C1999G01	**EZBP2024R**	42C1999G13	**EZT2024S**	42C4255G01	**EZT2024F**	42C4258G01	**EZTV2024S**	42C4261G01	**EZTV2024F**	42C4264G01
30	**EZB2030R**	42C1999G02	**EZBP2030R**	42C1999G14	**EZT2030S**	42C4255G02	**EZT2030F**	42C4258G02	**EZTV2030S**	42C4261G02	**EZTV2030F**	42C4264G02
36	**EZB2036R**	42C1999G03	**EZBP2036R**	42C1999G15	**EZT2036S**	42C4255G03	**EZT2036F**	42C4258G03	**EZTV2036S**	42C4261G03	**EZTV2036F**	42C4264G03
42	**EZB2042R**	42C1999G04	**EZBP2042R**	42C1999G16	**EZT2042S**	42C4255G04	**EZT2042F**	42C4258G04	**EZTV2042S**	42C4261G04	**EZTV2042F**	42C4264G04
48	**EZB2048R**	42C1999G05	**EZBP2048R**	42C1999G17	**EZT2048S**	42C4255G05	**EZT2048F**	42C4258G05	**EZTV2048S**	42C4261G05	**EZTV2048F**	42C4264G05
54	**EZB2054R**	42C1999G06	**EZBP2054R**	42C1999G18	**EZT2054S**	42C4255G06	**EZT2054F**	42C4258G06	**EZTV2054S**	42C4261G06	**EZTV2054F**	42C4264G06
60	**EZB2060R**	42C1999G07	**EZBP2060R**	42C1999G19	**EZT2060S**	42C4255G07	**EZT2060F**	42C4258G07	**EZTV2060S**	42C4261G07	**EZTV2060F**	42C4264G07
72	**EZB2072R**	42C1999G09	**EZBP2072R**	42C1999G21	**EZT2072S**	42C4255G09	**EZT2072F**	42C4258G09	**EZTV2072S**	42C4261G09	**EZTV2072F**	42C4264G09
90	**EZB2090R**	42C1999G12	**EZBP2090R**	42C1999G24	**EZT2090S**	42C4255G12	**EZT2090F**	42C4258G12	**EZTV2090S**	42C4261G12	**EZTV2090F**	42C4264G12

PRL1X, PRL2X, PRL3X, PRL1a, PRL2a, PRL3a special trims and enclosures

Fastrim

Used when concealed trim-mounting hardware is required for PRL1X, PRL2X, PRL3X, PRL1a, PRL2a, and PRL3a. Trim clamps are included and shipped with the trim. Order by adding the letter "F" to the standard trim catalog number. Add 20% to standard trim list price.

Example: LT2072S becomes **LTF2072S**.

For trim clamps only, refer to **page 21**.

Fastrim

Door-in-door

Piano hinge on the right side of the trim provides access to the wiring gutters without requiring removal of the trim. Order by adding the letters "DD" to the standard trim catalog number. Add 20% to standard trim list price.

Example: LT2072S becomes **LTDD2072S**.

Door-in-door

Ventilated trim

Required on 600 A and above panels only. Order by adding the letter "V" to the standard trim catalog number. Add 10% to standard trim list price.

Example: LT2072S becomes **LTV2072S**.

Ventilated trim

Type 12/3R enclosures

The complete enclosure consists of a box and trim. The enclosure meets code requirements for both Type 12 (dust-tight) and Type 3R (rainproof) standards. Features include a laser-cut trim with rounded corners, concealed hinges, and a T-handle lock. Gasketing is provided around the trim door.

The box is gasketed and made from code gauge steel with dripshield and is painted ANSI-61.

Table 56. Type 12/3R enclosures for PRL1X, PRL2X, PRL3X, PRL1a, PRL2a, PRL3a

Box dimensions in inches (mm)			Catalog number	
Height	**Width**	**Depth**	**Box**	**Trim**
24.00 (609.6)	20.00 (508.0)	6.00 (152.4)	**VWPB2024**	**LWPT2024**
36.00 (914.4)	20.00 (508.0)	6.00 (152.4)	**VWPB2036**	**LWPT2036**
48.00 (1219.2)	20.00 (508.0)	6.00 (152.4)	**VWPB2048**	**LWPT2048**
60.00 (1524.0)	20.00 (508.0)	6.00 (152.4)	**VWPB2060**	**LWPT2060**
72.00 (1828.8)	20.00 (508.0)	6.00 (152.4)	**VWPB2072**	**LWPT2072**
90.00 (2286.0)	20.00 (508.0)	6.00 (152.4)	**VWPB2090**	**LWPT2090**

Type 12/3R enclosures

PRL4 special trims and enclosures

Door-in-door trim

Door-in-door trim

A piano hinge on the right side of the trim provides access to the wiring gutter without requiring the removal of the trim. When used with a standard PRL4 box, a special mounting channel must be used to add extra depth to the enclosure.

An extra depth box, not requiring a mounting channel, is another available option. Contact your local satellite for ordering information.

Table 57. Special trims and enclosures

Standard box catalog number	Mounting channel style number	Door-in-door trim catalog number	
		Surface	Flush
BX2457	8708C82G02	LDD2457STW	LDD2457FTW
BX2473	8708C82G03	LDD2473STW	LDD2473FTW
BX2490	8708C82G04	LDD2490STW	LDD2490FTW
BX3673	8708C82G05	LDD3673STW	LDD3673FTW
BX3690	8708C82G06	LDD3690STW	LDD3690FTW
BX4473	8708C82G07	LDD4473STW	LDD4473FTW
BX4490	8708C82G08	LDD4490STW	LDD4490FTW

Type 12/3R enclosures

Type 12, 24.00 inches (609.6 mm) wide

Type 3R, 36.00 inches (914.4 mm) wide

PRL4 enclosures are available in both Type 12 (dust-tight) and Type 3R (rainproof) designs. The 24.00-inch (609.6 mm) wide enclosure includes a single hinged door while the 36.00-inch (914.4 mm) wide is provided with double hinged doors.

The side gutter covers are an integral part of the box in all styles. Sizes and catalog numbers are shown in **Table 58**.

Table 58. Type 12/3R enclosures

Enclosure dimensions in inches (mm)			Catalog number	
Height	Width	Depth	Type 3R	Type 12
57.00 (1447.8)	24.00 (609.6)	13.90 (353.1)	RPCB2457	DPC2457
73.00 (1854.2)	24.00 (609.6)	13.90 (353.1)	RPCB2473	DPC2473
90.00 (2286.0)	24.00 (609.6)	13.90 (353.1)	RPCB2490	DPC2490
73.00 (1854.2)	36.00 (914.4)	13.90 (353.1)	RPCB3673	DPC3673
90.00 (2286.0)	36.00 (914.4)	13.90 (353.1)	RPCB3690	DPC3690

Ordering procedure

Select the correct part or branch device. When selecting, you need to know the following:

- Panelboard type
- Amperage
- System voltage
- Available short-circuit rating
- Number of poles available
- Size and number of wires per phase
- “X” space required

PRL1X-LX, PRL2X-LX, PRL1a-LX, PRL2a-LX column panelboards

Table 59. Type 1 box and trims

	Catalog number		
Box height in inches (mm)	**Box**	**Surface trim standard**	**Surface trim door-in-door**
Incoming location top fed			
69.00 (1752.6)	**YSC969**	**LTC969S**	**LTCD969S**
78.00 (1981.2)	**YSC978**	**LTC978S**	**LTCD978S**
81.00 (2057.4)	**YSC981**	**LTC981S**	**LTCD981S**
90.00 (2286.0)	**YSC990**	**LTC990S**	**LTCD990S**
Incoming location bottom fed			
69.00 (1752.6)	**YSC969**	**LTC969SB**	**LTCD969SB**
78.00 (1981.2)	**YSC978**	**LTC978SB**	**LTCD978SB**
81.00 (2057.4)	**YSC981**	**LTC981SB**	**LTCD981SB**
90.00 (2286.0)	**YSC990**	**LTC990SB**	**LTCD990SB**

Pow-R-Command

For replacement parts, see PRL3X, PRL3a section, **page 21**. The following parts are available:

- Connector kits
- Ground assemblies
- Service entrance kits
- Deadfront covers
- Trim locks

Pow-R-Command

Additional services

Because virtually all panelboards are supplied to meet specific customer requirements, other parts not listed in this publication might occasionally be needed. Price and availability for parts not shown here may be obtained by contacting your local satellite plant and providing a complete description of the part along with the data on the panelboard nameplate.

Should you experience difficulty in determining what replacement parts are needed, contact your local satellite plant manager who can provide help to:

- Identify and recommend replacement parts
- Remove damaged parts and instruct you in how to install replacement parts
- Verify the correct connector kits that should be ordered for each circuit breaker or fusible switch
- Retrofit existing panelboard boxes with new Pow-R-Line interiors
- Provide a recommended spare parts list

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May 2022

Powering Business Worldwide

Powering Business Worldwide

Dry Type Transformers

Powering Business Worldwide

Section Table of Contents
Dry Type Transformers

Powering Business Worldwide

Drawings

Dry-Type Transformers General Information

- Standard Transformer Catalog Number: V48M28B3016CU
- Transformer Type: General Purpose Vented
- Phase: 3
- kVA: 30
- Primary Volts: 480
- Secondary Volts: 208Y/120
- Temperature Rise: 80C with 220C Insulation System
- Winding Material: Copper
- Enclosure Type: NEMA 2 (for N3R, select Weather Shield in Mods tab)
- Frequency (Hz): 60
- Frame: 940
- Wiring Diagram: 280B
- Weight (lbs.): 466
- Impedance (%): 2.06
- UL Listed: Y
- Max Practical Inrush (Amps): 181
- X/R: 1.01
- No Load Losses (Watts): 205
- Total Losses (Watts): 560

Standard Values

- K-Factor: 1
- TAPS: 2@+2.5%, 4@-2.5%
- Sound Reduction (dB): 0
- NEMA ST20 Sound Level (dB): 45
- DOE 10 CFR Part 431 (2016) Efficient: Y
- Infrared Viewing Window: None

Field-Installed Accessories Included

- Lug Kit: Not Included

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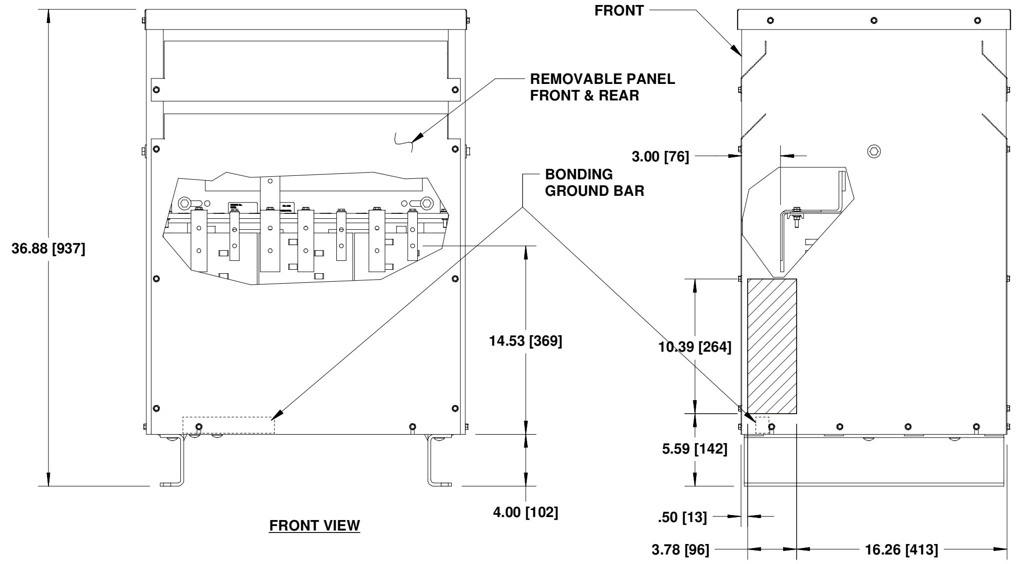
	APPROVED BY	DATE	JOB NAME Taunton WWTF PH2 DESIGNATION 30kVA 9XFMR2		
	VERSION 1.0.0.4		TYPE Dry-Type Transformer	DRAWING TYPE Final	
NEG-ALT Number D7580427X2K2-R001	REVISION 0	DWG SIZE A	G.O. LBS0031682	ITEM 033	SHEET 1 of 1

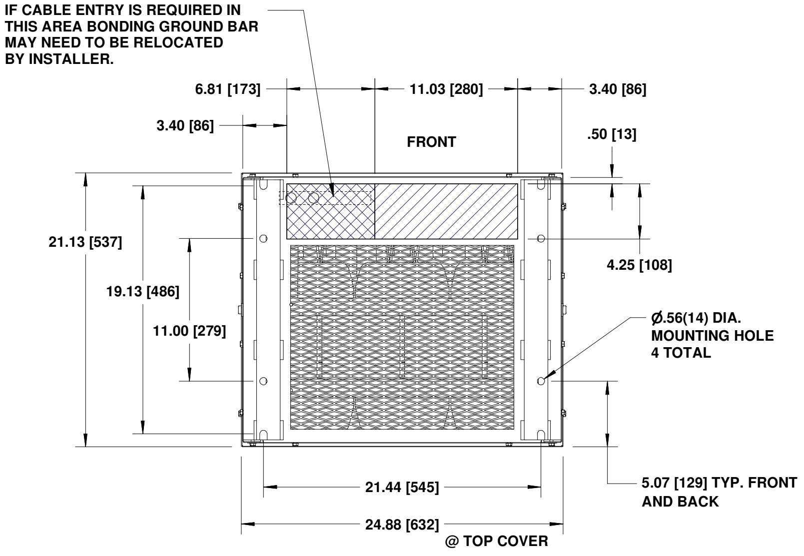
NOTE:

1. ALL UNITS ARE DESIGNED IN ACCORDANCE WITH APPLICABLE NEMA, UL, ANSI, AND IEEE STANDARDS.
2. DRY-TYPE VENTILATED, CLASS AA, NEMA TYPE 2 ENCLOSURE.
3. FOR NEMA 3R OUTDOOR APPLICATION, USE WEATHERSHIELD # WS58.
4. TRANSFORMERS ARE FLOOR-MOUNTED. USE WALL-MOUNT BRACKET WMB05 FOR WALL-MOUNTING.
5. 220°C CLASS INSULATION SYSTEM.
6. PAINT COLOR IS ANSI #61.
7. ALUMINUM UNITS HAVE ALUMINUM WINDINGS AND TERMINATIONS. COPPER UNITS HAVE COPPER WINDINGS AND TERMINATIONS.
8. TRANSFORMER CAN BE INSTALLED AT A MIN. DISTANCE TO BACK AND SIDE WALLS OF 2 INCHES AND TO A 6 INCHES MIN. DISTANCE TO BACK WALLS WHEN WEATHERSHIELDS ARE NEEDED. WALLMOUNT BRACKETS CANNOT BE USED IN COMBINATION WITH WEATHERSHIELDS.
9. DIMENSIONS IN INCHES[mm].



FRONT VIEW

SIDE VIEW



BOTTOM VIEW

USE 10.39[264] x 3.78[96] BOTH SIDES, AND (11.03[280]+6.81[173]) x 4.25[108] ON BOTTOM AS RECOMMENDED CABLE ENTRY LOCATIONS.

THIS DIMENSION DRAWING IS FOR REFERENCE ONLY. IT IS NOT BE REGARDED AS INDICATING THE EXACT DETAILS OF CONSTRUCTION.

PRODUCT CODE: ·
FEDERAL ID NO. ·

REV	DESCRIPTION	DFTR	APPD	DATE
8	CO-0204443 .	L.C.R.	L.N.	9/11/2023
7	ECO-164756 .	J.C.S.	D.G.	3/31/2021
6	ECO-133517 .	J.G.	C.B.	5/7/2019

REVISIONS

DFTR J.C.S. DATE 10/30/2015
APPD D.G. DATE 10/30/2015
S.O. .
REVISION 8

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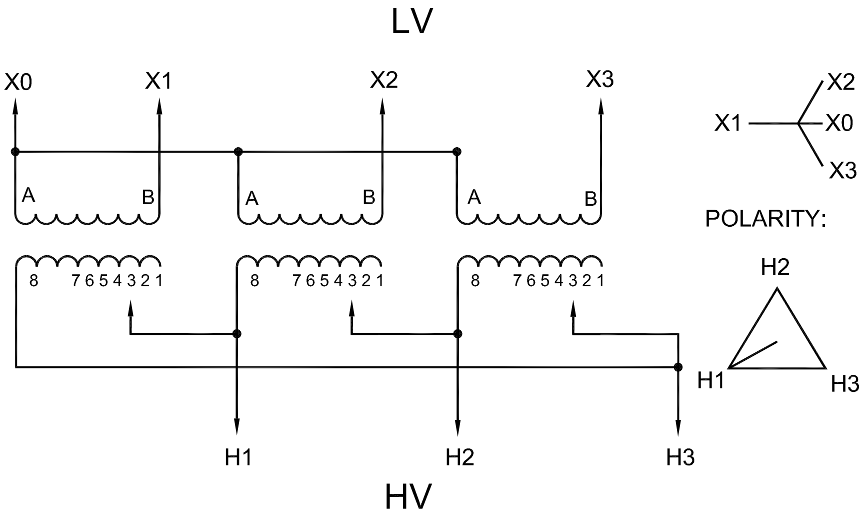
EATON

TITLE DRY TYPE TRANSFORMER OUTLINE
TYPE DRY TYPE TRANSFORMER
OUTLINE
G.O. .
DWG FR940
SHEET 1 OF 1

GO/NEG-Alt-Date: LBS0031682-R001-12/21/2023		**Job Name:** Taunton WWTF PH2
Item Number: 033	**Catalog Number:** V48M28B3016CU	**Designation:** 30kVA 9XFMR2

VOLTS	TAP
504	1
492	2
480	3
468	4
456	5
444	6
432	7



REV	DESCRIPTION	DFTR	APPD	DATE
.	. .	.	.	,
.	. .	.	.	.
4	UPDATE FORMAT EATON & CHANGE DESC. TO HV/LV	J.C.S.	C.B.	10/JUN/14

REVISIONS

PRODUCT CODE: TRANSFORMERS

FEDERAL ID NO.

DFTR HEG — DATE 12/01/01

APPD EER — DATE 12/01/01

S.O. .

REVISION 04

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EATON

TITLE DRY TYPE TRANSFORMER
WIRING SCHEMATIC

TYPE DRY TYPE TRANSFORMER

WIRING

G.O. .

DWG 280B

SHEET 1 OF 01

GO/NEG-Alt-Date:		Job Name:
LBS0031682-R001-12/21/2023		Taunton WWTF PH2
Item Number:	**Catalog Number:**	**Designation:**
033	V48M28B3016CU	30kVA 9XFMR2

Powering Business Worldwide

Instruction Data

Installation, Operation & Maintenance Manual

Low-Voltage Dry-Type Distribution Transformers.

Eaton’s Family of Dry-Type Distribution Transformers.

Powering Business Worldwide

CONTENTS

Description

Figures

CONTENIDO

Descripción

Figuras

⚠ DANGER

Indicates a hazardous situation that, if not avoided, will result in death or serious injury.

⚠WARNING

Indicates a hazardous situation that, if not avoided, could result in death or serious injury

⚠CAUTION

Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

Instructions for Installation, Operation, and Maintenance of Dry-Type Distribution Transformers.

⚠ DANGER

Turn off the power supplying this equipment before servicing.

Lockout power before servicing.

Burn hazard. Allow for a cool-down period before servicing equipment.

1. INTRODUCTION

Transformers should be installed and serviced only by competent personnel familiar with good safety practices. These instructions are written for such personnel and are not intended as a substitute for adequate training and experience in the use of transformers. Refer to Standards NEMA ST-20 and IEEE C57.94 for more information on general application requirements.

2. RECEIVING

All dry-type distribution transformers are completely assembled and carefully tested at the factory before being shipped.

Upon receipt of the transformer:

- Inspect for possible shipping damage.
- Check the bill of lading for possible shortages.

⚠ PELIGRO

Indica una situación de riesgo que de no ser evitada resultara en muerte o heridas severas.

⚠ ADVERTENCIA

Indica una situación de riesgo que de no ser evitada podría resultar en muerte o heridas severas.

⚠ATENCIÓN

Indica una situación de riesgo que de no ser evitada podría resultar en heridas menores o moderadas.

Instrucciones para la Instalación, Operación y Mantenimiento de los Transformadores de Distribución Tipo Seco.

⚠ PELIGRO

Apague el equipo antes de realizar cualquier trabajo en él.

Bloquee las fuentes de energía antes de realizar cualquier trabajo.

Riesgo de quemaduras. Permita que el equipo se enfrié antes de realizar cualquier trabajo.

1. INTRODUCCION

La instalación y mantenimiento de los transformadores deben estar a cargo de personal calificado que conozca las prácticas de seguridad recomendadas. Estas instrucciones van dirigidas a este sin intención de sustituir la adecuada capacitación y experiencia en transformadores. Consulte el estándar NEMA (National Electrical Manufacturers Association E.U.A.) ST-20 y IEEE C57.94 para más información.

2. ARRIBO

Todos los transformadores de distribución tipo seco son completamente ensamblados y cuidadosamente probados en la fábrica antes de ser enviados.

Al recibir el transformador:

- Inspeccione por posibles daños durante el transporte.
- Verifique la guía de carga por posibles faltantes.

If shipping damage occurs, a claim should immediately be filed with the carrier. Notify the local sales office with the carrier's name and the extent of the damage.

3. LIFTING AND HANDLING

⚠ DANGER

Carefully follow the lifting instructions below.

Use appropriate material handling equipment.

Move the transformer in an upright position only.

Ventilated transformers:

- Remove the top cover to access the lifting holes in the core frame. Use spreaders with lifting chains or slings to lift the transformer.

OR

- Lift the unit with a fork lift.
- For further information see Figure 1 and 2.

Encapsulated transformers (above 2 kVA):

- Lift the transformer by its lifting brackets.

OR

- Lift the unit with a fork lift when a pallet is provided.
- For further information see Figure 3.

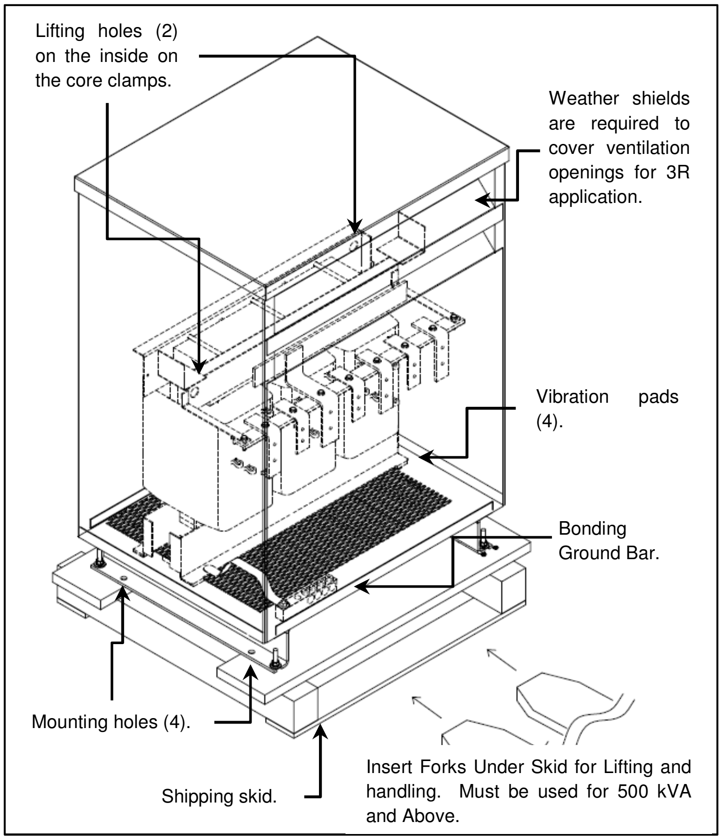


Figure 1: Typical Ventilated Transformer.

En caso de existir daño durante el transporte, inmediatamente levante un reporte con el transportista. Notifíquelo a la oficina local de ventas el nombre del transportista y el alcance del daño.

3. LEVANTAMIENTO Y MANEJO

⚠ PELIGRO

Siga cuidadosamente las instrucciones de levantamiento debajo .

Utilice equipo adecuado para el manejo del material.

Mueva el transformador en posición vertical solamente.

Transformadores ventilados:

- Remueva la tapa superior para acceder a los orificios de izado en el marco del núcleo. Use correas o cadenas con separadores para levantar el transformador

O

- Use montacargas.
- Para referencia vea las Figuras 1 y 2.

Transformadores Encapsulados (mayores de 2 kVA):

- Levante la unidad por las ménsulas.

o

- Levante la unidad con montacargas si el transformador está sobre una tarima.
- Para referencia, vea la Figura 3.

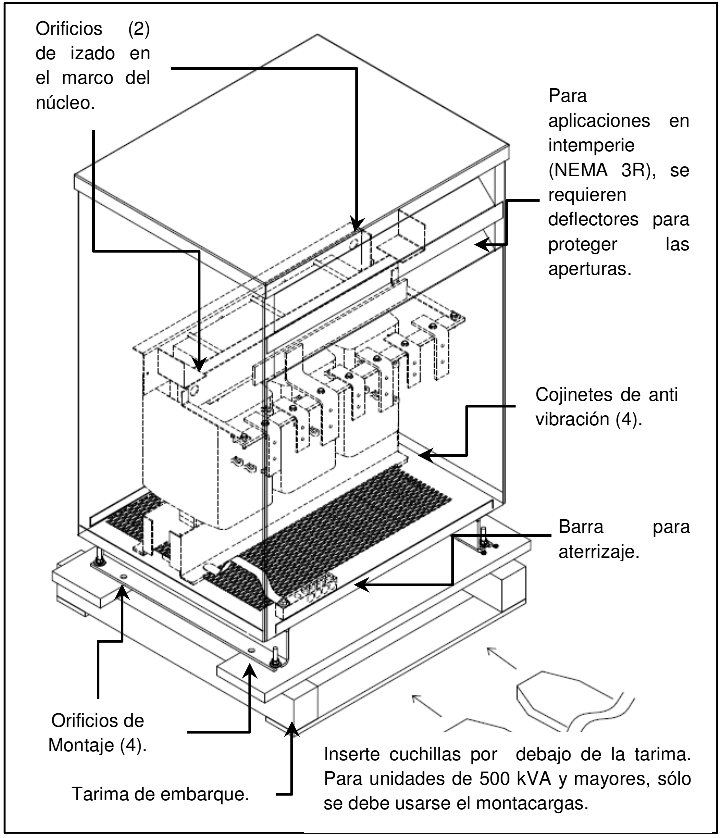
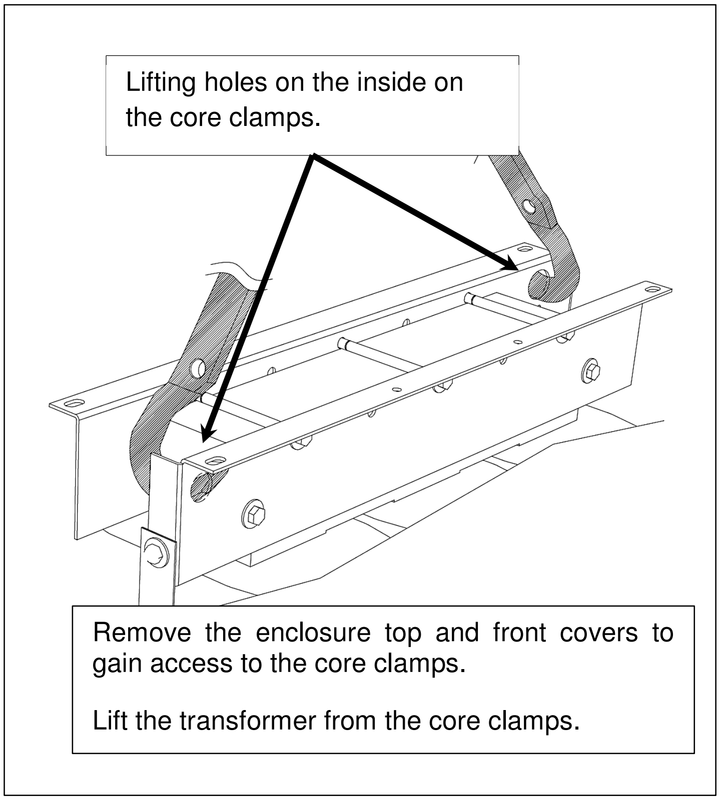


Figure 1: Transformador ventilado típico.



Remove the enclosure top and front covers to gain access to the core clamps.

Lift the transformer from the core clamps.

Figure 2: Typical location of the lifting holes for a ventilated transformer.

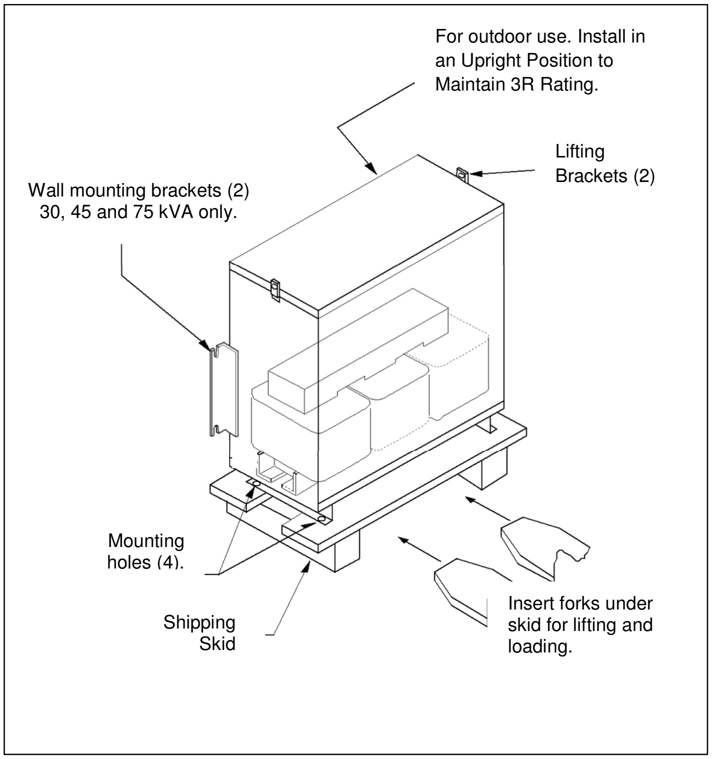
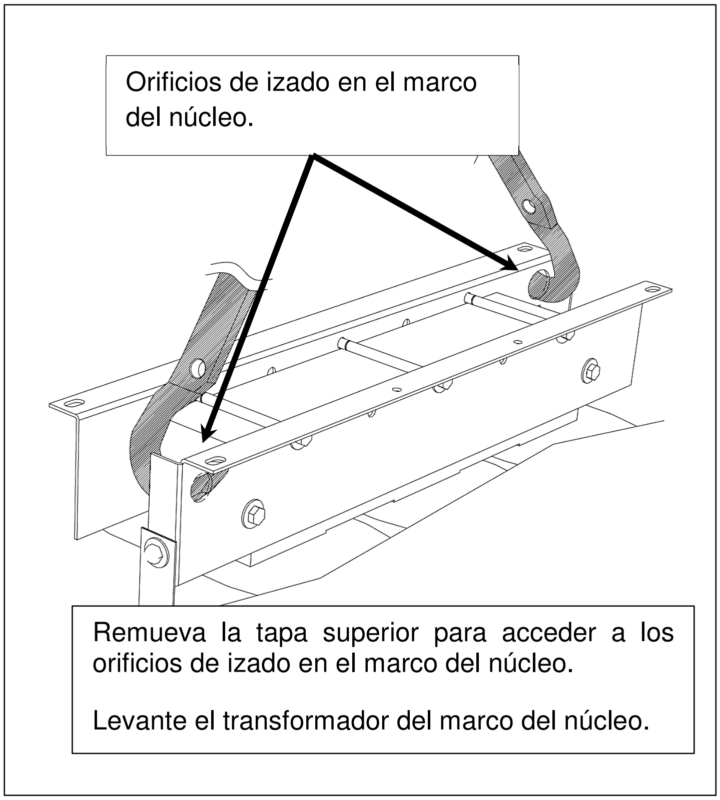


Figure 3: Typical Encapsulated Transformer.



Remueva la tapa superior para acceder a los orificios de izado en el marco del núcleo.

Levante el transformador del marco del núcleo.

Figure 2: Ubicación típica de los orificios de izado para un transformador ventilado.

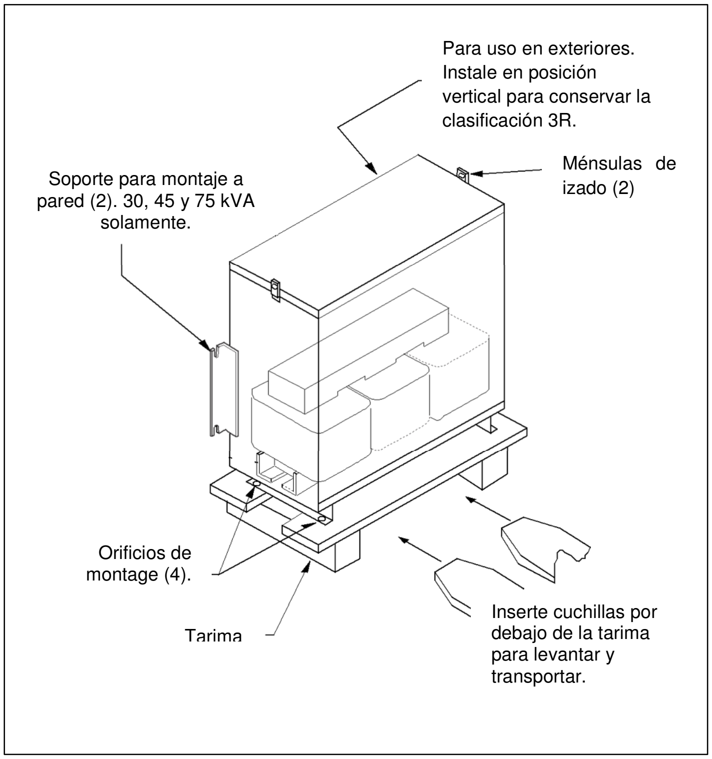


Figure 3: Transformador encapsulado típico.

4. STORAGE PRIOR TO ENERGIZATION

Store Low-Voltage Dry-Type Distribution Transformers in their original shipping cartons indoors in a clean, dry, temperature stable environment.

5. LOCATION AND MOUNTING

All dry-type transformers:
■ Locate the transformer in an area where the transformer is easily accessible and serviceable by qualified personnel.
■ Install the transformer in accordance with the requirements of Article 450 of the National Electrical Code and other appropriate local codes.
■ Install the transformer in a protected electrical circuit. Do not subject the transformer to voltage surges unless it is properly protected.
■ Transformers are not tamper proof and should be installed in secured locations away from all unauthorized personnel.
■ Locate transformer in a well-ventilated area free from excessive moisture, dust, dirt, or explosive/corrosive gases or vapors.
■ Locate the transformer at least the minimum distance marked on the nameplate to assure proper air circulation. Avoid any obstruction to the bottom and top panel ventilation openings.
■ Install transformer on a surface strong enough to support the weight of the transformer.
■ Install ventilated transformers in an upright position only.
■ Encapsulated transformers for indoor use may be mounted in any position. To maintain their Type 3R, Type 12, Type 4, or Type 4X enclosure rating, the transformer must be installed in an upright position with the top point upward.

Wall mount installation:
■ For wall mounted ventilated transformers see Instruction Leaflet IL009002EN (Wall-mounting bracket kits WMB04 and WMB05 assembly instructions).
■ WMB04 maximum weight capacity 1400 Lb.
■ WMB05 maximum weight capacity 810 Lb.
■ Do not install wall-mounted transformers over flammable materials, and do not store flammable materials under a wall-mounted transformer

6. HOW TO REDUCE SOUND TRANSMISSION

All transformers produce sound due to the vibration generated in its core by alternating flux. NEMA ST-20 defines the sound levels for dry-type distribution transformers.
All general purpose dry-type distribution transformers are designed to meet NEMA ST-20 established sound levels. However, to minimize the potential for sound transmission to surrounding structures and sound reflection, follow these instructions:

1. Mount the transformer away from corners, walls or ceilings. For installations which must be near a corner, use

4. ALMACENAJE PREVIO A CONEXION

Mantenga los transformadores en su empaque original, en interiores secos, limpios y a temperatura estable.

5. LOCALIZACION Y MONTAJE

Para todos los transformadores de tipo seco:
■ Coloque el transformador en un lugar que facilite el acceso y servicio del personal calificado.
■ Instale el transformador de acuerdo a lo provisto en el artículo 450 del NEC (Código Nacional Eléctrico EUA) y/o los códigos o normas locales aplicables.
■ Instale el transformador en un circuito eléctrico protegido. No exponga el transformador a sobre voltajes a menos que esté adecuadamente protegido.
■ Los transformadores no son a prueba de manipulación y deben ser instalados en localidades seguras lejos de personal no autorizado.
■ Ubique el transformador en un área ventilada, libre de humedad excesiva, polvo, suciedad, vapores y gases explosivos y/o corrosivos.
■ Instale el transformador con una separación de al menos la distancia mínima indicada en la placa de datos para asegurar la apropiada circulación de aire. Evite obstrucciones en las ventilaciones de los paneles superior e inferior.
■ Instale el transformador sobre una superficie suficientemente rígida para soportar el peso de la unidad.
■ Instale los transformadores ventilados solamente en posición vertical.
■ Los transformadores encapsulados para uso en interiores pueden ser montados en cualquier posición. Para mantener la clasificación en el gabinete 3R, 12, 4 o 4X, el transformador debe ser instalado en posición vertical.

Instalación montada a pared:
■ Para transformadores ventilados montados a pared refiera las instrucciones IL009002EN (instrucciones de ensamble para kits de montaje a pared WMB04 y WMB05).
■ Peso máximo para WMB04; 1400 Lb. [635 Kg].
■ Peso máximo para WMB05; 810 Lb. [367 Kg].
■ Transformadores montados a pared no deben instalarse sobre materiales inflamables. No almacene materiales inflamables debajo del transformador.

6. COMO REDUCIR LA TRANSMISION DE SONIDO

Todos los transformadores producen sonido debido a la vibración generada en el núcleo por el flujo magnético alternante. NEMA ST-20 define los niveles promedio máximos de sonido para transformadores de distribución tipo seco. Todos los transformadores de distribución tipo seco son diseñados para cumplir con los niveles de sonido establecidos por NEMA, norma ST-20. Sin embargo, para minimizar la potencial transmisión y reflexión de sonido siga estas instrucciones:

1. Instale el transformador alejado de esquinas, paredes y techos. En instalaciones donde sea necesario estar cerca de

sound absorbing materials on the adjacent walls and ceiling.
2. Use flexible conduit to make the connections to the transformers.
3. Locate the transformers as far away as possible from areas where noise is of concern.
4. Install the transformer over vibration isolators; for better results use Eaton B-Line's vibration isolation products.

7. CONNECTING CABLES TO TRANSFORMER TERMINATIONS.

Any standard cable of the conductor size specified in NEC Section 310 can be used. Recommended external cable should be rated 90ºC and sized at 75% ampacity for encapsulated transformers and sized at 75ºC for ventilated. Connectors should be selected on the basis of the type of cable and cable size used to wire the specific transformer, proper torque should be applied based on the connector's manufacturer recommendations.

■ Remove access panels to access the wiring compartment.
■ Top entry of cable should be avoided.
■ Clean all electrical joints.
■ Connect primary wiring first to correct terminal as shown on the transformer nameplate.

- Transformers labeled as "Bi-directional" are suitable for reverse-feeding (back-feeding). Transformers are designed to have the incoming cables connected to the primary terminals. Transformers marked as bi-directional are suited to have the incoming cables connected to the secondary terminals. When the secondary connection is a Y (208Y/120 for example), The neutral terminal (X0 or H0) should not be connected. If the secondary is a delta connection with a center tap (aka lighting tap or convenience tap), the center tap (normally X4) cannot be connected.

⚠WARNING

When reverse-feeding a transformer the circuit breakers and fuses should be the time-delay type.

Make sure to follow NEC 250 system grounding.

Reverse-feeding a transformer may result in higher than normal inrush currents.

Reverse-feeding a transformer may cause nuisance tripping of overcurrent protective devices.

una esquina, use materiales que absorban el sonido en paredes adyacentes y techo.
2. Use conducto flexible para hacer las conexiones al transformador.
3. Instale el transformador lo más alejado posible de áreas donde el ruido sea motivo de preocupación.
4. Utilice aisladores de vibración en la instalación del transformador, para mejores resultados use aisladores de vibración Eaton B-Line.

7. CONEXION DE CABLES A LAS TERMINALES DEL TRANSFORMADOR

Cualquier conductor estándar del calibre especificado por NEC sección 310 puede ser usado. El cable recomendado debe de estar clasificado para 90ºC calculado al 75% de ampacidad en transformadores encapsulados, y calculado para 75ºC en ventilados. Los conectores deberán seleccionarse específicamente de acuerdo al tipo y al calibre del conductor utilizado en la conexión al transformador, el torque correcto deberá ser aplicado de acuerdo a las recomendaciones del fabricante del conector.

■ Remueva los paneles de acceso al compartimiento de alambrado.
■ Evite el acceso de cable por la parte superior del gabinete.
■ Limpie todas las uniones eléctricas.
■ Conecte el devanado primario a la terminal correcta según se muestre en la placa de datos.

- Transformadores etiquetados como "Bidireccional" pueden ser alimentados en reversa (back-feeding). Los transformadores están diseñados para conectar los cables de alimentación a las terminales del primario. Los transformadores marcados como bidireccional pueden recibir cables de alimentación a las terminales del secundario. Cuando la conexión del secundario está en estrella (por ejemplo 208Y/120), La terminal neutral (X0 o H0) no debe ser conectada. Si el secundario es un configuración delta con derivación central (derivación de alumbrado), la derivación central (normalmente X4) no puede ser conectada.

⚠ADVERTENCIA

Cuando se alimente un transformador en reversa, las protecciones deben de ser con retardo.

Siga NEC 250 para el Sistema de tierra física.

Alimentar en reversa un transformador puede resultar en corrientes de arranque mayores a lo normal.

Alimentar en reversa un transformador puede causar falsos disparos de las protecciones.

- Insulate any unused tap leads and verify tap connections are tight.
- It is not necessary to loosen or remove any components or hardware for proper operation of this transformer.
- Energize transformer and measure secondary voltage to verify correct voltage.
- De-energize primary circuit and connect secondary wiring to terminations in accordance with nameplate wiring diagram.
- Make sure all connections are tight.
- Re-install access panels.

Grounding
As required by the National Electrical Code, connect a ground cable to the transformer enclosure. The transformer core is grounded to enclosure.

8. ENERGIZATION AND OPERATION GUIDELINES

⚠ DANGER

Follow the guidelines set forth below. Failure to do so could result in personal injury, death, property damage, or reduced transformer life.

For ventilated transformers only, if moisture is evident, the unit should be dried out by placing it in an oven or by blowing heated air over it. The temperature should not exceed 110º C (230ºF) to prevent damage to transformer's insulation.

When the tests and connections are complete, the transformer may be energized.

Do not make any connections other than those shown on the nameplate or diagram. Do not change connections or taps while the unit is energized.

This dry-type transformer was built and tested in accordance with applicable standards of American National Standards Institute and National Electrical Manufacturers Association.

The following operations guides are excerpts from these standards.

The maximum allowed overvoltage is 5% above rated secondary voltage at rated kVA load with load power factor at least 80%. If the transformer is energized while the secondary is not connected to a load, then the voltage applied to the primary must not result in a voltage exceeding 110% of the rated secondary voltage.

Continuous overload capability is not intentionally designed into general purpose transformers. For short term overload capability, See ANSI C57.96-01.250 for guidelines and limitations.

Transformers depend entirely on the surrounding air for

- Aislé las derivaciones sin usar y verifique que conexiones en las derivaciones en uso este apretadas.
- No es necesario el aflojar o remover ningún componente o tornillería para la correcta operación del transformador.
- Energice el transformador y mida el voltaje en la sección secundaria, verifique que el voltaje sea correcto.
- Des energice el circuito primario y conecte las terminales del devanado secundario según la placa de datos.
- Asegúrese que todas las conexiones han sido apretadas.
- Reinstale todos los paneles del transformador.

Conexión a tierra (potencial cero)
Por requerimiento del NEC (Código Nacional Eléctrico EUA), conecte el cable de tierra física al gabinete del transformador. El núcleo del transformador esta aterrizado al gabinete.

8. GUIA DE ENERGIZADO Y OPERACION

⚠ PELIGRO

La omisión en el seguimiento de las recomendaciones debajo puede resultar en lesiones severas, muerte o daño en propiedad o reducción de la vida útil del transformador.

Para transformadores ventilados solamente: si existiera humedad evidente, la unidad debe de secarse ya sea dentro de un horno o soplando aire caliente a través de la ella. La temperatura no debe exceder 110º C (230º F) para prevenir daños al aislamiento del transformador.

Una vez probado el transformador y terminadas las conexiones, el transformador puede ser energizado.

No intente realizar conexiones diferentes a las mostradas en la placa de datos. No intente modificaciones o cambio de derivaciones (taps) con el transformador energizado.

Este transformador tipo seco fue construido y probado de acuerdo a normas aplicables ANSI (American National Standards Institute, EUA) y NEMA (National Electrical Manufacturers Association, EUA).

Las siguientes instrucciones de operación son extractos de esas normas.

El sobre voltaje máximo permitido es 5% sobre el voltaje nominal secundario, a carga (kVA) nominal, con un factor de potencia de al menos 80%. Si el transformador se energiza sin que el secundario esté conectado a una carga, entonces el voltaje aplicado al primario no debe provocar un voltaje secundario mayor al 110% del nominal.

Los transformadores de uso general no están diseñados para soportar sobrecargas continuas. Para información acerca de capacidad de sobre carga durante periodos cortos de tiempo, consulte ANSI C57.96-01.250.

adequate ventilation. The ambient should not exceed 40ºC (104ºF) and the average temperature of the air for any 24 hour period should not exceed 30ºC (86ºF). For operation at higher ambient, the transformer kVA load needs to be reduced. Refer to NEMA ST-20 for detailed de-rating guidelines.

The transformer may be connected in parallel with other transformers if the phase angle shift is the same; phase rotation is the same; transformers' turn ratios and voltage ratings are within a 0.5% range; and the percent impedance on the same kVA base is within a 7.5% range.

Transformers are normally designed for operation at altitudes below 1000 meters (3300 feet). To operate a transformer above 1000 meters, it is necessary to reduce the kVA load and to increase the electrical insulation clearances between energized terminals. Refer to NEMA ST-20 for detailed guidelines.

9. MAINTENANCE AND REPAIR

⚠ DANGER

Follow the instructions set forth below before attempting repairs.

Electrical hazard. Turn off power before servicing.

Immediately replace cover after repair or adjustment.

Lockout power supply before servicing equipment.

Use proper personal protection equipment with qualified personnel only.

It is the responsibility of the owner to inspect, maintain and keep the transformer in good repair.

Report all failures during the warranty period to your local sales office prior to repairs. All warranty repairs must be made or approved by the manufacturer.

A minimal amount of maintenance is required on a dry-type transformers, however, periodic inspection should be performed as indicated below:

- ■ De-energize transformer.
- ■ Make sure the unit is cool before servicing.
- ■ Check for any accumulation of dust or dirt on the terminations or vents. If necessary, remove by vacuuming, brushing, or blowing dry air. Special care should be taken when blowing with dry air to prevent further damage to the product or injury to maintenance personnel from flying particles.
- ■ Inspect insulators, terminals, terminal boards, for tracking (discharge), breaks, cracks, or burns. Clean or repair if necessary.

Los transformadores ventilados dependen completamente del aire circundante para su adecuada ventilación. El ambiente no debe exceder los 40ºC (104ºF) y el promedio de temperatura del aire no debe exceder los 30ºC (86ºF) en un periodo de 24 horas. Para operación a temperaturas mayores, la carga del transformador necesita ser reducida. Consulte NEMA ST-20 para una guía detallada de como reajustar la capacidad del transformador.

El transformador puede conectarse en paralelo con otros transformadores solo si: el ángulo de fase es el mismo, la rotación de fase es igual, la relación de vueltas y los voltajes nominales están dentro de un 0.5% del rango, y el porcentaje de impedancia, basado en el mismo KVA, está dentro del rango de 7.5%.

Los transformadores normalmente se diseñan para operar a altitudes por debajo de 1000 metros (3300 Ft.). Para operaciones sobre 1000m es necesario reducir la carga en kVA e incrementar los claros entre terminales energizadas. Consulte NEMA ST-20 para más información.

9. MANTENIMIENTO Y REPARACION

⚠ PELIGRO

Antes de dar mantenimiento siga las instrucciones debajo.

Riesgo eléctrico. Des energice antes de dar mantenimiento.

Coloque de nuevo los paneles después de reparaciones o ajustes.

Bloquee las fuentes de poder antes de dar mantenimiento al equipo.

Use equipo de protección personal adecuado y personal calificado solamente.

Es responsabilidad del propietario la inspección, mantenimiento y reparación del transformador.

Durante la vigencia de la garantía, notifique las fallas a su oficina de ventas antes de intentar reparar el transformador. Toda reparación bajo garantía debe ser hecha o aprobada por el fabricante.

Un transformador tipo seco requiere una cantidad mínima de mantenimiento, sin embargo se requiere de inspecciones periódicas según las indicaciones debajo:

- ■ Des energice el transformador.
- ■ Deje enfriar la unidad antes de darle servicio.
- ■ Busque polvo y suciedad acumulados en terminales y ventilaciones. De ser necesario, remueva con aspiradora, cepillando o soplando aire seco. Se debe tener cuidado al soplar aire seco para prevenir posibles daños al producto o al personal debido a las partículas sueltas.
- ■ Inspeccione por quebraduras, quemaduras y fisuras en aislantes, terminales y soportes de terminales. Limpie o repare según sea necesario.

- Check terminal quality and connections, including taps, for tightness. Replace or tighten as necessary.
- Inspect ground connections and ground contact surfaces. Tighten or repair if needed.
- For ventilated transformers only, if moisture is evident, the unit should be dried out by placing it in an oven or by blowing heated air over it. The temperature should not exceed 110ºC (230ºF) to prevent damage to installation wiring.
- Inspect the paint finish for scratches or wear. Repair the finish if necessary.

10. SAFETY

The installation, operation and maintenance of a transformer present numerous potential unsafe conditions, including, but not limited to the following:

- Improper tap changing operation
- Arc Flash exposure
- Lethal voltages
- Moving machinery
- Heavy components
- High temperature components

All applicable safety procedures as OSHA requirements, regional and local safety requirements, safe working practices, NFPA 70 and good judgment must be used by personnel when installing, operating, and/or maintaining such equipment.

⚠ DANGER Failure to adhere to the following could result in severe bodily damage, injury, death, or property damage.

Refer to appropriate areas of this instruction book for further instructions.

1. When the transformer is energized, the electrical terminations are at high voltages. Close exposure to these parts could result in death by electrocution.
2. Do not remove enclosure panels and/or doors when the transformer is energized. Do not energize transformer for operation until the panels are properly installed.
3. Improper or inadequate maintenance could result in reduced transformer life, cause personal injury, death, or property damage.

11. DISCLAIMER OF WARRANTIES AND LIMITATION OF LIABILITY

There are no understandings, agreements, representations or warranties, express or implied, including warranties of merchantability or fitness for a particular purpose, other than those specifically set out by any existing contract between

- Revise la calidad y firmeza de terminales y contactos, incluyendo las derivaciones (taps). Apriete o reemplace según sea necesario.
- Revise conexiones y superficies de contacto a tierra (potencial cero). Limpie, apriete o repare según sea necesario.
- Para Transformadores ventilados solamente: si existiera humedad evidente, la unidad debe de secarse ya sea dentro de un horno o soplando aire caliente a través de la ella. La temperatura no debe exceder 110º C (230º F) para prevenir daños al aislamiento del transformador.
- Inspeccione raspaduras o deterioro en el acabado de la pintura exterior del gabinete. Retoque de ser necesario.

10. SEGURIDAD

La instalación, operación y mantenimiento de un transformador presenta numerosas condiciones inseguras, incluyendo entre otras:

- Modificar arreglo de derivaciones (taps) inapropiadamente.
- Exposición a arco eléctrico.
- Voltajes mortales
- Equipo en movimiento
- Partes y componentes pesados
- Componentes a altas temperaturas.

Todos los procedimientos de seguridad como los requeridos por OSHA (Occupational Safety & Health Administration, EUA), instituciones como CFE, IMSS y STPS (MEX) u otros aplicables, requerimientos locales y regionales deben ser usados por el personal durante la instalación y mantenimiento del transformador, así como también seguir prácticas de seguridad y buen juicio.

⚠ PELIGRO El no apegarse a las siguientes recomendaciones puede resultar en lesiones severas, muerte o daño en propiedad.

Para más información refiera las secciones apropiadas de este manual.

1. Cuando el transformador está energizado las terminales eléctricas mantienen un alto potencial (voltaje). El exponerse a estas partes puede causar muerte por electrocución.
2. No remueva los paneles y/o tapas cuando el transformador esté energizado. No energice el transformador sin haber reinstalado dichos elementos.
3. El mantenimiento inapropiado reduce la vida útil de la unidad y puede causar lesiones personales, muerte o daño a la propiedad.

11. LIMITES EN RESPONSABILIDAD Y GARANTIA

No hay entendimientos, acuerdos, representaciones o garantías, expresas o implícitas, incluyendo garantías de mercadeo o adecuación a un propósito particular, más que aquellas estipuladas en un contrato existente entre las the parties. Any such contract states the entire obligation of seller, the contents of this document shall not become part of or modify any prior or existing agreement, commitment or relationship.

The information, recommendations, descriptions and safety notations in this document are based on industry experience and judgment with respect to transformers. This information should not be considered to be all inclusive or covering all contingencies. If further information is required the local sales office should be consulted. No warranties express or implied, including warranties of fitness for a particular purpose or merchantability, or warranties arising from course of dealing or usage of trade, are made regarding the information, recommendations, descriptions, and safety notations contained herein. In no event will the manufacturer be responsible to the user in contract, in tort (including negligence), strict liability or otherwise for any special, indirect, incidental or consequential damage or loss whatsoever, including but not limited to damage or loss of use of equipment, plant or power system, cost of capital, loss of profits, or revenues, cost of replacement power, additional expenses in the use of existing power facilities, or claims against the user by its customers resulting from the use of the information, recommendations, descriptions and safety notations contained herein.

partes. Tal contrato establece toda la obligación del vendedor. El contenido de este instructivo no será parte ni modificará cualquier acuerdo, compromiso o relación previa o existente.

La información, recomendaciones, descripciones y notas de seguridad se basan en la experiencia y el juicio del fabricante en la industria de transformadores. Este instructivo no cubre ni incluye todas las contingencias posibles. Si requiere más información consulte la oficina local de ventas. Ninguna garantía, expresa o implícita, incluyendo garantías de adecuación a un propósito particular o mercadeo, o garantías surgidas de negociaciones o tratos comerciales, se hace concerniente a la información, recomendaciones descripciones y notas de seguridad contenidas aquí. En ningún caso el fabricante será responsable ante el usuario en contrato, por agravio, responsabilidad a terceros o de otra forma, por ningún daño o pérdida especial, indirecta, incidental o consecuente, incluyendo pero no limitado a daño o pérdida en el uso de equipo, sistemas de planta o potencia, costo de capital, pérdida de utilidades o ingresos, costo de reemplazo de potencia, gastos adicionales en el uso de instalaciones de potencia existentes, o reclamos contra el usuario de parte de sus clientes por el uso de la información, recomendaciones, descripciones y notas de seguridad contenidas aquí.

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- Special labeling
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Transformer Flex Center

Switching Devices Flex Center

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Powering Business Worldwide

Enclosed Control (NEMA)

Powering Business Worldwide

Section Table of Contents
Enclosed Control (NEMA)

Powering Business Worldwide

Drawings

General Information: ENCLOSC

Description	Value
==	======================
PRODUCTINFORMATION	
CATALOG NUMBER:	ECS9428CAL-C34C12K5P7P24P25P68P71S3U5W4C12C40
COUNTRY:	USA Enclosed Control
LEAD TIME CODE:	U
LEAD TIME (BUSSINESS DAYS):	Consult Factory
QTY:	4
==	======================
ENCLOSEDCONTROL	
STARTER DESIGN:	Soft Starter
STARTER/CONTACTOR TYPE:	S811 Soft Starter
==	======================
STARTERCONFIGURATION	
SERVICE FACTOR / DUTY RATING:	1.15 Severe Duty
MOTOR/LOAD VOLTAGE:	460V
COIL VOLTAGE:	24V DC
CPT SELECTION:	C34 - 300VA Control Power Transformer, 120V secondary with
MAX HORSEPOWER RATING:	150
NOMINAL MOTOR / LOAD AMPS:	180 Amps
RESULTANT SIZE:	360A
OVERLOAD TYPE:	Display On The Door
DISPLAY LOCATION:	======================
==	
ENCLOSURE	Disconnect Switch
DISCONNECT:	400A 600v Class R
DISCONNECT RATING (FURE CLIP OR CIRCUIT BREAKER):	NEMA 12 - Dusttight
ENCLOSURE TYPE:	

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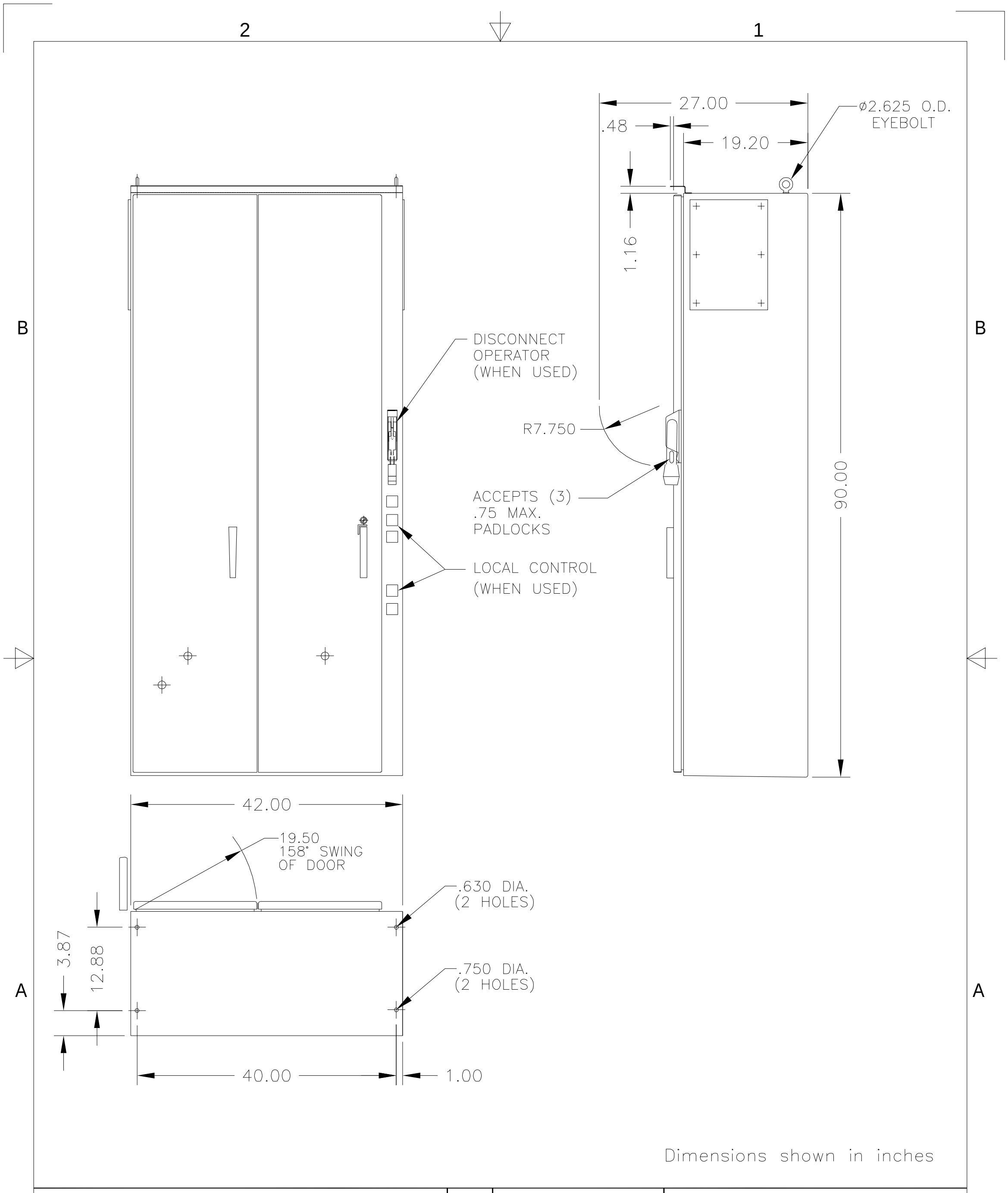
PREPARED BY Vaibhav Titame	DATE 12/21/2023	EATON Powering Business Worldwide		
APPROVED BY	DATE	JOB NAME Taunton WWTF PH2 DESIGNATION BTB6101 200HP		
VERSION 1.0.4.0		TYPE ENCLOSC	DRAWING TYPE Customer Appr.	
NEG-ALT Number D7580427X2K2-R001	REVISION 0	DWG SIZE A	G.O. LBS0031682	ITEM 034
SHEET 1 of 1				



Dimensions shown in inches

SIZE A	FILENAME 84-29113.DWG	DWG. NO. 84-29113	
REV. 2 **EATON**	SUBTITLE BOX F2A NEMA 1		SHEET NO. 1 OF 1

EAD_ACAD_FRMA1
REV. 05/13/08

2 1

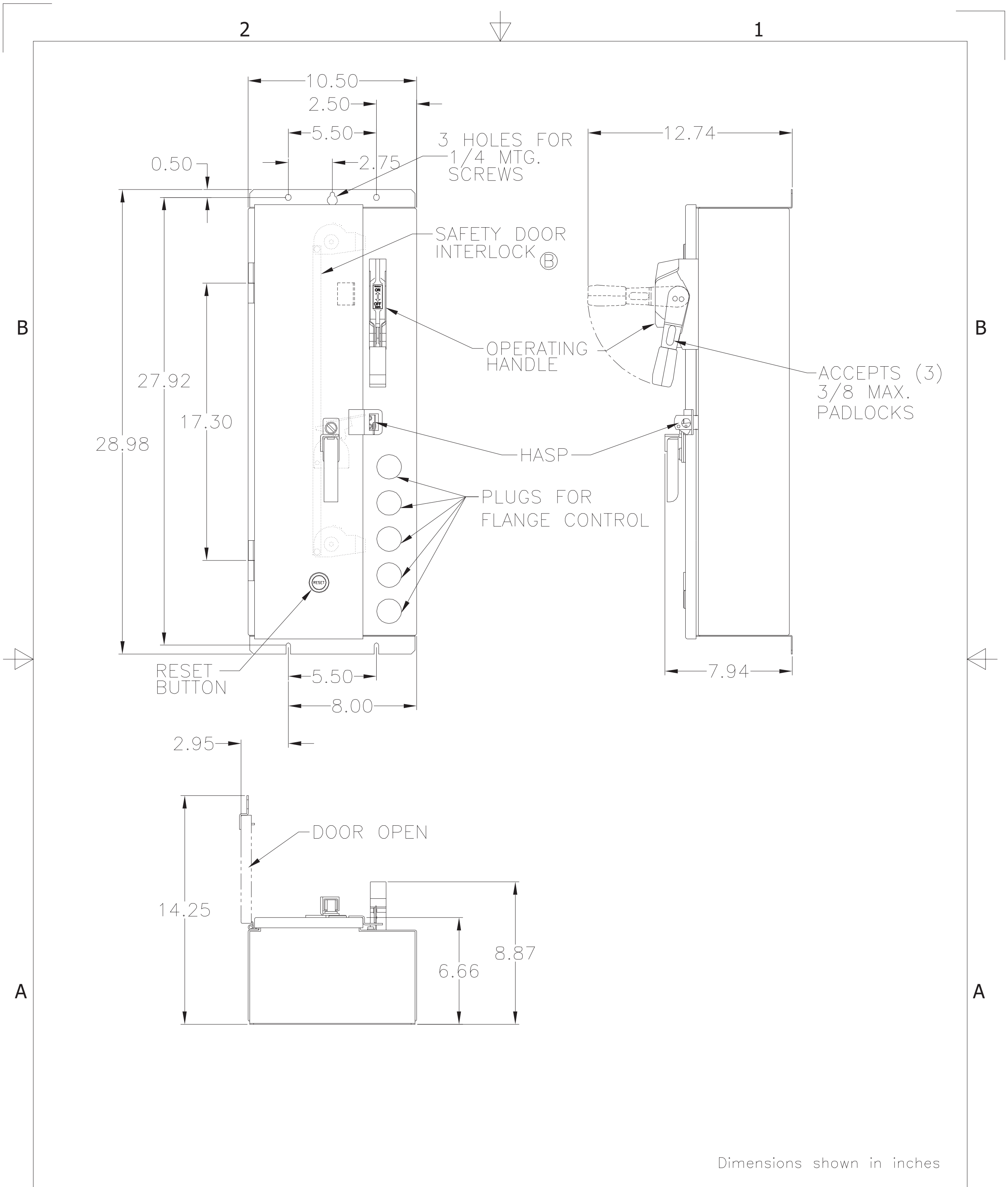
GO/NEG-Alt-Date: LBS0031682-R001-12/21/2023		**Job Name:** Taunton WWTF PH2
Item Number: 034	**Catalog Number:** ECS9428CAL-C40C12C34P24P2	**Designation:** BTB6101 200HP, BTB6201 200HP, BTB6301 200HP,...

General Information: ENCLOSC

Description	Value
===	=======================
PRODUCTINFORMATION	
CATALOG NUMBER:	ECN2418CAE-R63/C
COUNTRY:	USA Enclosed Control
LEAD TIME CODE:	U
LEAD TIME (BUSSINESS DAYS):	Consult Factory
QTY:	4
===	=======================
ENCLOSEDCONTROL	
STARTER DESIGN:	NEMA - Freedom
STARTER/CONTACTOR TYPE:	Full Voltage Non-Rev.
===	=======================
STARTERCONFIGURATION	
MOTOR/LOAD VOLTAGE:	460V
COIL VOLTAGE:	120V/60 110V/50
CPT SELECTION:	C1 - Standard Size CPT, 120V/60HZ,110V 50HZ secondary w/2 p
MAX HORSEPOWER RATING:	10
NOMINAL MOTOR / LOAD AMPS:	14 Amps
RESULTANT SIZE:	1
OVERLOAD TYPE:	SSOL - C440
OVERLOAD RANGE (AMPS, ONLY FOR SOLID STATEO O/L):	4-20
===	=======================
ENCLOSURE	
DISCONNECT:	Circuit Breaker
DISCONNECT RATING (FURE CLIP OR CIRCUIT BREAKER):	30 amp
ENCLOSURE TYPE:	NEMA 12 - Dusttight

PREPARED BY Vaibhav Titame	DATE 12/21/2023	EATON Powering Business Worldwide	
APPROVED BY	DATE	JOB NAME Taunton WWTF PH2 DESIGNATION FCD S1 FVNR	
VERSION 1.0.4.0		TYPE ENCLOSC	DRAWING TYPE Customer Appr.

NEG-ALT Number	REVISION	DWG SIZE	G.O.	ITEM	SHEET
D7580427X2K2-R001	0	A	LBS0031682	035	1 of 1



Dimensions shown in inches

	SIZE A	FILENAME 84-28854.DWG	DWG. NO. 84-28854
REV. 2	EATON	SUBTITLE BOX A NEMA 12 (SDI ENCLOSURE)	SHEET NO. 1 OF 1

EAD_ACAD_FRMA1
REV. 05/13/08

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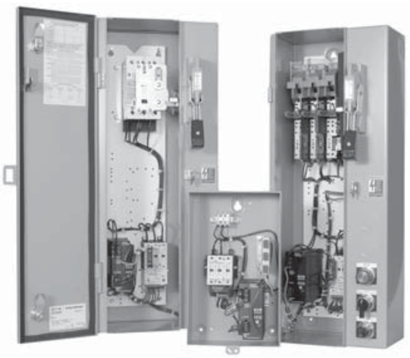
Powering Business Worldwide

Instruction Data

Technical Data **TD03309002E**

Effective April 2017
Supersedes January 2005

Storage, handling, installation and Maintenance of controllers



Eaton's Enclosed Control Units

Storage

Electrical control equipment which is to be stored prior to its installation should be checked before being placed in storage for possible damage during transit. It should then be repacked and stored in a location which is clean and dry.

When storage is in or near buildings under construction, provide covers to protect the equipment against dust, moisture and falling objects.

Apparatus stored for long periods may corrode. Damage, while stored, will be minimized by maintaining the best possible storage conditions, and by periodically inspecting the equipment and arresting the progress of corrosion and other forms of deterioration which may be found. A small amount of heat will stop corrosion that occurs from moisture due to condensation.

Handling

Industrial control equipment often includes instruments, relays and similar devices which are readily damaged when roughly handled. Because of this, it is important that control equi ment be handled with care.

Lift unpacked controllers by lifting angles when provided, and by the frame or enclosure when special lifting devices are not included. Never attempt to lift a control by means of panel mounted switches, contacters, etc.

If practical, the controller should not be unpacked until it is delivered to the plant location where it is to be installed.

Unpacked controllers are more readily damaged while being moved from one point to another than controllers still in the carton.

Location

Motor controllers should be located within plain view of the motor and as close to it as conditions will permit. If possible, locate the controller in a direct line between the power supply and the motor to save cable and minimize line losses.

Refer to local authorities having juridiction for specific requirements or application considerations.

Installation

Industrial controllers are designed to be installed in accordance with NFPA 70 (NEC) and operated and maintained by adequately trained technicians in accordance with safety practices of NFPA 70E. These instructions do not cover all details, variations, or combinations of the equipment, its storage, delivery, installation, check-out, safe operation or maintenance. Care must be exercised to comply with local, state and national regulations, as well as safety practices, for this class of equipment.

1. **The nameplate ratings of the controller must agree with the power supply and the rating of the load (motor).**
2. **Controller mounting should be solid to prevent vibration. When the controller is provided with a channel iron base, grout the base in place. For high vibration applications, additional mounting equipment may be required. Refer to Technical Data documentation of the controller for vibration ratings and installation considerations.**
3. **Make connections in accordance with the diagrams furnished with the controller. Select 75°C wire in accordance with the National Electrical Code (NEC) where conductor size is not specified in the instruction material furnished with the controller.**

4. For the connections between a DC ammeter shunt and a remotely mounted ammeter, choose a wire size which will give the lead resistance specified on the dial of the ammeter. A remotely mounted ammeter may have a calibrating resistor to compensate for insufficient lead resistance. In this case choose an oversize wire and adjust the calibrating resistor to obtain the correct lead resistance.
5. Before making any connections, be certain that all leads to be handled are dead. Make no connections with live conductors.
6. Make connections to power leads last, applying proper lock-out tagout procedures.
7. A disconnecting means and short circuit protection must be installed ahead of the controller, unless they are included as a part of the controller.
8. With the power off, operate contactors, relays and interlocks by hand to see that they work freely. Mechanical interlocks should prevent the contacts of one contactor from touching while the other contactor is closed.
9. Turn the handles of rheostats, if provided, throughout their travel to see that the contact arm does not stub in passing over the contacts.
10. See that all terminals and current carrying joints are clean and tight. Refer to published torque requirements of the controller.
11. Before starting, disconnect the motor and check the operating sequence of the controller. Disconnect power and then reconnect the motor.
12. Close the circuit to the power supply. If a motor controller has separate switches for the power circuit and for the control circuit, always close the power circuit switch first and the control circuit switch last; this sequence will prevent picking up the contactors and then starting the motor with the disconnect switch.

If a DC motor has both a shunt field and a series field, their polarities should be the same. To check the relative polarities of these two fields, disconnect the shunt field and jog the motor with the series field alone; then reconnect the shunt field and jog the motor again; if the motor jogs in the same direction both times, the relative polarities of the shunt and series fields are correct.

If the controlled motor rotates in the wrong direction, check its field polarity and the power supply polarity or phase rotation to be sure they agree with the diagram. If so, for a DC motor interchange the armature connections A1 and A2. (Do not change the motor internal connection between the brush holder and the commutating field coil.) For a three-phase AC motor, interchange any two of the power connections to the motor. For other AC motors, refer to the instructions on the motor nameplate.

Preventive Maintenance

Preventive maintenance should be a program, a scheduled periodic action that begins with the installation of the equipment. At that time, specific manufacturer's instruction literature should be consulted, then stored for future reference. Follow-up maintenance should be at regular intervals, as frequently as the severity of duty justifies. Time intervals of one week, or one month, or one year may be appropriate, depending on the duty. It is also desirable to establish specific check lists for each control, as well as a logbook to record the history of incidents. A supply of renewal parts should be obtained and properly stored.

General guidelines

The whole purpose of maintaining electrical equipment can be summarized in two rules:

- Keep those portions conducting that are intended to be conducting.
- Keep those portions insulated that are intended to be insulated.

Good conduction requires clean tight joints free of contaminates such as dirt and oxides.

Good insulation requires the absence of carbon tracking and the absence of contaminants such as salt and dust that become hydroscopic and provide an unintended circuit between points of opposite polarity.

⚠ WARNING

MAINTENANCE OF CONTROL COMPONENTS REQUIRES THAT ALL POWER TO THESE COMPONENTS BE TURNED OFF BY OPENING AND LOCKING OPEN THE BRANCH CIRCUIT DISCONNECT DEVICE, USUALLY A SWITCH OR CIRCUIT BREAKER LOCATED IN THE SAME ENCLOSURE AS THE CONTROL COMPONENTS OR IN A PANEL BOARD OR SWITCHBOARD FEEDING THE CONTROL ENCLOSURE. SEPARATE CONTROL SOURCES OF POWER MUST ALSO BE DISCO NECTED. IF CONTROL POWER IS USED DURING MAINTENANCE, CAUTION SHOULD BE USED TO PREVENT FEEDBACK OF A HAZARDOUS VOLTAGE THROUGH A CONTROL TRANSFORMER. BE ALERT TO POWER FACTOR CORRECTION CAPACITORS THAT MAY BE CHARGED. DISCHARGE THEM BEFORE WORKING ON ANY PART OF THE ASSOCIATED POWER CIRCUIT.

Cleaning

Soot, smoke, or stained areas (other than inside arc chutes), or other unusual deposits, should be investigated and the source determined before cleaning is undertaken. Vacuum or wipe clean all exposed surfaces of the control component (especially the pollution of the magnet pole surfaces) and the inside of its enclosure. Equipment may be vacuumed or blown clean with compressed air that is dry and free from oil. (Be alert to built-in oilers in factory compressed air lines!) If air blowing techniques are used, remove arc covers from contactors and seal openings to control circuit contacts that are present. It is essential that the foreign debris be removed from the control enclosure, not merely rearranged. Be careful not to force debris into other components such as circuit breakers. Control equipment should be clean and dry. Remove dust and dirt inside and outside the cabinet without using liquid cleaner. Remove foreign material from the outside top and inside bottom of the enclosure, including hardware and debris, so that future examination will reveal any parts that have fallen off or dropped onto the equipment. If there are liquids spread inside, determine the source and correct by sealing conduit, adding space heaters, or other action as applicable. It is advised that proper personal protection equipment be used while cleaning.

Mechanical checks

Tighten all electrical connections. Look for signs of overheated joints, charred insulation, discolored terminals, etc. Mechanically clean to a bright finish (don’t use emery paper) or replace those terminations that have become discolored. Determine the cause of the loose joint and correct. Be particularly careful with aluminum wire connections. Aluminum wire is best terminated with a crimp type lug that is attached to the control component. When screw type lugs (marked CU/AL) are used with aluminum wire, joints should be checked for tightness every 200 operations of the device.

Wires and cables should be examined to eliminate any chafing against metal edges caused by vibration, that could progress to an insulation failure. Any temporary wiring should be removed, or permanently secured and diagramsmarked accordingly.

The intended movement of mechanical parts, such as the armature and contacts of electromechanical contactors, and mechanical interlocks should be checked for freedom of motion and functional operation.

Wrap-Up

Check all indicating lamps, mechanical flags, doors, latches, and similar auxiliaries and repair, if required.

Log changes and observations into record book before returning equipment into service. Do not remove any labels or nameplates. Restore any that are damaged.

Contact Wear and Replacement

Contactors are subject to both mechanical and electrical wear during their operation. In most cases mechanical wear is insignificant. The erosion of the contacts is due to electrical wear. During arcing, material from each contact is vaporized and blown away from the useful contacting surface.

A critical examination of the appearance of the contact surfaces and a measurement of the remaining contact overtravel will give the user the information required to get the maximum contact life.

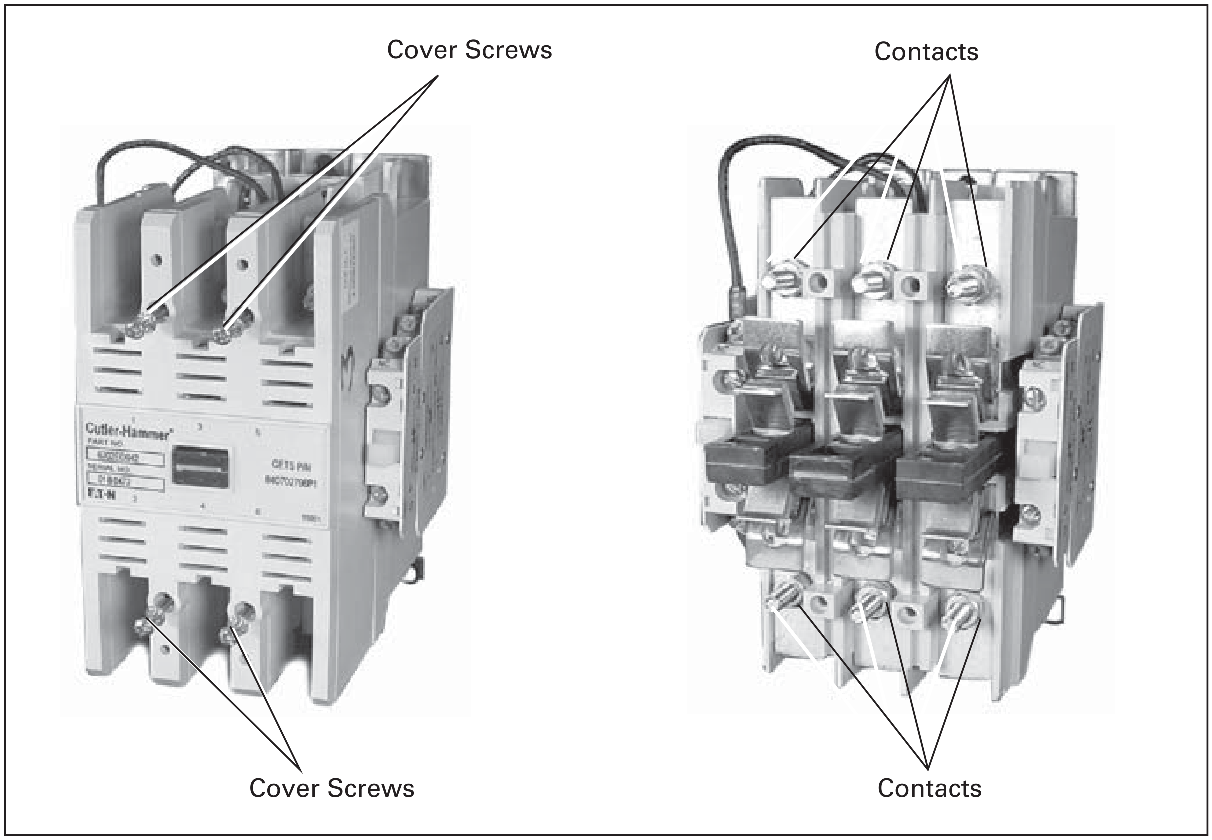


Figure 1. Example Contact Configuration

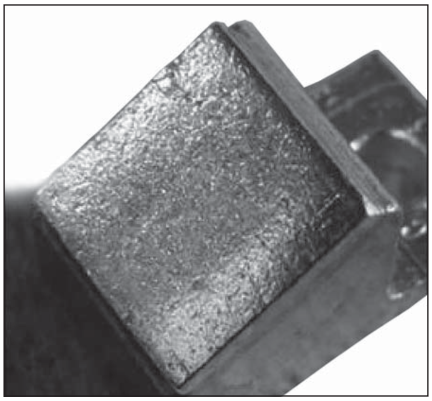


Figure 2. New

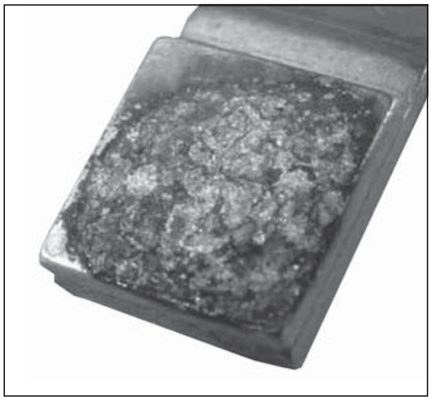


Figure 3. Start of Service Life

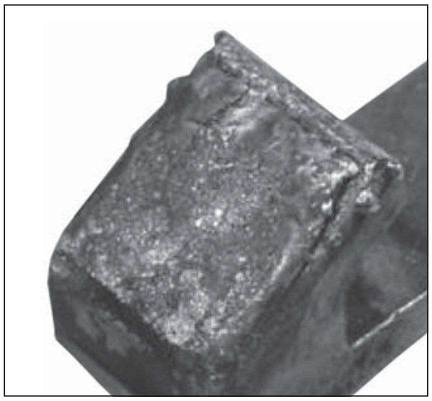


Figure 4. End of Service Life

Table 1. Contact Evaluation

Time of Service	Contact Appearance
New	The new contact has a uniform silver color. (**See Figure 2** .)
Start of Service	The contact surface will have a blue coloring. The geometric form of the contact is unchanged. The sharp outer corners will be rounded with small silver beads. (**See Figure 3** .)
Intermediate Service to End of Service Life	The coloring changes to brown or black with distributed small silvery white areas. The surface has a finely chiselled appearance. Material transfer causes small peaks and valleys in the contact button surface. (See Figure 4 .)

Table 2. Abnormal Wear Conditions

Contact Appearance	Cause
Curling and Separation of Corner of Contact	Curling is usually a result of service that produces very high heat, as under jogging or inching duty.
Irregular Contour or Slantwise Wear	One corner of a contact may wear more quickly than the other three corners. This wear is normally due to misalignment of the moving and stationary contacts. Contacts should be replaced if it is apparent that one contact is nearly making direct contact with the contact carrier.
Large Beads of Silver on Edges of Contacts	Breaking an excessive current.
Welded Spot (Core of Smooth, Shining Silver Surrounded by a Roughened Halo	Making an excessive current. High frequency of operation, i.e., jogging.

Overtravel Measurement

Contact life has ended when the overtravel of the contacts has been reduced to .020 inch.

Overtravel of the contact assembly is that part of the stroke which the moving contacts would travel after touching the fixed contacts, if they were not blocked from movement by the fixed contacts.

A method of measuring overtravel is as follows:

A. **Place a .020 inch feeler gauge between the armature and magnet, with the armature held tightly against the magnet.**

B. **Check continuity in each phase, i.e., determine if circuit from terminal-to-terminal for each pole is open under these conditions.**

C. **If there is continuity through all phases, the remaining overtravel is sufficient. If there is not continuity through all phases, replace all stationary and moving contacts plus moving contact overtravel springs. After replacing parts, manually operate contactor to be sure binding does not occur.**

When Contact Replacement Is Required

Contacts should be replaced when indicated by either the visual or measurement methods outlined in the previous paragraphs.

In the case of extreme pitting or curling of the contacts, it is possible that the measurement method would indicate sufficient overtravel, but the contacts should be replaced. In this case, the application should be questioned. A larger unit may be required to meet jogging duty, inching duty, or abnormal load currents.

When the appearance of the contacts is good, the overtravel should be measured. The contact material cannot be allowed to wear completely away. If too much wear is allowed, single phasing of a three-phase motor or contact welding may take place.

Table 3. Contactor Troubleshooting Chart

Defect	Cause	Remedy
Contactor		
Overheating	Load current too high	Reduce load. Use larger contactor.
	Loose connections	Clean discolored or dirty connections and retighten. Replace poorly crimped lugs.
	Overtravel and/or contact force too low	Adjust overtravel, replace contacts, and replace contact springs as required to correct defect.
	Collection of copper oxide or foreign matter on copper contact faces	Clean with fine file. Use Type 12 enclosure for dirty atmosphere.
	Load is on in excess of 8 hours on copper contacts	Change operating procedure. Check factory for more suitable contacts.
	Ambient temperature is too high	Reduce load. Provide better ventilation. Relocate starter. Use larger contactor.
	Line and/or load cables are too small	Install terminal block and run larger conductors between contactor and terminal block.
Poor Arc Interruption	Arc box not in place	Install arc box.
	Arc box damaged	Replace broken or eroded insulating parts, arc horns, and grid plates. Clean or replace insulating parts having a heavy coating of foreign conducting material.
	Dirt or paint on arc horns or steel-grid plates	Remove contaminating materials which may have accumulated on arc horns and steel-grid plates.
	Magnetic hardware substituted for nonmagnetic hardware in arc box and blowout assemblies	Replace with correct hardware; brass or stainless steel as available.
	Blowout coil reversed or shorted	Replace with new blowout coil or correct defect by reversing coil.
	Oil level is low or oil is contaminated (in oilimmersed contactor)	Fill tank to proper level with fresh oil. Test at 28 kV.
Welding of Contacts	Overtravel and/or contact force is too low	Adjust overtravel, replace contacts, and replace contact springs as required to correct defect.
	Magnet armature stalls or hesitates at contact touch point	Correct low voltage at coil terminals as coil draws inrush current.
	Contactor drops open to contact-touch position because of voltage dip	Maintain voltage at coil terminals. Install low voltage protective device, sometimes called “Brownout Protector.”
	Excessive contact bounce on closing	Correct coil overvoltage condition.
	Contacts rebound to contact-touch position when opening	Correct mechanical defect in stop assembly. Correct mechanical defect in latch if one is used.
	Poor contact alignment	Adjust contacts to touch simultaneously within 1/32 inch.
	Jogging duty is too severe	Reducing jogging cycle. Check factory for more weld-resistant contact material. Use larger contactor.
	Excessive inrush current	Motor has locked rotor code letter greater than G. Most contactors are designed for motors with code letters A through G. Therefore, use larger contactor. Check factory for more weld-resistant contact material.
	Vibration in starter mounting	Move starter to location having less shock and vibration. Insulate starter form shock and vibration. Provide more rigid support for starter.
Contacts		
Contact Chatter	Low voltage	Check supply voltage, especially during starting. Check coil voltage rating. Increase voltage or change coil rating as required.
	Poor contact in control circuit	Replace the contact or use holding-circuit interlock (3-wire control).
	Broken shading coil	Replace magnet and armature assemblies.
Welding	Abnormal inrush current	Use next larger size contactor or check for grounds, shorts, or excessive motor load current.
	Rapid jogging	Install larger device rated for jogging service.
	Insufficient contact pressure	Replace contacts and springs, check contacts for abnormal wear or damage.
	Low voltage preventing magnet from sealing	Check supply voltage to coil, especially for momentary voltage dip during starting.
	Foreign matter preventing contacts from closing	Clean contacts with freon. Contacts used at low current and voltage levels should be cleaned with freon.
	Vibration in starter mounting	Insulate starter from shock and vibration.
	Short circuit	Remove fault and check to be sure fuse or breaker size is correct.

Contactor Troubleshooting Chart, Continued

Defect	Cause	Remedy
Contacts, continued		
Short Contact Life or Overheating	Filing or dressing	DO NOT FILE SILVER CONTACTS. Rough spots or discoloration will not harm contacts or impair their efficiency.
	Interrupting excessively high currents	Install larger unit. Check for grounds, shorts or excessive motor currents.
	Excessive jogging	Install larger unit rated for jogging service.
	Weak contact pressure	Replace contacts and springs. Check contacts for abnormal wear or damage.
	Foreign matter on contact surface	Clean contacts with freon. Take steps to reduce entry of foreign matter into enclosure.
	Short circuit or ground fault	Remove fault and check to be sure fuse or breaker size is correct.
	Loose connection in power circuit	Clean and tighten.
	Sustained overload	Check for excessive motor load current or install larger unit.
Magnetic and Mechanical Parts		
Noisy Magnet	Broken shading coil	Replace magnet and armature.
	Rust or dirt on pole faces	Clean with freon.
	Low voltage	Check system voltage and coil voltage rating.
	Misalignment or mismating of magnet pole faces	Realign or replace magnet assembly.
Failure to Pick Up and Seal	Low voltage	Check system voltage and voltage dips during starting.
	Wrong coil or wrong connection	Check coil marking and wiring.
	Mechanical obstruction	With power off, check for free movement of armature and contacts.
	Coil open or overheated	Replace.
Failure to Drop Out	Sticky substance on pole faces	Replace.
	Voltage not removed	Check coil circuit or length of leads from supply voltage to coil. May be excessive.
	Worn or rusted parts causing binding	Replace unit.
	Contacts welded	See Welding under contacts.
Coils		
Open Circuit	Mechanical damage	Replace with new coil. Handle and store coil carefully.
Overheated Coil	Over-voltage or excessive ambient temperature	Voltage should not exceed 110% of coil rating. 40°C is maximum ambient.
	Incorrect coil	Check coil rating and replace with proper coil.
	Shorted turns caused by mechanical damage	Replace coil.
	Under-voltage/failure of magnet to seal in	Correct system voltage. 85% of rated coil voltage is minimum allowable.
	Dirt or rust on pole faces	Clean pole faces with freon or equivalent solvent.
	Mechanical obstruction	With power off, check for free movement of armature and contacts.
Overload Relays		
Nuisance Tripping	Sustained overload	Check for motor or electrical equipment grounds and shorts, as well as excessive motor currents due to overload. Check motor winding resistance to ground.
	Loose or corroded connection in power circuit	Clean and tighten.
	Loose heater screws	Clean and tighten.
	Incorrect heater	Check heater sizing and ambient temperature and replace with correct heater.
Failure to Trip	Relay previously damaged by short circuit	Replace relay and heaters.
	Incorrect heater	Check heater table and replace with correct heater.
	Relay contact welded or not in series with contactor coil	Use manual trip to check circuit. Check circuit for a fault and correct condition. Replace entire relay as required.

Contactor Troubleshooting Chart, Continued

Defect	Cause	Remedy
Manual Starters		
Failure to Operate Mechanically	Worn or broken mechanical parts	Replace unit.
	Welded contacts due to misapplication or other abnormal cause	Replace contacts and use correct application.
Nuisance Tripping	Incorrect heater	Check heater table.
Manual Pilot Devices		
Button Mechanically Inoperable	Shaft binding due to dirt or residue	Check, clean, and clear — replace as required.
	Contact block spring broken	Replace contact block.
Poor Continuity	Contaminated contacts and corrosion	Replace contact block and protect unit from environment.
Excessive Electrical Wear	Excessive jogging	Install larger device or caution operator.
	Weak contact pressure	Replace contact block.
	Short circuit	Remove fault and check to be sure fuse or breaker size is correct.
	Sustained overload	Install larger device.
Circuits, Supports Discoloring	Loose connections	Tighten hardware, or replace contact block.

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United States
Eaton.com

Publication No. TD03309002E / CPG
April 2017

EATON

Powering Business Worldwide

Component Data

S811+ Soft Starter

User Manual

Effective November 2012
Supersedes July 2012

EATON
Powering Business Worldwide

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Cover Photo: S811+ Soft Starters

Support Services

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You should contact your local distributor for product pricing, availability, ordering, expediting, and repairs.

Web Site

Use the Eaton Web site to find product information. You can also find information on local distributors or Eaton's sales offices.

Web Site Address

www.eaton.com/electrical

EatonCare Customer Support Center

Call the EatonCare Support Center if you need assistance with placing an order, stock availability or proof of shipment, expediting an existing order, emergency shipments, product price information, returns other than warranty returns, and information on local distributors or sales offices.

Voice: 877-ETN-CARE (386-2273) (8:00 a.m.–6:00 p.m. EST)
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After-Hours Emergency: 800-543-7038
(6:00 p.m.–8:00 a.m. EST)

If you are in the U.S. or Canada, and have OI or PLC questions, you can take advantage of our toll-free line for technical assistance with hardware and software product selection, system design and installation, and system debugging and diagnostics. Technical support engineers are available for calls during regular business hours.

Technical Resource Center

Voice: 877-ETN-CARE (386-2273) (8:00 a.m.–5:00 p.m. EST)

FAX: 828-651-0549

e-mail: TRC@Eaton.com

European PanelMate Support Center

This engineering company, located in Zurich, Switzerland, provides high-level quality support and repair assistance for your PanelMate products. You will receive technical and application support.

For Customers in Europe, contact:

BFA Solutions, Ltd.
Voice: +41 1 806.64.44 (9:00 a.m.–5:00 p.m. CET)

e-mail: gk@bfa.ch

www.bfa.ch

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Additional support is also available from our well-equipped Repair and Upgrade Service department. If you have questions regarding the repair or upgrade of an OI product, contact your local distributor.

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414-449-7100 (8:00 a.m.–5:00 p.m. EST)

FAX: 614-882-3414

e-mail: TRC@eaton.com

Table of Contents

SAFETY

INTRODUCTION

TECHNICAL DATA AND SPECIFICATIONS

RECEIPT/UNPACKING

INSTALLATION

Table of Contents, continued

FUNCTIONAL DESCRIPTION

S811+ OPERATING CONFIGURATION

TROUBLESHOOTING

ACCESSORIES

Table of Contents, continued

APPENDIX A—PARAMETERS

APPENDIX B—PROTECTION

APPENDIX C—RATINGS, COOLING AND POWER LOSSES—INLINE

APPENDIX D—RATINGS, COOLING AND POWER LOSSES—INSIDE-THE-DELTA

APPENDIX E—MOTOR/APPLICATION CONSIDERATIONS

APPENDIX F—PUMP CONTROL OPTION

APPENDIX G—MODBUS REGISTER MAP

APPENDIX H—UNIVERSAL COMMUNICATIONS ADAPTER

APPENDIX I—TROUBLESHOOTING GUIDE

List of Figures

List of Tables

Introduction

Technical Data and Specifications

Installation

Operating Configuration

Troubleshooting

Accessories

List of Tables, continued

Appendix A—Parameters

Appendix B—Protection

Appendix C—Ratings

Appendix G—Modbus Register Map

Appendix I—Troubleshooting

Safety

Definitions and Symbols

⚠ WARNING

This symbol indicates high voltage. It calls your attention to items or operations that could be dangerous to you and other persons operating this equipment. Read the message and follow the instructions carefully.

⚠

This symbol is the "Safety Alert Symbol." It occurs with either of two signal words: CAUTION or WARNING, as described below.

⚠ WARNING

Indicates a potentially hazardous situation which, if not avoided, can result in serious injury or death.

⚠ CAUTION

Indicates a potentially hazardous situation which, if not avoided, can result in minor to moderate injury, or serious damage to the product. The situation described in the CAUTION may, if not avoided, lead to serious results. Important safety measures are described in CAUTION (as well as WARNING).

Hazardous High Voltage

⚠ WARNING

Motor control equipment and electronic controllers are connected to hazardous line voltages. When servicing drives and electronic controllers, there may be exposed components with housings or protrusions at or above line potential. Extreme care should be taken to protect against shock.

Stand on an insulating pad and make it a habit to use only one hand when checking components. Always work with another person in case an emergency occurs. Disconnect power before checking controllers or performing maintenance. Be sure equipment is properly grounded. Wear safety glasses whenever working on electronic controllers or rotating machinery.

Warnings and Cautions

This manual contains clearly marked cautions and warnings which are intended for your personal safety and to avoid any unintentional damage to the product or connected appliances.

Please read the information included in cautions and warnings carefully.

⚠ CAUTION

Unit may weigh up to 103 pounds. Use suitable lifting device.

⚠ WARNING

Hazardous voltage can cause electric shock and burns. To avoid shock hazard, disconnect all power to the controller, motor or other control devices before any work is performed on this equipment. Failure to do so will result in personal injury, death or substantial property damage.

Do not apply a disconnect device on the output of the S811+ soft starter unless a means to turn off the soft starter when disconnect switch is open is used. Opening disconnect while the soft starter is operating may cause a malfunction. Closing disconnect switch while the soft starter is operating will result in a soft starter failure and potential equipment damage and personnel hazard.

⚠ CAUTION

Only apply 24 Vdc to Control Terminal Block. All control wiring is 22–12 AWG (0.33–2.5 mm^2).

⚠ CAUTION

Do not apply 120 Vac to the control input terminals of the Control Power Terminal Block.

⚠ CAUTION

Do not apply 24 Vdc to Network communications Terminal Block.

⚠ CAUTION

If the AUTO Reset mode setting is used, CAUTION must be exercised to assure that any restart occurs in the safe manner.

⚠ CAUTION

If the AUTO Reset mode setting is used with level sensing, CAUTION must be exercised to assure that any restart occurs in a safe manner. Motor restart may occur immediately and unexpectedly after any fault condition has cleared.

⚠ CAUTION

In the AUTO Reset mode, CAUTION must be exercised to assure that any restart occurs in a safe manner.

⚠ WARNING

Make sure you read and understand the procedures in this manual before you attempt to set up or operate the equipment.

⚠ WARNING

Do not work on energized equipment unless absolutely required. If the troubleshooting procedure requires equipment to be energized, all work must be performed by properly qualified personnel, following appropriate safety practices and precautionary measures.

⚠ WARNING

Setting the Overload Trip Class parameter to OFF disables this feature resulting in no thermal overload protection for the motor.

⚠ WARNING

Certain protection parameters may be set for TRIP Faults, WARNING Faults, or DISABLE (No TRIP or WARNING indication). Parameters set to WARNING Fault, or DISABLE will not result in a TRIP Fault and system damage may occur. Disabling protection parameters is not recommended.

Introduction

Overview

The Eaton S811+ Soft Starter from Eaton's electrical business is an electronic, self-contained, panel- or enclosure-mounted motor soft-starting device. It is intended to provide three-phase induction motors with a smooth start, both mechanically and electrically. The S811+ Soft Starters utilize six SCRs connected in a full wave power bridge. Varying the SCR conduction period controls the voltage applied to the motor. This in turn controls the torque developed by the motor. After the motor reaches speed, internal contacts are closed to bypass the SCRs.

The S811+ has built-in communications capabilities via a Communications Port. The Communications Port is a screw terminal block that is utilized for ModBus® communications or communication to an EATON HMI. Communications adapters are available for other protocols. Please consult Eaton for availability.

The S811+ Soft Starter utilizes a Digital Interface Module (DIM) that allows the user to configure the device, read and write system parameters, and evaluate fault codes for troubleshooting.

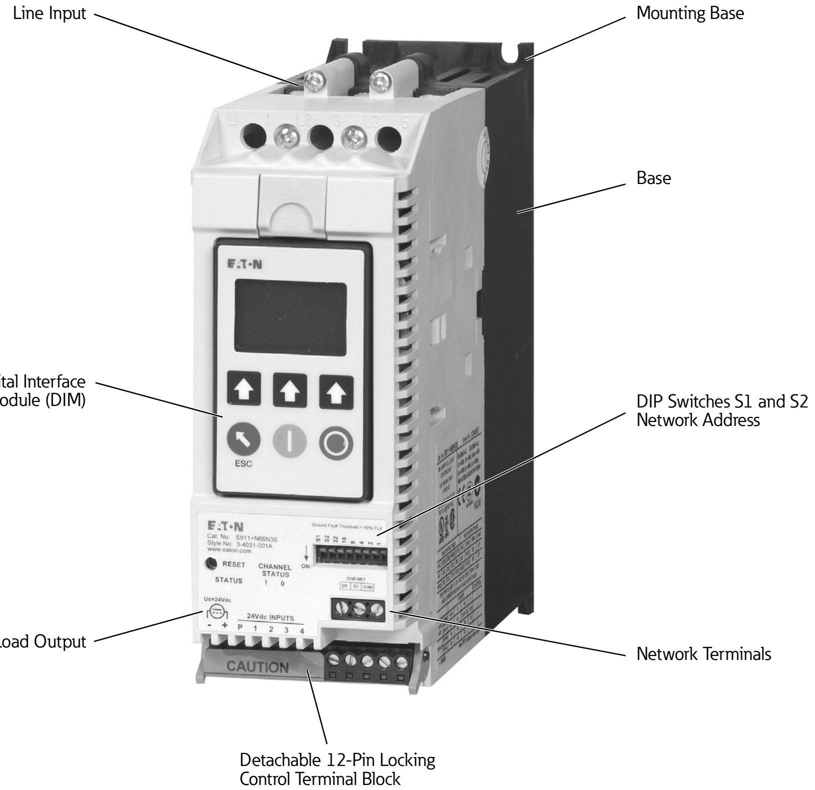
The DIM includes an easy-to-read display and keypad to scroll through the parameters. The Digital Interface Module allows the user to modify control parameters, enable or disable protections, set system variances from Fault TRIP to Fault WARNING, set communication variables, monitor system parameters such as line voltages and currents and access the fault queue.

The S811+ is designed to fulfill the industrial service requirements for applications such as Chillers, Pumps and Machine Tools that require less than 100% of the motor's rated starting torque for worst case starting condition.

The S811+ meets all relevant specifications set forth by UL 508, CSA 22.2-14-1995 IEC 60947-4-2, and CCC GB14048.

General Appearance Notes

Eaton S811+ Soft Starter



Standards and Certifications

- UL 508
- CSA 22.2-14-1995
- IEC 60947-4-2
- CCC GB14048

CE Conformance

EMC Conformance

Immunity	Severity Level
Electrostatic Discharge IEC 61000-4-2	4 kV contact discharge
	8 kV air discharge
Electromagnetic Field IEC 61000-4-3	10 V/m
	80–1000 MHz
	2 angles
Fast Transient Bursts IEC 61000-4-4	2 kV, 5 kHz rep, 2 min. intervals
1.2/50 uS to 8/20 uS Surges IEC61000-4-5	2 kV Line to earth
	1 kV Line to Line
	1 minute intervals
Conducted RF IEC 61000-4-6	10 V rms
	0.15 to 80 MHz
50 Hz Magnetic Field IEC 61000-4-8	N/A
Voltage dips Interrupt IEC 61000-4-11	30% dip at 10 mS
	60% dip at 100 mS
	100% dip at 5 S
Emissions	
Radiated	EN 55011, Class A
Conducted	EN 55011, Class A

1. The 24 Vdc power supply must be grounded.
2. Add ferrite, Fair-Rite #0446176451 to DC Control Power Leads and Control I/O Leads (all through one ferrite) at S811+.

RF Susceptibility Statement

It is possible, in the presence of strong RF fields, and at specific RF frequencies, that this device could indicate an increase of up to 40V in the measured line voltages in the 370 to 420 kHz frequency range; or an increase of up to 10% (FLA) of the measured load currents in the 111 to 132 MHz and 152 to 155 MHz frequency range. Should this occur, and affect the functions of the required motor protection settings, refer to the troubleshooting section of this manual.

Technical Data and Specifications

Environmental

Environmental Specifications

Description	Specification
Temperature range	
Operating	–40° to 122°F (–40° to 50°C)
Storage	–58° to 158°F (–50° to 70°C)
Elevation	Up to 6600 ft (2000m) above 6600 ft (2000m), derate 0.5% per 330 ft (100m)
Humidity	Functional to 95% noncondensing
Operating orientation	Any
Pollution degree IEC 60947-1	3
Shock resistance	15g in any direction
Vibration resistance	
Operating	3g in any direction
Non-Operating	3g in any direction

Physical

Unit Weight and Dimensions

			Product Size—Inches (mm)					
Catalog Number	Unit Weight Lbs (kg)		Length		Width		Height	
S811+N37…	5.8	(2.6)	7.37	(187.2)	2.66	(67.6)	6.45	(163.9)
S811+N66…	5.8	(2.6)	7.37	(187.2)	2.66	(67.6)	6.45	(163.9)
S811+R10…	10.5	(4.8)	7.92	(201.2)	4.38	(111.3)	6.64	(168.6)
S811+R13…	10.5	(4.8)	7.92	(201.2)	4.38	(111.3)	6.64	(168.6)
S811+T18…	41	(18.6)	12.71	(322.9)	7.65	(194.4)	6.47	(164.4)
S811+T24…	41	(18.6)	12.71	(322.9)	7.65	(194.4)	6.47	(164.4)
S811+T30…	41	(18.6)	12.71	(322.9)	7.65	(194.4)	6.47	(164.4)
S811+U36…	41	(18.6)	12.72	(323.1)	7.73	(196.3)	7.16	(196.3)
S811+U42…	41	(18.6)	12.72	(323.1)	7.73	(196.3)	7.16	(196.3)
S811+U50…	41	(18.6)	12.72	(323.1)	7.73	(196.3)	7.16	(196.3)
S811+V36…	91	(41.4)	16.57	(420.8)	11.05	(280.6)	7.39	(187.8)
S811+V42…	91	(41.4)	16.57	(420.8)	11.05	(280.6)	7.39	(187.8)
S811+V50…	91	(41.4)	16.57	(420.8)	11.05	(280.6)	7.39	(187.8)
S811+V65…	91	(41.4)	16.57	(420.8)	11.05	(280.6)	7.39	(187.8)
S811+V72…	91	(41.4)	16.57	(420.8)	11.05	(280.6)	7.39	(187.8)
S811+V85…	91	(41.4)	16.57	(420.8)	11.05	(280.6)	7.39	(187.8)
S811+V10…	91	(41.4)	16.57	(420.8)	11.05	(280.6)	7.39	(187.8)

Short-Circuit Ratings—Component

Frame Size	Fuses	Circuit Breaker	Voltage	SCCR Rating (A)
S811+N…	J	HFD	600	10 kA
S811+R…	RK5/J	HFD,HKD	600	10 kA
S811+T…	RK5/J	HLD	600	18 kA
S811+U…	RK5/J	HLD	600	30 kA
S811+V…	L	HND, RD	600	42 kA

Short-Circuit Ratings—Enclosed Control (Fuses)

Frame Size	Fuses	Voltage	SCCR Rating (A)	Switch Size (max), A	Switch Type
S811+N…	J	600	100 kA	100	K
S811+R…	RK5/J	600	100 kA	200	K
S811+T…	RK5/J	600	100 kA	600	K
S811+U…	RK5/J	600	100 kA	600	K
S811+V36…	RK5/J	600	100 kA	600	K
S811+V42…	L	600	100 kA	800	K
S811+V50…	L	600	100 kA	800	K
S811+V72…	L	600	100 kA	1200	ND
S811+V85…	L	600	100 kA	1200	ND
S811+V10…	L	600	100 kA	2000	K

Short-Circuit Ratings—Enclosed Control (Breaker)

Frame Size	Thermal Magnetic Circuit Breaker	Motor Circuit Protector	Voltage	SCCR Rating (A)	Max Size (breaker) A
S811+N…	HFD	HMCP	600	10 kA	150
S811+R…	HFD,HKD	HMCP	600	10 kA	150, 300
S811+T…	HLD	HMCP	600	18 kA	600
S811+U…	HLD	HMCP	600	18 kA	600
S811+V…	HND, RD	HMCP	600	35 kA, 42 kA	1000, 2000

Short-Circuit Information with IEC Breakers

Catalog Number Prefix	Starter—Maximum Rated Operational Current (Standard Duty) [A]	Motor Current—Based Upon Maximum Operational Voltage of 400 Vac [A]	Four-Pole Motor kW at 400V 50 Hz [kW]	Short Circuit Rating at 400V 50 Hz [kA]	Motor Current—Based Upon Maximum Operational Voltage of 690 Vac [A]	Four-Pole Motor kW at 690V 50 Hz [kW]	Short Circuit Rating at 690V 50 Hz [kA]	Recommended Mag—Only Breaker for IEC Markets
S811+N37…	37	34.9	18.5	50	These devices do not have 690 Vac ratings			NZMN1-S40
S811+N66…	66	55.5	30	50				NZMN1-S63
S811+R10…	105	99.7	55	50				NZMN1-S100
S811+R13…	135	135	75	50				NZMN2-S160
S811+T18…	180	161	90	50	163	160	18	NZMN2-S200
S811+T24…	240	196	110	50	253	250	18	NZMN2-S200
S811+T24…	240	231	132	50	253	250	18	NZMN3-S250
S811+T30…	304	279	160	50	303	300	18	NZMN3-S320
S811+V36…	360	351	200	50	357	355	20	NZMN3-S400
S811+V42…	420	351	200	50	357	355	20	NZMN3-S400
S811+V50…	500	437	250	50	500	500	20	NZMN3-S500
S811+V65…	650	544	315	50	628	630	20	NZMN4-ME875
S811+V72…	720	683	400	50	706	710	20	NZMN4-ME875
S811+V85…	850	769	450	50	844	850	20	NZMN4-ME875
S811+V10…	1000	863	500	50	991	1000	20	NZMN4-ME1400

Note: For more details on short-circuit protector selections and enclosure sizing, please refer to the linked spreadsheet on UL's website at: http://www.ul.com/global/documents/offerings/industries/buildingmaterials/industrialcontrolpanels/shortcut.Eaton.xls

Note: Suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 600 volts maximum when protected by Class RK5 fuses.

Note: Suitable for use on a circuit capable of delivering not more than 65,000 rms symmetrical amperes, 480 volts maximum when protected by a circuit breaker.

Receipt/Unpacking

General

Upon receipt of the unit, verify that the catalog number and unit options stated on the shipping container match those stated on the order/purchase form.

Inspect the equipment upon delivery. Report any crate or carton damage to the carrier prior to accepting the delivery. Have this information noted on the freight bill. Eaton is not responsible for damage incurred in shipping.

Unpacking

Carefully remove the unit from the shipping container. Check the unit for any signs of shipping damage. If damage is found after unpacking, report it to the freight company. Retain the packaging materials for carrier to review.

Verify that the unit's catalog number and options match those stated on the order/purchase form.

⚠ CAUTION

Unit may weigh up to 103 pounds. Use suitable lifting device.

Storage

It is recommended that the unit be stored in its original shipping box/crate until it is to be installed.

The unit should be stored in a location where:

- The ambient temperature is –58° to 158°F (–50° to 70°C)
- The relative humidity is 0–95%, non-condensing
- The environment is dry, clean and non-corrosive
- The unit will not be subjected to shock in excess of 15g's and/or vibration exceeding 3g in any direction.

Shipping

S811+Soft Starters are to be shipped in packaging that adequately protects the unit.

S811+ units installed in an OEM system as a mounted assembly in a cabinet or panel in enclosed control systems are to be adequately secured and shipped via Air-Ride carrier to prevent damage from excessive shock or vibration during shipment.

Installation

Mounting

The S811+ does not require any special tools for mounting operations.

To aid with panel layout, refer to the dimension drawings on **Pages 8–10**. Drill holes per mounting hole location as shown. Mounting hardware may utilize either tapped holes in the panel or lock washers and nuts to secure the soft starter.

To mount the unit, use all the hardware specified in the table below.

Required Mounting Hardware

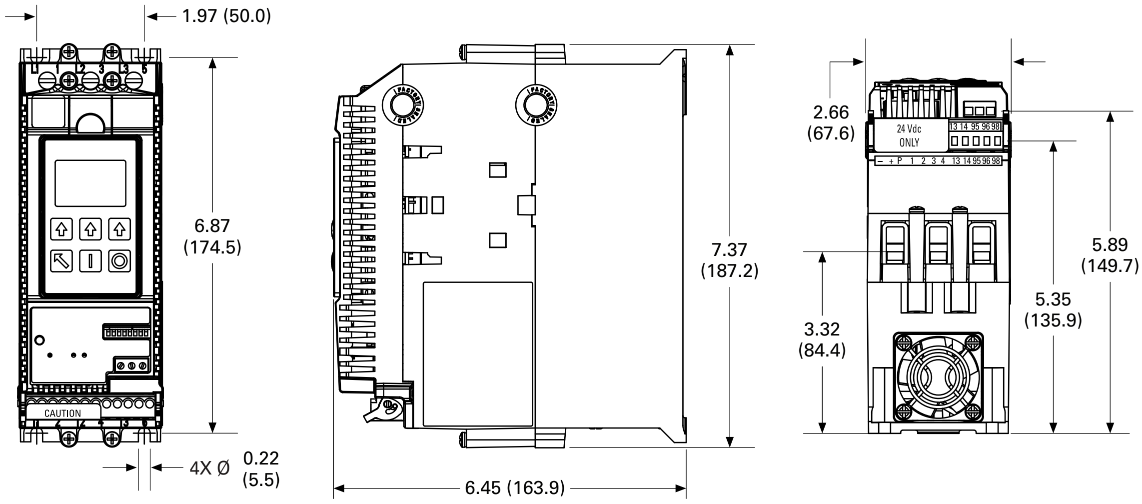
Frame Size	Bolt Dia.	Length—Minimum	Grade	Quantity—Minimum	Torque—Lb-in (Nm)
S811+N…	#10-32	0.5	5	4	15 (1.7)
S811+R…	1/4 in	0.625	5	4	25 (2.8)
S811+T…	1/4 in	0.625	5	6	30 (3.4)
S811+U…	1/4 in	0.625	5	6	30 (3.4)
S811+V…	1/4 in	1.50	8	8	50 (5.6)

Note: See **Page 3** for Weight Support Requirements.

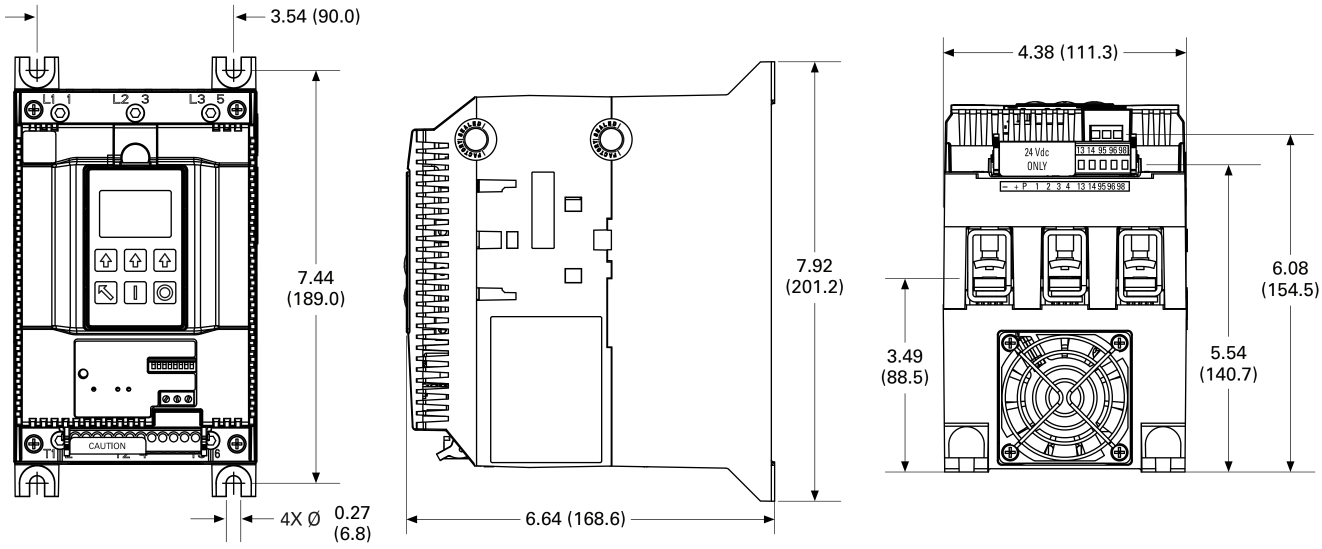
Dimensions

Approximate Dimensions in inches (mm)

S811+N…

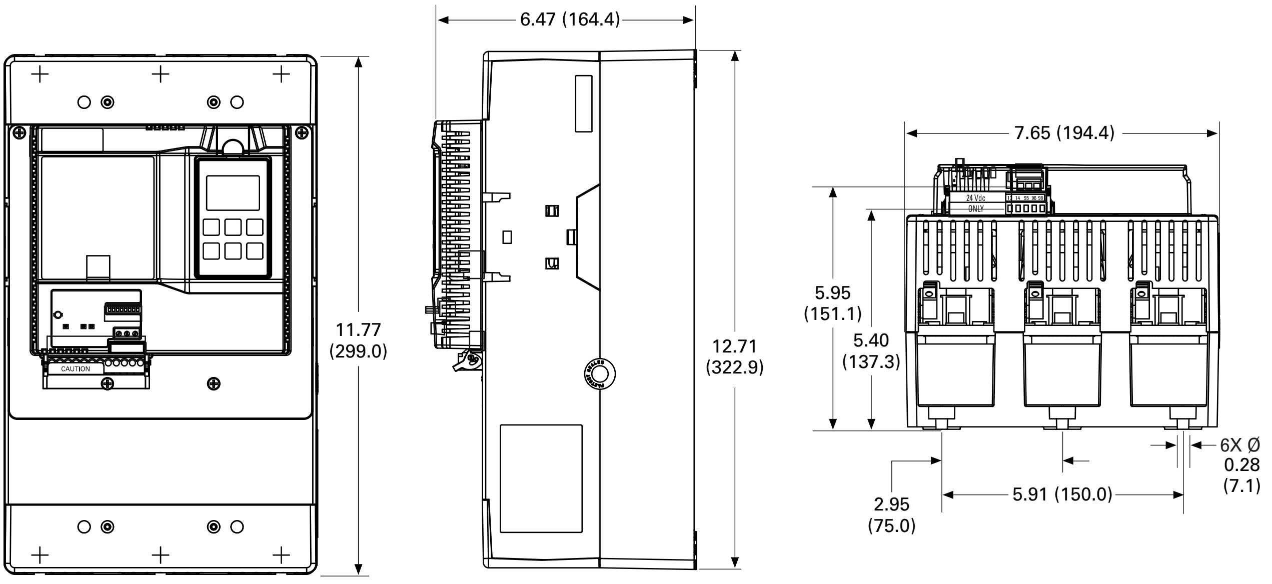


S811+R…

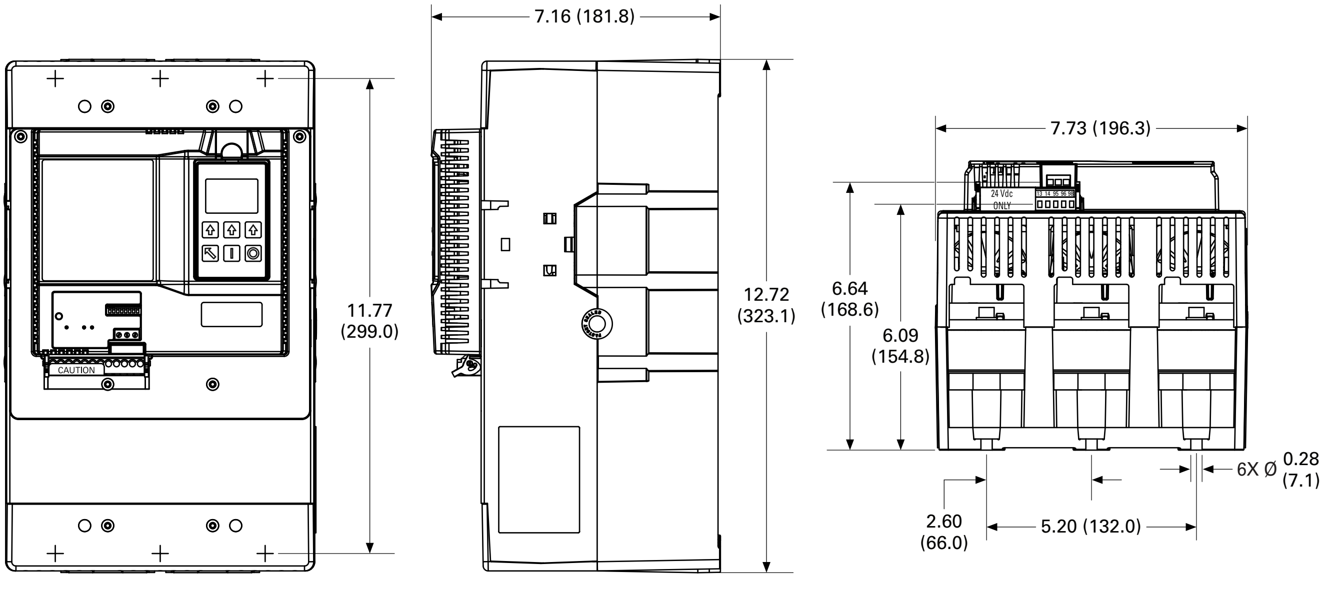


Approximate Dimensions in inches (mm)

S811+T…

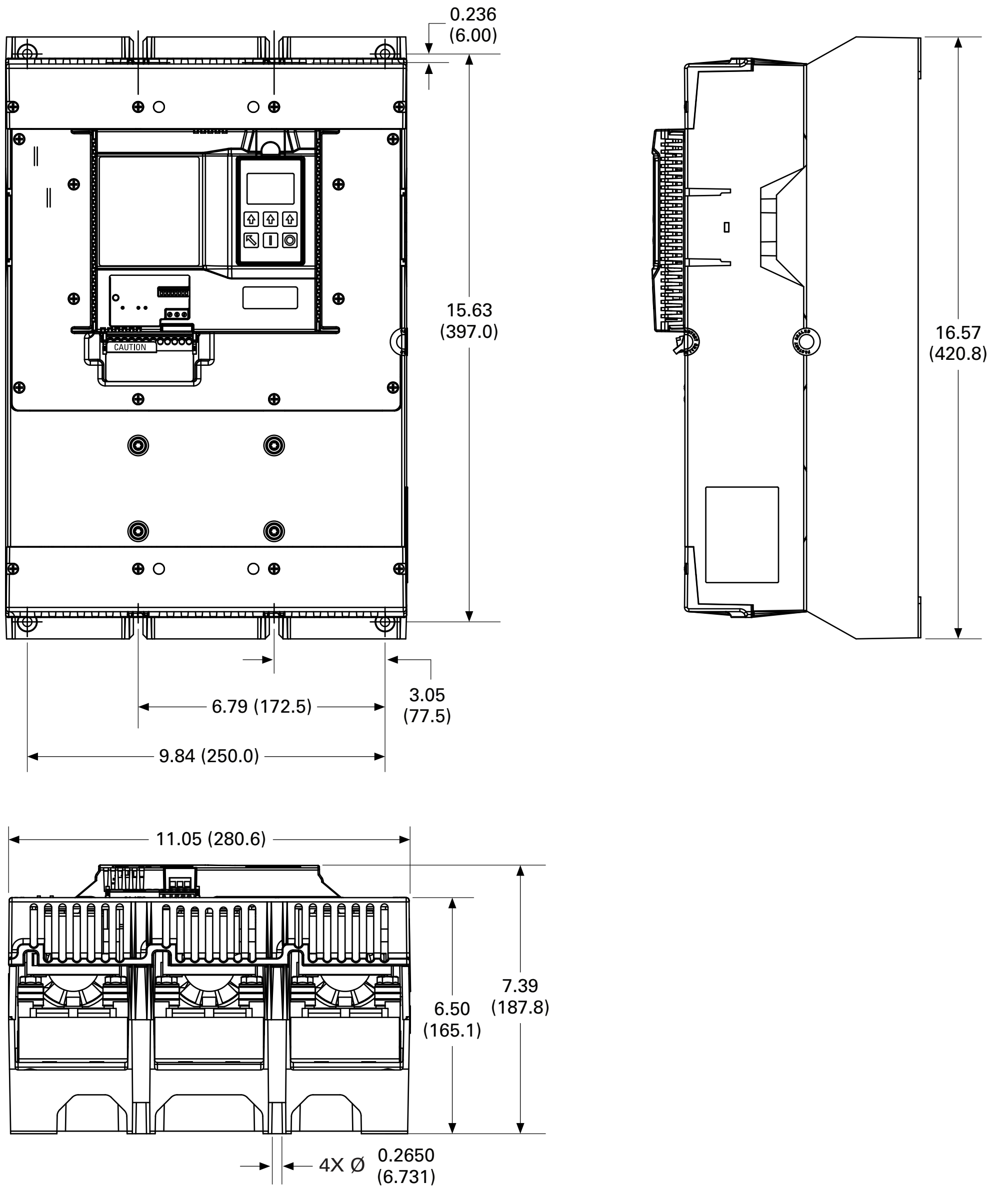


S811+U…



Approximate Dimensions in inches (mm)

S811+V…



Power Wiring

Using the wiring diagrams in below as guides, connect the Line and Motor wiring in accordance with appropriate local and national codes.

Note: To provide optimum motor protection the Line and Motor power wiring should be tightly bundled and run perpendicular to the orientation of the S811+.

WARNING

Hazardous voltage can cause electric shock and burns. To avoid shock hazard, disconnect all power to the controller, motor or other control devices before any work is performed on this equipment. Failure to do so will result in personal injury, death or substantial property damage.

Do not apply a disconnect device on the output of the S811+ Soft Starter unless a means to turn off the soft starter when disconnect switch is open is utilized. Opening a disconnect while the Soft Starter is operating may cause a malfunction. Closing a disconnect switch while the Soft Starter is operating will result in a soft starter failure and potential equipment damage and personnel hazard.

Note: Short circuit protection must be applied on the line side of the soft starter.

The S811+ may be wired in an inline, or inside-the-delta configuration.

By factory default, the S811+ is to be connected with an ABC phase rotation on the incoming power wiring. If the motor turns in the incorrect direction upon energization, exchange two phases at the motor terminal box or at the output terminals of the soft starter. Changing the input wiring may cause a voltage phase reversal trip.

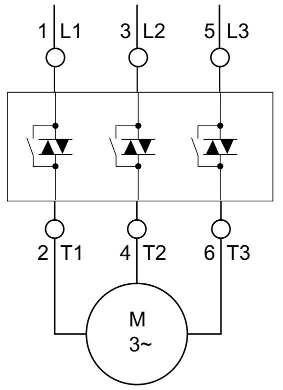
If the input phase sequence to the S811+ cannot be changed, the incoming Phase Sequence parameter in the Soft Start Config. Menu may be set to ACB. Setting ACB as the incoming phase sequence causes the S811+ to recognize the reverse direction of phase rotation. Phase rotation selection and monitoring may be turned off by setting the Phase Sequence Parameter in the Soft Start Config Menu.

IMPORTANT

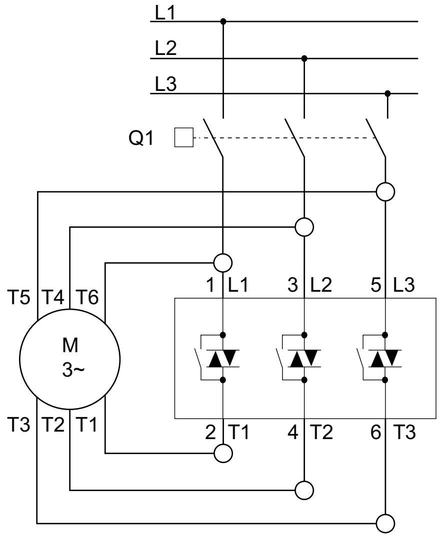
A reversing contactor must never be switched while the soft starter is operating. In order to gain the full benefit of the S811+ with a reversing contactor, the S811+ needs to be OFF when switching the direction of the motor. The soft starter settings must account for catching a motor spinning in the opposite direction upon soft restarts. The time required for slowing the motor to a stop and then ramping up to speed in the opposite direction adds to the overall starting time. This condition will also impact the overload protection setting.

See the Motor/Application Considerations in **Appendix E** for information on typical motor winding configurations.

Inline Connected Soft Starter (default) Power Wiring Diagram S811+…N3S, S811+…P3S, S811+…V3S



Inside-the-Delta Connected Soft Starter Power Wiring Diagram S811+…N3S, S811+P3S



Selecting Inline or Inside-the-Delta Operating Configuration

The mains wiring configuration is set with the Motor Wiring Config parameter located in the Soft Start Config menu to Inline (default) or Inside the Delta.

The Motor Nameplate FLA parameter range changes when the Motor Wiring Config parameter is changed from Inline to Inside Delta. If the Motor Nameplate FLA is not within the range, verify that the Motor Wiring Config parameter is correct and/or the proper size S811+ has been selected.

The following table lists the maximum wire sizes and number of conductors required per phase for line and load power wiring lugs.

Line and Load Power Wiring

S811+N… and S811+R… soft starters utilize box lugs to accomplish line and load power wiring. Refer to the table below for wire sizing requirements.

Line and Load Power Wiring, S811+N… and S811+R…

Catalog Number	Conductor Size ①	Number of Conductors	Torque Lb-in (Nm)
S811+N…	2 AWG	1	50 (5.6)
	4–6 AWG	1	45 (5.0)
	8 AWG	1	40 (4.5)
	10–14 AWG	1	35 (4.0)
S811+R…	14–8 AWG	1	90–100 (10.1–11.3)
	6–4 AWG	1	
	3–3/0 AWG	1	
	6–4 AWG	1	
	3–3/0 AWG	1	

Note

① Wire sizes Cu 75°C only.

Line and Load Power Wiring, S811+T…, S811+U…, and S811+V…

Catalog Number	Conductor Size	Number of Conductors	Torque Lb-in (Nm)	Lug Kit	Kits Required
S811+T…	4–1/0 MCM	2	250 (28.3)	EML22	2
	4/0–500 MCM	1	250 (28.3)	EML23	2
	4/0–500 MCM	2 ②	250 (28.3)	EML24	2
	2/0–300 MCM	1	225 (25.5)	EML25	2
	2/0–300 MCM	2	225 (25.5)	EML26	2
S811+U…	4–1/0 MCM	2	250 (28.3)	EML22	2
	4/0–500 MCM	1	250 (28.3)	EML23	2
	4/0–500 MCM	2 ②	250 (28.3)	EML24	2
	2/0–300 MCM	1	225 (25.5)	EML25	2
	2/0–300 MCM	2	225 (25.5)	EML26	2
S811+V…	4/0–500 MCM	2 ②	250 (28.3)	EML28	2
	4/0–500 MCM	4 ②	250 (28.3)	EML30	2
	4/0–500 MCM	6 ②③	250 (28.3)	EML32	2
	2/0–300 MCM	4	225 (25.5)	EML33	2

Notes

② CSA approved 350–500 MCM.

③ Requires special lug cover.

Note: S811+T…, S811+U…, and S811+V… units are supplied standard without lugs. One kit consists of required hardware to make connections for three (3) phases on either line or load side of the soft starter.

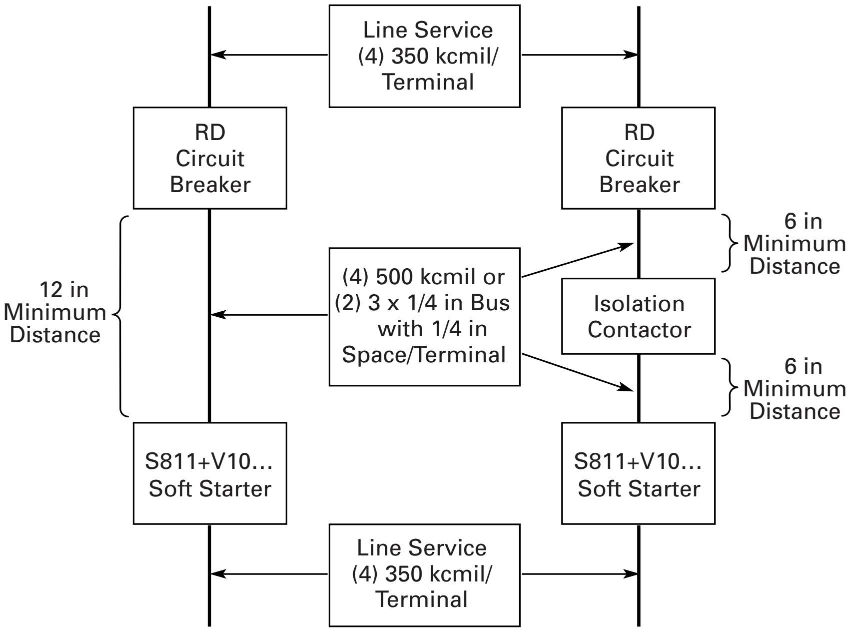
S811+V10… Installation Requirements

1. Install the device in a minimum enclosure size 30 ft^3.
2. Two (2) forced air ventilation fans with a minimum 500 ft^3/min, at a location for "air in"—bottom right or left corner and "air out"—opposite upper right or left corner.
3. RD circuit breaker.
4. For power wiring: Use four (4) 500 kcmil cables for each phase between RD circuit breaker and soft starter.

   OPTIONAL: Two (2) 3 in x 1/4 in bus with a 1/4 in spacer per terminal.

   Note: See the figure below for alternative layouts.
5. Line and load service entrance wiring must not cross in the enclosure.

Power Wiring Alternatives



Lug Installation, S811+N… and S811+R…

Wire the appropriate line and load conductors to the Soft starter in accordance with federal and local codes. Torque fasteners per table on **Page 12**.

Lug Installation, S811+T…, S811+U…, and S811+V… Frames

1. Remove line and load terminal lug covers by removing the screws that hold each cover onto the soft starter.
2. With screws removed, slide the covers off the unit.
3. Position lugs and install lug mounting hardware according to the instructions included in the kit. Tighten lug mounting hardware included in the kit to 120 Lb-in (13.6 Nm).
4. Install line and load conductors and torque hardware in accordance with table on **Page 12**.
5. Slide the line and load lug covers back into their original positions.
6. Secure with the screws previously removed.

S811+V… Shown with Terminal Cover Removed and EML30 Lug Kit Installed on Load Side

Control Wiring Inputs

Control wiring is connected to the S811+ by two (2) terminal blocks and one (1) RJ12 connection located at the front of the unit.

Control Terminal Block—A 12 position connector is utilized to make connections for 24 Vdc control power, soft starter control function commands, and Auxiliary Relay functions.

Network Communications Terminal Block—A 3 position screw connector utilized to make connections for ModBus and other network connections.

User Interface Module Terminal Block—An RJ12 connection utilized to make the connection to the Digital Interface Module (DIM) or the Control Interface Module (CIM).

Control Terminal Block/Network Connection Terminal Block

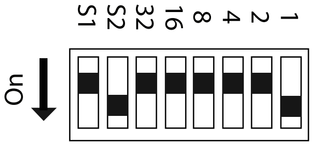
DIP Switch

Switch S1 selects Edge (ON) or Level (OFF) sense detection on the Run1 input on control block Terminal 1 (default).

Switch S2 configures the remote communication port for Modbus (ON) or QCPort (OFF) upon 24 Vdc power up of the unit.

Switches 32–1 are utilized to set a unique remote field bus address (1–63).

DIP Switch



Additional information on Level and Edge Sensing may be found in Functional Description starting on **Page 28**.

Control Wiring Terminal Blocks

⚠ CAUTION

Only apply 24 Vdc to Control Power Terminal Block. All control wiring is 22–12 AWG (0.33–2.5 mm^2).

⚠ CAUTION

Do not apply 120 Vac to the control input terminals of the Control Power Terminal Block.

⚠ CAUTION

Do not apply 24 Vdc to Network communications Terminal Block.

Terminal Block Wiring Capacity

Wire Size	Number of Conductors	Torque Requirements
22–14 AWG (0.33–2.5 mm^2)	2	3.5 Lb-in (0.4 Nm)
14–12 AWG (2.5–4.0 mm^2)	1	3.5 Lb-in (0.4 Nm)

S811+ Control Terminal Block Wiring

Control Terminal Block—Descriptions

The S811+ Soft Starter has the following control terminal block control input and aux relay functions:

Terminal Block Functions

Position	Options	Minimum	Maximum	Default
"–"	Not Programmable	—	—	"–"
"+"	Not Programmable	—	—	"+"
P	Not Programmable	—	—	P
1	Input Config Entry 0	0	10	1
2	Input Config Entry 1	0	10	3
3	Input Config Entry 2	0	10	4
4	Input Config Entry 3	0	11	5
13	Relay Config Entry 0	0	10	2
14				
95	Relay Config Entry 1	0	10	1
96				
98				

"–" and "+" Control Power—Connect power supply negative to pin "–" and to system ground. Connect +24 Vdc output to pin "+". Verify that the 24 Vdc control power source has the recommended capacity. Minimum control voltage is 18 Vdc.

Note: To avoid voltage drop during bypass contactor inrush, a minimum of 14 AWG (2.5 mm^2) wire should be used between the power supply and the "+" and "–" inputs at the S811+ terminal block.

P-Permissive—Control Input 24 Vdc only (maintained). Permissive must be energized (+24 Vdc) to enable START or RUN operation of the unit from any source. If power is removed from the permissive circuit at any time, the unit will begin a STOP command. If a soft stop or pump stop is selected, the soft stop or pump stop will begin and run to time-out. Required input for network commands.

Terminal Block Control Input Function Options

Programmable control input functions are available on terminals 1, 2, 3, and 4. Please note that all input signals except the analog input must be 18 Vdc or greater (High) and 5 Vdc or less (Low).

Input Configuration Options

Option	Input Config Options	Notes
0	No Function	OFF
1	RUN1	One (1) RUN1 command required, minimum.
2	Ramp2	Selects 2nd ramp profile from Advanced I/O menu
3	JOG	Follows START ramp profile, no bypass operation
4	LOCAL	Enables Command control from the terminal block
5	RESET	Fault reset
6	E-Stop	External E-Stop
7	Alarm-No-Trip	Enables Alarm-No-Trip
8	Ext Trip	Fault Trip from external 24 Vdc signal
9	Ext Warn	Fault Warning Alarm from external 24 Vdc signal
10	Disable OL on Strt (edge only)	Disable Overload protection on Start Ramp
11	Analog	Analog Input

0–No Function—May be used to configure terminal so no input signal will be recognized. This option has no Fault Trip or Fault Warning functionality.

1–RUN1—Control Input 24 Vdc only (momentary input with 3 wire control, maintained for 2 wire control). Applying 24 Vdc to terminal 1 while terminal P is energized will initiate a START command. As shipped from the factory this input is "level" sensitive. Multiple RUN1 control commands are allowed.

Note: To achieve start control from the terminal block, at least one (1) terminal input must be assigned with RUN1. Not required for network control.

Note: There are three (3) Start Delay timers available in the Advanced I/O menu that may be used to select Start Delay Configurations.

Power On Start Delay—A timer will start upon 24 Vdc power up of the S811+. A RUN1 (Start) command or RUN2 (JOG) will not be recognized until the expiration of this timer.

Start Delay—A timer will start upon receiving a valid RUN1 (Start) command. The S811+ will initiate a Start ramp at the expiration of the timer in accordance with user selected Start Ramp parameter settings.

Run Change Delay—If the Ramp2 (second ramp profile) is enabled, a timer will start anytime the S811+ transitions from running to stop. The S811+ will initiate a Start at the expiration of the timer in accordance with user selected Ramp2 parameter settings.

If a RUN1 command is active prior to the expiration of an enabled timer, a Fault Warning will be displayed on the DIM.

2–Ramp2—Control Input 24 Vdc only. Applying a 24 Vdc signal prior to a RUN1 command will select the functionality of a second start/stop ramp profile. The start ramp time, initial torque, soft stop, and pump stop parameters are located in the Advanced I/O Menu.

3–JOG—Control Input 24 Vdc only (momentary). Applying 24 Vdc to this input while P is energized will initiate a JOG. JOG will follow the selected ramp profile as long as the signal remains present. The unit will not close the internal bypass contactors.

4–LOCAL–HAND/AUTO Control Input 24 Vdc only (maintained). The LOCAL option is HAND. Energizing this input will select the terminal block as the source of motor control. It must be energized to START or JOG the motor from the terminal block

5–RESET–Fault RESET Control Input 24 Vdc only (momentary). Energizing this input will reset a fault only if no active faults are present.

6–E-Stop–Control Input 24 Vdc only (maintained). E-Stop action of the unit may be triggered by an external device. Removal of the 24 Vdc signal (maintained) from the E-Stop terminal will initiate a Fault Trip action. E-Stop functionality will remove power from the motor with no soft stop or pump stop, if enabled.

7–Alarm-No-Trip–Control Input 24 Vdc only (maintained). Removal or loss of the 24 Vdc signal will enable this function. Please refer to the Alarm-No-Trip information in the Operating Configuration section for additional information.

Note: The Alarm-No-Trip feature disables all but the most severe protection parameters, and may result in undesirable START ramp characteristics. The Alarm-No-Trip feature should not be used to address nuisance trip issues.

8–Ext Trip–Control Input 24 Vdc only (maintained) The S811+ unit may be tripped by an external device. Removal of the 24 Vdc signal (maintained) will initiate a Fault Trip action. Functionality of this feature will remove power from the motor with no soft stop ramp or pump stop ramp, if enabled.

9–Ext Warning–Control Input 24 Vdc only (maintained) The S811+ unit may receive a Warning signal from an external device. Removal of the 24 Vdc signal (maintained) will initiate a Fault Warning action. Functionality of this feature will report a Fault Warning and allow motor control by control input signals.

10–Disable OL on Strt–Control Input 24 Vdc only (maintained) Applying 24 Vdc to this input prior to the soft starter receiving a START command will disable the overload functionality of the soft starter during the start ramp profile only. When the motor reaches synchronous speed and the S811+ closes the internal bypass contactors, overload protection will be enabled.

11–Analog–Terminal #4 of the terminal control block may be configured for analog input. Analog input ranges are 0.0–20.0 ma DC and 4.0–20 ma DC. Range scaling is 0–100% with programmable high and low Fault Trip or Fault Warning alarms. The analog input trip threshold is user adjustable and may be set to Fault Trip, Fault Warning, or Disabled.

The S811+ Soft Starter contains two (2) auxiliary contacts to indicate status. Both relays accept user defined attributes.

Relay Configuration Options

Option	Relay Config Options	Notes
0	No Function	OFF
1	Fault	Relay changes state when any Fault occurs
2	Fault NOT	
3	Bypassed	Relay changes state when internal bypass contactors close
4	Bypassed NOT	
5	Motor Energized	Relay changes state during Start ramp, Top of Ramp (Run), Soft Stop, or Pump stop.
6	Motor Energized NOT	
7	Warning	Relay changes state when any Fault Warning occurs.
8	Warning NOT	
9	Custom Flt/Warn	Relay changes state when any selected fault/warning code is detected, up to a maximum of three (3). Faults + Warnings are allowed. Faults take priority in reporting.
10	Custom Flt/Warn NOT	

Note: The Custom Fault/Warning option will accept any combination of user selected fault trip or fault warning codes. The relay will change state when any one of the selected codes is present. If multiple codes occur simultaneously, the fault trips will have priority over fault warnings.

Note: Custom Fault/Warning relay operation is dependent on fault protection operating parameters. If a fault parameter is entered into the Custom Fault Warning option, but the fault parameter is disabled, the Custom Fault/Warning relay will not react to the fault condition.

Using Auxiliary Contacts

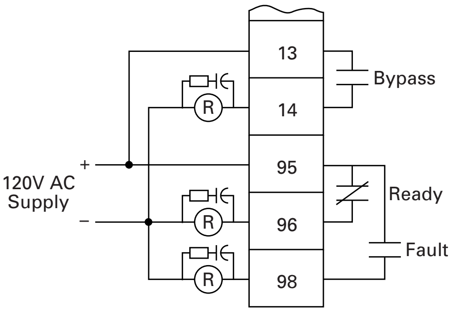
Often these contacts are used as shown in the illustrations on this page with indicating lamps. In some installations the user may wish to use an electromagnetic relay for indication of the status at a remote location for use by a programmable controller (PLC), or in a 120 Vac control circuit.

If the S811+ Soft Starter is subject to mechanical shock during operation, it is possible that these contacts may momentarily open, causing nuisance fault tripping of down stream devices. When used with an indicating lamp, a momentary contact opening would not be observed. In order to assure proper application, it is suggested that the following recommendations be implemented:

PLC Interface—It is suggested that a 20 ms delay be programmed to assure the contact status before a change of status is indicated. The application and the environmental issues will determine the exact requirements.

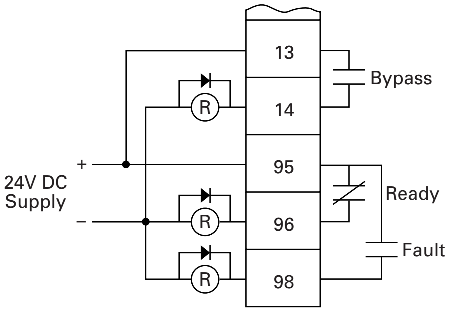
120 Vac Signal Control—When a relay is used in conjunction with an electronic control, it is highly recommended that a noise suppressor be used across the relay coil. In the case of an AC coil, the noise suppressor is made up of a series connected resistor and capacitor as shown in the figure below. Usually the delay in the relay opening is very small, so if the system is subject to shock, a delay should be added in the external control before the contact change of state is recognized. The resistor is rated 100 ohms at 0.5 watts. The capacitor is 0.25 µF at 250 Vac.

120 Vac Control



24 Vdc Signal Control—When a relay is used in conjunction with an electronic control, it is highly recommended that a noise suppression/snubber diode be placed across the relay coil as shown below. This diode offers two benefits. First, the suppression of any electrical noise generated when the relay coil is de-energized. Second, the diode delays the opening of the relay slightly as it dissipates the energy stored in the relay coil. This delay is often long enough to compensate for the potential effects of a mechanical shock opening the control contact. A typical suppression diode is a 1N4001.

24 Vdc Control



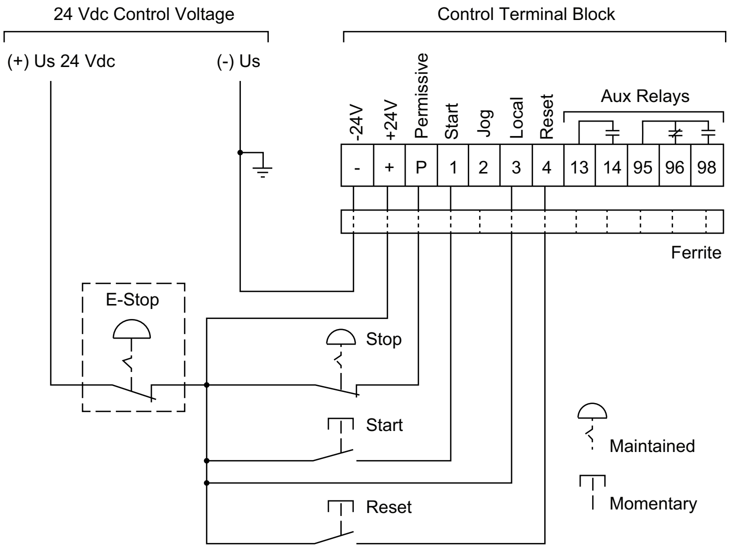
Network Control Terminal Block

The network control terminal block provides connections D0, D1, and Ground for connection directly to a ModBus system. Additional networks may be accommodated by utilizing communications adapters.

Typical Control Wiring Diagrams

Each diagram illustrates a typical wiring scheme for the options described. The additional components shown on the diagrams are not included, but may be purchased from Eaton.

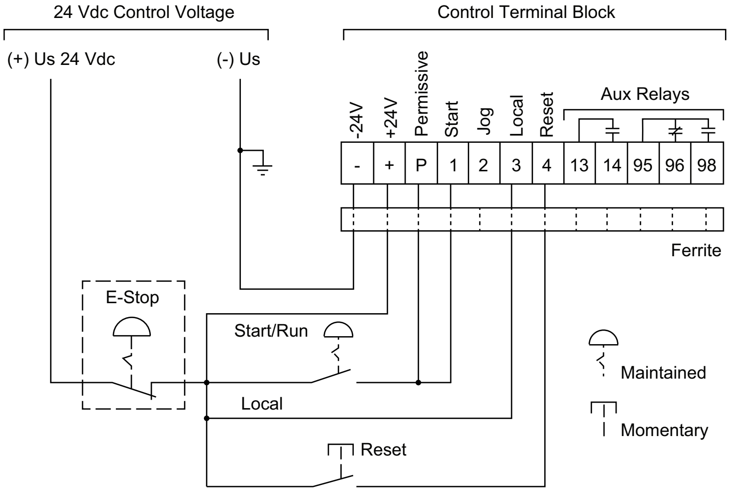
Basic Connection Diagram for 3-Wire Pushbutton



Notes

1. A minimum wire of 14 AWG (2.5 mm^2) should be used between the 24 Vdc control power supply and the control terminal block.
2. See Using an Auxiliary Relay section below if it is desired to use a relay instead of an indicating lamp for terminals 13, 14, 95, 96 and 98.
3. 120 Vac may be applied to terminals 13, 14, 95, 96, and 98.
4. Add ferrite, Fair-Rite #0446176451 to DC Power Leads and Control I/O Leads (all through one ferrite) at S811+.
5. Functionality of terminals 1, 2, 3, and 4 are shown in the default configuration. These terminals are programmable for other functions. In a 3-wire control system, at least one terminal must be assigned to a Start command (RUN1) signal.
6. Auxiliary relays: 3 amps at 120 Vac or 24 Vdc, 10 amps max. (resistive) switching.

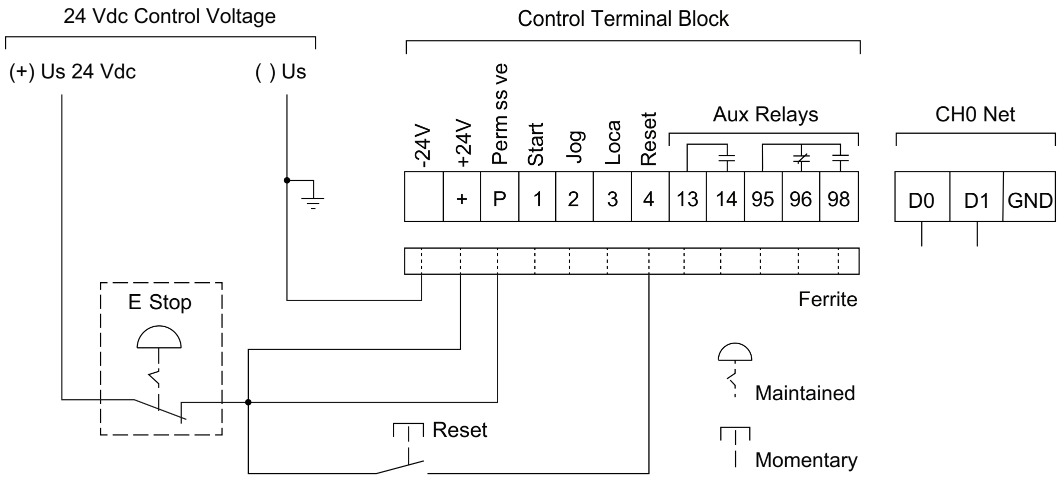
Basic Connection Diagram for 2-Wire Pushbutton



Notes

1. A minimum wire of 14 AWG (2.5 mm2) should be used between the control power supply and the control terminal block.
2. See Using an Auxiliary Relay section below if it is desired to use a relay instead of an indicating lamp for terminals 13, 14, 95, 96 and 98.
3. 120 Vac may be applied to terminals 13, 14, 95, 96, and 98.
4. Add ferrite, Fair-Rite #0446176451 to DC Power Leads and Control I/O Leads (all through one ferrite) at S811+.
5. Functionality of terminals 1, 2, 3, and 4 are shown in the default configuration. These terminals are programmable for other functions. In a 2-wire control system, at least one terminal must be assigned to a Start command (RUN1) signal.
6. Auxiliary relays: 3 amps at 120 Vac or 24 Vdc, 10 amps max. (resistive) switching.

Basic Connection Diagram for Network Control



Notes

1. A minimum wire of 14 AWG (2.5 mm^2) should be used between the control power supply and the control terminal block.
2. See Using an Auxiliary Relay section below if it is desired to use a relay instead of an indicating lamp for terminals 13, 14, 95, 96 and 98.
3. 120 Vac may be applied to terminals 13, 14, 95, 96, and 98.
4. Add ferrite, Fair-Rite #0446176451 to D/C Power Leads and Control I/O Leads (all through one ferrite) at S811+.
5. Functionality of terminals 1, 2, 3, and 4 are shown in the default configuration. These terminals are programmable for other functions.
6. Auxiliary relays: 3 amps at 120 Vac or 24 Vdc, 10 amps max. (resistive) switching.
7. The Local Control must be disabled to allow Network Control.

24 Vdc Control Power Requirements

The S811+ Soft Starter requires 24 Vdc control power. The sealed in and inrush characteristics of the S811+ Soft Starter are summarized in the table below:

Control Power Requirements

Soft Starter Frame	Sealed Amps	Sealed Watts	Inrush Amps	Inrush Watts	Duration (ms)
S811+N…	1.0	25	10	240	150
S811+R…	1.0	25	10	240	150
S811+T…	1.0	25	10	240	150
S811+V…	1.0	25	10	240	150
S811+U…	1.0	25	10	240	150

For applications where one starter is used with one power supply, the power supply selected must be equal to or greater than both the sealed in and inrush requirements of the starters.

- Max Steady State for the power supply ≥ Sealed In Power of the Starter
- Outrush for the power supply ≥ Inrush Power of the Starter

Multiple starters can be used with one power supply. If the application requires the starters to start at the same time, the power supply must be sized for the sum of the sealed in and inrush power for each starter.

- Max Steady State for the power supply ≥ Sum of the Sealed In Power of all the Starters
- Outrush for the power supply ≥ Sum of the Inrush Power of all the Starters

Formulas to calculate control power requirements are as follows:

- Definitions:
  SI = Sum of Seal Incurrent
  LS = Largest Seal Incurrent
  LI = Largest Inrush Needed
  TS = Total Seal Incurrent Needed
  LO = Largest Outrush Needed
- TS = (SI –LS)
  LO = TS +LI
- Max Steady State for the power supply ≥ SI
- Outrush for the power supply ≥ LO

The voltage on the S811+ Control Power Supply and Control Input terminals must be 24 Vdc ±10% to provide proper operation of the soft starter.

Eaton Recommended 24 Vdc Power Supplies

Catalog Number	Sealed Amps	Sealed Watts	Inrush Amps	Inrush Watts	Primary Voltage Vac
PSG240E	10	240	15	360	85–264
PSG240F	10	240	15	360	320–575
PSG480E	20	480	30	720	85–264
PSG480F	20	480	30	720	320–575

Control Wiring Application Notes

⚠ CAUTION

Only apply 24 Vdc to the control terminal block. Control wiring is 22–12 AWG (0.33–4.0 mm^2). Failure to follow this caution may result in damage to the control circuit.

1. Connect 24 Vdc Supply positive to Terminal "+" using a minimum wire of 14 AWG (2.5 mm^2).
2. Connect 24 Vdc Supply negative to Terminal "–" using a minimum wire of 14 AWG (2.5 mm^2).
3. 24 Vdc Control voltage must not exceed 30 Vdc to prevent hardware damage.
4. 24 Vdc Control voltage must not fall below 18 Vdc.

Exchanging a Digital Interface Module (DIM)

The S811+ utilizes the Digital Interface Module (DIM) to change the configuration of operating parameters with a display to indicate values and fault codes. When entering parameter changes, parameter information is stored on the S811+ printed circuit board.

The S811+ is configured to operate if the Digital Interface Module is removed from the soft starter (default). The soft starter may be configured to require installation of the DIM for operation.

Upon initial power up with 24 Vdc control voltage, the S811+ will auto detect an installed Digital Interface Module or a Control Interface Module (CIM)

Using a Supplemental Line Contactor

In some installations, it may be necessary to use an electromagnetic contactor in series with the soft starter. In this case, it is recommended that the contactor be placed on the load side of the soft starter. The contactor must be closed prior to starting the soft starter and remain closed until the Soft Starter has been stopped to ensure proper soft starter and system operation.

If an electromagnetic contactor is used on the line side of the soft starter, additional control circuitry must be supplied by the user when using edge control to ensure the line power is supplied to the soft starter before control power is applied. If this sequence is not followed, the soft starter will fault on either a phase loss or zero voltage-crossing fault.

If it is desired to place an electromagnetic contactor on the line side of the soft starter, Eaton recommends using level sense option. With level sense, no additional control circuitry is required. A start can be completed when the line power is supplied to the unit after the control power, providing the *Reset Mode* parameter is set to AUTO and the unit has a Ready light status with 24 Vdc on the *Start* terminal.

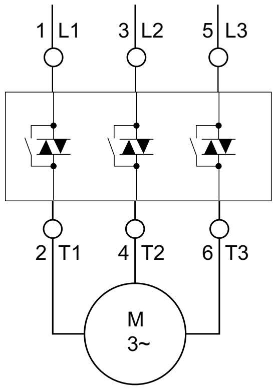
If the AUTO Reset Mode setting is used, CAUTION must be exercised to assure that any restart occurs in the safe manner.

Functional Description

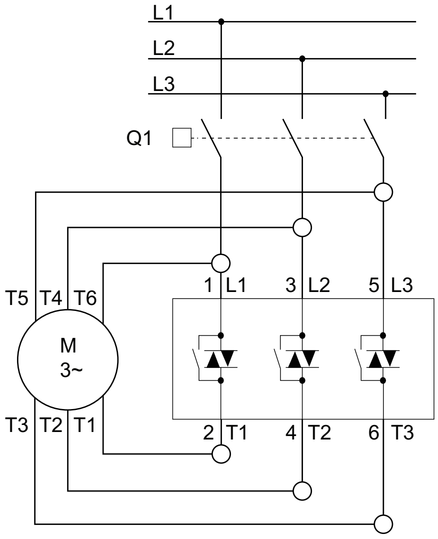
Power

The S811+ Soft Starter controls the voltage applied to a three-phase induction motor in order to control the starting torque and provide a smooth starting characteristic. Within the soft starter are three power poles, each of which includes a set of anti-parallel SCRs (thyristors) in parallel with a contact. During a start, the conduction periods of the SCRs are continuously adjusted to apply a gradually increasing voltage to the motor, resulting in gradually increasing torque and a smooth start. As the motor reaches its rated speed, the power pole contacts are closed, bypassing the SCRs for the most efficient operation.

Inline Connected Soft Starter (default)



Inside-the-Delta Connected Soft Starter



Note: For soft starters used in an Inside-the-Delta application, use of a shunt trip breaker is highly recommended. The S811+ may be configured to actuate a shunt trip breaker on user selected Fault Trip parameters.

For each start, the length of time the SCRs are conducting current as well as the magnitude of that current determine how hot the SCRs will get. Between successive starts the SCRs must cool down to avoid exceeding their thermal limits. **Appendix D** gives the S811+'s application ratings for various starting conditions. Staying within these specified limits will aid in avoiding over temperature trips.

Control

There is one (1) 12-position connector, one (1) screw terminal connector, and one (1) RJ45 connector on the face of the S811+ soft starter that are used for control circuit functions:

1. 24 Vdc Control Inputs—Soft Starter Permissive, Start, Reset, and Auxiliary Relay control functions.
2. Network Communications—ModBus connection (native).
3. Digital Interface Module (DIM) or Control Interface Module (CIM)—soft starter communication with a user interface device.

Note: Do not apply 120 Vac to any Terminal Block Control Input. 120 Vac will permanently destroy the printed circuit board.

The software contained in the S811+ Soft Starter is the heart of the product. This software allows you to control nearly every aspect of the soft starter's functionality. In this section, various features and protection options are described.

Note: You will find a complete listing of these parameters in **Appendix A**.

Starting/Stopping Options

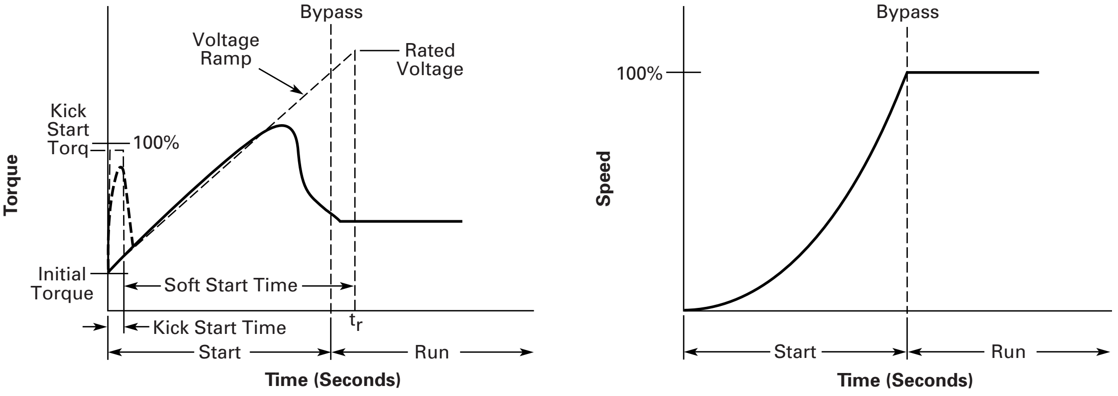
The following starting options are available in the S811+ Soft Starter:

Voltage Ramp Start

This is the most commonly used mode of soft starting. Starting at an initial value set by the *Initial Torque* parameter, the voltage applied to the motor is gradually increased at a rate that will reach rated voltage at the end of the Start Ramp time, set by the *Soft Start Time* parameter. As the voltage increases the motor develops torque that accelerates the load toward full speed. When the S811+ senses that the motor has achieved synchronous speed prior to expiration of the Start Ramp time, it quickly completes the voltage ramp and closes the bypass contactor(s).

It should be noted that a lightly loaded motor takes less torque, and thus lower voltage and time, to accelerate to full speed. For this case the S811+ will go into bypass before the ramp reaches full voltage. In other words, the S811+ may go into bypass before the *Soft Start Time* has elapsed.

Voltage Ramp Start



Kick Start

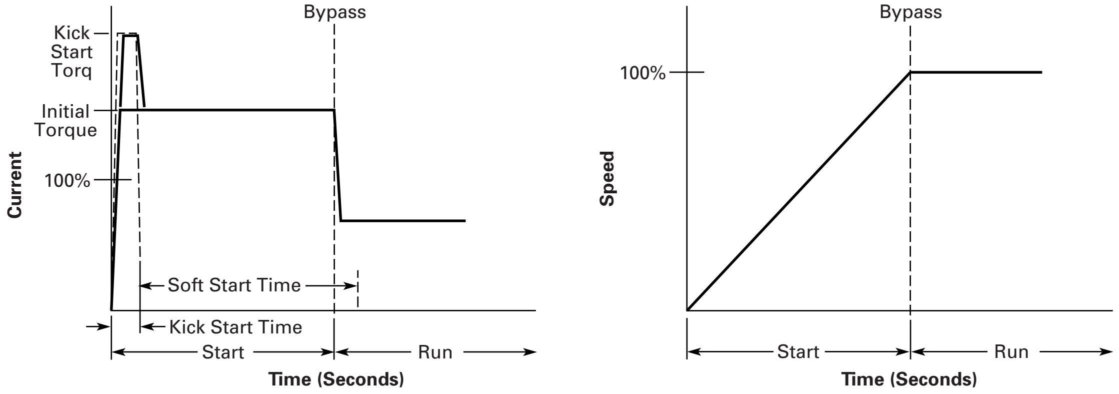
The Kick Start feature works in both the Voltage Ramp Start and Current Limit Start modes. By momentarily applying up to a two (2) second pulse of current to the motor, it provides an initial boost in torque to overcome the static friction or high inertial loads common in some applications. The level of torque boost is set by the *Kick Start Torq* parameter and the duration of the "kick" is set by the *Kick Start Time*. Setting the *Kick Start Time* to 0 effectively disables this feature.

Current Limit Start

This mode is typically used when it is necessary to limit the maximum current during start-up due to line power limitations or other considerations. During a Current Limit Start the S811+ applies a constant voltage to the motor, resulting in limited current flowing through the motor's windings. The level of current is set by the *Initial Torque* parameter. See below.

Note: Current Limit Starts are not recommended on variable torque load applications like fans and pumps. Attempting starts with the Current Limit set to a value of 20% *Initial Torque* or lower are not recommended as the motor may not develop adequate torque to accelerate properly.

Current Limit

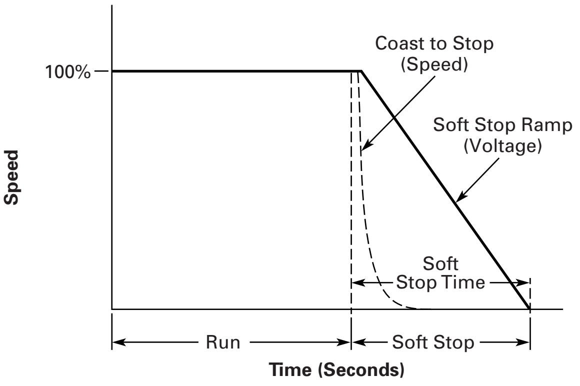


Soft Stop/Pump Stop

The Soft Stop feature is used for applications that require a controlled (ramp) extended stop. It is designed for high frictional loads that tend to stop suddenly when voltage to the motor is removed. During Soft Stop the voltage is ramped to zero in the time set by the *Soft Stop Time* parameter. The Pump Stop feature (optional) is used for pump applications that require special algorithms that bring the application to a controlled stop to prevent water hammer from occurring.

Note: The Soft Stop mode is not an electronic brake function and will not stop a motor any faster than it would normally take to coast to a stop under load.

Soft Stop



Control Functions

Network Control

When the S811+ is in Network control and a 24 Vdc signal is present at control block terminal “P”, it is ready to respond to motor *START* control commands issued through the Network Comms Port.

The *Local Control* must be disabled to allow Network control. *Local Control* is available for configuration through a programmable function on the control terminal block (default—terminal #3) or enabling the *Local Ctrl Only* parameter in the Advanced I/O Menu.

The Comms Port enables complete communications between the S811+ and the Network including changing parameters settings, issuing control commands, and monitoring selected operational values via ModBus, or other networks. The Comms Port provides ModBus motor control commands as the native protocol.

Local Control

S811+ Local Control (default) consists of *Permissive*, *Start*, *Jog*, *Local* and *Reset* 24 Vdc control commands to the Terminal Block. The S811+ can also be started/stopped from the Digital Interface Module.

The default configuration of the Control Terminal Block utilizes five (5) functions to control the S811+ soft starter. Terminals 1 thru 4 may be (re)programmed for other functions.

Terminal P–*Permissive* (run enable)—Must be energized with 24 Vdc to enable operation of the S811+ soft starters by either local and/or network control. If power is lost or removed from *Permissive* terminal at any time, the unit will initiate a coast Stop, Soft Stop, or Pump Stop in accordance with the setup parameter selections. If the S811+ is being controlled from a network, loss of the Permissive signal will initiate a coast Stop, Soft Stop, or Pump Stop in accordance with the setup parameter selections. Functionality of this terminal cannot be changed.

Terminal 1—*Start* (default)—If 24 Vdc is present at the *Permissive* terminal, momentary application of 24 Vdc to the *Start* terminal will initiate a Voltage Ramp or Current Limit start for the S811+ soft starter. Application of 24 Vdc may be maintained

Note: With level sensing control, if 24 Vdc is lost or removed from the *Permissive* terminal at any time, the unit will initiate a stop in accordance with setup parameter selections. A restart may occur when 24 Vdc is restored or reapplied if:

a) 24 Vdc is present on the *Start* terminal (maintained), and;

b) the S811+ shows a Ready LED (not faulted) status. If the starter has faulted and the fault condition clears AND the *Auto Reset Mode* parameter in the Operation Mode list is set to AUTO, the starter will restart.

See the Edge and Level Sensing sections on **Page 28** for additional details.

If the AUTO Reset Mode setting is used with level sensing, CAUTION must be exercised to assure that any restart occurs in a safe manner. Motor restart may occur immediately and unexpectedly after any fault condition has cleared.

Terminal 2—*Jog* (default)—Application of 24 Vdc power to the *Jog* terminal will apply a Start command for as long as the signal is present. The S811+ will perform a Start ramp in accordance with Start parameters. If the motor achieves synchronous speed, the internal bypass contactors will not close. When the 24 Vdc signal is removed, the soft starter will perform a coast stop, irrespective of any Soft Stop or Pump Stop parameter values.

Terminal 3—*Local* (default)—Application of 24 Vdc power to the *Local* terminal will allow Start or Jog control from the terminal block.

Note: Local Control only may be enabled by the Local Ctrl Only parameter in the Advanced I/O menu. If this parameter is enabled, control commands from any network will not be recognized.

Terminal 4—*Reset* (default)—Application of 24 Vdc power to the Reset terminal will reset the soft starter after all fault conditions are cleared and no active fault is present. If the Fault LED is not able to be reset, a fault condition still exists and must be corrected. A Reset signal may also be sent from any network connection.

Level or Edge Sensing

Level or Edge Sensing determines how the soft starter reacts to Start control commands after a fault trip has occurred. It is important to be aware if the *Start* command is a momentary or maintained signal. If the *Start* control signal is momentary, then either Edge or Level Sensing may be selected and S811+ operation will be the same, as in either case only a momentary signal is placed on the Start terminal. If the Start control signal is maintained, then the signal must be removed, then reapplied to initiate a start if Edge Sensing is selected.

Level or Edge Sensing is selected with the S1 DIP switch located on the face of the S811+. The position of the switch is verified in the Run Input Ctrl parameter in the Advanced I/O Setup menu.

Level Sensing

Level sensing selection may be verified by observing the status of the *Run Input Control* sub-parameter in the Advanced IO Setup Menu. Level sense means that the 24 Vdc signal at the Start terminal may be continuous and does not require voltage to be removed and reapplied after a fault trip has occurred.

Level sensing will result in an automatic motor restart after a fault when:

- Fault condition is cleared.
- The *Permissive* terminal is supplied with 24 Vdc.
- The *Reset Mode* parameter is set to AUTO,
- There is 24 Vdc power to the *Start* terminal (*Start* command—maintained).

Level sensing will allow a motor restart after a fault when:

- All faults remain cleared or reset.
- The *Permissive* terminal is supplied with 24 Vdc.
- The *Reset Mode* parameter is set to AUTO or MANUAL.
- 24 Vdc power to the *Start* terminal is again applied (*Start* command—momentary)

This control configuration can be used where it is desirable to restart a motor after a fault without additional manual or automatic control. An example of this condition would be on a remote pumping station where it is desirable to automatically restart a pump after a power outage without operator intervention.

In the AUTO RESET MODE, CAUTION must be exercised to assure that any restart occurs in a safe manner.

Edge Sensing

Edge sensing (default) selection may be verified by observing the status of the *Run Input Control* sub-parameter in the Advanced IO Setup. Menu. Edge sense means that the 24 Vdc signal at the *Start* terminal must be removed (if maintained) and reapplied after a fault trip has occurred. If the *Start* signal is momentary, no further action is required to restart the motor. The cycling of 24 Vdc power to the *Start* terminal before starting is required regardless of the setting of the *Reset Mode* parameter.

Edge sensing will allow a motor restart when:

- Fault condition is cleared.
- The *Permissive* terminal is supplied with 24 Vdc
- The *Reset Mode* parameter is set to AUTO or MANUAL,
- 24 Vdc power to the *Start* terminal is reapplied (*Start* command—momentary)

Edge sensing will allow a motor restart when:

- Fault condition is cleared.
- The *Permissive* terminal is supplied with 24 Vdc
- The *Reset Mode* parameter is set to AUTO or MANUAL,
- 24 Vdc power to the *Start* terminal is removed, then reapplied (*Start* command—maintained)

This control configuration can be used when restarting of the motor after a stop command or fault must be supervised manually or as a part of a control scheme.

AUTO RESET

Reset Mode—Three (3) modes of resetting Fault Trips are available:

> 0–Manual—Requires pressing Reset button on DIM, pressing Reset button on the face of the S811+, or by providing a signal to an Input Control Terminal configured for this function (Terminal 4 default).
>
> 1–AUTO—The S811+ firmware attempts to clear any active Fault Trips.
>
> 2–Powerup Reset—The S811+ will perform a Fault Reset action after the unit has completed the initialization process when 24 Vdc control power is applied. Fault trip reset action then reverts to Manual

Auto Reset Delay Timer—When the Reset Mode is set to one (1), the S811+ will automatically reset any fault or warning after the reset delay time has expired and the condition no longer is active. The delay timer will start as soon as any fault is detected. If the fault is still present after the delay time has expired, the reset protocol will remain active to attempt to clear the fault trip condition. The delay timer is user settable with a range of 0.1 (default)—600 seconds.

Auto Reset Count—A counter will log the number of successful Reset attempts. The Auto Reset Count may be observed in the Monitoring Menu. The Auto Reset Count will reset to zero (0) with each power cycle of the 24 Vdc control power.

Auto Reset Limit—The Auto Reset Limit is selected by the user, up to a maximum of 10000 Auto Reset attempts. When the maximum number of Auto Resets is attained, a Manual Reset is then required. When a Manual Reset is performed, the counter is set to zero (0). Setting this parameter to zero (0) disables the counter function.

Auto Rest Mode, Auto Reset Delay, and Auto Reset Limit parameters are located in the Soft Start Config. Menu.

FAULT WARNINGS

Fault Warnings do not require any reset action. The Fault Warning indication in the DIM is discontinued when the Fault Warning condition is no longer active.

S811+ Operating Configuration

Introduction

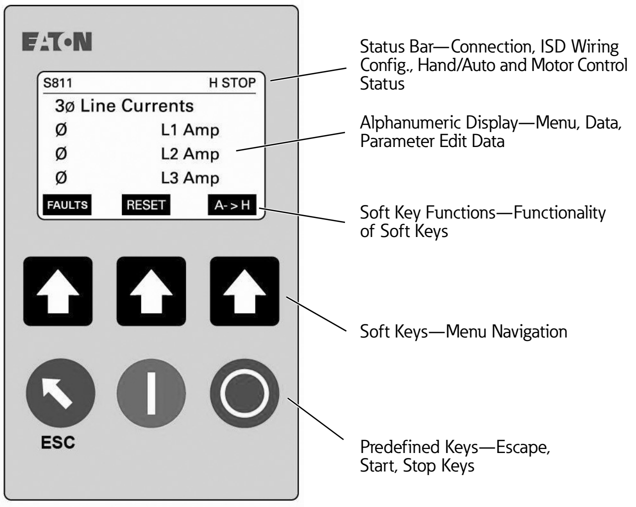
The S811+ has a wide range of operation and protection parameters to enable coordinated motor and load protection. Commonly used parameters are directly accessible through the Digital Interface Module (DIM).

The unit is supplied with default settings that accommodate general induction motor applications that provide very basic motor protection. The user should adjust the parameters to their specific application.

User Interface

A Digital Interface Module (DIM) is used to configure all models of the S811+ Soft Starter.

Digital Interface Module (DIM)

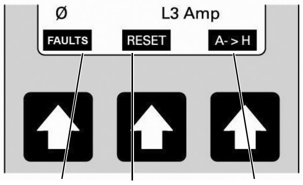


The Status Bar at the top of the display indicates the operating and communicating status of the S811+ and DIM.

- Motor control status may be;
  - Stop—Motor stopped.
  - Run1—Run (Start command) during ramp.
  - Run2—Jog
  - Ref—Motor at synchronous speed, internal bypass contactors closed.
  - Flt.—Faulted
  - Warn—Warning

- The center of the display shows the value of the selected S811+ parameter. The default display at power-up is "3 ø Line Currents".
- The Alpha Numeric Data Display Area displays system and parameter values.
- Three Soft Key Functions at the bottom of the display indicate the functions of the Soft Keys (pushbuttons) directly below them. The Soft Key Functions will change as you navigate through the different menus of the DIM.
- Soft Keys are used to perform several functions and navigate through parameter menus. Functionality of the soft keys change with menu selection.

Soft Keys

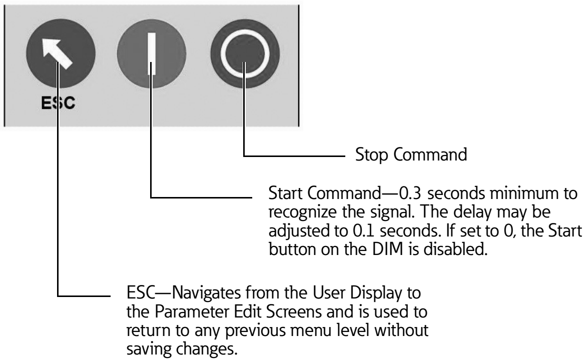


FAULTS	RESET	A>H	= Default Display at power up.
PREV	NEXT	<ENTER>	= Menu Navigation selections
PREV	NEXT		= Uneditable Parameter Navigation
PREV	NEXT	<EDIT>	= Editable Parameter Navigation
DEC	INC	<SAVE>	= Adjust or Save Parameter value
PREV	NEXT	<MORE>	= Fault/Warning Navigation
GROUP	MEMBER	<SEND>	= Network Navigation

Note: The FAULTS key (left-hand UP arrow key) shown in the Default Display at power up may be set to JOG function with the Local JOG button enable parameter found in the LCD DIM Setup menu.

- Predefined keys are used to perform critical functions:

Predefined Keys



Transfer of S811+ Configuration Parameters

The 811+ has the ability to capture (store) Configuration Parameters to the DIM. The Configuration Parameters can then be downloaded into other S811+ units.

To upload parameters: From the LCD DIM Setup Menu, select “Upload Settings”

To download parameters: From the LCD DIM Setup Menu, select “Download Settings”

To erase the parameter set stored in the DIM memory, select “Flush” from the “Upload Settings” parameter.

Access Level (Password) Option

Levels of edit may be set to protect parameter settings.

- Level 0—All parameters are Read Only
- Level 1—Basic Editing
- Level 2—Advanced Editing allows access to all editable parameters.
- Default Password for Levels 1 and 2 is 0. There is no password required for Level 0.

DIM Removal

The DIM may be removed at any time (default) and the S811+ will maintain functionality. The S811+ may be configured to Fault Trip if the DIM is removed by disabling the Removable DIM parameter located in the LCD DIM Setup Menu.

Note: If the S811+ received a START command from the DIM, the unit will Fault Trip if the DIM is removed while the unit is running. If the START command was received from the control terminal block or a network connection, the S811+ will continue to run.

Setup and Starting

Before You Begin

Be Aware of the Following:

1. The Permissive terminal must have 24 Vdc applied to ENABLE start or run commands from any source.
2. To initiate a Stop remove the 24 Vdc *Permissive* terminal input.
3. For 2-wire local control, jumper *Permissive* and *Start* terminal inputs together.
4. After an Overload Trip, the S811+ Soft Starter cannot be restarted until the prescribed cool-down time has elapsed. Review the START Inhibit times noted in **Appendix B**. Cycling 24 Vdc control power does not reset the timer. If control power is removed, the soft starter will retain the remaining time and will resume the cool-down timing when power is again reapplied.
5. When the S811+ internal bypass contactor(s) close, a sound similar to contactor chatter may be heard. This sound is the result of multiple contactors in some models closing one after the other in a very short period. It is normal operation intended to reduce the surge current requirements of your power supply. During normal operation, the S811+ will cycle the internal bypass contactors at random intervals to clean the contacts. During this operation, the contactors may be heard to release then pull in again as described above.

Setup

After all power and control connections have been made and you have read and understood the different operating modes and protection features of the soft starter, set the Operations and Protection parameters for your application. In many cases, only the Motor FLA parameter requires adjustment to the proper value, and all other parameters may be used with the default values for the initial Start. Review the Protection Options of the S811+ **Appendix B** and adjust as required.

Initial Configuration:

1. It is suggested that the S811+ Soft Starter be configured before applying the line voltage. Before applying the Line voltage, apply 24 Vdc to the Supply connections of the S811+'s control terminal block.
2. Set the Operating Parameters to the desired values. These settings assume the motor has a 1.15 Service Factor.

Operating Parameters—Soft Start Configuration—S811+ …N3S Standard

Soft Start Config Menu	Units	Minimum Inline (InsideDelta)	Maximum Inline (InsideDelta)	Default Inline (InsideDelta)	Notes	Access Level
Mtr Nameplate FLA						2
S811+N37…	Amps	11 (19)	37 (65)	11 (19)	Motor FLA parameter must be set to motor nameplate FLA to achieve proper overload protection.	2
S811+N66…	Amps	20 (35)	66 (114)	20 (35)		2
S811+R10…	Amps	32 (55)	105 (182)	32 (55)		2
S811+R13…	Amps	42 (73)	135 (234)	42 (73)		2
S811+T18…	Amps	56 (97)	180 (311)	56 (97)		2
S811+T24…	Amps	75 (130)	240 (415)	75 (130)		2
S811+T30…	Amps	95 (164)	304 (526)	95 (164)		2
S811+U36…	Amps	112 (195)	360 (623)	112 (195)		2
S811+U42…	Amps	131 (227)	420 (727)	131 (227)		2
S811+U50…	Amps	156 (270)	500 (865)	156 (270)		2
S811+V36…	Amps	112 (195)	360 (623)	112 (195)		2
S811+V42…	Amps	131 (227)	420 (727)	131 (227)		2
S811+V50…	Amps	156 (270)	500 (865)	156 (270)		2
S811+V65…	Amps	203 (352)	650 (1125)	203 (352)		2
S811+V72…	Amps	225 (389)	720 (1246)	225 (389)		2
S811+V85…	Amps	265 (458)	850 (1471)	265 (458)		2
S811+V10…	Amps	312 (539)	1000 (1732)	312 (539)		2
Ovrld Trip Class		5	30	20		2
Phase Rev Fault		0	1	0	**0** = Enabled **1** = Disabled	2
Phase Sequence		0	1	0	**0** = ABC **1** = ACB	2
Start Method		0	1	0	**0** = Voltage Ramp **1** = Current Limit	2
Initial Torque	%	0	85	45		1
Soft Start Time	Seconds	0.5	180	20		1
Kick Start Torq	%	0	85	0		1
Kick Start Time	Seconds	0	2	0		1
Soft Stop Time	Seconds	0	60	0		1
Reset Mode		0	2	0	**0** = Manual **1** = Auto **2** = Powerup Reset	2
Auto Reset Delay	Seconds	0.1	600	0.1		2
Auto Reset Limit		0	10000	0		2
Motor Wiring Config		0	1	0	**0** = Inline **1** = InsideDelta	2

Operating Parameters—Soft Start Configuration—S811+ …P3S Premium

Soft Start Config Menu	Units	Minimum Inline (InsideDelta)	Maximum Inline (InsideDelta)	Default Inline (InsideDelta)	Notes	Access Level
Mtr Nameplate FLA						2
S811+N37…	Amps	11 (19)	37 (65)	11 (19)	Motor FLA parameter must be set to motor nameplate FLA to achieve proper overload protection.	2
S811+N66…	Amps	20 (35)	66 (114)	20 (35)		2
S811+R10…	Amps	32 (55)	105 (182)	32 (55)		2
S811+R13…	Amps	42 (73)	135 (234)	42 (73)		2
S811+T18…	Amps	56 (97)	180 (311)	56 (97)		2
S811+T24…	Amps	75 (130)	240 (415)	75 (130)		2
S811+T30…	Amps	95 (164)	304 (526)	95 (164)		2
S811+U36…	Amps	112 (195)	360 (623)	112 (195)		2
S811+U42…	Amps	131 (227)	420 (727)	131 (227)		2
S811+U50…	Amps	156 (270)	500 (865)	156 (270)		2
S811+V36…	Amps	112 (195)	360 (623)	112 (195)		2
S811+V42…	Amps	131 (227)	420 (727)	131 (227)		2
S811+V50…	Amps	156 (270)	500 (865)	156 (270)		2
S811+V65…	Amps	203 (352)	650 (1125)	203 (352)		2
S811+V72…	Amps	225 (389)	720 (1246)	225 (389)		2
S811+V85…	Amps	265 (458)	850 (1471)	265 (458)		2
S811+V10…	Amps	312 (539) ①	1000 (1732) ①	312 (539) ①		2
Ovrld Trip Class		5	30	20		2
Phase Rev Fault		0	1	0	**0** = Enabled **1** = Disabled	2
Phase Sequence		0	1	0	**0** = ABC **1** = ACB	2
Start Method		0	3	0	**0** = Voltage Ramp **1** = Current Limit **2** = Not Used **3** = Pump Start	2
Initial Torque	%	0	85	45		1
Soft Start Time	Seconds	0.5	360	20		1
Kick Start Torq	%	0	85	0		1
Kick Start Time	Seconds	0	2	0		1
Pump Stop Time	Seconds	5	120	10		1
Soft Stop Time	Seconds	0	60	0		1
Reset Mode		0	2	0	**0** = Manual **1** = Auto **2** = Powerup Reset	2
Auto Reset Delay	Seconds	0.1	600	0.1		2
Auto Reset Limit		0	10000	0		2
Motor Wiring Config		0	1	0	**0** = Inline **1** = InsideDelta	2

Note

① Has no reference.

Note: S811+… units cannot be configured with Pump Start + Inside-the-Delta functionality enabled at the same time.

Operating Parameters—Soft Start Configuration—S811+ …V3S Premium (690 Volt)

Soft Start Config Menu	Units	Minimum Inline	Maximum Inline	Default Inline	Notes	Access Level
Mtr Nameplate FLA						2
S811+T18…	Amps	56	180	56	Motor FLA parameter must be set to motor nameplate FLA to achieve proper overload protection.	2
S811+T24…	Amps	75	240	75		2
S811+T30…	Amps	95	304	95		2
S811+V36…	Amps	112	360	112		2
S811+V42…	Amps	131	420	131		2
S811+V50…	Amps	156	500	156		2
S811+V65…	Amps	203	650	203		2
S811+V72…	Amps	225	720	225		2
S811+V85…	Amps	265	850	265		2
Ovrld Trip Class		5	30	20		2
Phase Rev Fault		0	1	0	**0** = Enabled **1** = Disabled	2
Phase Sequence		0	1	0	**0** = ABC **1** = ACB	2
Start Method		0	3	0	**0** = Voltage Ramp **1** = Current Limit **2** = Unavailable **3** = Pump Start	2
Initial Torque	%	0	85	45		1
Soft Start Time	Seconds	0.5	360	20		1
Kick Start Torq	%	0	85	0		1
Kick Start Time	Seconds	0	2	0		1
Pump Stop Time	Seconds	5	120	10		1
Soft Stop Time	Seconds	0	60	0		1
Reset Mode		0	2	0	**0** = Manual **1** = Auto **2** = Powerup Reset	2
Auto Reset Delay	Seconds	0.1	600	0.1		2
Auto Reset Limit		0	10000	0		2
Motor Wiring Config		0	0	0	**0** = Inline	2

Protection Parameters

In addition to motor overload protection, the S811+ has many programmable features designed to protect the motor.

- Incoming Line Phase Reversal, Loss, Imbalance, Over Voltage, and Under Voltage trips.
- Selectable Overcurrent trip levels.
- Stall and Jam trips.

A Phase Reversal Fault is a likely fault condition on new installations. It can be addressed by either changing the *Phase Sequence* from ABC to ACB, disabling phase rotation monitoring, or removing Mains power and switching the incoming line connections at L1 and L2 of the S811+.

For troubleshooting purpose trips are recorded, as they occur, in the S811+'s Fault Log.

Apply the Mains voltage and verify that no fault is present. The S811+ indicates faults with a Fault message and corresponding Fault Code in the DIM.

When a Fault Trip occurs, the Fault Trip screen will automatically display on the DIM. Fault Trips are displayed with the most current Fault at the top of the list. If the Fault is no longer active, the S811+ may be Manually reset by pressing the corresponding soft key on the DIM.

Fault History

S811 H STOP
Faults
V Phase Rvsl Flt
Empty
Empty

The Fault history may be displayed at any time by pressing the Faults soft key on Digital Interface Module (DIM).

Fault Codes

For additional details on troubleshooting fault codes and fault conditions, please refer to **Troubleshooting** and **Appendix I**.

Fault Trips

The S811+ is configured from the factory with most protection parameters enabled. Selected protection parameters may be changed to Fault Warnings in which case the fault is detected and reported, but the soft starter remains in operation. It is recommended that all appropriate protection parameters are enabled for proper operation and protection of the soft starter and the load.

Fault Warnings

Selected S811+ Configuration and Protection parameters may be configured to provide warning indications only. If a parameter is set to Warning status, the unit will not trip if operation is not within the protection level of the parameter.

A Fault Warning is displayed on the DIM by the "Warning" message being toggled with the current motor status in the status bar of the DIM.

Fault Warning

Fault Trip/Fault Warning/Disable Options

The S811+ has a comprehensive array of protection parameters. Selected Protection Parameters have options to be set to a Fault Trip, Fault Warning, or disabled. Disabling fault protections is not recommended.

Fault Code Options

Code	Description	Fault Options
1	Firmware incompatible	Fault Trip, Fault Warning, Disable
3	Internal Com fault	Fault Trip
4	Low Control V	Fault Trip
5	Pole Overtemp	Fault Trip, Fault Warning, Disable
6	PhaseLoss	Fault Trip, Fault Warning, Disable
7	Phase Imbalance	Fault Trip, Fault Warning, Disable
9	Underload	Fault Trip, Fault Warning, Disable
10	Overcurrent(contactor)Jam disabled	Fault Trip
11	Jam	Fault Trip, Fault Warning, Disable
13	Bypass dropout	Fault Trip, Fault Warning, Disable
14	Overload	Fault Trip, Fault Warning, Disable
18	Inst I overcurrent	Fault Trip
32	Internal NV error	Fault Trip
36	ComLoss Stop fault	Fault Trip
38	Temperature sensor fault	Fault Trip, Fault Warning, Disable
39	Internal CPU fault	Fault Trip
40	Motor Low Power	Fault Trip, Fault Warning, Disable
41	Motor High Power	Fault Trip, Fault Warning, Disable
42	UnderVoltage	Fault Trip, Fault Warning, Disable
43	OverVoltage	Fault Trip, Fault Warning, Disable
44	Phase Reversal Fault	Fault Trip, Fault Warning, Disable
54	E-Stop	Fault Trip
55	MotorControl Device missing	Fault Trip
56	Internal Com2 fault	Fault Trip
57	Internal Fault	Fault Trip
58	SCR Not Firing	Fault Trip, Fault Warning, Disable
59	Shorted SCR	Fault Trip, Fault Warning, Disable
60	SCR Overcurrent (Stall disabled)	Fault Trip
61	Mains AC V Lost	Fault Trip
63	Motor Stall Fault	Fault Trip, Fault Warning, Disable
64	V Zero cross	Fault Trip
65	Analog Input Out of range (high)	Fault Trip, Fault Warning, Disable
66	Analog Input Out of range (low)	Fault Trip, Fault Warning, Disable
71	Analog Input Overdrive	Fault Trip, Fault Warning, Disable
72	External trip/warning	Fault Trip, Fault Warning, Disable
73	Motor Load Disconnect	Fault Trip
74	Line Frequency (high)	Fault Trip, Fault Warning, Disable
75	Line Frequency (low)	Fault Trip, Fault Warning, Disable
76	Auto Reset Limit	Fault Trip

Alarm-No-Trip Option

The Alarm-No-Trip option is intended for use with applications that have motor run-to-destruction protocols in the application specifications. This feature allows the S811+ to Start/Run the motor under the most severe of conditions with minimal motor protections and will Start/Run until;

A) the S811+ can no longer maintain effective control of the load, and/or;

B) catastrophic motor failure occurs.

Enabling the Alarm-No-Trip parameter from the Protections Menu will dramatically change how the S811+ reacts to fault conditions, defeating some of the normal protection protocols of the S811+. Alarm-No-Trip functionality must be thoroughly understood before enabling this feature.

Note: User settable parameters that have been disabled in the Protections Menu will also disable the Alarm-No-Trip Fault(s) in table (1).

Alarm-No-Trip functionality will respond in accordance with the protocols listed in tables (1), (2) and (3).

Fault Warnings may be displayed on the DIM or the network connection. Fault Warnings will not Trip the S811+.

Note: The Alarm-No-Trip terminal signal is active low. This means that any time the 24 Vdc signal falls below 5 Vdc, the Alarm-No-Trip option will be enabled.

When the Alarm-No-Trip option is enabled, only faults critical to motor control are effective. These faults are noted in table (1) below:

(1) Alarm-No-Trip Faults

Code	Alarm-No-Trip Fault Trip Parameters
*	Watchdog
*	Watchdog Reset
*	FRam
*	Comm Failure
*	Flash CRC
5	Pole Overtemp
58	SCR Not Firing
59	Shorted SCR
18	SCR Instantaneous Overcurrent
60	SCR Overcurrent

(1) S811+ Alarm-No-Trip Fault Trip protocol:

Condition

1. Alarm-No-Trip feature is enabled;
2. One or more faults noted in table (1) are active.

Action

1. Motor not running = S811+ Inhibits motor START/RUN function.
2. Motor running, Top of Ramp = S811+ conducts Fault Trip action, motor stop.

When the Alarm-No-Trip option is enabled, mains voltage operating conditions noted in table (2) below are monitored by the S811+.

(2) Mains Voltage Operating Faults—Full SCR Start

Code	Alarm-No-Trip Condition Full Voltage Start Parameters
64	Zero Voltage Cross Lost
61	Mains Loss
6	Voltage Phase Loss
74	Line Frequency High
75	Line Frequency Low

(2) S811+ Mains Voltage Operating Faults—Full SCR Start protocol:

Condition

1. Motor not running
2. Alarm-No-Trip feature is enabled;
3. No faults noted in table (1) are active;
4. One or more faults noted in table (2) are active.
5. START command is received by the S811+

Action

1. Motor not running = SCRs commanded to full gate + internal bypass contactors close.
2. Motor running = no action.

When the Alarm-No-Trip option is enabled, faults noted in table (3) below are monitored by the S811+. One or more faults will actuate the Fault Trip Relay only.

(3) Fault Trip Warnings

Code	Alarm-No-Trip Condition Fault Relay Only Parameters
44	Phase Reversal
7	Phase Imbalance
14	Overload
11	Jam
63	Stall
42	Mains Voltage Low
43	Mains Voltage High
9	Underload
13	Bypass Dropout
40	Low Power
41	High Power

(3) S811+ Alarm-No-Trip Condition Fault Relay Only protocol:

Condition

1. Alarm-No-Trip feature is enabled;
2. No faults in tables (1) or (2) active.
3. One or more faults noted in table (3) are active.

Action

1. Motor not running = Fault Trip Relay changes state, Start ramp occurs in accordance with Start parameter settings when Start command received.
2. Motor running = Fault Trip Relay changes state, no change in Run status.

Thermal Overload

The S811+ Soft Starter features an electronic motor overload protection feature. It is designed to protect the motor and power wiring against overheating caused by operating at excessive current levels for extended periods of time.

Entering the motor's full load current rating, using the *Motor Nameplate FLA* parameter programs the overload. The *Motor Nameplate FLA* is settable from 32–100% of the S811+'s rated current (frame size).

The overload's trip class (default = 20) is set in the *Ovld Trip Class* parameter in the Soft Start Config Menu.

Thermal Overload may be disabled during the Voltage Ramp or Current Limit start ramps (default = Enabled) by disabling the *Overload* on *Start* parameter located in the Protections menu. Disabling this protection parameter is not recommended.

Additional details on the Thermal Overload can be found in **Appendix B**.

Soft Start Configuration Application Notes

a) Voltage Ramp Start Configuration

Default values may be used for Start Time and Initial Torque.

Kick Start Torque = 0% (fans and pumps), 75% (high breakaway loads)

Kick Start Time = 0 sec (fans and pumps), 1 sec (high breakaway loads)

Start the motor and determine the worst case starting conditions. Adjust Initial Torque for smooth start without hesitation. Motor rotation should begin within 2 seconds.

If Stall Faults occur at the end of the ramp time, increase *Initial Torque*, *Kick Start Torque and Time* and/or *Soft Start Time* to get into bypass before the Soft Start Time elapses. Also, verify that the motor is not overloaded.

b) Current Limit Start Configuration

Initial settings:

Initial Torque = 50%
Soft Start Time = 60 sec
Kick Start Torque = 0%
Kick Start Time = 0 sec (disabled)

c) Start the motor and determine the worst case starting conditions. Adjust *Initial Torque* for smooth start without hesitation. Rotation should begin within 2 seconds and the motor should smoothly accelerate to full speed.

d) If Stall Faults occur, increase *Initial Torque* and/or *Soft Start Time* to get into bypass before the Soft Start Time elapses. Also, verify that the motor is not overloaded. Verify that the motor is not in a stall condition. A stall condition will be noted when the motor does not continue to accelerate during the start ramp.

e) After suitable performance has been achieved, determine the starting time to bypass and set *Soft Start Time* at 1.25 times this time. For example, if it takes 10 seconds to accelerate the motor and go into bypass, set the *Soft Start Time* for 12.5 seconds. Adjust the *Soft Stop Time* for the desired stopping time.

f) The Initial Torque setting is adjusted to achieve motor rotation within 2 seconds of motor energization. The Initial Torque value also determines the upper limit of applied current during a Current Limit start.

The table below notes the values of Initial Torque settings as a percentage of Locked Rotor Current.

Initial Torque Settings

Torque Setting	Current as % Locked Rotor	Initial Motor Torque
85%	92%	Maximum
71%	84%	
56%	75%	
45%	67%	Default Value
36%	60%	
33%	57%	Wye-Delta Equivalent
27%	52%	
19%	44%	Current Limit Minimum
14%	37%	
1%	10%	Minimum

The National Electrical Code requires that all alternating current motors of 1/2 horsepower and higher must have code letters on the data plate indicating motor current in a locked rotor condition. This code denotes the Kilovolt-Ampere per horsepower of the motor.

The KVA_{hp} value is obtained from NEMA and/or NEC publications. The table below is provided as a reference.

Locked rotor current of a three phase motor may be calculated using the following formula:

$$\text{Locked Rotor Current} = \frac{\text{Horsepower} \times KVA_{hp} \times 1000}{E \times 1.73}$$

Example: To calculate the locked rotor current range of a 50 horsepower motor operating at 460 volts with a code letter B, proceed as follows;

$$\text{Locked Rotor Current (minimum)} = \frac{50 \times 3.15 \times 1000}{460 \times 1.73} = 197.91 \text{ Amps}$$

$$\text{Locked Rotor Current (maximum)} = \frac{50 \times 3.54 \times 1000}{460 \times 1.73} = 222.42 \text{ Amps}$$

To determine the expected Initial Current value of the above example, apply the corresponding current reduction value base on the initial Torque setting of the soft starter. Using the default Initial Torque value of 45%, the expected current will be 67% of the above values, or 132.26 amps to 149.02 amps respectively.

Note: The current in the motor circuit will be subject to the total impedance of the motor circuit, so actual values may be slightly different than calculated values.

Code Letters

Code Letter	Kilovolt-Ampere per hp with Locked Rotor Minimum	Maximum
A	0	3.14
B	3.15	3.54
C	3.55	3.99
D	4.0	4.49
E	4.5	4.99
F	5.0	5.59
G	5.6	6.29
H	6.3	7.09
J	7.1	7.99
K	8.0	8.99
L	9.0	9.99
M	10.0	11.19
N	11.2	12.49
P	12.5	13.99
R	14.0	15.99
S	16.0	17.99
T	18.0	19.99
U	20.0	22.39
V	22.4	>22.41

Troubleshooting

General

In this section of the manual, we present a procedure you can follow to diagnose a problem with your S811+.

While many potential situations are outlined in this section, it is possible you may run into a problem that is not covered here. If you have worked through the following troubleshooting procedure and find that you require further assistance, please contact Eaton.

Please have the following information ready when you call:

Order Number:

Catalog Number:

Style Number:

Serial Number:

Before You Begin to Troubleshoot

WARNING

Make sure you read and understand the procedures in this manual before you attempt to set up or operate the equipment.

WARNING

HIGH VOLTAGE. Do not work on energized equipment unless absolutely required. If the troubleshooting procedure requires equipment to be energized, all work must be performed by properly qualified personnel, following appropriate safety practices and precautionary measure.

We highly recommend that you read this entire section of the manual before you begin to troubleshoot the S811+ Soft Starter.

You may want to obtain the following equipment to aid you in troubleshooting:

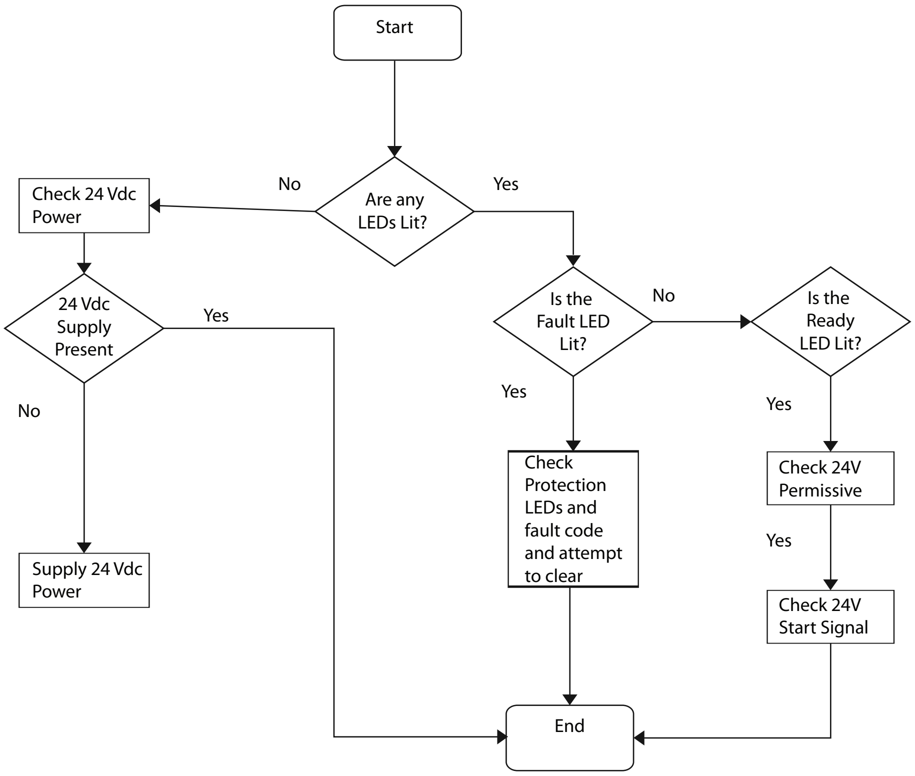
- Multimeter
- Clamp-on ammeter

Always assume the S811+ has high voltage applied and take proper precautions while troubleshooting the soft starter and associated equipment. Read all precautions at the front of this manual before starting the troubleshooting process.

Define the Problem

1. If the S811+ Soft Starter fails to respond in any way to a start command., look at the Digital Interface Module of the S811+ Soft Starter and determine the fault status of the unit. The following troubleshooting flowcharts provide a logical sequence to determine issues and suggest probable solutions to each problem.

Start Command Troubleshooting Flowchart



Troubleshooting—S811+ Does Not START

Start Source Attempted	Suggested Corrective Action
Digital Interface Module Terminal Block	Verify that the Status LED is GREEN prior to the Start attempt. Verify that the Status LED is not RED. Verify that the 24 Vdc Permissive signal is at the proper voltage. Verify that the 24 Vdc Start signal is at the proper voltage. If the Start Control parameter is set to Edge, verify that the 24 Vdc Start signal is transitioned from 0 Vdc after a fault trip.
Network	Determine if the S811+ can be started locally from TB1 or the DIM. Verify that the 24 Vdc Permissive signal is at the proper voltage. Verify that the Status LED is GREEN.

a. With the Status LED illuminated RED, the device will not start. Attempt to reset the S811+ Soft Starter by pressing the S811+'s RESET button for one second. If the Status LED remains RED, use the Digital Interface Module (DIM) to determine the fault and fault code and go to the Troubleshooting Fault Table in **Appendix I** to find the corrective action for the fault.

b. If the Status LED is GREEN, the S811+ Soft Starter is ready to start. Determine the Start source in table above to aid in determining the appropriate corrective action. Verify that the *Permissive* input terminal is at 24 Vdc. Then start the S811+ the Control Input terminal block. If the S811+ does not start, verify that the *Start* input terminal is at 24 Vdc.

Note: If connected to a network, starting the S811+ from the Control Input terminal block may isolate problems associated with the network and not with the soft starter.

2. It is often useful in determining the nature of the fault condition by noting when the trip occurs during operation of the S811+ soft starter. The operation of the S811+ may be categorized into the following periods;
    - The S811+ Soft Starter trips Immediately when the START command is issued.
    - The S811+ Soft Starter trips during the START ramp and never reaches bypass.
    - The S811+ Soft Starter trips when the bypass contactors are closing.
    - The S811+ Soft Starter trips during running operation while bypass contactors are closed.
    - The S811+ Soft Starter trips after the Stop command is received.
    - The S811+ Soft Starter stops sooner than expected during a soft stop. If the *Soft Stop Time* is set too long for the motor loading (high loads), the motor will begin to stall when delaying SCR firing reduces the voltage. The S811+ Soft Starter will detect this stalling due to the increase in current flow and end the stop immediately and not indicate any faults.

Refer to the flowchart on **Page 44** to aid in determining the appropriate corrective action during the various run phases of operation.

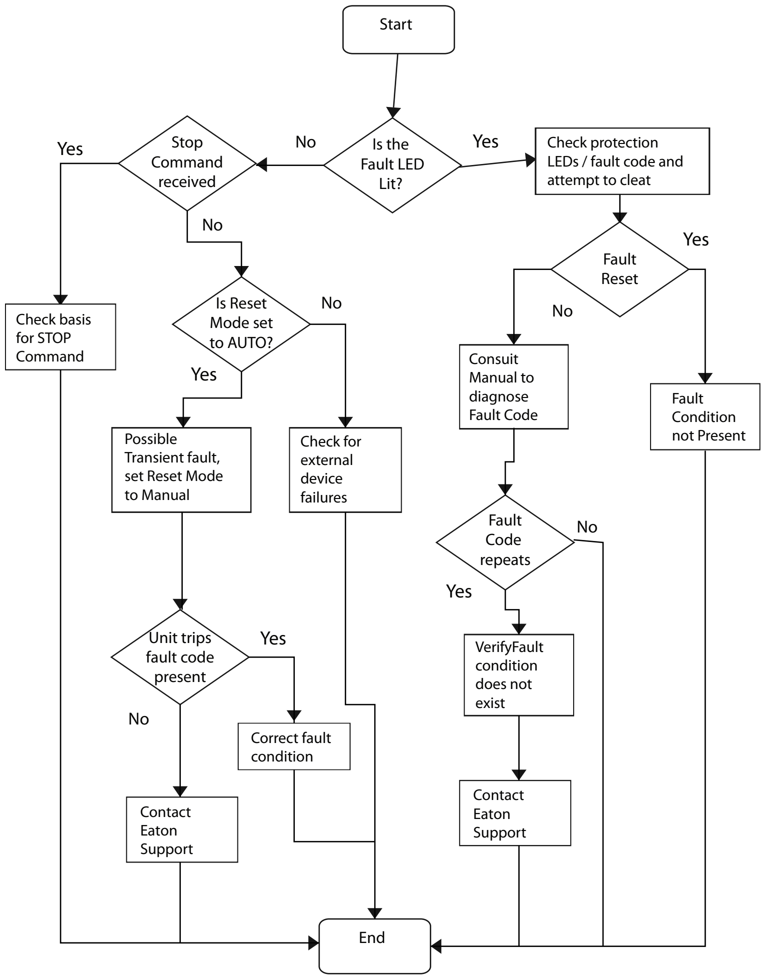
Note: If no fault codes are present during an unexpected "trip" of the soft starter, verify that the soft starter did not receive a STOP command.

Detailed information describing fault codes and corrective action may be found in Appendix I.

Troubleshooting—S811+ Stopped or Faulted

Condition	Possible Problem	Suggested Corrective Action
Status LED is GREEN	Stop command received. Terminal block wiring not secure. Loss of 24 Vdc control power. Transient fault when Reset Mode set to AUTO. External control device failure. External mains device failure or trip condition. Control board failure.	24 Vdc permissive signal lost—investigate control system. Check control wiring for security. Check 24 Vdc power source for correct sizing and circuit connections. Change Reset Mode to Manual to capture fault condition. Inspect external control devices for proper operation. Inspect external devices for condition and proper operation. Possible device fatal error.
Status LED is RED	Protection/Operation parameters not set to proper values. Fault condition exists. Fault not reset from previous trip. Reset Mode set to Manual.	Determine Fault condition from the Fault History. Adjust Protection parameter values to prevent recurring fault trips. Correct problems with mains voltages and/or phase conditions. Attempt to reset fault—the fault will not reset if the fault condition exists. Set Reset Mode to Manual to retain soft starter in fault condition for troubleshooting. Correct fault condition and change Reset Mode to Auto if desired. Set Protection parameters to Warning. Reset Mode set to Manual and no Reset signal was sent to the soft starter. Reset soft starter or change Reset Mode to AUTO.
No status LEDs illuminated, DIM display dark.	No Control Power supply Device failure.	Provide 24 Vdc to Control power terminal block. Check Control Power for proper value and reliability.

Local Control Troubleshooting Flow Chart



In extreme cases, it may be necessary to reset parameter settings and operating values to restore proper operation. The S811+ may be reset by following the instruction below.

Resetting the S811+

#1 Place all DIP switches on the front cover of the S811+ in the OFF position

#2 Using the table below, toggle (ON-OFF) the indicated switch 5 times to perform the desired Reset

#3 After the reset is complete, set the DIP switches back to the desired Network Communication Port Node ID (1-63)

Switch "1"	Factory Reset (Reset to default Factory [Out-of-Box] state)
Switch "2"	Application Configuration Reset (Resets all application parameters to defaults. Leaves QCP network parameters unchanged.)
Switch "4"	Commission Reset (Reset Mode and Baud Rate only)
Switch "8"	Network Config Reset (Reset Node ID, Baud and Mode only)

Accessories

Lug Kits

Lug Kits—S811+T, U…

Description	Part Number
2 cable connections, 4 AWG to 1/0 cable	**EML22**
1 cable connection, 4/0 to 500 kcmil cable	**EML23**
2 cable connections. 4/0 to 500 kcmil cable	**EML24**
1 cable connection, 2/0 to 300 kcmil cable	**EML25**
2 cable connections, 2/0 to 300 kcmil cable	**EML26**

Lug Kits—S811+V…

Description	Part Number
2 cable connections. 4/0 to 500 kcmil cable	**EML28**
4 cable connections. 4/0 to 500 kcmil cable	**EML30**
6 cable connections. 4/0 to 500 kcmil cable	**EML32**
2 cable connections, 2/0 to 300 kcmil cable	**EML33**

Optional Accessory Kits

Accessory Kits

Description	S811+ Frame	Accessory Kit Part Number
Panel Mounting Kit—3 ft cable	S811+…	**EMA69A**
Panel Mounting Kit—5 ft cable	S811+…	**EMA69B**
Panel Mounting Kit—8 ft cable	S811+…	**EMA69C**
Panel Mounting Kit—10 ft cable	S811+…	**EMA69D**
Mounting Plate, S811+N…	S811+N…	**EMM13N**
Mounting Plate, S811+R…	S811+R…	**EMM13R**
Mounting Plate, S811+T…	S811+T…	**EMM13T**
Mounting Plate, S811+U…	S811+U…	**EMM13T**
Mounting Plate, S811+V…	S811+V…	**EMM13V**
Vibration Plate, S811+N…	S811+N…	**EMM14N**
Vibration Plate, S811+R…	S811+R…	**EMM14R**
Vibration Plate, S811+T…	S811+T…	**EMM14T**
Vibration Plate, S811+U…	S811+U…	**EMM14T**
Vibration Plate, S811+V…	S811+V…	**EMM14V**
IP20 Kit, S811+N…	S811+N…	**SS-IP20-N**
IP20 Kit, S811+R…	S811+R…	**SS-IP20-R**
IP20 Kit, S811+T…	S811+T…	**SS-IP20-TU**
IP20 Kit, S811+U…	S811+U…	**SS-IP20-TU**
IP20 Kit, S811+V…	S811+V…	**SS-IP20-V**
Fan Kit	S811+…	**EMM18**

Communications

Contact EatonCare for availability of communications adapters.

Communications

Description	Catalog Number
CH0 RJ-12 Adapter	**S811+QCPA**
EtherNet/IP / Modbus TCP Communication Adapter with 120 Vac I/O	**C441U**
EtherNet/IP / Modbus TCP Communication Adapter with 24 Vdc I/O	**C441V**

Replacement Parts

Replacement Parts

Description	S811+ Frame	Replacement Part Number
DIM for Standard Unit	S811+…	**EMA91**
Control Wire Connector	S811+…	**EMA75**
CIM for Standard Unit	S811+…	**EMA71**

Appendix A—Parameters

Monitoring Menu

Monitoring Menu

Description	Units	Access Level
Flt/Warn Active		0
Fault/Warn List		0
Fault/Warn History		0
3Ø Line Currents	Amps	0
Current as % FLA	%	0
DC Cntrl Voltage	Volts	0
3Ø Pole Voltages	Volts	0
Line Frequency	Hz	0
Phase Sequence		0
Ave Line Power	kW	0
Power Factor		0
Thermal Memory	%	0
Pole Temp	°C	0
Start Count		0
Auto Reset Count		0

Soft Start Config Menu

Soft Start Config—S811+ …N3S Standard

Soft Start Config Menu	Units	Minimum Inline (InsideDelta)	Maximum Inline (InsideDelta)	Default Inline (InsideDelta)	Notes	Access Level
Mtr Nameplate FLA						2
S811+N37…	Amps	11 (19)	37 (65)	11 (19)	Motor FLA parameter must be set to motor nameplate FLA to achieve proper overload protection.	2
S811+N66…	Amps	20 (35)	66 (114)	20 (35)		2
S811+R10…	Amps	32 (55)	105 (182)	32 (55)		2
S811+R13…	Amps	42 (73)	135 (234)	42 (73)		2
S811+T18…	Amps	56 (97)	180 (311)	56 (97)		2
S811+T24…	Amps	75 (130)	240 (415)	75 (130)		2
S811+T30…	Amps	95 (164)	304 (526)	95 (164)		2
S811+U36…	Amps	112 (195)	360 (623)	112 (195)		2
S811+U42…	Amps	131 (227)	420 (727)	131 (227)		2
S811+U50…	Amps	156 (270)	500 (865)	156 (270)		2
S811+V36…	Amps	112 (195)	360 (623)	112 (195)		2
S811+V42…	Amps	131 (227)	420 (727)	131 (227)		2
S811+V50…	Amps	156 (270)	500 (865)	156 (270)		2
S811+V65…	Amps	203 (352)	650 (1125)	203 (352)		2
S811+V72…	Amps	225 (389)	720 (1246)	225 (389)		2
S811+V85…	Amps	265 (458)	850 (1471)	265 (458)		2
S811+V10…	Amps	312 (539)	1000 (1732)	312 (539)		2
Ovrld Trip Class		5	30	20		2
Phase Rev Fault		0	1	0	**0** = Enabled **1** = Disabled	2
Phase Sequence		0	1	0	**0** = ABC **1** = ACB	2
Start Method		0	2	0	**0** = Voltage Ramp **1** = Current Limit	2
Initial Torque	%	0	85	45		1
Soft Start Time	Seconds	0.5	180	20		1
Kick Start Torq	%	0	85	0		1
Kick Start Time	Seconds	0	2	0		1
Soft Stop Time	Seconds	0	60	0		1
Reset Mode		0	2	0	**0** = Manual **1** = Auto **2** = Powerup Reset	2
Auto Reset Delay	Seconds	0.1	600	0.1		2
Auto Reset Limit		0	10000	0		2
Motor Wiring Config		0	1	0	**0** = Inline **1** = InsideDelta	2

Soft Start Config—S811+ …P3S Premium

Soft Start Config Menu	Units	Minimum Inline (InsideDelta)	Maximum Inline (InsideDelta)	Default Inline (InsideDelta)	Notes	Access Level
Mtr Nameplate FLA						2
S811+N37…	Amps	11 (19)	37 (65)	11 (19)	Motor FLA parameter must be set to motor nameplate FLA to achieve proper overload protection.	2
S811+N66…	Amps	20 (35)	66 (114)	20 (35)		2
S811+R10…	Amps	32 (55)	105 (182)	32 (55)		2
S811+R13…	Amps	42 (73)	135 (234)	42 (73)		2
S811+T18…	Amps	56 (97)	180 (311)	56 (97)		2
S811+T24…	Amps	75 (130)	240 (415)	75 (130)		2
S811+T30…	Amps	95 (164)	304 (526)	95 (164)		2
S811+U36…	Amps	112 (195)	360 (623)	112 (195)		2
S811+U42…	Amps	131 (227)	420 (727)	131 (227)		2
S811+U50…	Amps	156 (270)	500 (865)	156 (270)		2
S811+V36…	Amps	112 (195)	360 (623)	112 (195)		2
S811+V42…	Amps	131 (227)	420 (727)	131 (227)		2
S811+V50…	Amps	156 (270)	500 (865)	156 (270)		2
S811+V65…	Amps	203 (352)	650 (1125)	203 (352)		2
S811+V72…	Amps	225 (389)	720 (1246)	225 (389)		2
S811+V85…	Amps	265 (458)	850 (1471)	265 (458)		2
S811+V10…	Amps	312 (539)	1000 (1732)	312 (539)		2
Ovrld Trip Class		5	30	20		2
Phase Rev Fault		0	1	0	**0** = Enabled **1** = Disabled	2
Phase Sequence		0	1	0	**0** = ABC **1** = ACB	2
Start Method		0	3	0	**0** = Voltage Ramp **1** = Current Limit **2** = Unavailable **3** = Pump Start	2
Initial Torque	%	0	85	45		1
Soft Start Time	Seconds	0.5	360	20		1
Kick Start Torq	%	0	85	0		1
Kick Start Time	Seconds	0	2	0		1
Pump Stop Time	Seconds	5	120	10		1
Soft Stop Time	Seconds	0	60	0		1
Reset Mode		0	2	0	**0** = Manual **1** = Auto **2** = Powerup Reset	2
Auto Reset Delay	Seconds	0.1	600	0.1		2
Auto Reset Limit		0	10000	0		2
Motor Wiring Config		0	1	0	**0** = Inline **1** = Inside-the-Delta	2

Note: S811+… units cannot be configured with Pump Start + Inside-the-Delta functionality enabled at the same time.

Soft Start Config—S811+ …V3S Premium (690 Volt)

Soft Start Config Menu	Units	Minimum Inline	Maximum Inline	Default Inline	Notes	Access Level
Mtr Nameplate FLA						2
S811+T18…	Amps	56	180	56	Motor FLA parameter must be set to motor nameplate FLA to achieve proper overload protection.	2
S811+T24…	Amps	75	240	75		2
S811+T30…	Amps	95	304	95		2
S811+V36…	Amps	112	360	112		2
S811+V42…	Amps	131	420	131		2
S811+V50…	Amps	156	500	156		2
S811+V65…	Amps	203	650	203		2
S811+V72…	Amps	225	720	225		2
S811+V85…	Amps	265	850	265		2
Ovrld Trip Class		5	30	20		2
Phase Rev Fault		0	1	0	**0** = Enabled **1** = Disabled	2
Phase Sequence		0	1	0	**0** = ABC **1** = ACB	2
Start Method		0	3	0	**0** = Voltage Ramp **1** = Current Limit **2** = Unavailable **3** = Pump Start	2
Initial Torque	%	0	85	45		1
Soft Start Time	Seconds	0.5	360	20		1
Kick Start Torq	%	0	85	0		1
Kick Start Time	Seconds	0	2	0		1
Pump Stop Time	Seconds	5	120	10		1
Soft Stop Time	Seconds	0	60	0		1
Reset Mode		0	2	0	**0** = Manual **1** = Auto **2** = Powerup Reset	2
Auto Reset Delay	Seconds	0.1	600	0.1		2
Auto Reset Limit		0	10000	0		2
Motor Wiring Config		0	0	0	**0** = Inline	2

Protection Menu

Protections Menu—All Catalog Numbers

Fault Code	Protections Menu	Units	Minimum	Maximum	Default	Notes
14	Overload Fault Enable		0	2	1	**0** = Disable **1** = Enable **2** = Warning
*	Ovld On Start		0	1	1	**0** = Disable **1** = Enable
*	Motor Rated Volt	volts	115	600	480	
		volts	115	690	480	690 volt option
42	Low Volt Trip Enable		0	2	1	**0** = Disable **1** = Enable **2** = Warning
	Low Volt Level	%	1	99	90	
	Low V Trip Dly	seconds	1	60	3	
43	Hi Volt Trip—Enable		0	2	0	**0** = Disable **1** = Enable **2** = Warning
	Hi Volt Level	%	101	120	110	
	Hi V Trip Dly	seconds	1	60	3	
7	V Imbal Trip Lev	%	1	100	6	
	V Imbal Trip Dly	seconds	1	60	0.5	
6	Phase Loss Fault		0	2	1	**0** = Disable **1** = Enable **2** = Warning
	Phase Loss % Trp	%	1	100	80	
	Ph Loss Trip Dly	seconds	1	60	0.5	
9	Lo I Trip Enable		0	2	1	**0** = Disable **1** = Enable **2** = Warning
	Low I Trip % FLA	%	0	100	6	
	Lo I Trip Delay	seconds	1	60	2	
7	Phase Imb Fault—Enable		0	2	1	**0** = Disable **1** = Enable **2** = Warning
	I Imbal Trip Lev	%	1	100	40	
	I Imbal Trip Dly	seconds	1	60	0.5	
11	Jam Fault—Enable		0	2	1	**0** = Disable **1** = Enable **2** = Warning
63	Stall Fault—Enable		0	2	1	**0** = Disable **1** = Enable **2** = Warning

Protections Menu, continued

Fault Code	Protections Menu	Units	Minimum	Maximum	Default	Notes
40	3Ø Power Fault—Enable		0	2	0	**0** = Disable **1** = Enable **2** = Warning
	Low Power Trip Level	%	0	100	50	
	High Power Trip Level	%	0	800	125	
	Pwr Flt Trip Dly	seconds	1	60	3	
74, 75	Rated Line Freq	Hz	50	60	60	
	Line Freq Fault—Enable		0	2	0	**0** = Disable **1** = Enable **2** = Warning
	Freq Deviatn Trp	%	5	150	50	
	Freq Trip Delay	seconds	1	60	3	
59	SCR Short Fault—Enable		0	2	1	**0** = Disable **1** = Enable **2** = Warning
58	SCR Cnduct Fault—Enable		0	2	1	**0** = Disable **1** = Enable **2** = Warning
38	Temp Sense Fault—Enable		0	2	1	**0** = Disable **1** = Enable **2** = Warning
*	Alarm-No-Trip		0	1	0	**0** = Disable **1** = Enable

Advanced I/O Menu

Parameter List—Advanced I/O Setup—All Catalog Numbers

Advanced I/O Setup Menu	Units	Minimum	Maximum	Default	Notes	Access Level
Input Config	Entry 0 = Terminal “1”	0	10	1	**0** = No Function **1** = RUN1 **2** = Ramp2 **3** = JOG **4** = LOCAL **5** = RESET **6** = E-Stop **7** = Alarm-No-Trip **8** = Ext Trip **9** = Ext Warn **10** = Disable OL on Strt (edge only) **11** = Analog	2
	Entry 1 = Terminal “2”	0	10	3		
	Entry 2 = Terminal “3”	0	10	4		
	Entry 3 = Terminal “4”	0	11	5		
	Entry 4 = Network Input 1	0	10	0		
	Entry 5 = Network Input 2	0	10	0		
	Entry 6 = Network Input 3	0	10	0		
	Entry 7 = Network Input 4	0	10	0		
Run Input Ctrl		0	0	0	**0** = Read Only	0
Local Ctrl Only		0	1	0	**0** = Disable **1** = Enable	2

Parameter List—Advanced I/O Setup—All Catalog Numbers, continued

Advanced I/O Setup Menu	Units	Minimum	Maximum	Default	Notes	Access Level
Relay Config	Entry 0 = Terminals 13, 14	0	10	3	**0** = No Function **1** = Fault **2** = Fault NOT **3** = Bypassed **4** = Bypassed NOT **5** = Motor Energized **6** = Motor Energized NOT **7** = Warning **8** = Warning NOT **9** = Custom Flt/Warn **10** = Custom Flt/Warn NOT	2
	Entry 1 = Terminals 95, 96, 98	0	10	1		
	Entry 2 = Network Output 1	0	10	0		
	Entry 3 = Network Output 2	0	10	0		
Relay Custom Cfg	User-Entered Fault Warning Codes	—	—	—		2
Pwr On Start Dly	Seconds	0	60	0		2
Start Delay	Seconds	0	60	0		2
Run Chg Strt Dly	Seconds	0	60	0		2
Start Delay Warn		0	1	1	**0** = Disable **1** = Enable	2
R2 Phase Seq		0	1	0	**0** = ABC **1** = ACB	2
R2 Start Method		0	3	0	**0** = Voltage Ramp **1** = Current Limit **2** = Unavailable **3** = Pump Start (Opt.)	2
R2 Initial Torq	%	0	85	45		1
R2 Soft Start Tm	Seconds	5	180	20		1
R2 Kick St Torq	%	0	85	0		1
R2 Kick St Time	Seconds	0	2	0		1
R2 Pump Stop Tm	Seconds	20	120	60		1
R2 Soft Stop Tm	Seconds	0	60	0		1
Analog Input Flt		0	2	0	**0** = Disable **1** = Enable **2** = Warning	2
Analog Low Trip	%	0	100	10		2
Analog High Trip	%	0	100	90		2
Analog Trip Dly	Seconds	1	60	3		2
Analog In Range		2	3	3	**2** = 0–20.0 ma DC **3** = 4.0–20.0 ma DC	2
Analog In Sense	%					0
Analog In Status						0

Network Setup Menu

Network Setup

Network Setup	Minimum	Maximum	Default	Notes	Access Level
Comm Loss Action	0	7	0	**0** = Auto Stop **1** = Auto Run1 **2** = Unavailable **3** = Hold Last **4** = Unavailable **5** = Unavailable **6** = Unavailable **7** = All Stop Fault	2
Modbus Baud Rate	0	7	4	**0** = 1200 **1** = 2400 **2** = 2800 **3** = 9600 **4** = 19200 **5** = 38400 **6** = 57600 **7** = 115200	2
Modbus Address					0
Modbus Parity	0	1	0	**0** = Even (1 stop bit) **1** = Odd (1 stop bit)	2
Modbus Stop Bits	1	2	1		2
Modbus Mode					2
Config CRC					0
Firmware Version					0
Hardware Version					0
Discrete Input					0
Discrete Output					0
Motor Status					0
Modbus User Name					2
Product Code					0
Network 2 Enable	0	1	0	**0** = disabled, register 500 active **1** = enabled, register 501 active	2

LCD DIM Setup Menu

LCD DIM Setup

LCD DIM Setup	Units	Minimum	Maximum	Default	Access Level
Upload Settings					2
Dnload Settings					2
DIM Access Level		0	3	2	0
Access Timeout	seconds	0	600	600	2
Change Password					2
Clear Fault Hist					1
Get Register					0
Set Register					2
Run Button Delay	seconds	0	0.3	0.3	2
Removable DIM ①②		0.3	0	1	2
Fault Disp Tmout					1
Menu Disp Tmout					1
Reset—Soft					2
Backlight Level				3	1
Backlite Tmout		0	300	0	1
DIM Firmware Ver					0
Local jog button enable ③		0	1	0	2

Notes

① Digital Interface Module.

② 0 = Disabled (Fault)
1 = Enabled (No Fault).

③ 0 = Disabled (Fault)
1 = Enabled (Jog).

Appendix B—Protection

Thermal Overload

The S811+ Soft Starter features an electronic motor overload protection feature. This is intended to protect the motor and power wiring against overheating caused by excessive current for extended periods of time.

Note: Short circuit protection must be applied on the line side of the soft starter.

Enter the motor full load current rating, using the *Mtr Nameplate FLA* parameter in the Soft Start Config Menu to program the trip current. It is programmable from 32–100% of the unit's rated current.

Overload—Adjustment Range—Inline Connected

Catalog Number	Min	Max	Default	Notes
S811+N37…	11	37	11	Motor FLA parameter must be set to motor nameplate FLA to achieve proper overload protection
S811+N66…	20	66	20	
S811+R10…	32	105	32	
S811+R13…	42	135	42	
S811+T18…	56	180	56	
S811+T24…	75	240	75	
S811+T30…	95	304	95	
S811+V36…	112	360	112	
S811+V42…	131	420	131	
S811+V50…	156	500	156	
S811+V65…	203	650	203	
S811+V72…	225	720	225	
S811+V85…	265	850	265	
S811+V10…	312	1000	312	

Overload—Adjustment Range—Inside-the-Delta Connected

Catalog Number	Min	Max	Default	Notes
S811+N37…	19	65	19	Motor FLA parameter must be set to motor nameplate FLA to achieve proper overload protection
S811+N66…	35	114	35	
S811+R10…	55	182	55	
S811+R13…	73	234	73	
S811+T18…	97	311	97	
S811+T24…	130	415	130	
S811+T30…	164	526	164	
S811+V36…	193	623	193	
S811+V42…	227	727	227	
S811+V50…	270	865	270	
S811+V65…	352	1125	352	
S811+V72…	389	1246	389	
S811+V85…	458	1471	458	
S811+V10…	539	1732	539	

Note: *Mtr Nameplate FLA* parameter is adjustable to any point within its range.

The thermal overload is designed to protect the motor from overheating caused by excessive current. If the motor is overloaded, the current drawn rises and heats the motor. The FLA sets the trip threshold and the trip class (5 to 30) is set with the *Ovrld Trip Class* parameter.

If the device trips on a thermal overload, an internal timer is started which inhibits a reset for three minutes. After this timer expires, the device may be reset and the thermal fault is cleared. At this point another internal timer is started, this timer is 26 x 3 or 48 minutes. If another trip occurs before this timer expires, the reset inhibit time is increased to 6 minutes.

Once the trip level reaches level 3, it will take 144 minutes to go back to level 2, then 96 minutes to get back to level 1. To get from level 3 to a reset thermal overload at level 1, it takes 240 minutes without a trip. A reset thermal overload at level 1 means the next thermal overload trip will have a 3-minute reset inhibit as in the table below.

Thermal Motor Overload Times

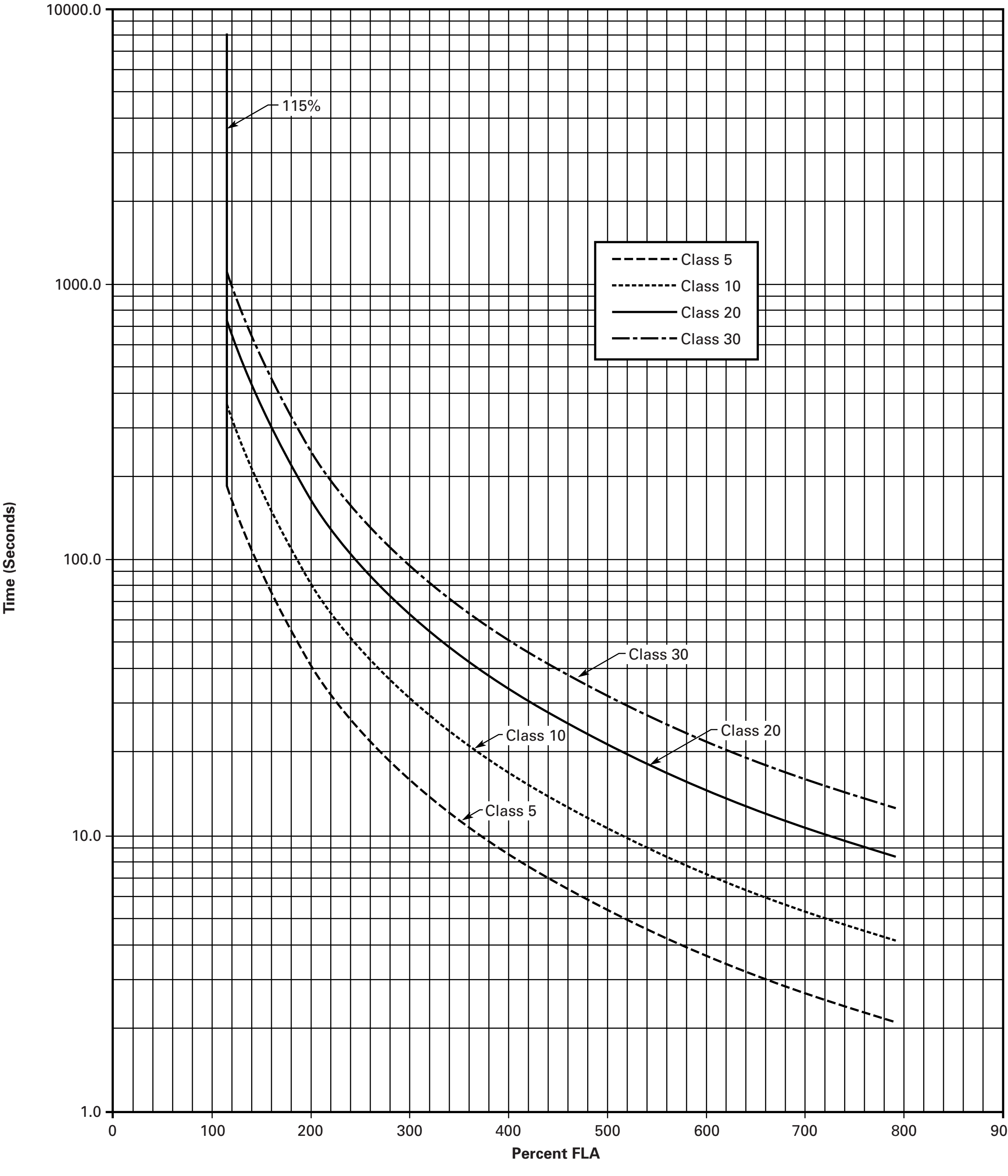
Trip Level	Preset Inhibit Time	Reset Time to Previous Trip Level
1	3 minutes	N/A
2	6 minutes	96 minutes
3	9 minutes	144 minutes

Total 240 minutes to reset to level 1.

Cycling power on the device will NOT clear the thermal trip. The thermal memory and the reset inhibit time are saved to the non-volatile memory. These values are reloaded when the device boots and the timer is restarted at the full reset time. This means if the 3-minute inhibit timer has been running two minutes, cycling power will require the user to wait the full three minutes before a reset can clear the overload fault.

If the device is shut down when the overload fault is tripped, the temperature is also saved to the non-volatile memory. If the device is left to cool and then powered, the temperature read from the sensor is compared to the saved temperature. If the current temperature is 87% or less of the saved temperature, a full thermal memory reset is initiated.

Overload Trip Curves



Appendix C—Ratings, Cooling and Power Losses—Inline

Power Ratings

Standard Duty—15 Second Ramp, 300% Current Limit at 40°C—Inline Connection

	Three-Phase Motors											
	kW Rating (50 Hz)			hp Rating (60 Hz)								
Maximum Current	230V 1.0SF	380–400V 1.0SF	440V 1.0SF	200V 1.0SF	1.15SF	230V 1.0SF	1.15SF	460V 1.0SF	1.15SF	575–690V 1.0SF	1.15SF	Catalog Number
Frame Size N												
37	10	18.5	18.5	10	10	10	10	25	20	30	30	**S811+N37N3S**
66	18.5	30	37	20	15	20	20	50	40	60	50	**S811+N66N3S**
Frame Size R												
105	30	55	59	30	25	40	30	75	60	100	75	**S811+R10N3S**
135	40	63	80	40	30	50	40	100	75	125	100	**S811+R13N3S**
Frame Size T												
180	51	90	110	60	50	60	60	150	125	150	150	**S811+T18N3S**
240	75	110	147	75	60	75	75	200	150	200	200	**S811+T24N3S**
304	90	160	185	100	75	100	100	250	200	300	250	**S811+T30N3S**
Frame Size U												
360	110	185	220	125	100	150	125	300	250	350	300	**S811+U36N3S**
420	129	220	257	150	125	175	150	350	300	450	350	**S811+U42N3S**
500	150	257	300	150	150	200	150	400	350	500	450	**S811+U50N3S**
Frame Size V												
360	110	185	220	125	100	150	125	300	250	350	300	**S811+V36N3S**
420	129	220	257	150	125	175	150	350	300	450	350	**S811+V42N3S**
500	150	257	300	150	150	200	150	400	350	500	450	**S811+V50N3S**
650	200	355	425	250	200	250	200	500	450	600	500	**S811+V65N3S**
720	220	400	450	①	①	300	250	600	500	700	600	**S811+V72N3S**
850	257	475	500	①	①	350	300	700	600	900	700	**S811+V85N3S**
1000	277	525	500	①	①	400	350	800	700	900	800	**S811+V10N3S**

Notes

1.0SF = 1.0 Service Factor.

1.15SF = 1.15 Service Factor.

① Consult factory.

Severe Duty—30 Second Ramp and/or 450% Current Limit at 50°C—Inline Connection

	Three-Phase Motors											
	kW Rating (50 Hz)			**hp Rating (60 Hz)**								
Maximum Current	**230V**	**380–400V**	**440V**	**200V**		**230V**		**460V**		**575–690V**		**Catalog Number**
	1.0SF	**1.0SF**	**1.0SF**	**1.0SF**	**1.15SF**	**1.0SF**	**1.15SF**	**1.0SF**	**1.15SF**	**1.0SF**	**1.15SF**	
Frame Size N												
22	5.5	10	11	5	5	7.5	5	15	10	20	15	**S811+N37N3S**
42	11	18.5	22	10	10	15	10	30	25	40	30	**S811+N66N3S**
Frame Size R												
65	15	30	33	15	15	20	15	50	40	50	50	**S811+R10N3S**
80	22	40	45	25	20	30	25	60	50	75	60	**S811+R13N3S**
Frame Size T												
115	33	59	63	30	30	40	30	75	75	100	100	**S811+T18N3S**
150	45	80	90	50	40	50	50	100	100	150	125	**S811+T24N3S**
192	55	100	110	60	50	75	60	150	125	200	150	**S811+T30N3S**
Frame Size U												
240	75	110	147	75	60	75	75	200	150	200	200	**S811+U36N3S**
305	90	160	185	100	75	100	100	250	200	300	250	**S811+U42N3S**
Frame Size V												
240	75	110	147	75	60	75	75	200	150	200	200	**S811+V36N3S**
305	90	160	185	100	75	100	100	250	200	300	250	**S811+V42N3S**
365	110	185	220	125	100	150	125	300	250	350	300	**S811+V50N3S**
420	129	220	257	150	125	150	150	350	300	450	350	**S811+V65N3S**
480	147	257	295	150	150	200	150	400	350	500	450	**S811+V72N3S**
525	160	280	335	150	150	200	150	450	350	500	450	**S811+V85N3S**
575	172	303	370	200	150	250	200	500	450	600	500	**S811+V10N3S**

Notes

1.0SF = 1.0 Service Factor.

1.15SF = 1.15 Service Factor.

Appendix D—Ratings, Cooling and Power Losses—Inside-the-Delta

Power Ratings

Standard Duty—15 Second Ramp, 300% Current Limit at 40°C—Inside-the-Delta Connection

Maximum Continuous Line Current	Three-Phase Motors kW Rating (50 Hz) 230V 1.0SF	380–400V 1.0SF	440V 1.0SF	hp Rating (60 Hz) 200V 1.0SF	1.15SF	230V 1.0SF	1.15SF	460V 1.0SF	1.15SF	575–690V 1.0SF	1.15SF	Catalog Number
Frame Size N												
65	10	18.5	18.5	15	15	15	15	40	30	50	50	**S811+N37N3S**
114	18.5	30	37	30	25	30	30	75	60	100	75	**S811+N66N3S**
Frame Size R												
182	30	55	59	50	40	60	50	125	100	150	125	**S811+R10N3S**
234	40	63	80	60	50	75	60	150	125	200	150	**S811+R13N3S**
Frame Size T												
311	51	90	110	100	75	100	100	250	200	250	250	**S811+T18N3S**
415	75	110	147	125	100	125	125	300	250	300	300	**S811+T24N3S**
526	90	160	185	150	125	150	150	400	300	400	400	**S811+T30N3S**
Frame Size U												
623	110	185	220	200	150	250	200	450	400	550	450	**S811+U36N3S**
727	129	220	257	250	200	300	250	550	450	700	550	**S811+U42N3S**
865	150	257	300	250	250	300	250	600	550	750	700	**S811+U50N3S**
Frame Size V												
623	110	185	220	200	150	250	200	450	400	550	450	**S811+V36N3S**
727	129	220	257	250	200	300	250	550	450	700	550	**S811+V42N3S**
865	150	257	300	250	250	300	250	600	550	750	700	**S811+V50N3S**
1125	200	355	425	400	300	400	300	750	700	900	750	**S811+V65N3S**
1246	①	①	①	①	①	①	①	①	①	①	①	**S811+V72N3S**
1471	①	①	①	①	①	①	①	①	①	①	①	**S811+V85N3S**
①	①	①	①	①	①	①	①	①	①	①	①	**S811+V10N3S**

Notes

1.0SF = 1.0 Service Factor.

1.15SF = 1.15 Service Factor.

① Consult factory.

Severe Duty—30 Second Ramp and/or 450% Current Limit at 50°C—Inside-the-Delta Connection

Maximum Continuous Line Current	Three-Phase Motors kW Rating (50 Hz)			hp Rating (60 Hz)								Catalog Number
	230V	380–400V	440V	200V		230V		460V		575–690V		
	1.0SF	1.0SF	1.0SF	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	1.0SF	1.15SF	
Frame Size N												
39	5.5	10	11	7.5	7.5	10	7.5	25	15	30	25	**S811+N37N3S**
73	11	18.5	22	15	15	25	15	50	40	60	50	**S811+N66N3S**
Frame Size R												
111	15	30	33	25	25	30	25	75	60	75	75	**S811+R10N3S**
138	22	40	45	40	30	50	40	100	75	125	100	**S811+R13N3S**
Frame Size T												
199	33	59	63	50	50	60	50	125	125	150	150	**S811+T18N3S**
257	45	80	90	75	60	75	75	150	150	250	200	**S811+T24N3S**
324	55	100	110	100	75	100	100	250	200	300	250	**S811+T30N3S**
Frame Size U												
415	75	110	147	125	100	125	125	300	250	300	300	**S811+U36N3S**
526	90	160	185	150	125	150	150	400	300	450	400	**S811+U42N3S**
623	110	185	220	200	150	250	200	450	400	550	450	**S811+U50N3S**
Frame Size V												
415	75	110	147	125	100	125	125	300	250	300	300	**S811+V36N3S**
526	90	160	185	150	125	150	150	400	300	450	400	**S811+V42N3S**
623	110	185	220	200	150	250	200	450	400	550	450	**S811+V50N3S**
727	129	220	257	250	200	250	250	550	450	700	550	**S811+V65N3S**
816	147	257	295	250	250	300	250	600	550	750	700	**S811+V72N3S**
908	160	280	335	250	250	300	250	700	550	750	700	**S811+V85N3S**
①	①	①	①	①	①	①	①	①	①	①	①	**S811+V10N3S**

Notes

1.0SF = 1.0 Service Factor.

1.15SF = 1.15 Service Factor.

① Consult factory.

Power Losses

The following table lists the maximum power loss for each S811+ Soft Starter when it is operating in bypass at the maximum frame size current. These losses should be used in conjunction with the losses of another cabinet mounted device to determine the enclosure size and any cooling requirements.

Maximum Power Loss

Catalog Number	FLA Current Range Inline	FLA Current Range Inside-the-Delta	Power Loss (Watts)
S811+N37…	11–37 amps	19–65 amps	30
S811+N66…	20–66 amps	35–114 amps	33
S811+R10…	32–105 amps	55–182 amps	47
S811+R13…	42–135 amps	73–234 amps	55
S811+T18…	56–180 amps	97–311 amps	37
S811+T24…	75–240 amps	130–415 amps	40
S811+T30…	95–304 amps	164–526 amps	45
S811+U36…	112–360 amps	193–623 amps	76
S811+U42…	131–420 amps	227–727 amps	92
S811+U50…	156–500 amps	270–865 amps	116
S811+V36…	112–360 amps	193–623 amps	56
S811+V42…	131–420 amps	227–727 amps	64
S811+V50…	156–500 amps	270–865 amps	78
S811+V65…	203–650 amps	352–1125 amps	109
S811+V72…	225–720 amps	389–1246 amps	127
S811+V85…	265–850 amps	458–1471 amps	164
S811+V10…	312–1000 amps	Not Available	215

Appendix E—Motor/Application Considerations

Squirrel Cage Motor

This is the most common application.

The motor is configured with three motor leads available.

In this case, wire the motor to the soft starter with one lead per phase, observing proper phase rotation. An in-sight disconnect means should be installed, per code requirements.

Wye-Delta Motor

The wye-delta motor is a traditional way of achieving a reduced voltage start using regular contactors and starters. In this method, the motor is constructed with all six leads brought out to connect the unit in a wye configuration. This allows about 58% of the current (33% starting torque) to be applied during start-up. A timer is used to control the circuit and switch to the delta configuration as the unit approaches full speed.

In this case, wire the six-lead motor in a standard delta configuration. The soft starter is then used to control the voltage and motor torque without the need for additional circuitry. An insight disconnect means should be installed, per local code. The S811+ Soft Starter must be wired into the three-phase line feeding the three main motor input leads as would be done for normal across-the-line starting. **It must not be wired internally between motor windings in an inside-the-delta configuration**.

Part Winding Motor

The part winding motor is another design created to help achieve a soft start to the load. A part winding motor is constructed of two separate (but parallel) windings. When using a traditional starter, the first winding would receive full voltage. This winding supplies as much as 400% of the motors FLA; about 45% starting torque in a delta configuration for motor startup. After a timed delay, full voltage is applied to the second winding. The second winding acts in parallel with the first to provide for normal running current. Part winding motors are available in both a wye and delta configuration, dependent upon the manufacturer. Refer to the motor nameplate for the correct wiring information. In this case, wire the two windings in parallel. The soft starter is then used to control the current applied to the motor. An in-sight disconnect means should be installed, per code requirements.

Dual Voltage Motor

A dual voltage motor should be wired into the appropriate configuration for the line voltage it is being applied to. Refer to the motor nameplate for the correct wiring information. The soft starter must be selected for the appropriate line voltage.

Multi-Speed Motor

Some motors have multiple windings to allow operation at different base speeds. The multiple speeds are sometimes utilized for soft starting and other times for a process requirement of the machine to which it is attached. If only one speed is required, the motor should be wired for that speed. If multiple speeds are required, the appropriate contactors will need to be connected to the output of the Soft Starter. The contactors must be in the selected speed position before the soft starter is started. The motor must be stopped and the soft starter turned off before the speed selection contactors are changed.

Other Winding Configurations

Motors with other winding configurations, designed for specific characteristics, should be wired in a fashion consistent with their intended use. The motor nameplate contains information on the available configurations. The motor winding configuration chosen must be appropriate for the available line voltage. The soft starter must also be selected on the basis of the configuration chosen.

Power Factor Correction Capacitors

Power factor correction capacitors should be installed on the line side of the soft starter. It is recommended that at least 10 feet of cable be between the capacitor and the soft starter. The power factor correction capacitors can be switched with a separate contactor. NEMA ICS2-1988 Part 2-210.81.01 provides recommendations for when a separate contactor should be used to switch the power factor correction capacitor including high inertia loads, reversing motors, frequently jogged motors and multi-speed motors.

It is not recommended that the power factor correction capacitors be used on the load side of the soft starter. If used on the load side, the overload relay will measure the combination of capacitor and motor current causing the overload relay to not function correctly.

Appendix F—Pump Control Option

Pump Control Option

This option is intended to reduce the potential for water hammer in a centrifugal pump system by utilizing a starting and stopping algorithm developed for pump control. Upon a start command, the speed of the motor is increased, under the control of the S811+ Soft Starter microprocessor, to achieve a gentle start. After the speed has reached its nominal value, the bypass contactors close and the pump operates as with any other starter. Upon a stop command, the bypass contactors are opened and the motor speed is decreased in a tapered manner, to gradually slow the flow until the motor is brought to a stop. The start and stop ramp times are user adjustable and are to be set for the application requirements.

Installation

Install and wire your S811+ Soft Starter per the instructions found in the beginning of this manual.

Setup

All pump control parameters are set via the DIM or network connection. Units configured with the pump control option can activate this feature by selecting the pump option under the DIM "Start Method" parameter.

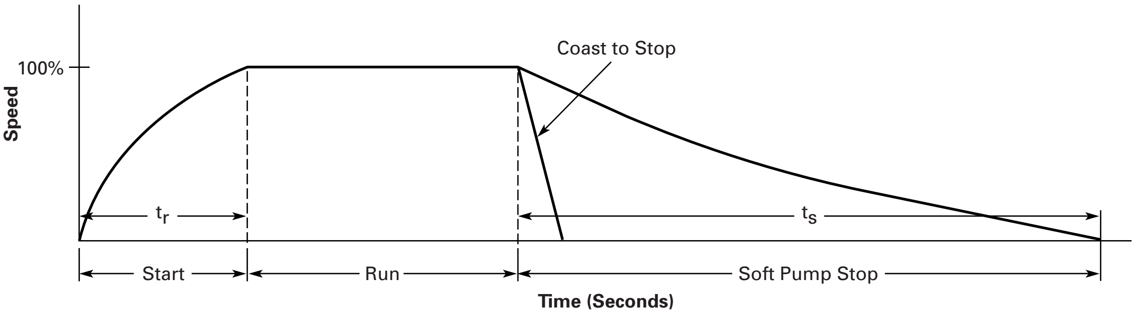
Adjustment

All of the adjustments to the S811+ Premium Soft Starter are made as noted in this user manual. The major difference between the standard S811+ Soft Starter and Premium is the special algorithm for gentle start and stop with centrifugal flow loads to minimize the potential for water hammer.

Using the DIM, set the S811+ Soft Start Configuration parameters described below:

The *Pump Start Ramp Time* parameter adjusts the start ramp. It has a standard range of 0.5 to 180.0 seconds. The factory default is 20.0 seconds. The pump stop time is adjusted by *Pump Stop*, which has a range of 5.0 to 120.0 seconds with the factory default being 10.0 seconds. (**NOTE**: The *Stop Ramp Time* setting used in non-pump S811+'s has no effect on units with the Pump Control Option installed if start method is Pump Start.) These adjustments are application dependent, and should be made to minimize any surge or water hammer effects. Typically *Pump Stop* would not be set short, since the stop might not differ much from a coast-to-stop. The soft stop time adjustment may often be in the range of 30 to 40 seconds, but needs to be set appropriately for the system requirements. If reduction or elimination of water hammer is not achieved, it may be necessary to lengthen *Pump Stop* to achieve the desired result. Note that long stop times will result in greater motor heating than shorter stop times. This can affect the number of start/stop cycles allowed per hour due to the S811+ Soft Starter or motor thermal limits.

Pump Control Option



Appendix G—Modbus Register Map

Register Map

Parameter	Data Length	Modbus Register Number	Read/Write	Data Type	Description
Motor Control Status	1	300	R	UINT8	**bit** **status** 0 Running1 1 Running2 2 Permissive 3 Ramp2 4 LocalControlStatus 5 Faulted 6 Warning 7 In bypass
Active Faults & Warning List (latest Fault)	2	301	R	UINT16	Latest Fault/Warning code
	2	302	R	UINT16	2nd Latest Fault/Warning code
	2	303	R	UINT16	3rd Latest Fault/Warning code
Motor Control Faults	2	304	R	UINT16	**bit** **fault** 0 Phaseloss 1 Phase Imbalance 2 Thermal Pile 3 Overcurrent 4 Breaker Fault 5 GND Fault 6 Motor Stall 7 Motor Jam 8 OverTemp 9 UnderLoad 10 Reserved 11 Estop 12 Reserved 13 Reserved 14 Reserved 15 Other
Motor Control Warnings	2	305	R	UINT16	**bit** **warning** 0 0 Phaseloss 1 Phase Imbalance 2 Thermal Pile 3 Overcurrent 4 Breaker Fault 5 GND Fault 6 Motor Stall 7 Motor Jam 8 OverTemp 9 UnderLoad 10 Overload Impending Trip 11 Reserved 12 Reserved 13 Reserved 14 Reserved 15 Other
Ave 3phase RMS AC Current as a % of FLA	2	306	R	UINT8	0–255%; Percent of FLA setting
Thermal Pile Percentage	1	307	R	UINT8	0–255%; Thermal Pile % used (100% trip)

Register Map, continued

Parameter	Data Length	Modbus Register Number	Read/Write	Data Type	Description
Three-Phase RMS AC Voltage	2	308	R	UINT16	L1 RMS Voltage
	2	309	R	UINT16	L2 RMS Voltage
	2	310	R	UINT16	L3 RMS Voltage
Total Number of Motor Starts	4	311	R	UINT32	# of motor starts
		312	R		Reg311 = LSB1, LSB0 Reg312 = MSB, LSB2
Analog Input Percent of Rated Range	1	313	R	UINT8	0–255%; Analog input status reported as% of selected range
Analog Input Value Status	1	314	R	UINT8	**Value** **Description** 0x00 Not Active 0x01 Under Range 0x02 Over Range 0x03 Input Overdrive 0x04 Input in range
Discrete Data Input	1	315	R	UINT8	**bit** **Description** 0 S811 TB Input#1 status 1 S811 TB Input#2 status 2 S811 TB Input#3 status 3 S811 TB Input#4 status 4 C441 Input#1 status 5 C441 Input#2 status 6 C441 Input#3 status 7 C441 Input#4 status
Discrete Data Output	1	316	R	UINT8	**bit** **Description** 0 S811 form1C relay 1 S811 formA relay 2 C441—Q1/Network output0 3 C441—Q2/Network output1 4 5 6 7
Network Outputs	1	317	R	UINT8	**bit** **Description** 0 C441—Q1/Network output0 1 C441—Q2/Network output1 2 3 4 5 6 7

Register Map, continued

Parameter	Data Length	Modbus Register Number	Read/Write	Data Type	Description
Fault Queue (Fault/Warning codes are not repeated in the list)	2	318	R	UINT16	Latest Fault/Warning code
	2	319	R	UINT16	2nd Latest Fault/Warning code
	2	320	R	UINT16	3rd Latest Fault/Warning code
	2	321	R	UINT16	4th Latest Fault/Warning code
	2	322	R	UINT16	5th Latest Fault/Warning code
	2	323	R	UINT16	6th Latest Fault/Warning code
	2	324	R	UINT16	7th Latest Fault/Warning code
	2	325	R	UINT16	8th Latest Fault/Warning code
	2	326	R	UINT16	9th Latest Fault/Warning code
	2	327	R	UINT16	10th Latest Fault/Warning code
Average RMS AC Current—Line	4	328	R	FLOAT	Average RMS Line Current
		329	R		Reg329 = LSB1, LSB0 Reg330 = MSB, LSB2
Three-Phase RMS Current On the line	4	330	R	FLOAT	L1 RMS Line Current
		331	R		Reg331 = LSB1, LSB0 Reg332 = MSB, LSB2
	4	332	R	FLOAT	L2 RMS Line Current
		333	R		Reg333 = LSB1, LSB0 Reg334 = MSB, LSB2
	4	334	R	FLOAT	L3 RMS Line Current
		335	R		Reg335 = LSB1, LSB0 Reg336 = MSB, LSB2
Scaled Average Three-Phase Currents in Amps—Line	2	336	R	UINT16	Scaled Average current in Amps
Scaled Three Phase Currents in Amps—Line	2	337	R	UINT16	L1 RMS current in Amps
	2	338	R	UINT16	L2 RMS current in Amps
	2	339	R	UINT16	L3 RMS current in Amps
Scaled Average Three-Phase Currents in deciamps—Line	2	340	R	UINT16	Scaled Average current in 0.1 Amps
Scaled Three Phase Currents in deciamps—Line	2	341	R	UINT16	L1 RMS current in 0.1 Amps
	2	342	R	UINT16	L2 RMS current in 0.1 Amps
	2	343	R	UINT16	L3 RMS current in 0.1Amps
Average RMS AC Current—Pole	4	344	R	FLOAT	Average RMS Pole Current
		345	R		Reg345 = LSB1, LSB0 Reg346 = MSB, LSB2
3 Phase RMS Current on the Pole itself	4	346	R	FLOAT	L1 RMS Pole Current
		347	R		Reg347 = LSB1, LSB0 Reg348 = MSB, LSB2
	4	348	R	FLOAT	L2 RMS Pole Current
		349	R		Reg349 = LSB1, LSB0 Reg350 = MSB, LSB2
	4	350	R	FLOAT	L3 RMS Pole Current
		351	R		Reg351 = LSB1, LSB0 Reg352 = MSB, LSB2

Register Map, continued

Parameter	Data Length	Modbus Register Number	Read/Write	Data Type	Description
Scaled Average Three Phase Currents in amps—Pole	2	352	R	UINT16	Scaled Average pole current in Amps
Scaled Three Phase Currents in amps—Pole	2	353	R	UINT16	L1 RMS pole current in Amps
	2	354	R	UINT16	L2 RMS pole current in Amps
	2	355	R	UINT16	L3 RMS pole current in Amps
Scaled Average Three Phase Currents in deciamps—Pole	2	356	R	UINT16	Scaled Average pole current in 0.1 Amps
Scaled Three Phase Currents in deciamps—Pole	2	357	R	UINT16	L1 RMS pole current in 0.1 Amps
	2	358	R	UINT16	L2 RMS pole current in 0.1 Amps
	2	359	R	UINT16	L3 RMS pole current in 0.1Amps
Power Factor	2	360	R	SINT16	0 to 1.0000 (in 0.0001)
Integer Average Three Phase Real Power kW	2	361	R	UINT16	Average Real Power (kW)
Power Device Pole Temperature	2	362	R	SINT16	L1 pole temp in 0.1°C
	2	363	R	SINT16	L2 pole temp in 0.1°C
	2	364	R	SINT16	L3 pole temp in 0.1°C
DC Control Voltage	2	365	R	UINT16	DC voltage reported in 0.001V
Device Temperature in Degrees C	2	366	R	SINT16	Device temp in 0.1°C
Auto Reset Count	2	367	R	UINT16	# of times S811+ has been auto reset
Line Frequency	2	368	R	UINT16	Line Frequency (in 0.01Hz)
Line Phase Sequence	1	369	R	UINT8	0x01—ABC Phase sequence 0x02—ACB Phase sequence
Fault List (Fault/Warning codes will be repeated in the list)	2	370	R	UINT16	Latest Fault/Warning code
	2	371	R	UINT16	2nd Latest Fault/Warning code
	2	372	R	UINT16	3rd Latest Fault/Warning code
	2	373	R	UINT16	4th Latest Fault/Warning code
	2	374	R	UINT16	5th Latest Fault/Warning code
	2	375	R	UINT16	6th Latest Fault/Warning code
	2	376	R	UINT16	7th Latest Fault/Warning code
	2	377	R	UINT16	8th Latest Fault/Warning code
	2	378	R	UINT16	9th Latest Fault/Warning code
	2	379	R	UINT16	10th Latest Fault/Warning code
Application Status	2	380	R	UINT16	Applications status (present fault)
Motor RUN1input level sense enable	1	381	R	UINT8	0x00—edge sense 0x01—level sense
Modbus Motor Control (3-Wire)	1	500	R/W	UINT8	**bit Description** 0 Run1 1 Run2 2 Permissive 3 Fault Reset 4 reserved 5 reserved 6 reserved 7 Ramp2 enable

Register Map, continued

Parameter	Data Length	Modbus Register Number	Read/Write	Data Type	Description	
Modbus Motor Two Wire Control	1	501	R/W	UINT8	**bit**	**Description**
					0	Run1—Level Sense
					1	Run2—Level Sense
					2	reserved
					3	Fault Reset
					4	reserved
					5	reserved
					6	reserved
					7	Ramp2 enable
Network Inputs	1	502	R/W	UINT8	**bit**	**Description**
					0	C441/Network Input#1
					1	C441/Network Input#2
					2	C441/Network Input#3
					3	C441/Network Input#4
					4	
					5	
					6	
					7	
MODBUS Baud Rate	1	503	R/W	UINT8	**Value**	**Description**
					0x00	1200 baudrate
					0x01	2400 baudrate
					0x02	4800 baudrate
					0x03	9600 baudrate
					0x04	19.2k baudrate
					0x05	38.4k baudrate
					0x06	57.6k baudrate
					0x07	115.2k baudrate
					0x08	230.4k baudrate
					0x09	460.8k baudrate
MODBUS Slave Address	1	504	R	UINT8	address values 1–63	
MODBUS Parity	1	505	R/W	UINT8	**Value**	**Description**
					0x00	Even parity
					0x01	Odd parity
					0x02	None
MODBUS Stop Bits	1	506	R/W	UINT8	**Value**	**Description**
					0x01	1 stop bit
					0x02	2 stop bits
MODBUS Transmission Mode (RTU/ASCII)	1	507	R/W	UINT8	**Value**	**Description**
					0x00	RTU mode
					0x01	ASCII mode
Motor FLA Value	4	600	R/W	FLOAT	Motor nameplate fla	
		601	R/W		Reg600 = LSB1, LSB0 Reg601 = MSB, LSB2	
Motor FLA Value scaled in 0.1A	2	602	R/W	UINT16	110–10,000 range	
Overload Trip Class Value	1	603	R/W	UINT8	Class 5–30	
Motor Rated Volts	2	604	R/W	UINT16	115V–600V (Motor nameplate voltage)	
Motor Line Frequency Rating	2	605	R/W	UINT16	50.00–60.00Hz (in 0.01Hz)	
Motor Wiring Cfg	1	606	R/W	BOOL	0 = Inline Wiring 1 = Inside Delta	
Motor Phase Sequence	1	607	R/W	UINT8	0 = ABC Phase sequence 1 = ACB Phase sequence	

Register Map, continued

Parameter	Data Length	Modbus Register Number	Read/Write	Data Type	Description
Motor Start Method	1	608	R/W	UINT8	0 = Voltage Ramp 1 = Current Limit 2 = Unavailable 3 = Pump Start (w pump option)
Percent Initial Torque	1	609	R/W	UINT8	0–100%
Motor Start Ramp Time	2	610	R/W	UINT16	0.5–180s (in 0.1 sec)
Motor Stop Ramp Time	2	611	R/W	UINT16	0.0–60.0s (in 0.1 sec)
Motor Pump Stop Time	2	612	R/W	UINT16	20.0–120.0 (in 0.1 sec)
Kick Start Initial Torque	1	613	R/W	UINT8	0–100%
Kick Start Time	1	614	R/W	UINT8	0.0–2.0 sec (in 0.1 sec)
Ramp2 Motor Phase Sequence	1	615	R/W	UINT8	0 = ABC Phase sequence 1 = ACB Phase sequence
Ramp2 Motor Start Method	1	616	R/W	UINT8	0 = Voltage Ramp 1 = Current Limit 2 = Unavailable 3 = Pump Start (w pump option)
Ramp2 Motor Percent Initial Torque	1	617	R/W	UINT8	0–100%
Ramp2 Motor Start Ramp Time	2	618	R/W	UINT16	0.5–180s (in 0.1 sec)
Ramp2 Motor Stop Ramp Time	2	619	R/W	UINT16	0.0–60.0s (in 0.1 sec)
Ramp2 Motor Pump Stop Time	2	620	R/W	UINT16	20.0–120.0 (in 0.1 sec)
Ramp2 Motor Kick Start Initial Torque	1	621	R/W	UINT8	0–100%
Ramp2 Motor Kick Start Time	1	622	R/W	UINT8	0.0–2.0 sec (in 0.1 sec)
Motor Control Terminal Block Local Control Enable	1	623	R/W	UINT8	1 = local control only enabled 0 = disable(terminal block input selects local/network control)
Motor Control Input Configuration					0 = No function 1 = Run1 2 = Ramp2 3 = Jog 4 = Local control enable 5 = Fault reset 6 = E-stop input 7 = Alarm-No-Trip 8 = External Trip 9 = External Warning 10 = Disable overload on start 11 = Analog Input (S811 input #4 only)
S811 input#1 cfg	2	624	RW	UINT16	
S811 input#2 cfg	2	625	RW	UINT16	
S811 input#3 cfg	2	626	RW	UINT16	
S811 input#4 cfg	2	627	RW	UINT16	
Network input#1 cfg	2	628	RW	UINT16	
Network input#2 cfg	2	629	RW	UINT16	
Network input#3 cfg	2	630	RW	UINT16	
Network input#4 cfg	2	631	RW	UINT16	
Analog Input Data Range	1	632	R/W	UINT8	**Value** **Description** 0x01 not supported 0x02 0–20 mA range 0x03 4–20 mA range

Register Map, continued

Parameter	Data Length	Modbus Register Number	Read/Write	Data Type	Description
Motor Control Output Configuration					0 = No function 1 = Faulted 2 = Not Faulted 3 = Bypass 4 = Not Bypass 5 = Motor Energized 6 = Motor Not Energized 7 = Warning 8 = Not Warning 9 = Custom Codes 10 = Not Custom Codes
S811 output#1 cfg	2	633	R/W	UINT16	
S811 output#2 cfg	2	634	R/W	UINT16	
Network output#1 cfg	2	635	R/W	UINT16	
Network output#2 cfg	2	636	R/W	UINT16	
Motor Control Output Custom Fault Configuration	2	637	R/W	UINT16	Custom fault code#1
	2	638	R/W	UINT16	Custom fault code#2
	2	639	R/W	UINT16	Custom fault code#3
Fault Reset Mode	1	640	R/W	UINT8	0 = Manual reset 1 = Auto reset 2 = Power on reset
Auto Reset Delay Time	2	641	R/W	UINT16	0.1–600.0 sec (in 0.1 sec)
Auto Reset Number of Reset Attempts Limit	2	642	R/W	UINT16	0–10000
Overload Fault Enable	1	643	R/W	UINT8	0 = Protection disabled 1 = Fault enabled 2 = Warning enabled
Motor Overload During Start Enable	1	644	R/W	UINT8	1 = enable 0 = disable
Phase Reversal Fault Enable	1	645	R/W	UINT8	0 = Protection disabled 1 = Fault enabled 2 = Warning enabled
Motor Undercurrent Fault (Warning) Trip Enable	1	646	R/W	UINT8	0 = Protection disabled 1 = Fault enabled 2 = Warning enabled
Motor Undercurrent Fault Trip Level (% FLA)	1	647	R/W	UINT8	0–100%
Motor Undercurrent Fault Duration	2	648	R/W	UINT16	0.1–60.0 sec (in 0.1 sec)
Motor Jam Fault Enable	1	649	R/W	UINT8	0 = Protection disabled 1 = Fault enabled 2 = Warning enabled
Motor Stall Fault Enable	1	650	R/W	UINT8	0 = Protection disabled 1 = Fault enabled 2 = Warning enabled
Motor Phase Loss Fault Enable	1	651	R/W	UINT8	0 = Protection disabled 1 = Fault enabled 2 = Warning enabled
Motor Phase Loss Trip Level	1	652	R/W	UINT8	1–100%
Motor Phase Loss Duration	2	653	R/W	UINT16	0.1–60.0 sec (in 0.1 sec)
Motor Phase Imbalance Fault Enable	1	654	R/W	UINT8	0 = Protection disabled 1 = Fault enabled 2 = Warning enabled
Motor Phase Imbalance Fault Level	1	655	R/W	UINT8	1–100%
Motor Phase Imbalance Fault Duration	2	656	R/W	UINT16	0.1–60.0 sec (in 0.1 sec)

Register Map, continued

Parameter	Data Length	Modbus Register Number	Read/Write	Data Type	Description
Motor Voltage Imbalance Fault Level	1	657	R/W	UINT8	1–100%
Motor Voltage Imbalance Fault Duration	2	658	R/W	UINT16	0.1–60.0 sec (in 0.1 sec)
Motor Under Voltage Fault Enable	1	659	R/W	UINT8	0 = Protection disabled 1 = Fault enabled 2 = Warning enabled
Motor Under Voltage Fault (% of Rated Voltage)	1	660	R/W	UINT8	1–99%
Motor Under Voltage Fault Duration (Running)	2	661	R/W	UINT16	0.1–60.0 sec (in 0.1 sec)
Motor Over Voltage Fault Enable	1	662	R/W	UINT8	0 = Protection disabled 1 = Fault enabled 2 = Warning enabled
Motor Over Voltage Fault (% of Rated Voltage)	1	663	R/W	UINT8	101–120%
Motor Over Voltage Fault Duration	2	664	R/W	UINT16	0.1–60.0 sec (in 0.1 sec)
Motor Line Frequency Fault (Warning) Enable, Len=1	1	665	R/W	UINT8	0 = Protection disabled 1 = Fault enabled 2 = Warning enabled
Motor Line Frequency Deviation From Rated Fault Level	1	666	R/W	UINT8	0–100% deviation from setting
Motor Line Frequency Fault Duration	2	667	R/W	UINT16	0.1–60.0 sec (in 0.1 sec)
Motor Average Power Fault (Warning) Enable	1	668	R/W	UINT8	0 = Protection disabled 1 = Fault enabled 2 = Warning enabled
Motor Average Power Percent Rated Low Fault Level	2	669	R/W	UINT16	0.0–100.0% (in 0.1%)
Motor Average Power Percent Rated High Fault Level	2	670	R/W	UINT16	0.0–800.0% (in 0.1%)
Motor Average Power Fault Duration	2	671	R/W	UINT16	0.1–60.0 sec (in 0.1 sec)
Analog Input Fault (Warning) Enable	1	672	R/W	UINT8	0 = Protection disabled 1 = Fault enabled 2 = Warning enabled
Analog Input Percent of Rated Range Low Fault Level	1	673	R/W	UINT8	0–100% (of range)
Analog Input Percent of Rated Range High Fault Level	1	674	R/W	UINT8	0–100% (of range)
Analog Input Fault Duration	2	675	R/W	UINT16	0.1–60.0 sec (in 0.1 sec)
Temperature Sensor Fault Enable	1	676	R/W	UINT8	0 = Protection disabled 1 = Fault enabled 2 = Warning enabled
SCR Not Firing Fault Enable	1	677	R/W	UINT8	0 = Protection disabled 1 = Fault enabled 2 = Warning enabled

Register Map, continued

Parameter	Data Length	Modbus Register Number	Read/Write	Data Type	Description
SCR Shorted Fault Enable	1	678	R/W	UINT8	0 = Protection disabled 1 = Fault enabled 2 = Warning enabled
Alarm-No-Trip Enable	1	679	R/W	UINT8	1 = enable 0 = disable
Motor Control Start Delay Warning Enable	1	680	R/W	UINT8	1 = enable 0 = disable
Motor Control Power on Start Delay	2	681	R/W	UINT16	0.0–600.0 sec (in 0.1 sec)
Motor Control Start Delay	2	682	R/W	UINT16	0.0–600.0 sec (in 0.1 sec)
Motor Control Run Command Change Start Delay	2	683	R/W	UINT16	0.0–600.0 sec (in 0.1 sec)
Motor Comm Loss Action	1	684	R/W	UINT8	0 = Auto Stop 1 = Auto Run1 2 = Unavailable 3 = Hold Last 4 = Unavailable 5 = Unavailable 6 = Unavailable 7 = All Stop Fault
Transient Motor Control Timeout	2	685	R	UINT16	2000 ms
Motor Control Device Command Missing Timeout	2	686	R	UINT16	2000 ms
Network 2 Wire Enable	1	687	R	UINT8	0 = Disabled, #500 register active 1 = Enabled. #501 register active
Modbus Device Reset Register	1	800	R/W	UINT8	0 = No Reset 1 = Soft Reset 2 = Factory Reset 3 = App parameter Reset 4 = reserved 5 = reserved 6 = Flush Fault History/Queue 7 = Reset Motor Starts
Modbus_User_App_Name	2	900	R/W	UINT8	ASCII char#0
	2	901	R/W	UINT8	ASCII char#1
	2	902	R/W	UINT8	ASCII char#2
	2	903	R/W	UINT8	ASCII char#3
	2	904	R/W	UINT8	ASCII char#4
	2	905	R/W	UINT8	ASCII char#5
	2	906	R/W	UINT8	ASCII char#6
	2	907	R/W	UINT8	ASCII char#7
	2	908	R/W	UINT8	ASCII char#8
	2	909	R/W	UINT8	ASCII char#9
	2	910	R/W	UINT8	ASCII char#10
	2	911	R/W	UINT8	ASCII char#11
	2	912	R/W	UINT8	ASCII char#12
	2	913	R/W	UINT8	ASCII char#13
	2	914	R/W	UINT8	ASCII char#14
	2	915	R/W	UINT8	ASCII char#15

Register Map, continued

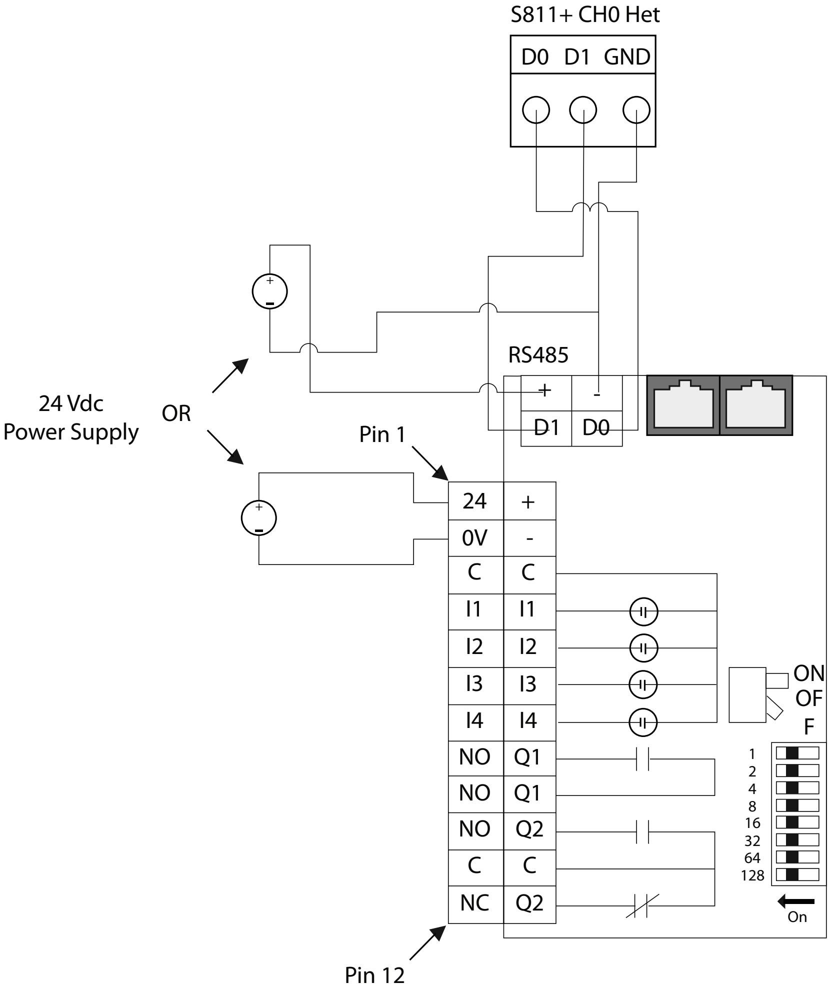
Parameter	Data Length	Modbus Register Number	Read/Write	Data Type	Description
Modbus_Production List Note that the values must be Modbus Register Address (i.e., Register Number-1) not Register Number.	2	1000	R/W	UINT16	1st Modbus Production Register#
	2	1001	R/W	UINT16	2nd Modbus Production Register#
	2	1002	R/W	UINT16	3rdt Modbus Production Register#
	2	1003	R/W	UINT16	4th Modbus Production Register#
	2	1004	R/W	UINT16	5th Modbus Production Register#
	2	1005	R/W	UINT16	6th Modbus Production Register#
	2	1006	R/W	UINT16	7th Modbus Production Register#
	2	1007	R/W	UINT16	8th Modbus Production Register#
	2	1008	R/W	UINT16	9th Modbus Production Register#
	2	1009	R/W	UINT16	10th Modbus Production Register#
	2	1010	R/W	UINT16	11th Modbus Production Register#
	2	1011	R/W	UINT16	12th Modbus Production Register#
	2	1012	R/W	UINT16	13th Modbus Production Register#
	2	1013	R/W	UINT16	14th Modbus Production Register#
	2	1014	R/W	UINT16	15th Modbus Production Register#
	2	1015	R/W	UINT16	16th Modbus Production Register#
Modbus_Production Data	2	2000	R		1st Modbus Production Register data
	2	2001	R		2nd Modbus Production Register data
	2	2002	R		3rdt Modbus Production Register data
	2	2003	R		4th Modbus Production Register data
	2	2004	R		5th Modbus Production Register data
	2	2005	R		6th Modbus Production Register data
	2	2006	R		7th Modbus Production Register data
	2	2007	R		8th Modbus Production Register data
	2	2008	R		9th Modbus Production Register data
	2	2009	R		10th Modbus Production Register data
	2	2010	R		11th Modbus Production Register data
	2	2011	R		12th Modbus Production Register data
	2	2012	R		13th Modbus Production Register data
	2	2013	R		14th Modbus Production Register data
	2	2014	R		15th Modbus Production Register data
	2	2015	R		16th Modbus Production Register data
Modbus_Consumption List Note that the values must be Modbus Register Address (i.e., Register Number-1) not Register Number.	2	3000	R/W	UINT16	1st Modbus Consumption Register#
	2	3001	R/W	UINT16	2nd Modbus Consumption Register#
	2	3002	R/W	UINT16	3rd Modbus Consumption Register#
Modbus_Consumption_Data	2	4000	W		1st Modbus Consumption Register data
	2	4001	W		2nd Modbus Consumption Register data
	2	4002	W		3rd Modbus Consumption Register data
Communication Device Product Code	2	65521	R	UINT16	Device Product Code used for UCA adapter

Appendix H—Universal Communications Adapter

External adapters can be connected to the S811+ to enable the unit to be controlled by networks other than Modbus.

Connect the adapter in accordance with the wiring diagram below.

Wiring Diagram



Notes

1. Connect the C441 RS485 Modbus Port on the Universal Communications Adapter to the S811+ CH0 Net terminal block.
2. Connect 24 Vdc to either the RS485 port or the 12 position I/O terminal as shown. Only one (1) connection is required.
3. Set the S811+ communications port for Modbus by setting dip switch S2 (on).
4. Use the S811+ address dip switches to set the S811+ Modbus address to 1.
5. Dip switch S2 is used for level/edge sense, and has no effect on the Communications adapter.

Appendix I—Troubleshooting Guide

This guide is intended to provide the information necessary to successfully troubleshoot issues that may occur during the operation of the S611 Soft Starter. The troubleshooting sequence and fault codes (FC) are identified below in two basic groups, New Applications and Existing Installations. While any fault may occur in either category, experience has shown that some faults are routinely experienced in one category. The following information is intended to be a reference guide to quickly move through the process to achieve or restore operational status of the Soft Starter.

New Applications Checklist—During Commissioning

Note: It is not unusual for the S811+ Soft Starter to trip in the process of being commissioned as it is likely that one or more parameter(s) setting are not appropriate.

24 Vdc control power applied.

- Sufficient minimum wattage and voltage value and inrush capacity.

Mains applied.

- All circuit breakers closed, fuses installed—no open fuses.
- All isolation devices closed.
- Verify continuity of mains power to soft starter.

Load connected.

- All isolation devices closed.
- Reversing contactors (if used) in proper position.
- Continuity of circuit from soft starter to the motor.

Parameter Setup—Operation Mode

- Motor FLA (A)—Motor Nameplate FLA value (Default—frame size minimum).
- Motor Rated Voltage (Default—480V).
- Start Method—Voltage Ramp or Current Limit (Default—Voltage Ramp).
- Start Time—As required (Default—20 seconds).
- Initial Torque—As required (Default—45%).
- Auto Reset Mode—As Required (Default—Manual).

Parameter Setup—Protection Mode

- Overld Trip Class—As Required (Default—20).

Parameter Setup—Operation Mode—Advanced Config Parameters

- Start Control—As Required (Default—Level).
- Aux Relay 1—As Required (Default—Run).
- Aux Relay 2—As Required (Default—Faulted).
- Network Communications Parameter Setup As Required.

The following Fault Codes may be experienced during commissioning of a new installation or a new soft start into an existing application. Verify all connections and settings with test equipment as appropriate.

Common Commissioning Fault Codes

- FC6—Phase Loss
- FC7—Phase Imbalance
- FC11—Jam
- FC14—Overload
- FC44—Motor Voltage Phase Reversal
- FC58—SCR Not Firing
- FC63—Motor Stall Fault

Existing Installations Checklist

External Circuit Components Issues

- 24 Vdc control power undersized and/or failed.
- Isolation contactors open or damaged.
- Mains power faulty.
- Load disconnected.
- Load failure.
- Line/Load/Control circuits not restored after component replacement.

Verification of Recent Maintenance Functions

- All disconnected connections restored.
- Isolation devices restored to proper operating positions.
- Proper selection of replacement components.
- Verify suitability of added or modified components to circuitry.

Fault Code Verification

- Use of test equipment to confirm/refute validity of fault code.
- Determine if the fault can be reset.
- Determine if the fault is continuous or intermittent.
- Note operating conditions at time of fault if possible.

Common Fault Codes

- FC5—Power Pole Over Temperature
- FC7—Phase Imbalance
- FC11—Jam
- FC14—Overload
- FC38—Temperature Sensor
- FC58—SCR Not Firing
- FC59—Shorted SCR.
- FC61—Mains AC Voltage Lost
- FC64—Voltage Zero Cross

General Information

24 Vdc Control Power—Terminal Block Connections

- Run Enable ⟶ 24 Vdc applied to Terminal "P", This 24 Vdc input must be maintained continuously during RUN operation from either the terminal block or a network.
- START Command enable from Terminal Block ⟶ Voltage applied to terminal "3" of the control power terminal block. When a 120 Vac signal is applied to the Comms Select terminal, START control from the terminal block will not be recognized.
- START Command ⟶ with 24 Vdc applied to Terminal "P", apply 24 Vdc to Terminal "1" The signal requirement is momentary, but maintained is acceptable. Terminals "P" and "1" may be tied together for 2-wire control START/STOP commands.
- STOP Command ⟶ Remove 24 Vdc from Terminal "P". Terminals "P" and "1" may be tied together for 2-wire control START/STOP commands.
- Wire size, minimum—14 AWG to all Terminal Block connections. Wire should have no stands missing or damaged during wire stripping. The use of terminal ferrules is recommended to maintain connection integrity.
- Control Power Supply Requirements.
  - Must meet or exceed steady state and inrush capacity requirements.
    - Steady State (sealed) = 25 Watts, 24 Vdc.
    - Outrush = 240Watts, 24 Vdc for 150 ms minimum.
    - Minimum supply voltage 24 Vdc measured at the Terminal Block.
    - Maximum allowable voltage drop measured at the Terminal Block = 5 Vac.

Fault Reset Details

- If the Status led is RED, the soft starter is in a fault condition and will not recognize a START command. If a reset attempt is unsuccessful, the fault is still present and must be corrected.
- If the soft starter appear s to have "tripped", but the Status LED is GREEN and there is no new Fault code in memory, verify that the soft starter has not stopped due to a STOP command.
- Terminal "P" (permissive) must be energized (maintained) to enable operation, but will not prevent a fault from being reset. The Status LED can be GREEN without a signal at the "P" terminal.
- Terminal "1" is energized (momentary or maintained) to issue a START command. Signal duration must be a minimum of 500ms for the Soft Starter to recognize the START command.
- Terminal "P" is de-energized to issue a STOP command.
- LEVEL Sense
  - Most commonly used Start Control parameter setting.
  - **Maintained** Terminal "1" energized:
    - START command is present when Terminal "P" is energized (maintained).
    - START command is present when any fault clears and is then RESET.

      RESET function may be either AUTO or MANUAL.
  - IMPORTANT NOTE: If the LEVEL sense parameter AND the AUTO RESET parameters are selected, a motor START command will exist if a 24 Vdc signal is present on Terminal "P" and Terminal "1 and remains energized when the fault condition clears. After a transient fault, this condition may cause the motor to start unexpectedly.
  - **Momentary** Terminal "1" energized:
    - START command is present when Terminal "P" is energized (maintained).
    - START command is not present when any fault clears and is then RESET.
    - Terminal "1" must be again energized to issue a START command.
- EDGE Sense
  - **Maintained** Terminal "1" energized:
    - After a fault has been RESET the 24 Vdc signal must be removed from the Terminal "1" to enable a START command. After a fault has been RESET, re-energizing Terminal "1" (maintained or momentary) will issue a START command.
  - **Momentary** Terminal "1" energized:
    - If Terminal "1" is energized (momentary) by the soft starter control system, the START signal must be reapplied after the RESET has been accomplished.
  - In either case above, Terminal "1" must be de-energized momentarily if the RESET parameter is in either MANUAL or AUTO to enable a START command.
- Thermal Overload
  - After an Overload trip—no restart is allowed until the prescribed time period has elapsed.
  - Trip Rest Time Periods
    - 1st Trip = 3 minute RESET inhibit.
    - 2nd Trip (within 48 minutes of 1st Trip) = 6 minute RESET inhibit.

      96 minutes to restore 3 minute inhibit level.
    - 3rd Trip (within 48 minutes of 2nd Trip) = 9 minute RESET inhibit.

      144 minutes to restore 6 minute inhibit level.

      240 minutes to restore 3 minute inhibit level.
    - Cycling 24 Vdc control power does not reset the inhibit times.

- Thermal Memory
  - This parameter is not the same as Thermal Overload.
  - Parameter may be viewed in the Monitoring Menu.
  - At 100% Thermal memory the soft starter will stop with a RED status LED.
  - At 99% thermal Memory a START command will be allowed BUT, as soon as 100% is again reached, as it will be during the start sequence, the soft starter will again stop.
  - Cycling 24 Vdc control power will not reduce the Thermal Memory value.
- Fault Occurrence Categories
  - Immediately when START command is issued.
  - During the START ramp, before the internal bypass contactors close.
  - During the Internal Bypass Contactor closure event.
  - Anytime during the RUN operation.
  - During the STOP (PUMP STOP, SOFT STOP) command.
- Status LED Indication Conditions
  - RED
    - Active fault is present, cannot RESET.
  - GREEN
    - Not responding to START command from field wiring.
      - LEVEL Sense
        - Insufficient voltage at Terminal “P”.
        - Insufficient voltage at Terminal “1”.
      - EDGE Sense
        - Cycle 24 Vdc at Terminal “1”
        - Insufficient voltage at Terminal “P”.
        - Insufficient voltage at Terminal “1”.
  - OFF—All
    - Check for loss of 24 Vdc control power and/or less than 17 Vdc.
    - Check Terminal Block for condition and security.
    - Verify 24 Vdc at appropriate terminals.
    - Verify proper operation and capacity of control power supply.
- START Command Troubleshooting
  - From the Terminal Block
    - Verify that Terminal “P” is energized continuously.
    - Verify that 24 Vdc is applied to Terminal “1” to issue START command.
    - If Terminals “P” and “1” are tied together, verify that both Terminals receive 24 Vdc START signal.
    - If Start Control parameter is set to EDGE, verify that 24 Vdc has been cycled (removed, then reapplied) after faults have been reset.

S811+ Fault Codes

Code	Fault	Status	Condition	Solution
NA		Fault Warning	Impending OL Trip	Overload trip is impending. Motor current 120% above FLA parameter setting.
1	Firmware Incompatibility or Hardware failure.	Fault Trip/Fault Warning/Diable	Component failure on printed circuit board. Firmware corrupt.	Failed unit. Contact EatonCare for service information.
3	Internal Communications.	Fault Trip	Communications to DSP have been interrupted. Possible hardware failure.	Firmware is not communicating internally. Cycle 24 Vdc control voltage power to attempt to clear problem.
4	Low Control Voltage	Fault Trip	Low 24 Vdc Control Terminal Supply Voltage. 24 Vdc power supply of Insufficient capacity (less than 240 watts)	Verify power capacity (amperage) of 24V power supply to close contactors. Power supply voltage is intermittent and/or drifting. Read value on Monitoring Menu. Verify correct wire size (14 gage minimum) used to connect power supply to S811+. Inspect for wire damage or corrosion. Check voltage drop between power supply and Terminal "+". Possible internal hardware failure.
	Notes: Only voltage at Terminal "+" is monitored for condition that may generate this fault. Inspect control voltage circuit for proper configuration. If the 24 Vdc control voltage is lost at Terminal "P" just prior to the voltage loss at Terminal "+", the soft starter will recognize this condition as a STOP command. This condition would cause a shutdown of the soft starter without logging FC4. Suspect source voltage should be monitored for the appropriate length of time to determine if the voltage drifts more than 0.1 Vdc from nominal, or if the voltage is intermittent. When selecting a power supply, ensure that the outrush capacity of the power supply meet or exceed 240 watts at 24 Vdc for 100ms, minimum.			
5	Power Pole Over Temperature	Fault Trip Fault Warning Disable	One or more power poles exceed 100°C	Ventilate to specified maximum temperatures Clear obstructions. Verify fans are operational, Verify system is not exceeding the specified maximum starts per hour. Verify bypass contacts are closing at the end of ramp time. Reduce excessive cabinet temperature. Soft Starter running continuously in JOG mode.
	Notes: Any power pole temperature in excess of 100°C will cause a fault trip. Observe the temperature values in the Monitoring Menu to verify that they make sense for the application and that they are reasonably close to each other. If one value is significantly higher than the others, the sensor on the power pole may be suspect. A value significantly lower than the others would indicate a damaged and/or open sensor lead. Note: If the temperature values observed in the Monitoring Menu are all significantly higher than normal, they are very likely indicating an actual over heating condition on the power poles and/or the starter in general. The soft starter will attempt to close the bypass contactors at the end of the ramp time, or if the motor is up to synchronous speed for 30 seconds. If the bypass contactors close, then open, then close, etc. several times, the contactor(s) may be failing to seal electrically. A common report of this condition is "chattering" of the soft starter. After the 30 second time period, the unit will discontinue attempting to close the bypass contactors and will continue to run on the SCRs. At some point in the future, the unit will very likely overheat due to insufficient cooling of the power poles. If the soft starter is run continuously in the JOG mode, the starter will use the normal start parameters, BUT the bypass contactors will not close. Running continuously on the SCRs will generate more heat than can be dissipated by the internal fans, resulting in a over temperature fault trip.			
6	Phase Loss	Fault Trip Fault Warning Disable	Loss of one or more phases	Repair broken connection. Replace fuse. Inspect system for phase imbalance conditions.
	Notes: Phase loss is a severe condition of phase imbalance, even momentarily. In cases of severe imbalance causing nuisance trips, this feature may be disabled (not recommended) Prior to disabling this protection, adjust *the Phase Loss %* Trip parameter value (default is 80%) to see if it will improve the condition. Adjusting the *Phase Loss Delay* (default is 0.5 seconds) may also improve performance in cases where phase instability is a problem. Phase performance should be monitored for an appropriate length of time to ensure that the phase is not dropping just long enough for the soft starter to detect the condition.			

S811+ Fault Codes, continued

Code	Fault	Status	Condition	Solution
7	Phase Imbalance	Fault Trip Fault Warning Disable	Phase imbalance exceeds parameter value.	Correct imbalance problem with mains. Increase the *Current* and/or *Voltage Fault Imbalance* parameters. Disable the fault if the other issues cannot be resolved.
	Notes: Phase imbalance may be impacted by voltage issues and/or current issues. Current Imbalance Trip threshold range is 1–100% (default 40%). Current Imbalance Trip Delay range is 0–60 seconds (default is 0.5 seconds). Voltage imbalance Trip threshold range is 1–100% (default 6%). Voltage Imbalance Trip Delay range is 0–10 seconds (default is 0.5 seconds). Both Current and Voltage Phase Imbalance protections may be disabled (not recommended).			
9	Low Current Fault	Fault Trip Fault Warning Disable	No load Motor being driven by application.	Repair/replace failed couplings. Increase load. Reduce *Low I Trip % FLA* to an acceptable value (0% will disable).
	Notes: When the internal bypass contactors are closed, the average value of the 3 phase currents is monitored as a % of FLA. Low I Trip (Motor Under Load) threshold range is 1–100% (default 6%). The Trip Delay is 2 seconds, and is not user settable.			
10	Motor Over Current	Fault Trip	Motor over current with Jam parameter disabled.	Remove obstruction in motor drive train. Verify S811+ is properly sized for the application.
	Notes: This feature is active only with the *Jam* Fault Trip parameter disabled, and the internal bypass contactor(s) is closed. This results in a higher current trip threshold in most cases. Monitors the maximum RMS value of the 3 phase current. Catalog FLA refers to the maximum continuous line current capacity of the frame size of the S811+, NOT the motor rated FLA. Do not confuse this parameter with Instantaneous Over Current (FC18), Thermal Overload (FC14), or SCR Over Current (FC60).			
11	Jam	Fault Trip Fault Warning Disable	Excessive mechanical load on motor.	Remove obstruction. Verify proper FLA setting in Protections Menu. Jam Fault can be disabled if trips occur during normal operation (Over Current Fault will provide protection at a higher current threshold of 4X catalog FLA).
	Notes: The Jam Fault may be disabled (not recommended). The maximum RMS value of the 3 phase currents is monitored when the internal bypass contactors are closed. The Jam Fault Trip threshold is 3X Motor FLA and is not user settable. Jam Trip Delay is 1.5 seconds and is not user settable. This parameter results in a lower current trip threshold than Over Current (FC10) when enabled in most cases.			
13	Internal Bypass Contactor Open	Fault Trip Fault Warning Disable	One or more internal bypass contactors open or fail to seal electrically during Run operation.	Verify all bypass contactor(s) close (audible noise). Verify all bypass contactor(s) not opening during run cycle due to excessive vibration and/or shock. Reduce levels of vibration and/or shock. Verify control power and wire size meet specifications. Verify that the control power supply meets the 24 Vdc voltage and current requirements of the IT soft starter.
	Notes: This fault may occur even if just one contactor (larger soft starters have multiple contactors) fails to seal electrically, of if the contactors opens during operation. If the firmware detects that the bypass contactor(s) have failed to close (as measured by the voltage drop across the power poles), the firmware will command the contactors to release (open) and then reapply the signal to the coil of the contactor(s). this process may repeat for 30 seconds. If after 30 seconds, and the bypass contactor(s) have failed to close electrically, the firmware will discontinue the signal to close the contactor(s) and the soft starter will rum utilizing the SCRs. Bypass contactors may open during the motor run from excessive shock or 24 Vdc control voltage sag (insufficient voltage and/or current to maintain contact closure). If the OT soft starter is running continuously on the SCRs (JOG mode) pole overtemperature fault may occur after a period of time. If the fault occurs after the STOP command, it is likely that one or more contactors did not seal electrically during the START ramp and the unit has been running on the SCR(s).			

S811+ Fault Codes, continued

Code	Fault	Status	Condition	Solution
14	Overload Fault	Fault Trip Fault Warning Disable	Motor operation in excess of 115% or rated FLA. Excessive ramp times. Excessive starts per hour.	Reduce the motor's load. Verify the *Overld Trip FLA* and/or *Ovrld Trip Class* for proper adjustment. Note: Exceeding nameplate ratings will shorten equipment life. Fault during motor start: Verify system is not exceeding the specified maximum starts per hour. Increase the initial torque and/or reduce ramp time to bring the motor up to speed faster. Increase Trip Class setting (30 maximum) and/or reduce ramp time setting.
	Notes: Normal thermal memory during routine operation may be observed in the *Monitoring* menu. Higher than normal thermal memory may indicate an abnormal operating condition and signal an impending *Overload* fault. After a motor start, the thermal memory should stabilize at a value consistent with the load.			
18	Instantaneous Over Current	Fault Trip	Excessive motor load. Undersized soft starter.	Reduce starting load. Increase soft starter capacity (be sure model ratings can handle current demands).
	Notes: During the Start Ramp Time, the maximum RMS value of the 3 phase current(s) are monitored. Instantaneous Over Current Trip threshold is 6 X catalog FLA. The Trip Delay is 1.5 seconds and is not user settable. Catalog FLA refers to the maximum continuous line current capacity of the S811+ soft starter, NOT the motor rated FLA. Do not confuse this parameter with Over Current (FC10), Thermal Overload (FC14), or SCR Over Current (FC60).			
32	Internal NV Memory	Fault Trip	Component failure on printed circuit board.	Not repairable in the field. Contact EatonCare for service.
	Notes: Failure can potentially be caused by component exposure to excessive heat or vibration.			
36	CommLoss Stop Fault	Fault Trip	Control communications lost.	Reattach network controller, verify that the unit is recognized by the system controller. Contact EatonCare for service.
	Notes: This fault corresponds only to network communications. It does not relate to internal communications among components on the printed circuit board (PCB).			
38	Temperature Sensor Fault	Fault Trip Fault Warning Disable	Failed sensor. Failed sensor cable or cable connection.	Internal hardware failure (sensor and/or cable). Note: Disabling this feature (*Temp Sense Fault* in *Protection* menu) will remove protection from excessive temperature exposure (not recommended). Not field repairable, contact Eaton support.
	Notes: There are three (3) independent temperature sensors that incorporate a current sensor on each power pole (phase). This fault may be generated by any one of the sensors. Temperature and/or current values observed in the *Monitoring* Menu should be within ± 5% of each other. Verify that the values of all phases are approximately equal. Sensors are calibrated to the printed circuit board (PCB) during manufacture and are not field serviceable. The *Device Temp* value shown in the *Monitoring* Menu monitors a sensor mounted directly on the PCB and is not related to any Temperature Sensor Fault. Contact EatonCare for service.			
39	Internal CPU	Fault Trip	Hardware failure on the printed circuit board (PCB) Firmware is corrupted.	Contact EatonCare for support.
	Notes: Failure can potentially be caused by component exposure to excessive heat or vibration.			
40	Motor Low Power	Fault Trip Fault Warning Disable	Average power has decreased below the low threshold set by user.	Inspect application for cause of low power. Decrease Low Power Trip threshold
	Notes: Rated Power = √3 x .8 Power Factor x Motor FLA x Motor Voltage. As an example, the Rated Power for an application with a Motor FLA or 156 amps at a voltage 460 Vac = 99.4kW. *Motor Low Power* range is 0–100% (default 50%) of this calculated value.			

S811+ Fault Codes, continued

<table>
<tr><th>Code</th><th>Fault</th><th>Status</th><th>Condition</th><th>Solution</th></tr>
<tr><td rowspan="2">41</td><td>Motor High Power</td><td>Fault Trip
Fault Warning
Disable</td><td>Average power has increased above the high threshold set by user.</td><td>Inspect application for cause of high power.
Increase High Power Trip threshold</td></tr>
<tr><td colspan="4">Notes:
Rated Power = √3 x 0.8 Power Factor x Motor FLA x Motor Voltage. As an example, the Rated Power for an application with a Motor FLA or 156 amps at a voltage 460 Vac = 99.4kW. <i>Motor High Power</i> range is 0–800% (default 125%) of this calculated value.</td></tr>
<tr><td rowspan="2">42</td><td>Under Voltage</td><td>Fault Trip
Fault Warning
Disable</td><td>Mains voltage below trip threshold.</td><td>Connect to correct supply voltage. Verify that mains voltage is within acceptable values.
Verify <i>Motor Rated Volt</i> in the Protection Setup Menu is set to correct value</td></tr>
<tr><td colspan="4">Notes:
Verify that the value in the <i>Motor Rated Volt</i> parameter is set to the correct line voltage and not to a nominal value. <i>Under Voltage</i> trip level threshold range is 1–99% (default 90%) of line voltage. The <i>Under Voltage Trip Delay</i> range is 1–60 seconds (default 3 seconds). This feature may be disabled (not recommended). Verify that the mains voltage levels are not decreasing to unacceptable levels during the start sequence or during motor run operation. The <i>Motor Rated Volt</i> range is 115 to 690 Vac. The trip threshold is not user settable.
MAINS LOW—a similar fault that may occur if the incoming mains voltage is less than 80 volts AC. The trip threshold is not user settable.</td></tr>
<tr><td rowspan="2">43</td><td>OverVoltage</td><td>Fault Trip
Fault Warning
Disable</td><td>Mains voltage above trip threshold</td><td>Connect to correct supply voltage.
Verify <i>Motor Rated Volt</i> in the <i>Protection</i> menu is set to correct value.</td></tr>
<tr><td colspan="4">Notes:
Verify that the value in the <i>Motor Rated Volt</i> parameter is set to the correct line voltage and not to a nominal value. <i>Hi Voltage</i> trip level threshold range is 101–120% (default 110%) of line voltage. The <i>Hi Voltage</i> Trip Delay range is 1–60 seconds (default 3 seconds). This feature may be disabled (not recommended). Verify that the mains voltage levels are not increasing to unacceptable levels during the start sequence or during motor run operation. The <i>Motor Rated Volt</i> range is 115 to 690 Vac. MAINS HIGH—a similar fault that may occur if the mains voltage is in excess of 800 Vac. The trip threshold is not user settable.</td></tr>
<tr><td rowspan="2">44</td><td>Phase Reversal Fault</td><td>Fault Trip
Fault Warning
Disable</td><td>Incoming line phase rotation sequence opposite of device setting.
One phase missing and/or open fuse or breaker.</td><td>Set <i>Phase Sequence</i> to match incoming sequence OR
Exchange two incoming mains phases.
Verify that all circuit breakers are closed or fuses are serviceable.</td></tr>
<tr><td colspan="4">Notes:
If mains leads need to be changed, swap incoming leads and set <i>Phase Sequence</i> to match incoming sequence. If an upstream reverser is used, disable <i>Phase Rev Fault</i> (not recommended). This fault is not uncommon in new installations. In the event of a blown fuse prior to a START command, this fault may occur as the unit is not able to determine phase rotation with one open fuse. If motor rotation requires exchange of phases, exchange the cables between the soft starter and the motor.</td></tr>
<tr><td rowspan="2">54</td><td>E-Stop</td><td>Fault Trip</td><td>External E-Stop input signal removed or lost.</td><td>E-Stop action commanded by external device.
E-Stop signal lost due to broken or damaged external circuitry.</td></tr>
<tr><td colspan="4">Notes:
This fault may be a result of a commanded E-Stop function by an external device. 24 Vdc is maintained on the terminal selected by the user. When the signal is removed, an E-Stop function will occur. The S811+ will shut down without any stop ramp or pump stop if so enabled.</td></tr>
<tr><td rowspan="2">55</td><td>Motor Control Device Missing</td><td>Fault Trip</td><td>Motor control command device was removed (DIM, Cover Control, or similar device).</td><td>Re-attach motor control command device, i.e. the Digital Interface Module (DIM) and reset the fault.</td></tr>
<tr><td colspan="4">Notes:
The S811+ by default will run without an installed DIM in accordance with the parameter settings stored on the printed circuit board. If the DIM is removed, or communications lost during operation, this fault trip will occur. To reinstall a DIM that has been removed, remove 24 Vdc control power, reinstall the DIM, then restore 24 Vdc control power. The DIM or CIM will be recognized during the initialization process.</td></tr>
</table>

S811+ Fault Codes, continued

Code	Fault	Status	Condition	Solution
56	Internal Comm2 Fault	Fault Trip	Internal communications error. Excessive electrical noise or hardware failure.	Try a 24 Vdc control voltage power cycle to attempt to clear problem. Contact EatonCare for service.
	Notes This fault concerns communication of devices located on the 2 printed circuit boards (PCB's) inside the unit. It is not relevant to an external communications to networks faults.			
57	Internal Fault	Fault trip	Corrupted firmware or memory.	Cycle 24 Vdc control power to the S811+. Contact EatonCare for service.
58	SCR Not Firing	Fault Trip Fault Warning Disable	SCR is not conducting when gated. Incoming phase lost. Special application—undersized or high impedance motor Load disconnected.	SCR failure. Re-apply lost phase. Review S811+ application. Circuitry damaged by megger testing. Contact EatonCare for service.
	Notes: Verify that both mains and load lines are connected and secure. Verify that any isolation and/or reversing contactors are properly engaged prior to the soft starter receiving a START command. If the current draw is significantly less than the frame size of the soft starter (less than 1/16 of motor FLA), not enough current may be flowing to allow the SCRs to fire. If this fault occurs immediately when the START command is issued, isolation contactors may be open and/or in transition. This feature may be disabled (not recommended).			
59	Shorted SCR	Fault Trip Fault Warning Disable	SCR is shorted. Internal bypass contactor welded shut. No load on the SCRs when START command is issued.	Test resistance of each phase. Contact EatonCare for service.
	Notes: Shorted SCRs are the most common mode of SCR failure. With power completely removed from the unit, measure the resistance of each pole, line to load. If the resistance is near zero (less than 5 ohms), it is most likely that the SCR is shorted. Resistance of a serviceable SCR is approximately 10k ohms. Resistance typically moves to a lower value as the SCR ages. This feature may be disabled (not recommended).			
60	SCR Over Current (Stall Disabled)	Fault Trip	Excessive SCR Current during the start ramp. Only active when *Stall* Fault is disabled.	Increase *Soft Start Time* and/or *Initial Torque* parameters in *Soft Start Config* menu. Reduce starting load. Verify S811+ is properly rated for current (undersized unit).
	Notes: The maximum RMS value of the three phase currents is monitored. The current values observed in the *Monitoring* Menu should be within ± 5% of each other The SCR Over Current Trip threshold is 3 X FLA and is not user settable.			
61	Mains AC Voltage Loss	Fault Trip	Fuses or breaker open. Disconnect open.	Replace fuses, close disconnect, or reset breaker.
	Notes: The Mains Loss Fault trip threshold is 80 Volts AC and is not user settable.			
63	Motor Stall	Fault Trip Fault Warning Disable	Motor not at rated RPM at end of start ramp time and/or current is in excess of 2 X FLA. Bypass contactors not closed at the end of the start time (start current low/ramp time short).	Lengthen *Soft Start Time* and/or increase *Initial Torque* in the *Soft Start Config* Menu. Loads that are heavily loaded (high inertia) during a start such as fans will often need an initial torque setting much greater than the factory default. Set *Kick Start* parameters.
	Notes: Motor rpm is monitored for a synchronous speed condition. A Motor Stall fault will occur at the end of the ramp time (default is 20 seconds) if the motor is not at synchronous speed and the current is in excess of 2 X FLA. This feature is not user settable. Verify that the motor is properly sized for the load.			

S811+ Fault Codes, continued

Code	Fault	Status	Condition	Solution
64	V Zero Cross Lost	Fault Trip	Mains voltage lost. Phase L1 or L3 lost. Load disconnected	Restore mains or lost phases. Verify that the load is connected and any disconnect devices are properly engaged. Contact EatonCare for service.
	Notes: The SCRs are unable to fire if there is no source voltage or load on the unit. Verify that all mains control devices are properly connected and powered prior to initiating a START command.			
65	Analog Input Out-of-Range (high)	Fault Trip Fault Warning Disable	Upper range limit exceeded.	Set operating range of input to correct value. Validate calibration of analog circuit. Inspect analog circuit for failed components or circuitry. Set range limit to proper value.
	Notes: Two ranges of analog operation are available and are user settable: Analog input ranges are 2.0–20.0 ma DC and 4.0–20 ma DC. If analog input is above maximum limit of the range, the input range or scaling should be adjusted.			
66	Analog Input Out-of-Range (low)	Fault Trip Fault Warning Disable	Lower range limit exceeded.	Set operating range of input to correct value. Validate calibration of analog circuit. Inspect analog circuit for failed components or circuitry. Set range limit to proper value.
	Notes: Two ranges of analog operation are available and are user settable: Analog input ranges are 2.0–20.0 ma DC and 4.0 –20 ma DC. If analog input is below the minimum limit of the range, the input range or scaling should be adjusted.			
71	Analog Input Overdrive	Fault Trip Fault Warning Disable	Analog input current has exceeded 25ma.	Analog current input has exceeded maximum limitation.
	Notes: This input will revert to a voltage input functionality. A soft reset is required to restore current input functionality.			
72	External Trip/Warning	Fault Trip Fault Warning Disable	External input signal indicates fault or warning	Trip/Warning action commanded by external device. Trip/Warning signal lost due to broken or damaged external circuitry.
	Notes: Input signal is 24 Vdc maintained. Removal or loss of signal will initiate Trip/Warning action in accordance with user selected parameter settings.			
73	Motor Load Disconnect	Fault Trip	No load Motor being driven by application.	Repair/replace failed couplings. Increase load. Reduce *Low I Trip % FLA* to an acceptable value (0% will disable).
	Notes: When the internal bypass contactors are closed, the average value of the 3 phase currents is monitored as a % of FLA. Low I Trip (Motor Under Load) threshold range is 1–100% (default 6%). The Trip Delay is 2 seconds, and is not user settable.			
74	Line Frequency (high)	Fault Trip Fault Warning Disable	Mains input voltage frequency has increased above the threshold set by the user.	Reduce line frequency to within limits. Adjust parameter limits.
	Notes: To address line frequency instability and/or excessive variations, adjust limit parameters according. This protection may be set to Fault Warning Status to allow continued operation during excessive frequency variations. *Line Frequency (high)* trip level threshold range is 5–150% (default 150%) of line voltage. The *Line Frequency Trip Delay* range is 1–60 seconds (default 3 seconds).			

S811+ Fault Codes, continued

Code	Fault	Status	Condition	Solution
75	Line Frequency (low)	Fault Trip Fault Warning Disable	Mains input voltage frequency has decreased below the threshold set by the user.	Increase line frequency to within limits. Adjust parameter limits.
	Notes: To address line frequency instability and/or excessive variations, adjust limit parameters according. This protection may be set to Fault Warning Status to allow continued operation during excessive frequency variations. *Line Frequency (low)* trip level threshold range is 5–150% (default 50%) of line voltage. The *Line Frequency Trip Delay* range is 1–60 seconds (default 3 seconds).			
76	Auto Reset Limit	Fault Trip	Number of AUTO reset attempts has been exceeded.	Reset limit counter with a Manual reset. Adjust reset limit counter threshold.
	Notes: This condition requires a MANUAL reset. A Manual reset clears the Fault Trip condition and resets the limit counter to zero (0).			
*	Product Fault Control Fault	Fault Trip	Internal PCB problems	Contact EatonCare for service.
*	LCD DIM setup	Fault Trip	Communications adapter connected to CH1 with DIM installed. Failure of PCB Firmware fault	Install communications adapter to correct port. Cycle 24 Vdc to attempt to clear fault. Perform a hard reset to attempt to clear fault.
*	DIM Display Unreadable	Fault Trip	<u>D</u>igital <u>I</u>nterface <u>M</u>odule failure	Replace the DIM to restore operation. Purge command device (DIM) from memory to enable the soft starter to run without the DIM.
	Notes: There is only one model DIM, part number EMA91 for all S811+ soft starters. All operating parameters for the soft starter are stored in non-volatile memory on the printed circuit board, so the DIM's may be exchanged between all models (sizes) of soft starters if a replacement DIM is not available.			
*	Cannot RESET fault	Fault Trip	Fault condition still exists. Soft Starter has not received RESET signal	Troubleshoot fault and correct defective condition. Attempt alternate methods of RESET
	Notes: The RESET signal can be applied from any one of three locations: the DIM soft key, the small recessed RESET button on the face of the soft strter, and by applying 24 Vdc to terminal "4" of the Control Voltage Terminal Block. The small recessed RESET button on the face of the soft starter is a sub-miniature switch mounted on the PCB. You will feel a slight detent when the switch closes. Pressing the switch beyond this point does not increase your chances of clearing a fault, but may cause permanent damage to the switch. If the detent cannot be felt when pushing the button, proper operation of the switch is suspect. If the soft starter <u>cannot</u> be RESET with the push button, but <u>can</u> be RESET by applying 24 Vdc to Terminal Block "4", the push button switch is damaged.			
*	Run without DIM	—	DIM is non-functional or intermittent.	Soft Starter may be run with existing parameters without the DIM installed. DIM may be reinstalled and control power applied, initialization process will recognize DIM.
	Notes: To run the soft starter without the DIM, simply remove the DIM from the S811+. To reinstall a DIM that has been removed, remove 24 Vdc control power, reinstall the DIM, then restore 24 Vdc control power. If the START command was issued from the Start button on the DIM, removal of the DIM will initiate a TRIP due to lost communication. If the START command was issued from the control terminal block or the network, the S811+ will continue to run.			

Notes

All mains and control power connections must be completed and voltage applied prior to a START command. Failure to make all connections will result in one or more faults.

All isolation and/or reversing contactors must be staged prior to any START commands. Manipulating contactors after the START command will result in one or more faults.

Eaton is dedicated to ensuring that reliable, efficient and safe power is available when it's needed most. With unparalleled knowledge of electrical power management across industries, experts at Eaton deliver customized, integrated solutions to solve our customers' most critical challenges.

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Powering Business Worldwide

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Pages 1-20, Dated 1/1/94

ECN01, ECN02, ECN05, ECN06, ECN07
AN16, AN56, CN15 & CN55
Sizes 00-9, 600V Max.
Non-Reversing & Reversing
NEMA Type Enclosures 1, 3R, 4X & 12
Details On UL & cUL Listing and CSA Certified
Included In This TIP

NEMA Contactors & Starters (Freedom)

SIZE 1
NON-REVERSING STARTER

SIZE 3
NON-REVERSING STARTER

DESIGN CHARACTERISTICS

- **Overload Relays —** Bimetallic Ambient Compensated

  Features include:
  - Selectable Manual or Automatic Reset operation.
  - Interchangeable Heater Packs ± 24% to match motor FLA and calibrated for 1.0 and 1.15 service factors.
  - Heater packs for Size 00-0 overload relays will mount in larger Size 1 and 2 overload relays — useful in derating applications such as jogging.
  - Single phase protection – Class 20 or 10 trip time.
  - Electrically isolated NO - NC contacts (pull RESET button to test).
  - Visual trip indication
  - Integral load lugs allows field wiring prior to heater pack installation.
  - NEMA Sizes 5-9 use Current Transformer with 32 Amp overload. Size 5 uses 300:5 CT, Size 6 uses 600:5 CT, Size 7 uses 1000:5 CT, Size 8 uses 1500:5 CT, and Size 9 uses 3000:5 CT.
- **Magnet Coil —** Encapsulated dual voltage/frequency – color coded and permanently marked with voltage, frequency and part number.

  A two-piece spring latch contactor design makes coil removal or replacement fast and simple for Sizes 00-2.

  The NEMA Size 3-5 features a quick change coil assembly which makes coil removal and replacement fast and simple.

  Coil terminals are located on top for easy accessibility. The Size 00 and 0 contactor magnet coils have three terminals, permitting either top or diagonal wiring — European or U. S. style starters can be replaced without changing wiring layout.

  The NEMA Sizes 6-8 features a special DC feeder group for coil feeding. This system allows AC or DC applied voltage, low noise and low inrush and holding consumption.

  The NEMA Size 9 coil is 110V dc/120V ac (Rectified).

  AC or DC magnet coils.
- **Contacts —** Long life twin break contacts provide excellent conductivity and superior resistance to welding and arc erosion. Generously sized for low resistance resulting in extended life.

NEMA, Contactors & Starters, (Freedom)

DESIGN CHARACTERISTICS (Continued)

- **Terminals — Size 00 through 1** ± screw type with captive, backed-out self-lifting pressure plates. Finger proof covers, to reduce electrical shock, are available. Size 2-9:
  Control: Back-out saddle clamp with ± screws
  Power: Box lugs, pressure type
- **Mounting Position —** Sizes 00-5: Horizontal or vertical on upright panel. Sizes 6-8: 25° from vertical maximum. Size 9: Vertical only.
- **Connections —** Straight through wiring — Line lugs at top, load lugs at bottom.
- **Standards —**
  UL listed (Size 00-8):
  Open — File #E1491, Guide #NLDX
  Enclosed — File #E19224, Guide #NLDX
  UL listed (Size 9):
  Open and Enclosed — File #E19224, Guide #NLDX
  Except Size 9 Reverser Not UL Listed.
  cUL listed (Size 00-8):
  Enclosed — File #E19224, Guide #NLDX
  CSA certified — (Size 00-8):
  Open — File #LR353, Class #3211-04
  Designed to meet or exceed NEMA standards.
- **Ambient Temperature —** –5°C to + 65°C
- **Enclosures —** Open or NEMA 1, 3R, 4X, and 12 enclosed. Snap-on cover control kits Size 00-4 NEMA 1; flange mount all other enclosure types.
- **Construction —** Designed specifically for use in applications requiring NEMA ratings. Starters meet or exceed NEMA standards ICS 2-1988.
- **Mechanical/Electrical Life —** Designed to 30 million mechanical operations at maximum HP ratings for Sizes 00 & 0, 10 million for Sizes 1& 2, 5 million for Sizes 3-8. Designed to 3 million electrical operations for Sizes 00-3 and 500 thousand for Sizes 4-8. Size 9 mechanical life in excess of 24K operations and electrical life AC-3 (N/A); AC-4 in excess of 50 operations.
- **Wiring —** Wired for separate or common control.
- **Holding Circuit Interlock —** NEMA Starters Sizes 0-3 are supplied with 1 NO auxiliary contact mounted on the right hand side. On Size 00, interlock occupies 4th power pole position — no increase in width. Sizes 4 and 5 have NO interlock on left side, Sizes 6 and 7 have a 2NO/2NC auxiliary mounted on top between arc-chutes and Size 8 has NO/NC auxiliary on left side and a NO on the right. Size 9 supplied with 2 auxiliary contacts. Each with 1 NO & 1 NC.
- **Mounting —** Supplied with steel mounting plate as standard.

OPTIONAL FEATURES

- **Auxiliary Contacts —** Open type starters will accept up to 8 NO or NC auxiliary contacts (4 for Size 8) — includes holding circuit interlock. Enclosed contactors and starters will accept up to 4 NO or NC auxiliary contacts up to Size 1 in NEMA 1 enclosures. For larger sizes and other NEMA type enclosures, up to 8 NO or NC auxiliary contacts can be added.
- **Mechanical Interlock & Reversing Kits —** Available for field assembly of reversing contactors/starters up to Size 7.
- **Timer —** Two types – Side mounted five function Solid-State timer with timing ranges up to 5 minutes for use with open or enclosed starters/contactors, and top mounted pneumatic timers convertible from OFF to ON delay with timing ranges up to 3 minutes for use with open starters/contactors. Sizes 00-5 only.
- **Transient Suppressor Kit —** Limit high voltage transients produced in the control circuit when power is removed from the coil. For Sizes 00 through 2 there are three separate panel-mounted suppressors for use on 120, 240 or 480 volt coils. For Sizes 3 through 5 there is one separate side mounted suppressor for use on 120 volt coils.
- **Control Circuit Fuse Block —** Sizes 00-2 panel mounted and Sizes 3-5 side mounted fuse holder for control circuit protection. Uses Class CC rejection type fuses, 30 ampere, 600 volt ac maximum.
- **Locking Cover for Overload Relay —** Snaps over top of overload relays to prevent accidental turning of trip or reset adjustments.
- **Branch Circuit Fuse Block Kits —** Sizes 00 through 2, 3-pole, top-mounted. Provide short circuit protection for branch circuits.
- **Phase Monitor Relays —** Designed to monitor phase voltage unbalance, incorrect phase sequence and line undervoltage of a 3 phase system. Sizes 00-5 only.
- **Cover Controls for Enclosures —** Numerous pushbuttons, selector switches and indicating lights are available either factory installed or as kits to be installed by others. These local control devices are available for NEMA 1, 3R, 4X and 12 enclosures.
- **Other Options for Enclosures —** Many other optional features such as meters, terminal strips, relays timers, control power transformers, fuse blocks and other accessories are available for installation in enclosed contactors and starters.

DESCRIPTION

Non-Reversing Starters

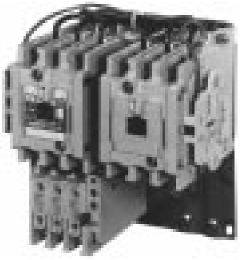
Line voltage magnetic starters are used for starting polyphase squirrel cage motors when full starting torque and the resulting inrush current are acceptable. These starters also provide protection to the motor against running or stalled overcurrents.

NEMA, Contactors & Starters, (Freedom)

The “Freedom Series” starters feature a compact space saving design using state-of-the-art technology and the latest in high strength, impact and temperature resistant insulating materials.

Reversing Starters

Three phase, full voltage magnetic starters are used primarily for reversing of polyphase squirrel cage motors. They consist of two contactors and a single overload relay assembled together. The contactors are mechanically and electrically interlocked to prevent line shorts and energization of both contactors simultaneously.



SIZE 1
REVERSING
STARTER

SIZE 0
REVERSING
STARTER

GENERAL

Magnet Coil — Magnet coils are encapsulated dual voltage/frequency coils which are color coded and permanently marked with voltage, frequency and part number. Coil terminals are located on top for easy accessibility.

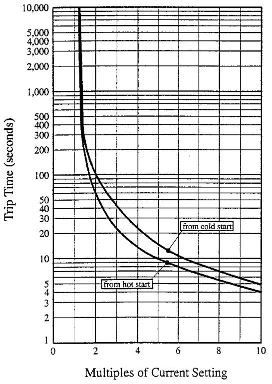
Overload and Heater Packs — Overload relays used on “Freedom Series” starters come in four sizes — 32 amperes, 75 amperes, 105 amperes and 144 amperes. They can be attached directly to contactors (panel mount or common mounting plate) or, with a panel mounting adapter, as a stand alone panel mounted 32 ampere or 75 ampere overload relay. The panel mounting adapter also provides a terminal block for line side wiring to the stand alone overload relay. Sizes 5-9 use 32 amps with CT’s.

The overload relay houses an adjustable, trip-free mechanism and provides mounting for three heater packs. The mechanism is bimetallic with ambient compensated operation. Single phase protection is built in. The reset mechanism can be set for AUTO or MANUAL operation. It has ± 24% adjustability to match motor full load ampere rating with calibration for 1.0 or 1.15 service factor motors. Two isolated contacts, one NC and one NO can be tested by pulling the RESET button. The NC and NO contacts are rated B600 and C600 (refer to Ratings tables on Page 8) respectively. Like the contactor, the overload relay has “finger proof” terminals to reduce the possibility of electrical shock.

Tamper proof overload relay adjustment locking covers snap over the top of overload relays to prevent accidental turning of trip or reset adjustments. Consult the Industrial Control Catalog for information on the variety of covers available.

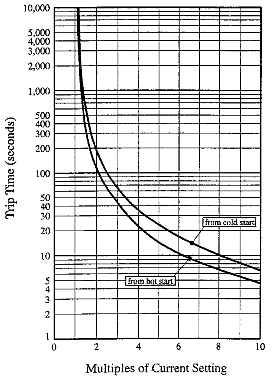
Visual trip indication is provided on all overload relays. The indicator window is located on the lower right-hand corner of the switch unit, just below the reset button. Upon an overload trip (or by pulling up on the reset button), a fluorescent orange indicating flag will appear in the window. Trip indication is only present when using Manual Reset.

CLASS 10
TYPE C306
OVERLOAD
RELAY



TRIP CURVE
TYPE C306 BIMETALLIC COMPENSATED
OVERLOAD RELAY 25°C OPEN RATING

CLASS 20
TYPE C306
OVERLOAD
RELAY

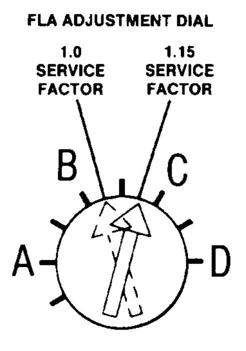


TRIP CURVE
TYPE C306 BIMETALLIC COMPENSATED
OVERLOAD RELAY 25°C OPEN RATING

The heater packs are securely held in the overload relay by two captive screws. Three Class 20 (Class 10 optional) heater packs are installed in the overload relay. The 32 ampere heater packs will mount in the 75 ampere overload relay for applications where the contactor is derated such as for jogging.

The overload relay is adjustable within the FLA range of the heater pack and will ultimately trip at 125% motor current. After the heater packs are selected and installed in the overload relay, the FLA adjustment dial should be rotated to the dial position corresponding to the motor FLA.

NEMA, Contactors & Starters, (Freedom)

Diagram	Heater Pack Selection Table ❶				
	Motor FLA Rating				Heater Pack Number
	FLA Dial Positions				
	A	B	C	D	
	18.0	20.2	22.3	24.5	H2018-3
	24.6	27.6	30.5	33.4	H2019-3
	33.5	37.5	41.5	45.6	H2020-3
	45.7	51.2	56.7	62.1	H2021-3
	62.2	69.7	77.1	84.6	H2022-3
	84.7	95.0	105.0	115.0	H2023-3
	106.0	118.0	131.0	144.0	H2024-3

❶ Example of Heater Pack Selection Table only. Refer to catalog for complete table.

For example, if the FLA rating is 75.2 amperes, heater packs number H2022-3 should be selected from the above listed Heater Pack Selection Table. For a 1.15 service factor motor the FLA adjustment dial should be set at the location shown in the above diagram by interpolating between the B position of 69.7 amperes and the C position of 77.1 amperes. If a 1.0 service factor motor would be involved, the dial should be rotated counterclockwise one graduation (one half position) to the dotted location in the diagram.

Power Poles — Power poles are available for the Sizes 00, 0, 1 and 2 contactors and starters only. The 00 & 0 power pole is rated 12 amps (20 amp thermal) and the 1 & 2 is rated the same as the basic devices.

A maximum of two power poles can be used per contactor or starter. They cannot be field or factory installed. The power poles have been designed to accept mechanical interlocks and side mounted auxiliary contacts.

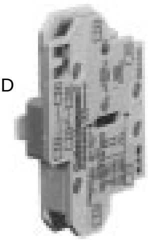
General Auxiliary Contacts Information — Auxiliary contact blocks are designed for snap-on installation — fast, easy installation (no tools required). Side mounted contact blocks are available in 8 different circuit configurations — top mounted contact blocks are offered in 21 different combinations. Enclosed type starters will accept side-mounted auxiliaries only when mounted in standard enclosures. In larger enclosures, top mounted contacts can be added.

All auxiliary contacts are of the bifurcated design with parallel circuit paths. This redundant path provides very high reliability.

For rating information, refer to the “Auxiliary Contact Ratings” table in this publication on Page 8.

TOP MOUNTED

SIDE MOUNTED



Side Auxiliary Contacts — All starters are supplied as standard with one normally open (1 NO) auxiliary contact for use as a holding circuit contact. Reversing starters have in addition, one normally closed (1 NC) auxiliary contact for electrical interlocking purposes.

On Size 00, the holding contact occupies the 4th power pole position (no additional space required). Up to two additional contacts may be added to each side of a Size 00 starter. On Sizes 0-2, the NO holding contact is located on the right side of the contactor. Up to two additional contacts may be added to the left side.

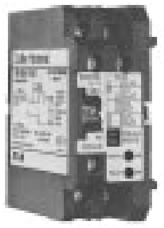
On Sizes 3-5, the NO holding contact is a base contact (on the right on Size 3 and on the left on Sizes 4 & 5). Up to 2 additional contacts can be mounted on the base interlock. On the opposite side, up to 4 additional auxiliary contacts can be added.

On Sizes 6 & 7, there is 2NO/2NC contact block mounted on the top-left position. An additional 2NO/2NC block may be added to the top-right position. On Size 8, there is a NO/NC block on the left back and a NO on the right back. Additional NO/NC blocks may be added on the left and right front positions.

On Size 9, 2 auxiliary contacts are provided, each with 1 NO and 1 NC.

Top Auxiliary Contacts — Open type starters, Sizes 00-2, will accept top auxiliary contacts (up to four circuits possible). This allows a total of up to 8 extra auxiliaries on Size 00 (6 extra auxiliaries on Sizes 00-2).

Electronic Timer — The side mounted, five-function Electronic Timer attachment has a 1 NO - 1 NC relay output and is designed for easy installation to any Freedom Series starter. It is available in three different timing ranges from 0.3 to 300 seconds. Additional auxiliary contacts cannot be installed on same side of starter when timer is used. For Sizes 3-5 a separate mounting bracket is required.



ELECTRONIC TIMER MODULE

- Timing Modes
  - ON DELAY - Timing begins when timer is energized.
  - OFF DELAY - Timing begins when timer is deenergized.
  - ONE SHOT - A single pulsed output occurs when timer is energized.

NEMA, Contactors & Starters, (Freedom)

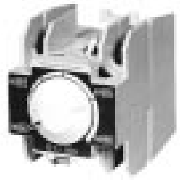
- ON DELAY/OFF DELAY - Timer delay occurs on both energization and deenergization of timer.
- CYCLE MODE - Dual delay with external connections to the NC output contact, cycles ON and OFF continuously.

Delay mode is selectable with two switches on the face of the timer. The time is set by a serrated dial on the module face. Timer can also be mounted directly on 35 mm DIN rail.

- Specifications
  - Repeat Accuracy – within ± 1%
  - Setting Accuracy – ± 10% of scale setting

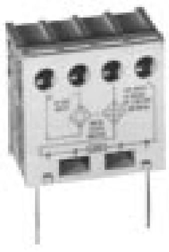
Maximum Current Rating, Amperes			
Description	Volts, ac		Volts, dc (Resistive)
	120	240	30
Make	30	15	5
Break	3	1.5	5
Continuous	3	1.5	5

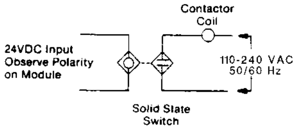
Pneumatic Timer — The Pneumatic Timer attachment is designed for snap-on installation to top of any Size 00-2 starter (top mounted auxiliary contacts cannot be installed on device when timer is used). It is available in two ranges from 0.1 to 180 seconds. Timer unit has D.P.D.T. timed contacts – circuits in each pole must be the same polarity. Units are convertible from OFF to ON delay or vice-versa. Contacts are rated A600. Repeat accuracy is ±10%.


PNEUMATIC TIMER ATTACHMENT

DC/AC Interface Module — The Interface Module is an optically isolated solid state switch which provides a means of operating ac coils with a 24 volt dc control signal. It acts as a space saving interposing relay which can switch a 110-240 volt, 50/60 Hz source to the contactor or starter coil.

The module may be directly attached to the coil terminals of any Freedom Series contactor or starter - Size 00-2. It also has provisions for DIN rail mounting.


INTERFACE MODULE



TYPICAL APPLICATION

DC Magnet Coils — Dc Magnet Coils are available either factory installed or as field conversion kits.

Transient Suppressor Kit — Sizes 00-2 device connects across terminals on any 120 V, 240 V or 480 V starter magnet coil and Sizes 3-5 side mounted device connects across terminals on a 120 volt starter magnet coil. Suppressors are designed to limit the high voltage transients produced in the circuit when power is removed from the coil.

TRANSIENT SUPPRESSOR KITS


FOR SIZES 00-2
FOR SIZES 3-5

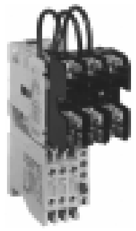
Control Circuit Fuse Block — Size 00-2 panel mounted and Size 3-5 side mounted fuse holders, designed for control circuit protection or other similar low current requirements, have extractor type fuse caps.

The Class CC rejection type fuses (KTK-R) used in these holders are intended for use with equipment designated as being suitable for use on systems having high available fault currents.

If branch circuit protective device is 45 amperes or greater, C320FBR1 fuse kit may be required for control circuit protection per NEC 430-72.


CONTROL CIRCUIT FUSE BLOCK

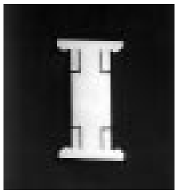
3-Pole Top Mounted Branch Circuit Fuse Block Kits — Designed to save space and reduce installation time, these top mounted fuse block kits field mount to any Size 00-2 starter and provide short circuit protection for branch circuits. Available for Class H, R, G or T fuses rated 15 through 60 amperes and Class J fuses rated 15 through 100 amperes, 250 through 600 volts.

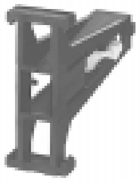

MOUNTED FUSE BLOCK

NEMA, Contactors & Starters, (Freedom)

Mechanical Interlock and Reversing Kits — These kits are available for field assembly of reversing starters using components. The Reversing Kits include a mechanical interlock, stabilizer bar and a pre-cut, trimmed and formed wire set. Auxiliary contacts are not supplied but can be ordered separately. The snap-fit mechanical interlock and stabilizer bar do not require tools for assembly. Installation instructions are included with the device.

STABILIZER BAR

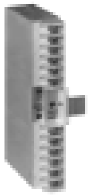




MECHANICAL INTERLOCK

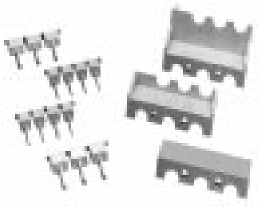
WIRE SET

Phase Monitor Relay — Phase Monitor Relays are designed to monitor phase voltage unbalance, incorrect phase sequence and line undervoltage of a 3 phase system.



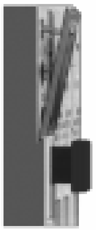
PHASE MONITOR RELAY

Finger Protection Shields — Snap-on shields for both contactors and starters, reversing and non-reversing provides type IP20 Finger Protection. Prevents accidental contact with line load terminals.



FINGER PROTECTION SHIELDS

Overload Locking Covers — Snap-on transparent or opaque plastic panel for covering access port to the overload relay trip setting dials. Helps prevent accidental or unauthorized changes to trip reset setting. Five varieties offers maximum application flexibility.



OVERLOAD LOCKING COVER

Short Circuit Protection — Fuses and Inverse-Time Circuit Breakers may be selected per Article 430, Part D of the National Electrical Code to protect motor branch circuits from fault conditions. If higher ratings or settings are required to start the motor, do not exceed the maximum as listed in Exception No. 2, Article 430-52.

ENCLOSURES

NEMA Definitions

Type	Definition
1	Enclosures are intended for indoor use primarily to provide a degree of protection against limited amounts of falling dirt.
3R	Enclosures are intended for outdoor use primarily to provide a degree of protection against rain, sleet, and damage from external ice formation.
4X	Enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against corrosion, windblown dust and rain, splashing water, hose-directed water, and damage form external ice formation.
12	Enclosures are intended for indoor use primarily to provide a degree of protection agains circulating dust, falling dirt, and dripping noncorrosive liquids.

NEMA 1 NEMA 3R
ENCLOSED STARTERS

Cover Control Kits for Enclosures — These kits are available for NEMA 1 enclosures in versions such as Start/Stop, Hand-Auto, Hand-Off-Auto, Test-Off-Auto — all available with and without pilot light options. For reversing applications, Forward-Stop-Reverse, Up-Stop-Down and Open-Stop-Close with and without pilot lights are available. For other NEMA types, these and other versions such as On-Off are available. The kits are complete with wires and instructions. Assembly is fast and easy, requiring only a screwdriver in most cases. NEMA 1 enclosures have removable blank plates or knockouts and NEMA 3R, 4X and 12 enclosures have removable hole plugs that cover the pre-punched holes.

ISLAND & 10250T TYPE COVER CONTROL
WITH ACCOMPANYING ENCLOSURES

NEMA, Contactors & Starters, (Freedom)

REFERENCE DATA

NEMA AN16 Starters — High Fault Current Circuit Ratings — UL508

SCPD	Max Rating SCPD (A)	Cir Bkr Intrp Rating (KA)	Short Circuit Volt (V)	Withstand Current (KA)	Typical Disconnect
Size 00					
Data To Be Available Later					
Size 0					
Class R, J Fuse ❶	60	100	600	100	C361
Mag Bkr — HMCP ❶	30	100	480	100	HMCP
Thrml Mag — FDC ❶	35	100	480	100	FDC
Size 1					
Class R, J Fuse ❶	60	100	600	100	C361
Mag Bkr — HMCP ❶	30	100	480	100	HMCP
Thrml Mag — FDC ❶	90	100	480	100	FDC
Size 2					
Class R, J Fuse ❶	100	100	600	100	C361
Mag Bkr — HMCP ❶	50	100	480	100	HMCP
Thrml Mag — FDC ❶	150	100	480	100	FDC
Size 3					
Class R, J Fuse ❶	200	100	600	100	C361
Mag Bkr — HMCP ❶	150	100	480	100	HMCP
Thrml Mag — FDC ❶	150	100	480	100	FDC
Size 4					
Class R, J Fuse ❶	400	100	600	100	400 A K SW
Mag Bkr — HMCP ❶	150	100	480	100	HMCP
Thrml Mag — JDC ❷	250	100	480	100	JDC
Size 5					
Class R, J Fuse ❶	600	100	600	100	600 A K SW
Mag Bkr — HMCP ❷	600	100	480	100	HMCP
Thrml Mag — KDC ❷	400	100	480	100	FDC
Size 6					
Class L Fuse ❶	1200	- - -	600	100	800 A K SW
Class L Fuse ❶	1200	- - -	600	100	Mld Case N Fr
Thrml Mag — HLD ❷	800	65	480	65	HLD

❶ UL File E39943 — Issue Date 2/15/89.
❷ UL File E47048 — Issue Date 11/23/87.

NOTE:
UL 508 STANDARD FAULT CURRENT RATINGS: All devices are UL Listed with fuses and inverse time circuit breakers to standard low level fault currents based on horsepower. All AN16 starters conform. Sizes 00-3 to 5kA. Sizes 4-5 to 10kA. Size 6 to 18kA. Size 7 to 30kA. Size 8 to 42kA and Size 9 to 85kA.

Electrical Data

NEMA Size Frame Width	Ampere Rating, Continuous	Maximum Horsepower		
		Motor Voltage 60 Hz	1 ϕ	3 ϕ
00 45 mm	9	115	⅓	- - -
		200	- - -	1½
		230	1	1½
		460	- - -	2
		575	- - -	2
0 45 mm	18	115	1	- - -
		200	- - -	3
		230	2	3
		460	- - -	5
		575	- - -	5
1 65 mm	27	115	2	- - -
		200	- - -	7½
		230	3	7½
		460	- - -	10
		575	- - -	10
2 65 mm	45	115	3	- - -
		200	- - -	10
		230	7½	15
		460	- - -	25
		575	- - -	25
3 90 mm	90	115	- - -	- - -
		200	- - -	25
		230	- - -	30
		460	- - -	50
		575	- - -	50
4 180 mm	135	115	- - -	- - -
		200	- - -	40
		230	- - -	50
		460	- - -	100
		575	- - -	100
5 180 mm	270	115	- - -	- - -
		200	- - -	75
		230	- - -	100
		460	- - -	200
		575	- - -	200
6 220 mm	540	115	- - -	- - -
		200	- - -	150
		230	- - -	200
		460	- - -	400
		575	- - -	400
7 280 mm	810	115	- - -	- - -
		200	- - -	200
		230	- - -	300
		460	- - -	600
		575	- - -	600
8 334 mm	1215	115	- - -	- - -
		200	- - -	400
		230	- - -	450
		460	- - -	900
		575	- - -	900
9 813 mm	2250	115	- - -	- - -
		200	- - -	- - -
		230	- - -	800
		460	- - -	1600
		575	- - -	1600

NEMA, Contactors & Starters, (Freedom)

Auxiliary Contact Ratings

NEMA Electrical Rating Designation	Volts	Amperes		
		Make	Break	Continuous
A600	120	60	6	10
	240	30	3	
	480	15	1.5	
	600	12	1.2	
B600	120	30	3	5
	240	15	1.5	
	480	7.5	0.75	
	600	6	0.60	
C600	120	15	1.5	2.5
	240	7.5	0.75	
	480	3.75	0.38	
	600	3.00	0.30	

Wire (75°C) Sizes — AWG or kcmil – Open and Enclosed

NEMA Size	Cu Only
Power Terminals — Contactors	
00	#12 – #16 Stranded, #12 – #14 Solid
0	#8 – #16 Stranded, #10 – #14 Solid
1	#8 – #14 Stranded or Solid
2	#3 – #14 (upper) and/or #6 – #14 (lower) Stranded or Solid ❷
Power Terminals — Load (Overload Relay)	
Heater Pack Cat. Nos.	**❶ Min. — Cu Only (Stranded or Solid)**
H2001B-H2010B H2101B-H2110B	#14
H2011B & H2111B	#12
H2012B & H2112B	#10
H2013B-H2014B H2113B-H2114B	#8
H2015B & H2115B	#6
H2016B & H2116B	#4
H2017B & H2117B	#3
H2015A-H2017A H2114-H2117	#14-#2
Power Terminals – Line and Load	
3	#1/0 – #14 Al Cu
4	#3/0 – #8 Al Cu
5	750 kcmil – #2 or (2) 250 kcmil – #3/0 Al Cu
6	(2) 750 kcmil — #3/0 Al Cu
7	(3) 750 kcmil — #3/0 Al Cu
8	(4) 750 kcmil — #1/0 Al Cu
9	(8) 500 kcmil
Control Terminals — Cu Only	
All	#12 – #16 Stranded or #12 – #14 Solid

❶ Minimum per NEC.
Maximum Wire Size: Sizes 00 & 0 — #8 and Sizes 1 & 2 — #2.
❷ Two compartment box lug.

Torque Requirements — Line/Load and Heaters (in-lbs)

NEMA Size	AN16/56 Starters				
	Line Lug ❹		Load Lug		Heater Packs in-lbs
	Torque in-lbs	Wire Range	Torque in-lbs	Wire Range	
00	7	❸	20	❸	9
0	15	❸	20	❸	9
1	20	❸	35	#14-10	9
			40	#8	9
			45	#6-4	9
			50	#3	9
2	40	#14-8	35	#14-10	9
	45	#6-4	40	#8	9
	50	#3	45	#6-4	9
			50	#3	9
3	35	#14-10	35	#14-10	24-30
	40	#8	40	#8	24-30
	45	#6-4	45	#6-4	24-30
	50	#3-1/0	50	#3-1/0	24-30
4	200	❸	200	❸	24-30
5-7	550	❸	550	❸	9
8	500	❸	500	❸	9
9	400	4/0-500 MCM	400	4/0-500 MCM	9

❸ See “Wire Sizes” Table adjacent.
❹ For contactors this is “Line and Load Lug” data.

Plugging and Jogging Service Horsepower Rating

NEMA Size	200 Volts	230 Volts	460 Volts	575 Volts
Maximum horsepower where operation is interrupted more than 5 times per minute, or more than 10 times in a 10 minute period.				
00	- - -	½	½	½
0	1½	1½	2	2
1	3	3	5	5
2	7½	10	15	15
3	15	20	30	30
4	25	30	60	60
5	60	75	150	150
6	125	150	300	300

NEMA, Contactors & Starters, (Freedom)

AC COIL DATA

NEMA Sizes	P.U. Volts		P.U.			Sealed			D.O. Volts		Mech. Max. Operation Rate Ops/Hour	P.U. Time mS	D.O. Time mS
	Cold	Hot	VAR	VA	Watts	VAR	VA	Watts	Cold	Hot			
00	74.0%	78%	64	80	49	7.1	7.5	2.4	45%	46%	10,800	12	12
0	74.0%	78%	78	100	65	9.2	10	3.1	45%	46%	10,800	12	12
1-2	74.0%	78%	210	230	95	27	28	7.8	49%	50%	7,200	20	14
3	72.0%	76%	374	390	112	48	49.8	13	50%	52%	7,200	14	11
4	72.5%	76%	1132	1158	240	96	100	27.2	54%	56%	4,800	28	14
5	75.0%	77%	1132	1158	240	96	100	27.2	63%	64%	4,800	25	13
6	75.0%	75%	516	890	798	- - -	11	10	❶	❶	2,400	100	150-1000 ❷
7	75.0%	75%	868	1000	1345	11	25	20	❶	❶	1,200	100	150-1000
8	75.0%	75%	1262	2400	- - -	- - -	70	- - -	❶	❶	600	100	25-50
9	50.0%	65%	- - -	- - -	2100	- - -	- - -	350	40%	50%	- - -	18	20

❶ 20-30% of rated coil voltage.

❷ Adjustable drop out time.

DC COIL DATA

NEMA Sizes	Volts	P.U.			Sealed		D.O. Volts (Hot)	P.U. Time mS	D.O. Time mS	Max. Operation Rate Ops/Hour	Mech. Life Millions
		Amps	Watts	Volts (Hot)	Amps	Watts					
00/0	12	6.4	76.8	80%	0.28	3.36	60%	22	17	3,600	5
	24	3.2	76.8	80%	0.14	3.36	60%	22	17	3,600	5
	48	1.6	76.8	80%	0.07	3.36	60%	22	17	3,600	5
	120	0.64	76.8	80%	0.028	3.36	60%	22	17	3,600	5
1/2	12	15.4	126	68%	0.42	4.98	30%	21	12	3,600	2
	24	6.2	88.4	60%	0.21	4.96	29%	20	13	3,600	2
	48	2.9	76.2	56%	0.11	5.04	28%	20	14	3,600	2
	120	1.1	67.3	53%	0.041	4.87	29%	20	16	3,600	2
3	12	24	293	65%	0.40	4.84	23%	39	14	3,600	2
	24	12	288	61%	0.20	4.75	22%	38	14	3,600	2
	48	6.1	295	62%	0.097	4.67	22%	37	14	3,600	2
	120	2.5	298	61%	0.038	4.57	22%	37	16	3,600	2
4/5	24	18	400	67%	0.22	5.3	25%	53	14	2,400	2
	48	9.0	400	67%	0.11	5.2	25%	49	16	2,400	2
	120	3.3	450	65%	0.05	5.4	28%	56	19	2,400	2
	240	1.7	440	64%	0.02	4.9	26%	49	21	2,400	2
6	106	8.25	775	N/A	0.085	9	N/A	N/A	N/A	2,400	5
	214	4.09	775	N/A	0.042	9	N/A	N/A	N/A	2,400	5
	340	2.57	775	N/A	0.026	9	N/A	N/A	N/A	2,400	5
	430	2.03	775	N/A	0.021	9	N/A	N/A	N/A	2,400	5
7	106	13.92	1425	N/A	0.184	19.5	N/A	N/A	N/A	1,200	5 ❸
	214	6.89	1425	N/A	0.091	19.5	N/A	N/A	N/A	1,200	5 ❸
	340	4.34	1425	N/A	0.057	19.5	N/A	N/A	N/A	1,200	5 ❸
	430	3.43	1425	N/A	0.045	19.5	N/A	N/A	N/A	1,200	5 ❸
8	106	19.81	2100	N/A	0.566	60	N/A	N/A	N/A	600	5 ❸
	214	9.81	2100	N/A	0.280	60	N/A	N/A	N/A	600	5 ❸
	340	6.18	2100	N/A	0.176	60	N/A	N/A	N/A	600	5 ❸
	430	4.88	2100	N/A	0.139	60	N/A	N/A	N/A	600	5 ❸

❸ Change armature, magnet and armature interlock after 1 x 10^4 operations.

GENERAL COIL DATA

Coil Offering — Encapsulated – NEMA Sizes 00-9
(Except Size 6 is tape)

UL Insulation Rating — Encapsulated – Class 130 (B)
– 105 degree C temp. rise

Operational Limits — 85% to 110% of Rated Voltage

Coil Data Notes

P.U. = Pick up time is the average time taken from closing of the coil circuit to main contact touch.

D.O. = Drop out time is the average time taken from opening of the coil circuit to main contact separation.

Cold = Coil data with a cold coil.

Hot = Coil data with a hot coil.

All data is based on a standard contactor with no auxiliary devices and a 120 VAC or 24 VDC magnet coil. Coil data has a ±5% range depending on the application, therefore specific data may vary.

NEMA, Contactors & Starters, (Freedom)

RENEWAL PARTS

Magnet Coils					
Coil Volts and Hertz	**Size 00 ❶**	**Size 0 ❶**	**Size 1-2**	**Size 3**	**Size 4-5**
120/60 or 110/50	9-2823-1	9-2824-1	9-2703-1	9-2756-1	9-1891-1
240/60 or 220/50	9-2823-2	9-2824-2	9-2703-2	9-2756-2	9-1891-2
480/60 or 440/50	9-2823-3	9-2824-3	9-2703-3	9-2756-3	9-1891-3
600/60 or 550/50	9-2823-4	9-2824-4	9-2703-4	9-2756-4	9-1891-4
24/60 or 24/50	9-2823-18	9-2824-18	9-2703-16	9-2756-16	– – –
24/60	9-2823-7	9-2824-7	9-2703-6	9-2756-6	9-1891-15
48/60	9-2823-8	9-2824-8	9-2703-11	9-2756-15	– – –
208/60	9-2823-5	9-2824-5	9-2703-9	9-2756-5	9-1891-13
277/60	9-2823-12	9-2824-14	9-2703-7	9-2756-9	9-1891-26
24/50	9-2823-13	9-2824-13	9-2703-12	9-2756-11	9-1891-16
208-240/60	9-2823-17	9-2824-17	– – –	– – –	– – –
32/50	– – –	– – –	9-2703-10	9-2756-10	9-1891-27
48/50	9-2823-9	9-2824-9	9-2703-13	9-2756-7	9-1891-18
240/50	9-2823-11	9-2824-11	9-2703-14	9-2756-13	9-1891-20
380/50	– – –	– – –	– – –	9-2756-12	9-1891-14
415/50	– – –	– – –	– – –	9-2756-8	9-1891-21
380-415/50	9-2823-6	9-2824-6	9-2703-8	– – –	– – –
550/50	– – –	– – –	– – –	9-2756-14	9-1891-8

Coil Volts and Hertz	Size 6	
	Main Coil	**Feeder Group**
120/60 or 110/50	9-3006	9-3007
240/60 or 220/50	9-3006-2	9-3007-2
480/60 or 440/50	9-3006-3	9-3007-3
600/60 or 550/50	9-3006-4	9-3007-4
218/60 or 200/50	9-3006-5	9-3007-5
277/60 or 254/50	9-3006-6	9-3007-6
415/60 or 380/50	9-3006-7	9-3007-7
52/60 or 48/50	– – –	– – –
110/50-60	– – –	– – –
120/50-60	– – –	– – –
208/50-60	– – –	– – –
220/50-60	– – –	– – –
240/50-60	– – –	– – –
380/50-60	– – –	– – –
415/50-60	– – –	– – –
440/50-60	– – –	– – –
480/50-60	– – –	– – –
550/50-60	– – –	– – –
600/60-50	– – –	– – –

Coil Volts and Hertz	Size 7	
	Main Coil	**Feeder Group**
120/60 or 110/50	9-2698	9-2705
240/60 or 220/50	9-2698-2	9-2705-2
480/60 or 440/50	9-2698-3	9-2705-3
600/60 or 550/50	9-2698-4	9-2705-4
415/60 or 380/50	9-2698-6	9-2705-6
48/60 or 44/50	9-2698-8	9-2705-8
208/50-60	9-2698-5	9-2705-5

❶ These are the only renewal parts available. Series B1/C1 only.

NEMA, Contactors & Starters, (Freedom)

RENEWAL PARTS

Magnet Coils (Continued)

Coil Volts and Hertz	Size 8			
	Common Control		Separate Control	
	Main Coils	Feeder Group	Main Coils	Feeder Group
120/50-60	9-2654	9-2664	9-2654	9-2664
208/50-60	9-2654-6	9-2664-6		
240/50-60	9-2654-2	9-2664-2		
380/50-60	9-2654-5	9-2664-5		
480/50-60	9-2654-3	9-2664-3		
550/50-60	9-2654-10	9-2664-10		
600/50-60	9-2654-4	9-2664-4		

Coil Volts and Hertz	Size 9	
	Common Control	Separate Control
120/50-60	5264C34G01	5264C34G01

Dc Coil Kits

NEMA Contactor or Starter Size	Volts	Catalog Number
00-0	12	**C335KD3R1**
	24	**KD3T1**
	48	**KD3W1**
	120	**KD3A1**
1-2	12	**C335KD4R4**
	24	**KD4T4**
	48	**KD4W4**
	120	**KD4A4**
3	12	**C335KD5R1**
	24	**KD5T1**
	48	**KD5W1**
	120	**KD5A1**
4-5	24	**C335KA3T1**
	48	**KA3W1**
	120	**KA3A1**
	240	**KA3B1**

Contact Kits

Contactor or Starter NEMA Size	Part Numbers	
	2 Pole	3 Pole
1	6-65	6-65-2
2	6-65-7	6-65-8
3	6-43	6-43-2
4	6-44	6-44-2
5	6-45	6-45-2
6 ❶	– – –	6-648
7	– – –	6-613
8	– – –	6-571
9	(2) — 5264C42G01	(3) — 5264C42G01

Publications

NEMA Size Starter	Publication Numbers
1-2	22177
3	20426
4	20428
5	20429
6	23349
7	20848
8	20849
9	IL 16978

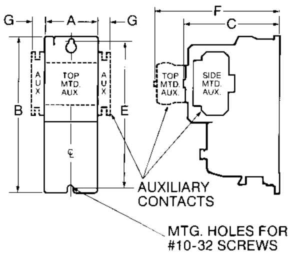
❶ Series B1 contactor, Series C1 starter.

NEMA, Contactors & Starters, (Freedom)

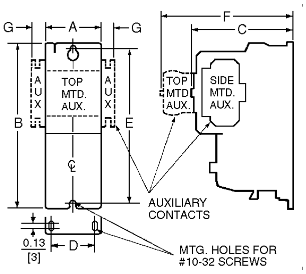
APPROXIMATE DIMENSIONS AND SHIPPING WEIGHTS

Do not use for construction.

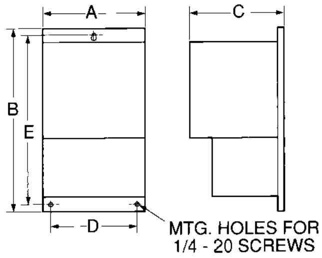
NON-REVERSING OPEN TYPE



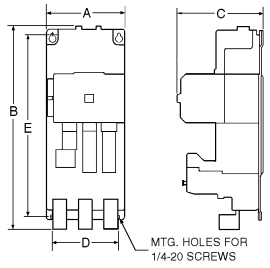
SIZE 00 & 0



SIZE 1 & 2



SIZE 3 & 4



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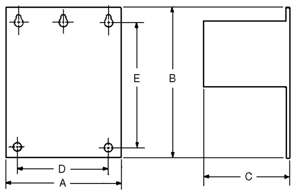
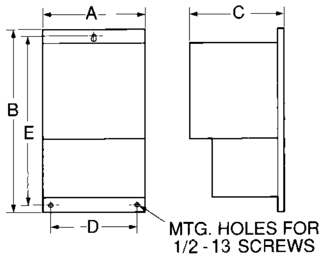


MOUNTING SCREWS — #1/2 - 13
SIZES 6 THROUGH 8



SIZE 9

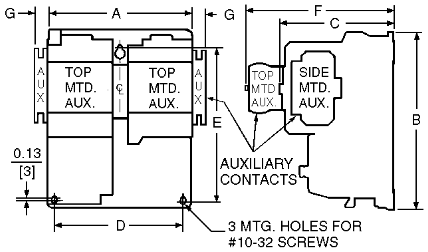
NEMA Size	Dimensions in Inches [mm]							Shipping Weight Lbs.
	Wide A	High B	Deep C	Mounting		F	G	
				D	E			
00-0	1.80 [45.5]	6.60 [168]	3.52 [89.5]	– – –	6.07 [154]	4.90 [124.5]	0.54 [13.7]	2.2
1	2.56 [65]	7.08 [180]	4.44 [113]	2.00 [51]	6.63 [168]	5.80 [147.5]	0.54 [13.7]	4.5
2	2.56 [65]	8.08 [205]	4.44 [113]	2.00 [51]	7.63 [194]	5.80 [147.5]	0.54 [13.7]	4.7
3	4.08 [104]	11.35 [288]	5.94 [151]	3.00 [76]	10.81 [275]	– – –	– – –	11.
4	7.05 [179]	12.06 [306]	7.25 [184]	6.00 [152]	8.50 [216]	– – –	– – –	23.
5	7.00 [178]	17.77 [451]	7.76 [197]	6.00 [152]	16.00 [406]	– – –	– – –	36.
6	9.47 [241]	21.69 [551]	9.90 [251]	3.10 [79]	18.00 [457]	– – –	– – –	75.
7	15.13 [384]	29.13 [740]	12.64 [321]	13.25 [337]	21.25 [540]	– – –	– – –	120.
8	15.13 [384]	34.50 [876]	15.00 [381]	13.75 [337]	16.75 [425]	– – –	– – –	210.
9	33.00 [838]	30.00 [762]	12.94 [329]	30.75 [781]	8.00 [203]	– – –	– – –	315.

NEMA, Contactors & Starters, (Freedom)

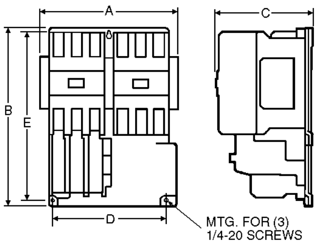
APPROXIMATE DIMENSIONS AND SHIPPING WEIGHTS (Continued)

Do not use for construction.

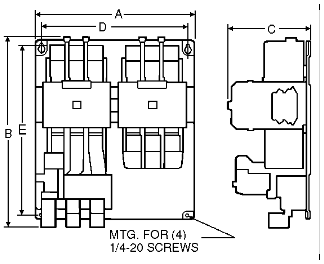
REVERSING OPEN TYPE



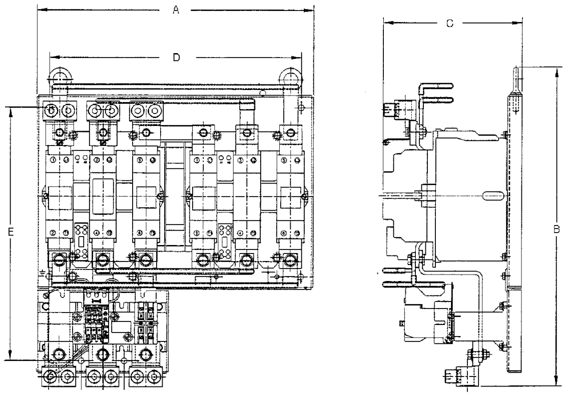
SIZE 00-2



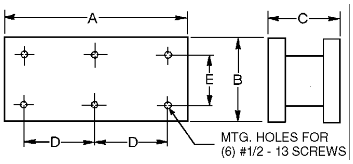
SIZE 3



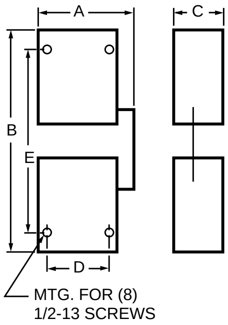
SIZE 4-5



SIZE 6



MOUNTING SCREWS #1/2 - 13
OPEN TYPE — SIZE 7-8 HORIZONTAL



SIZE 9
OPEN TYPE — VERTICAL

NEMA Size	Dimensions in Inches [mm]							Shipping Weight Lbs.
	Wide A	High B	Deep C	Mounting		F	G	
				D	E			
00-0	4.20 [106.5]	7.38 [187.5]	3.52 [89.5]	3.50 [89]	6.87 [174.5]	4.90 [124.5]	0.54 [13.7]	3.6
1	5.71 [145]	7.08 [180]	4.44 [113]	5.25 [133.5]	5.75 [146]	5.80 [147]	0.54 [13.7]	8.25
2	5.71 [145]	8.08 [205]	4.44 [113]	5.25 [133.5]	6.75 [171.5]	5.80 [147]	0.54 [13.7]	8.5
3	8.70 [221]	11.35 [288]	5.94 [151]	7.00 [178]	10.81 [275]	– – –	– – –	20.
4	14.68 [373]	12.06 [306]	7.25 [184]	13.50 [343]	8.50 [216]	– – –	– – –	49.
5	14.50 [368]	17.77 [451]	7.76 [197]	13.50 [343]	16.00 [406]	– – –	– – –	68.
6	19.77 [502]	22.63 [575]	9.90 [251]	18.00 [457]	18.00 [457]	– – –	– – –	130.
7	28.06 [713]	32.13 [816] ❶	12.70 [322]	12.75 [324]	21.25 [540]	– – –	– – –	175.
8	30.38 [772]	41.50 [1054] ❶	14.70 [373]	14.13 [359]	16.75 [425]	– – –	– – –	430.
9	33.00 [838]	63.12 [1603]	12.94 [329]	30.75 [781]	41.00 [1041]	– – –	– – –	640.

❶ Includes cross wiring overhang.

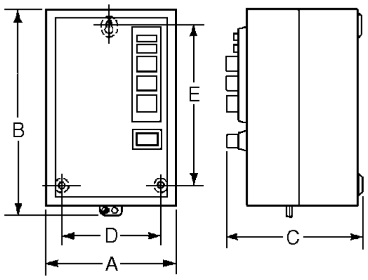
NEMA, Contactors & Starters, (Freedom)

APPROXIMATE DIMENSIONS AND SHIPPING WEIGHTS (Continued)

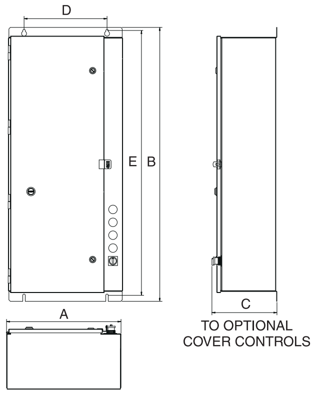
Do not use for construction.

NON-REVERSING & REVERSING CONTACTORS — ENCLOSED TYPE NEMA 1

NEMA Size (poles)	Box No.	Dimensions in Inches [mm]					Ship Wt. Lbs.
		Wide A	High B	Deep C	Mounting		
					Wide D	High E	
NON-REVERSING CONTACTORS - without Control Power Transformers							
00 (2P, 3P, 4P)	1	5.62 [143]	10.09 [256]	5.71 [145]	4.50 [114]	8.00 [203]	5.25
00 (2P, 3P, 4P) with top adders	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	7.3
0 (2P, 3P, 4P)	1	5.62 [143]	10.09 [256]	5.71 [145]	4.50 [114]	8.00 [203]	5.25
0 (2P, 3P, 4P) with top adders	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	7.3
0 (5P)	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	7.3
1 (2P, 3P)	1	5.62 [143]	10.09 [256]	5.71 [145]	4.50 [114]	8.00 [203]	7.9
1 (2P, 3P) with top adders	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	11
1 (4P, 5P)	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	8.5
2 (2P, 3P, 4P, 5P)	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	8.5
3 (2P, 3P)	4	11.66 [296]	26.51 [673]	8.89 [226]	9.00 [229]	23.38 [594]	35
4 (2P, 3P)	4	11.66 [296]	26.51 [673]	8.89 [226]	9.00 [229]	23.38 [594]	47
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	113
6		Consult Cutler-Hammer for Availability					
7							
8							
9							
NON-REVERSING CONTACTORS - with Control Power Transformers							
00 (2P, 3P, 4P)	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	12
00 (2P, 3P, 4P, 5P) with top adders	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	15
0 (2P, 3P, 4P, 5P)	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	12
0 (2P, 3P, 4P, 5P) with top adders	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	15
1 (2P, 3P)	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	12.2
1 (2P, 3P) with top adders	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	12.5
1 (4P, 5P)	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	12.6
2 (2P, 3P, 4P, 5P)	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	12.8
3 (2P, 3P)	4	11.66 [296]	26.51 [673]	8.89 [226]	9.00 [229]	23.38 [594]	40
4 (2P, 3P)	4	11.66 [296]	26.51 [673]	8.89 [226]	9.00 [229]	23.38 [594]	52
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	120
6		Consult Cutler-Hammer for Availability					
7							
8							
9							
3 POLE REVERSING CONTACTORS - without Control Power Transformers							
00	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	7.8
0	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	8
1	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	11
2	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	12
3	4	11.66 [296]	26.51 [673]	8.89 [226]	9.00 [229]	23.38 [594]	67
4	4	11.66 [296]	26.51 [673]	8.89 [226]	9.00 [229]	23.38 [594]	154
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	170
6		Consult Cutler-Hammer for Availability					
7							
8							
9							



BOXES 1-4



BOX 10

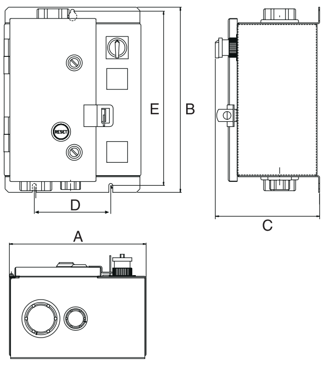
NEMA, Contactors & Starters, (Freedom)

APPROXIMATE DIMENSIONS AND SHIPPING WEIGHTS (Continued)

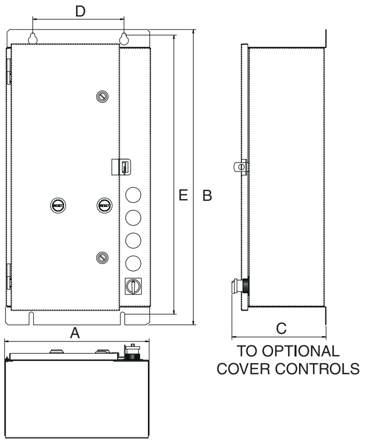
Do not use for construction.

NON-REVERSING & REVERSING CONTACTORS — ENCLOSED TYPE NEMA 3R, 4/4X & 12

NEMA Size (poles)	Box No.	Dimensions in Inches [mm]					Ship Wt. Lbs.
		Wide A	High B	Deep C	Mounting Wide D	Mounting High E	
NON-REVERSING CONTACTORS - without Control Power Transformers							
0 (2P, 3P, 4P)	5	9.84 [250]	13.31 [338]	7.51 [191]	5.50 [140]	12.50 [3.18]	14
1 (2P, 3P, 4P, 5P)	5	9.84 [250]	13.31 [338]	7.51 [191]	5.50 [140]	12.50 [3.18]	15
2 (2P, 3P, 4P, 5P)	5	9.84 [250]	13.31 [338]	7.51 [191]	5.50 [140]	12.50 [3.18]	15.5
3 (2P, 3P)	8	14.25 [362]	29.10 [739]	9.29 [234]	9.00 [229]	27.50 [699]	45
4 (2P, 3P)	8	14.25 [362]	29.10 [739]	9.29 [234]	9.00 [229]	27.50 [699]	56
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	140
6		Consult Cutler-Hammer for Availability					
7							
8							
9							
NON-REVERSING CONTACTORS - with Control Power Transformers							
0 (2P, 3P, 4P)	5	9.84 [250]	13.31 [338]	7.51 [191]	5.50 [140]	12.50 [3.18]	18
1 (2P, 3P, 4P, 5P)	6	12.01 [305]	14.39 [366]	7.51 [191]	8.00 [203]	13.50 [343]	19
2 (2P, 3P, 4P, 5P)	6	12.01 [305]	14.39 [366]	7.51 [191]	8.00 [203]	13.50 [343]	19.5
3 (2P, 3P)	8	14.25 [362]	29.10 [739]	9.29 [234]	9.00 [229]	27.50 [699]	52
4 (2P, 3P)	8	14.25 [362]	29.10 [739]	9.29 [234]	9.00 [229]	27.50 [699]	63
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	147
6		Consult Cutler-Hammer for Availability					
7							
8							
9							
3 POLE REVERSING CONTACTORS - with or without Control Power Transformers							
0	6	12.01 [305]	14.39 [366]	7.51 [191]	8.00 [203]	13.50 [343]	18
1	6	12.01 [305]	14.39 [366]	7.51 [191]	8.00 [203]	13.50 [343]	19
2	6	12.01 [305]	14.39 [366]	7.51 [191]	8.00 [203]	13.50 [343]	19
3	8	14.25 [362]	29.10 [739]	9.29 [234]	9.00 [229]	27.50 [699]	47
4	8	14.25 [362]	29.10 [739]	9.29 [234]	9.00 [229]	27.50 [699]	69
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	170
6		Consult Cutler-Hammer for Availability					
7							
8							
9							



BOXES 5, 6



BOXES 8, 10

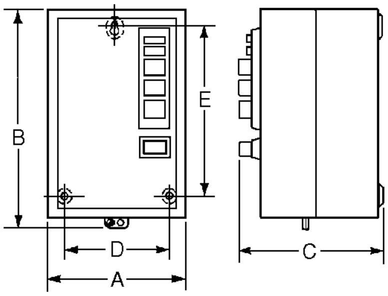
NEMA, Contactors & Starters, (Freedom)

APPROXIMATE DIMENSIONS AND SHIPPING WEIGHTS (Continued)

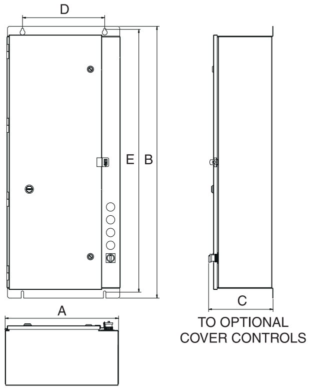
Do not use for construction.

NON-REVERSING & REVERSING STARTERS — ENCLOSED TYPE NEMA 1

NEMA Size (poles)	Box No.	Dimensions in Inches [mm]					Ship Wt. Lbs.
		Wide A	High B	Deep C	Mounting Wide D	Mounting High E	
NON-REVERSING STARTERS Without Control Power Transformers							
00	1	5.62 [143]	10.09 [256]	5.71 [145]	4.50 [114]	8.00 [203]	7
00 with top adders	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	10
0	1	5.62 [143]	10.09 [256]	5.71 [145]	4.50 [114]	8.00 [203]	7.1
0 with top adders	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	10
1	1	5.62 [143]	10.09 [256]	5.71 [145]	4.50 [114]	8.00 [203]	7.9
1 with top adders	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	11.5
2	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	8.5
3	4	11.66 [296]	26.51 [673]	8.89 [226]	9.00 [229]	23.38 [594]	35
4	4	11.66 [296]	26.51 [673]	8.89 [226]	9.00 [229]	23.38 [594]	47
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	139
6		Consult Cutler-Hammer for Availability					
7							
8							
9							
NON-REVERSING STARTERS With Control Power Transformers							
00	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	15
0	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	15
1	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	16
2	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	16.2
3	4	11.66 [296]	26.51 [673]	8.89 [226]	9.00 [229]	23.38 [594]	42
4	4	11.66 [296]	26.51 [673]	8.89 [226]	9.00 [229]	23.38 [594]	54
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	146
6		Consult Cutler-Hammer for Availability					
7							
8							
9							
REVERSING STARTERS Without Control Power Transformers							
00	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	8
0	2	7.73 [196]	13.21 [336]	6.75 [172]	6.00 [152]	10.75 [273]	8
0 with top adders	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	11
1	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	13
1 with top adders	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	13.4
2	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	15
3	4	11.66 [296]	26.51 [673]	8.89 [226]	9.00 [229]	23.38 [594]	43
4	9	25.50 [648]	29.10 [739]	9.31 [237]	20.00 [508]	27.50 [699]	65
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	165
6		Consult Cutler-Hammer for Availability					
7							
8							
9							
REVERSING STARTERS With Control Power Transformers							
00 with top adders	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	15
0	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	15
1 with top adders	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	17
2	3	12.65 [321]	14.40 [366]	7.31 [186]	9.75 [248]	11.25 [286]	19
3	4	11.66 [296]	26.51 [673]	8.89 [226]	9.00 [229]	23.38 [594]	50
4	9	25.50 [648]	29.10 [739]	9.31 [237]	20.00 [508]	27.50 [699]	72
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	172
6		Consult Cutler-Hammer for Availability					
7							
8							
9							



BOXES 1-4



BOXES 9-10

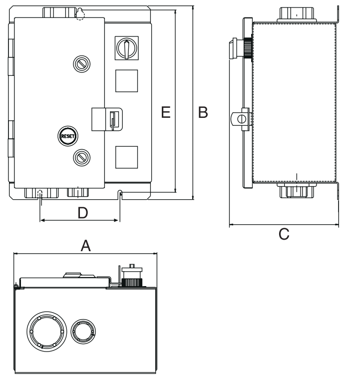
NEMA, Contactors & Starters, (Freedom)

APPROXIMATE DIMENSIONS AND SHIPPING WEIGHTS (Continued)

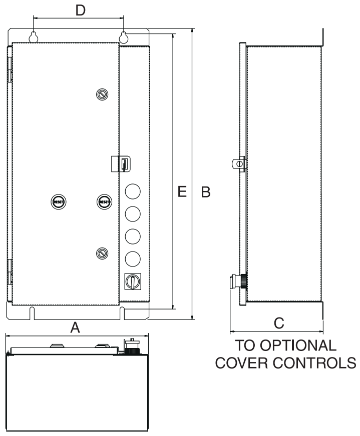
Do not use for construction.

NON-REVERSING & REVERSING STARTERS — ENCLOSED TYPE NEMA 3R, 4/4X & 12

NEMA Size (poles)	Box No.	Dimensions in Inches [mm]					Ship Wt. Lbs.
		Wide A	High B	Deep C	Mounting		
					Wide D	High E	
NON-REVERSING STARTERS - without Control Power Transformers							
0	5	9.84 [250]	13.31 [338]	7.51 [191]	5.50 [140]	12.50 [318]	14.3
1	5	9.84 [250]	13.31 [338]	7.51 [191]	5.50 [140]	12.50 [318]	15.3
2	6	12.01 [305]	14.39 [366]	7.51 [191]	8.00 [203]	13.50 [343]	16
3	8	14.25 [362]	29.10 [739]	9.29 [234]	9.00 [229]	27.50 [699]	46
4	8	14.25 [362]	29.10 [739]	9.29 [234]	9.00 [229]	27.50 [699]	60
4	9	25.50 [648]	29.10 [739]	9.31 [237]	20.00 [508]	27.50 [699]	60
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	150
6		Consult Cutler-Hammer for Availability					
7							
8							
9							
NON-REVERSING STARTERS - with Control Power Transformers							
0	6	12.01 [305]	14.39 [366]	7.51 [191]	8.00 [203]	13.50 [343]	18
1	6	12.01 [305]	14.39 [366]	7.51 [191]	8.00 [203]	13.50 [343]	19
2	6	12.01 [305]	14.39 [366]	7.51 [191]	8.00 [203]	13.50 [343]	20
3	8	14.25 [362]	29.10 [739]	9.29 [234]	9.00 [229]	27.50 [699]	53
4	8	14.25 [362]	29.10 [739]	9.29 [234]	9.00 [229]	27.50 [699]	67
4	9	25.50 [648]	29.10 [739]	9.31 [237]	20.00 [508]	27.50 [699]	67
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	157
6		Consult Cutler-Hammer for Availability					
7							
8							
9							
REVERSING STARTERS - with or without Control Power Transformers							
0	6	12.01 [305]	14.39 [366]	7.51 [191]	8.00 [203]	13.50 [343]	18.5
1	6	12.01 [305]	14.39 [366]	7.51 [191]	8.00 [203]	13.50 [343]	19.5
2	6	12.01 [305]	14.39 [366]	7.51 [191]	8.00 [203]	13.50 [343]	21
1-2	7	16.26 [413]	14.37 [365]	7.51 [191]	11.00 [279]	13.50 [343]	24
3	8	14.25 [362]	29.10 [739]	9.29 [234]	9.00 [229]	27.50 [699]	48
4	9	25.50 [648]	29.10 [739]	9.31 [237]	20.00 [508]	27.50 [699]	72
5	10	20.00 [508]	47.85 [1215]	11.36 [289]	14.50 [368]	46.25 [1175]	175
6		Consult Cutler-Hammer for Availability					
7							
8							
9							



BOXES 5, 6, 7, 9

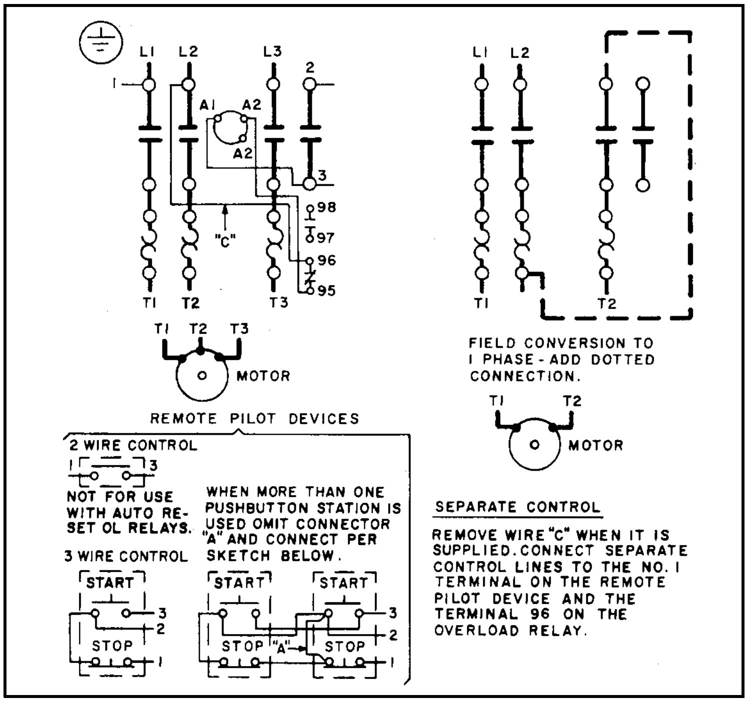


BOXES 8, 10

NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS

NON-REVERSING STARTERS



REMOTE PILOT DEVICES

2 WIRE CONTROL

NOT FOR USE WITH AUTO RESET OL RELAYS.

3 WIRE CONTROL

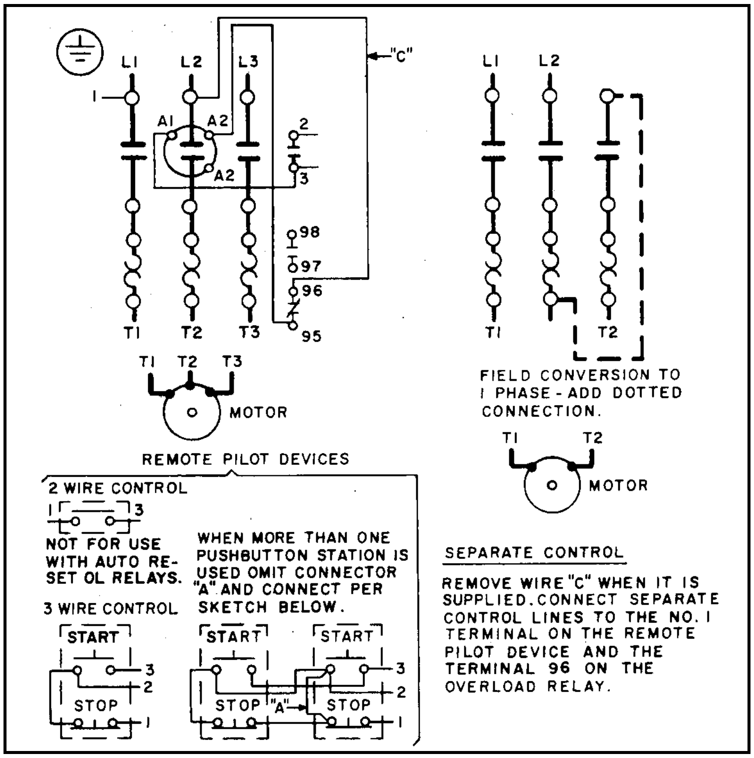
WHEN MORE THAN ONE PUSHBUTTON STATION IS USED OMIT CONNECTOR "A" AND CONNECT PER SKETCH BELOW.

FIELD CONVERSION TO 1 PHASE - ADD DOTTED CONNECTION.

SEPARATE CONTROL

REMOVE WIRE "C" WHEN IT IS SUPPLIED. CONNECT SEPARATE CONTROL LINES TO THE NO. 1 TERMINAL ON THE REMOTE PILOT DEVICE AND THE TERMINAL 96 ON THE OVERLOAD RELAY.

SIZE 00



REMOTE PILOT DEVICES

2 WIRE CONTROL

NOT FOR USE WITH AUTO RESET OL RELAYS.

3 WIRE CONTROL

WHEN MORE THAN ONE PUSHBUTTON STATION IS USED OMIT CONNECTOR "A" AND CONNECT PER SKETCH BELOW.

FIELD CONVERSION TO 1 PHASE - ADD DOTTED CONNECTION.

SEPARATE CONTROL

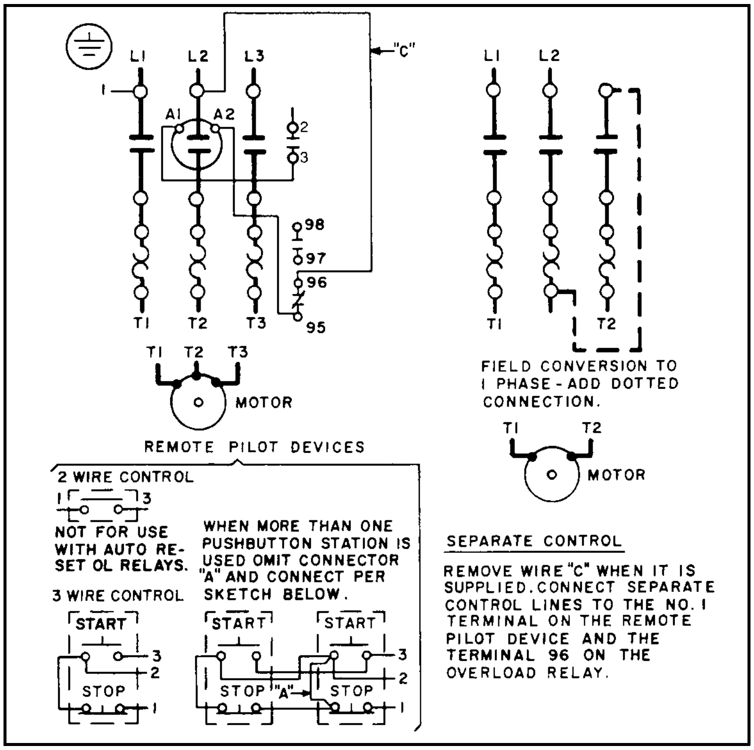
REMOVE WIRE "C" WHEN IT IS SUPPLIED. CONNECT SEPARATE CONTROL LINES TO THE NO. 1 TERMINAL ON THE REMOTE PILOT DEVICE AND THE TERMINAL 96 ON THE OVERLOAD RELAY.

SIZE 0

NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

NON-REVERSING STARTERS (Continued)



FIELD CONVERSION TO 1 PHASE - ADD DOTTED CONNECTION.

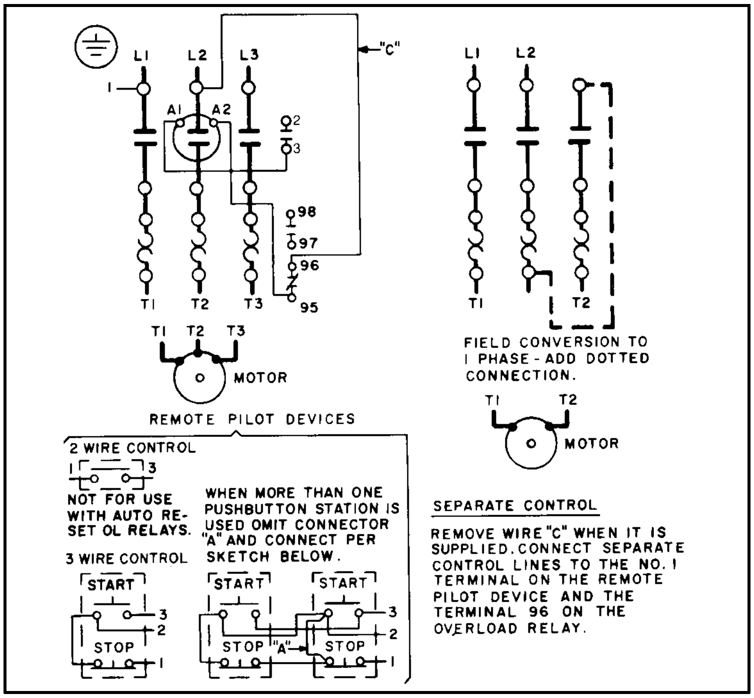
NOT FOR USE WITH AUTO RESET OL RELAYS.

WHEN MORE THAN ONE PUSHBUTTON STATION IS USED OMIT CONNECTOR "A" AND CONNECT PER SKETCH BELOW.

SEPARATE CONTROL

REMOVE WIRE "C" WHEN IT IS SUPPLIED. CONNECT SEPARATE CONTROL LINES TO THE NO. 1 TERMINAL ON THE REMOTE PILOT DEVICE AND THE TERMINAL 96 ON THE OVERLOAD RELAY.

SIZES 1 & 2



FIELD CONVERSION TO 1 PHASE - ADD DOTTED CONNECTION.

NOT FOR USE WITH AUTO RESET OL RELAYS.

WHEN MORE THAN ONE PUSHBUTTON STATION IS USED OMIT CONNECTOR "A" AND CONNECT PER SKETCH BELOW.

SEPARATE CONTROL

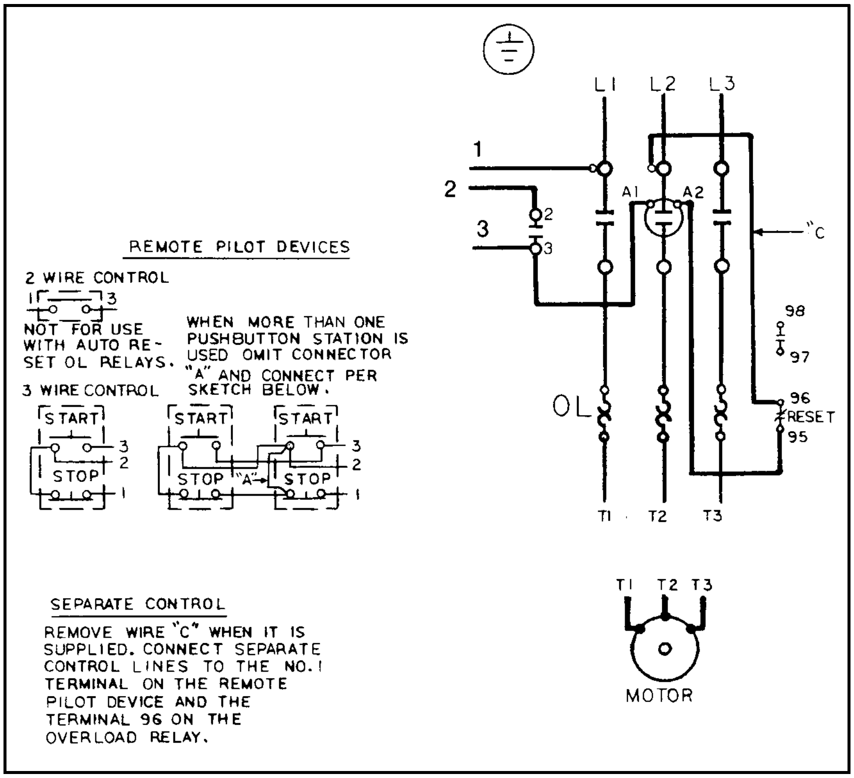
REMOVE WIRE "C" WHEN IT IS SUPPLIED. CONNECT SEPARATE CONTROL LINES TO THE NO. 1 TERMINAL ON THE REMOTE PILOT DEVICE AND THE TERMINAL 96 ON THE OVERLOAD RELAY.

SIZE 3

NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

NON-REVERSING STARTERS (Continued)

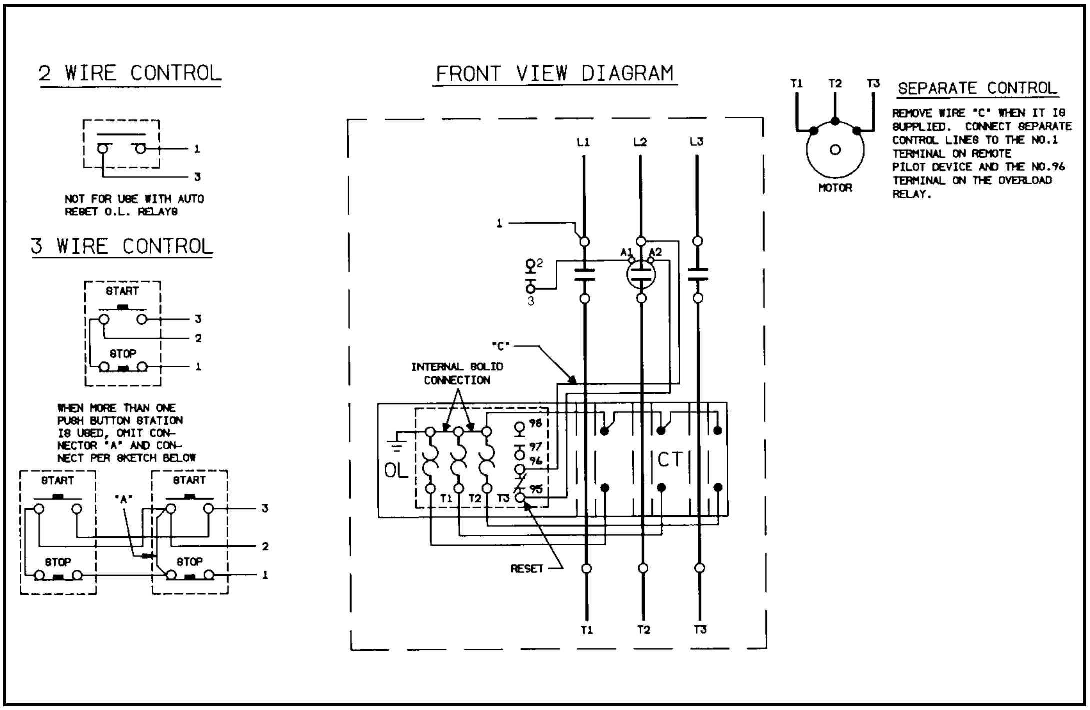


NOT FOR USE WITH AUTO RE-SET OL RELAYS.

WHEN MORE THAN ONE PUSHBUTTON STATION IS USED OMIT CONNECTOR "A" AND CONNECT PER SKETCH BELOW.

REMOVE WIRE "C" WHEN IT IS SUPPLIED. CONNECT SEPARATE CONTROL LINES TO THE NO. I TERMINAL ON THE REMOTE PILOT DEVICE AND THE TERMINAL 96 ON THE OVERLOAD RELAY.

SIZE 4



NOT FOR USE WITH AUTO RESET O.L. RELAYS

WHEN MORE THAN ONE PUSH BUTTON STATION IS USED, OMIT CONNECTOR "A" AND CONNECT PER SKETCH BELOW

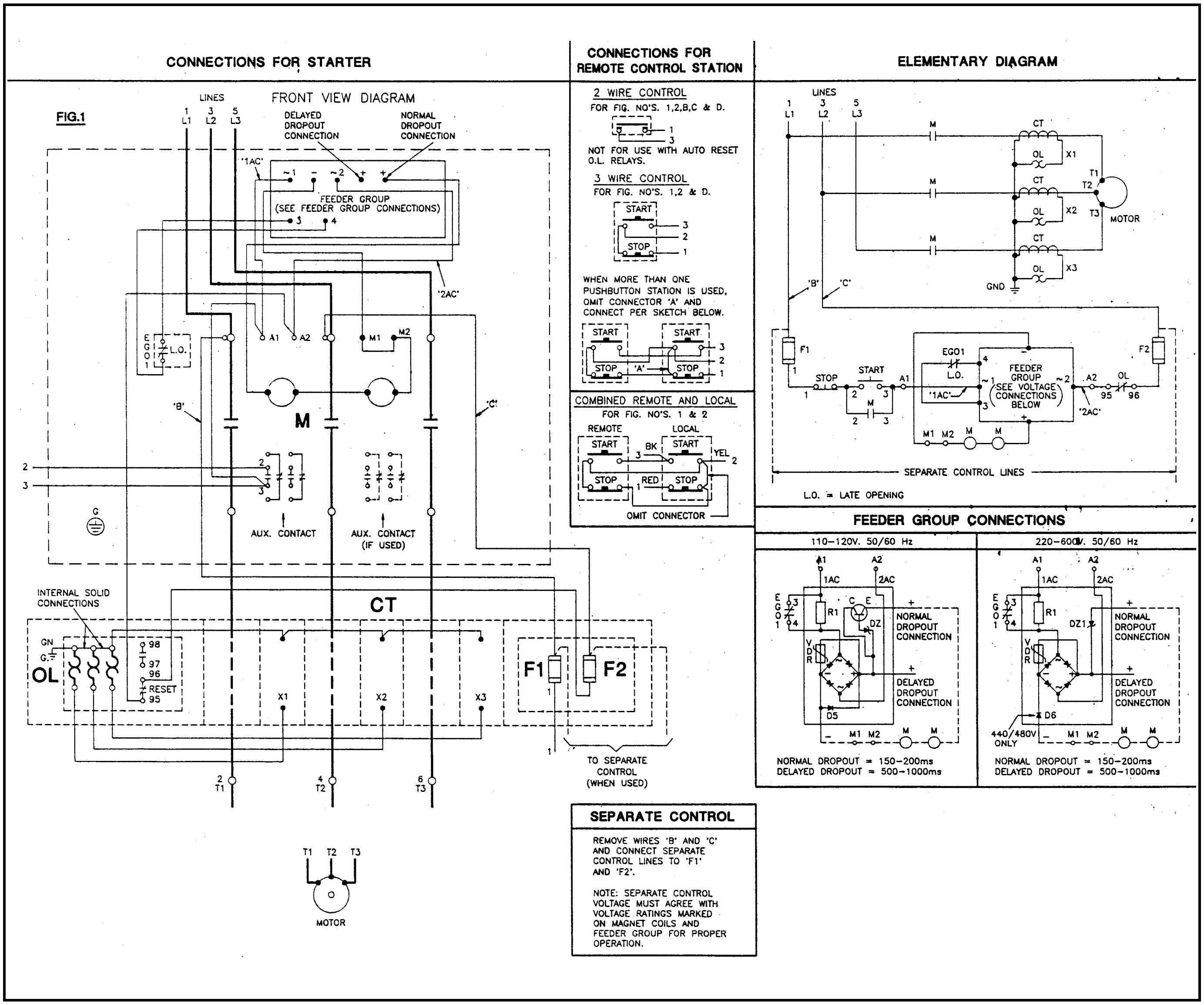
REMOVE WIRE "C" WHEN IT IS SUPPLIED. CONNECT SEPARATE CONTROL LINES TO THE NO.1 TERMINAL ON REMOTE PILOT DEVICE AND THE NO.96 TERMINAL ON THE OVERLOAD RELAY.

SIZE 5

NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

NON-REVERSING STARTERS (Continued)



SEPARATE CONTROL

REMOVE WIRES 'B' AND 'C' AND CONNECT SEPARATE CONTROL LINES TO 'F1' AND 'F2'.

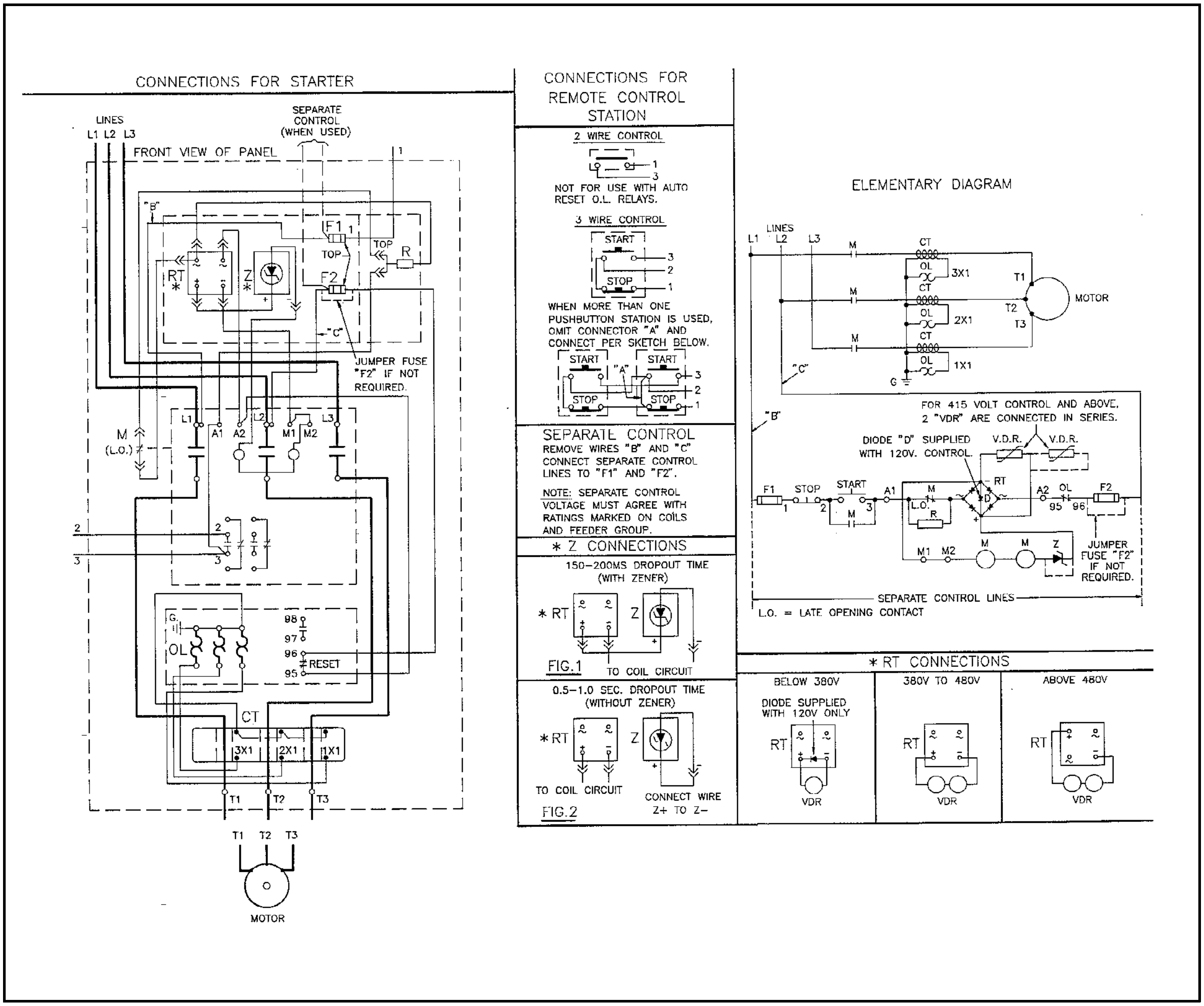
NOTE: SEPARATE CONTROL VOLTAGE MUST AGREE WITH VOLTAGE RATINGS MARKED ON MAGNET COILS AND FEEDER GROUP FOR PROPER OPERATION.

SIZE 6

NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

NON-REVERSING STARTERS (Continued)



NOT FOR USE WITH AUTO RESET O.L. RELAYS.

WHEN MORE THAN ONE PUSHBUTTON STATION IS USED, OMIT CONNECTOR "A" AND CONNECT PER SKETCH BELOW.

SEPARATE CONTROL
REMOVE WIRES "B" AND "C" CONNECT SEPARATE CONTROL LINES TO "F1" AND "F2".

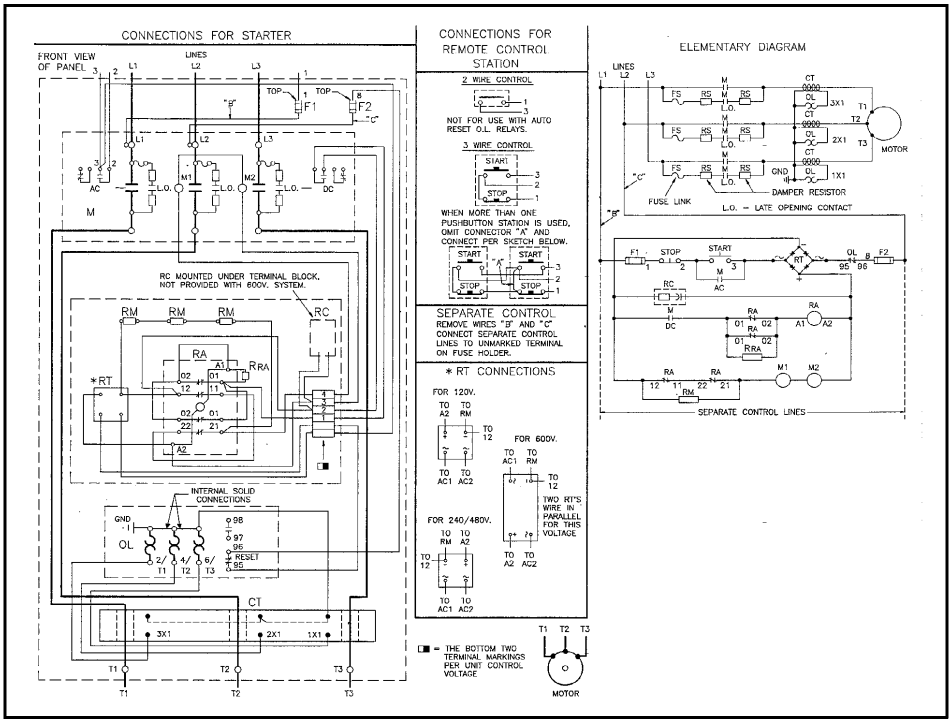
NOTE: SEPARATE CONTROL VOLTAGE MUST AGREE WITH RATINGS MARKED ON COILS AND FEEDER GROUP.

SIZE 7

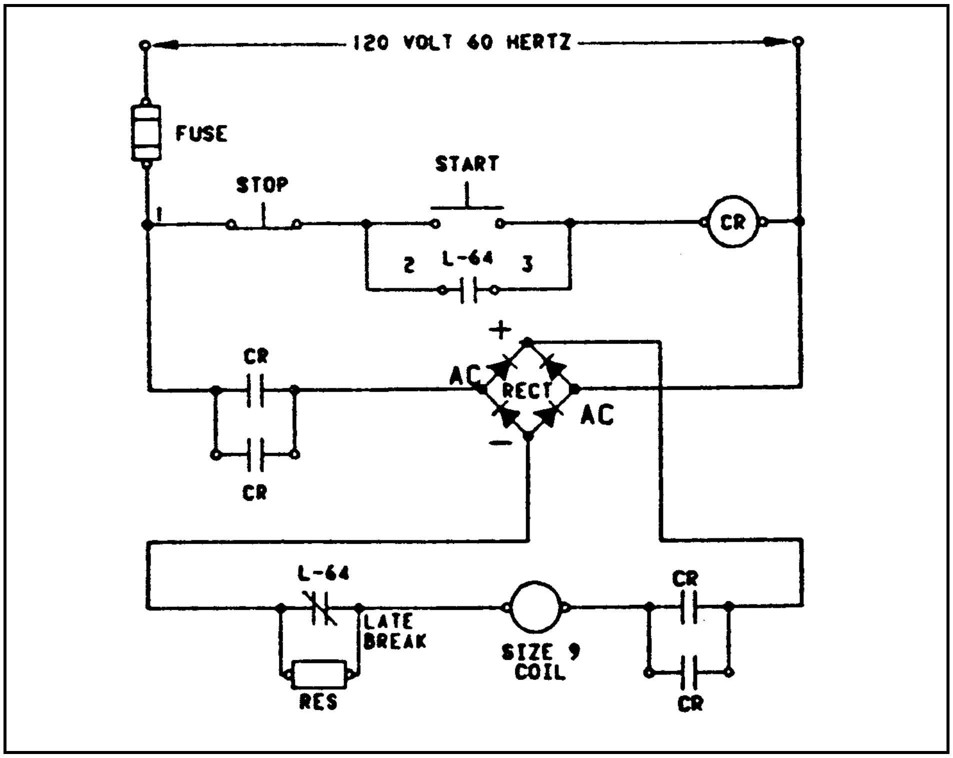
NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

NON-REVERSING STARTERS (Continued)



SIZE 8



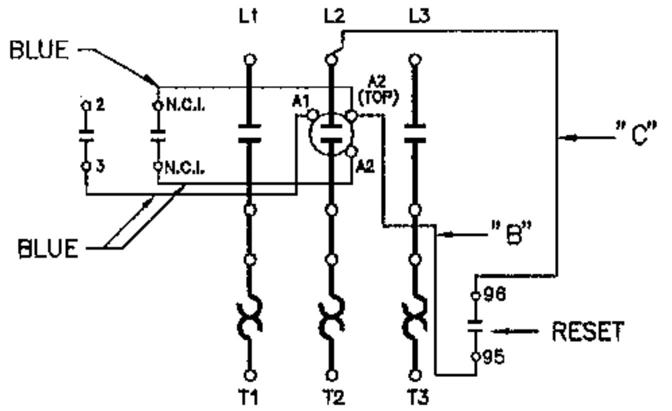
SIZE 9
CONTROL CIRCUIT

NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

TYPICAL DC CONTROL WIRING DIAGRAM

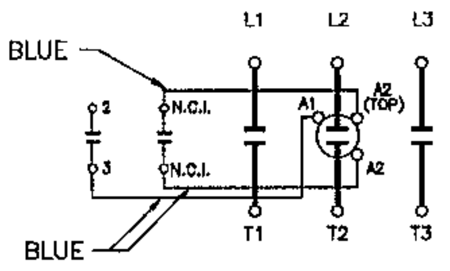
TYPICAL STARTER DIAGRAM



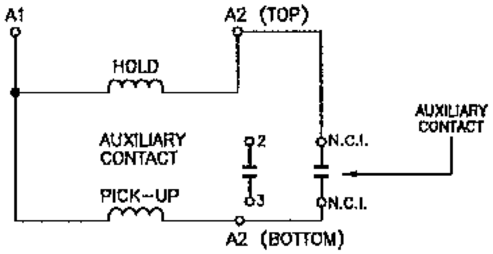
SEPARATE CONTROL

1. REMOVE WIRE "C" (WHEN SUPPLIED).
2. REMOVE RED CONTROL WIRE FROM TERMINAL NO.A2 (BOTTOM) TO TERMINAL NO.95 OF OVERLOAD RELAY.
3. CONNECT RED CONTROL WIRE "B" FROM TERMINAL NO.A2 (TOP) TO TERMINAL NO.95 OF THE OVERLOAD RELAY.
4. CONNECT SEPARATE CONTROL LINES TO THE NO.1 TERMINAL OF THE REMOTE PILOT DEVICE AND TO THE NO.96 TERMINAL OF THE OVERLOAD RELAY.

TYPICAL CONTACTOR DIAGRAM



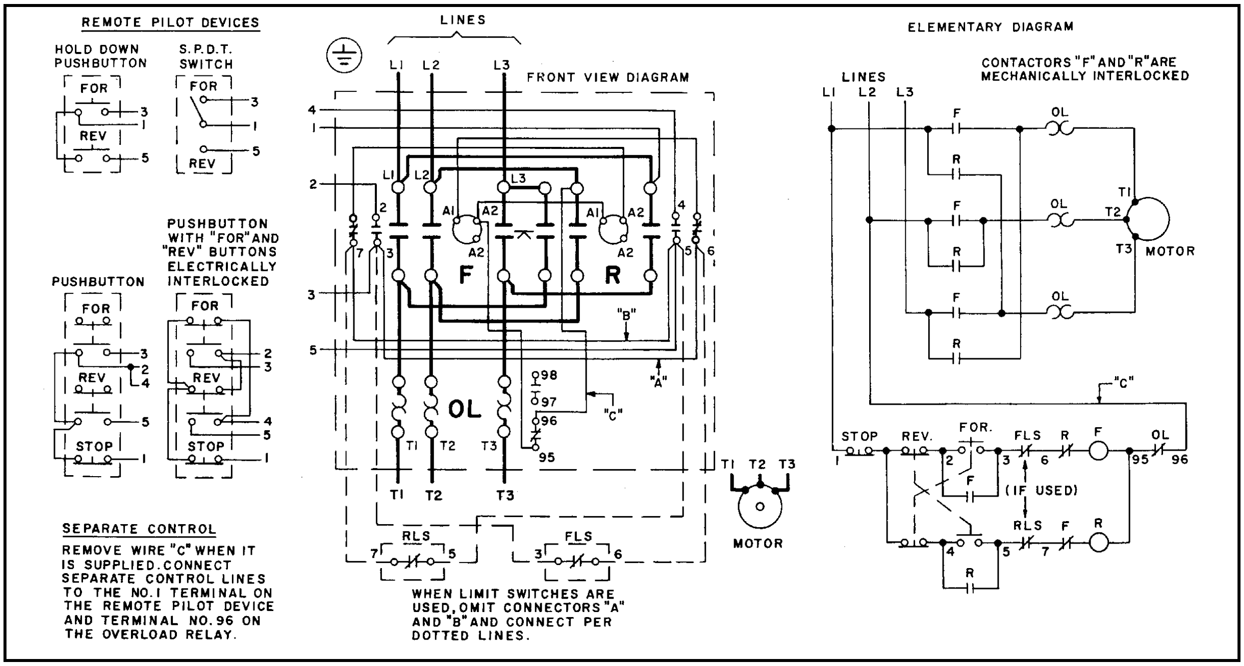
D.C. COIL ELEMENTARY DIAGRAM



NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

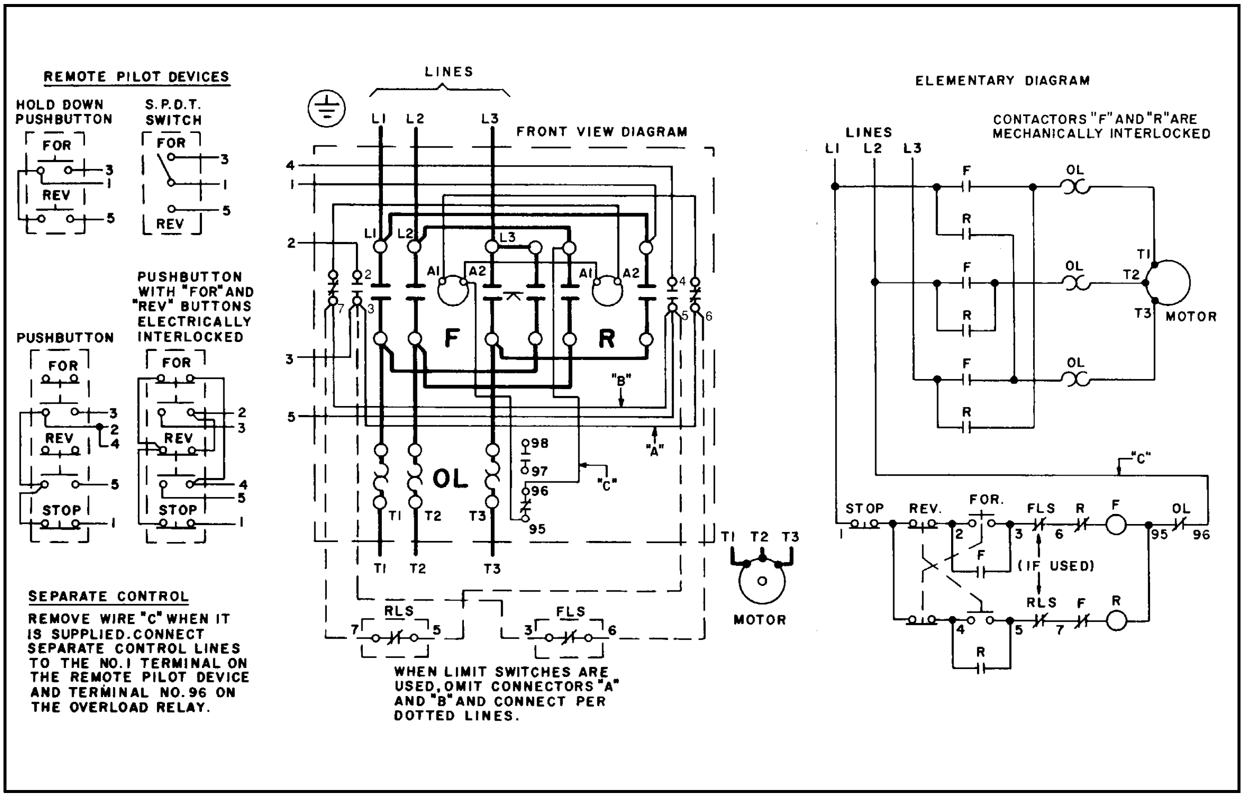
REVERSING STARTERS



SEPARATE CONTROL
REMOVE WIRE "C" WHEN IT IS SUPPLIED. CONNECT SEPARATE CONTROL LINES TO THE NO. 1 TERMINAL ON THE REMOTE PILOT DEVICE AND TERMINAL NO. 96 ON THE OVERLOAD RELAY.

WHEN LIMIT SWITCHES ARE USED, OMIT CONNECTORS "A" AND "B" AND CONNECT PER DOTTED LINES.

SIZES 00 & 0



SEPARATE CONTROL
REMOVE WIRE "C" WHEN IT IS SUPPLIED. CONNECT SEPARATE CONTROL LINES TO THE NO. 1 TERMINAL ON THE REMOTE PILOT DEVICE AND TERMINAL NO. 96 ON THE OVERLOAD RELAY.

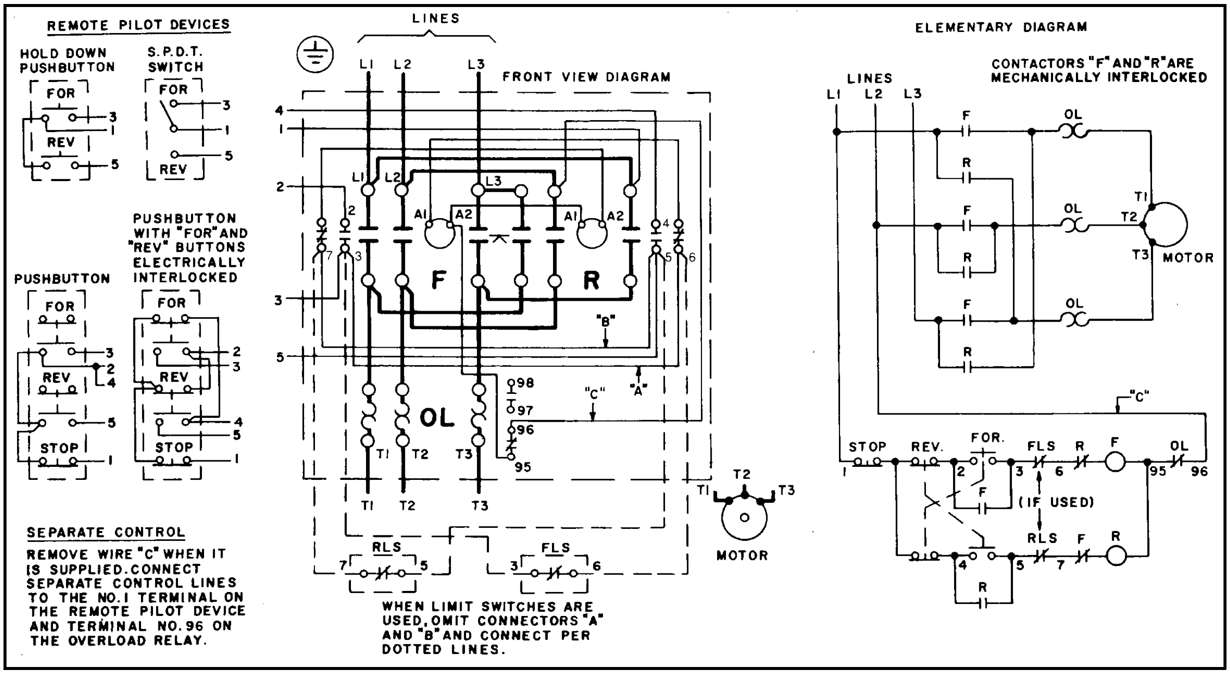
WHEN LIMIT SWITCHES ARE USED, OMIT CONNECTORS "A" AND "B" AND CONNECT PER DOTTED LINES.

SIZES 1 & 2

NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

REVERSING STARTERS (Continued)

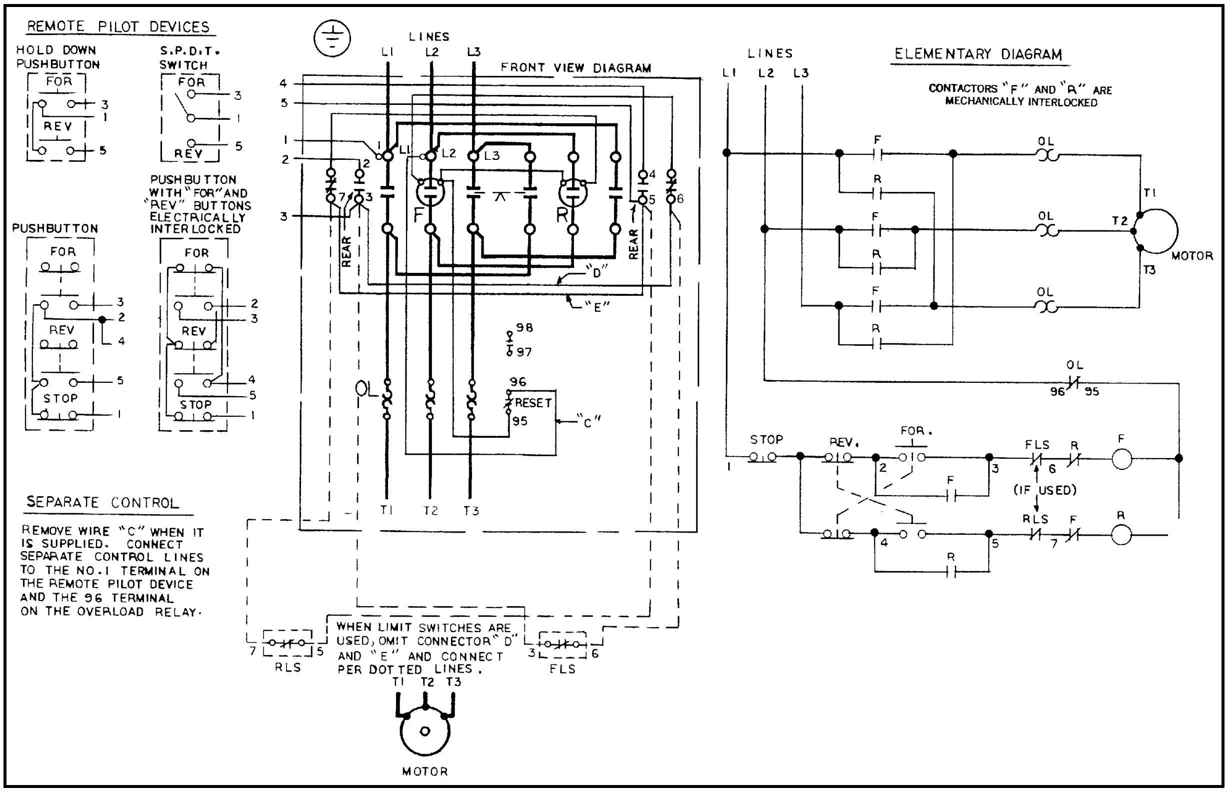


SEPARATE CONTROL

REMOVE WIRE "C" WHEN IT IS SUPPLIED. CONNECT SEPARATE CONTROL LINES TO THE NO. 1 TERMINAL ON THE REMOTE PILOT DEVICE AND TERMINAL NO. 96 ON THE OVERLOAD RELAY.

WHEN LIMIT SWITCHES ARE USED, OMIT CONNECTORS "A" AND "B" AND CONNECT PER DOTTED LINES.

SIZE 3



SEPARATE CONTROL

REMOVE WIRE "C" WHEN IT IS SUPPLIED. CONNECT SEPARATE CONTROL LINES TO THE NO. 1 TERMINAL ON THE REMOTE PILOT DEVICE AND THE 96 TERMINAL ON THE OVERLOAD RELAY.

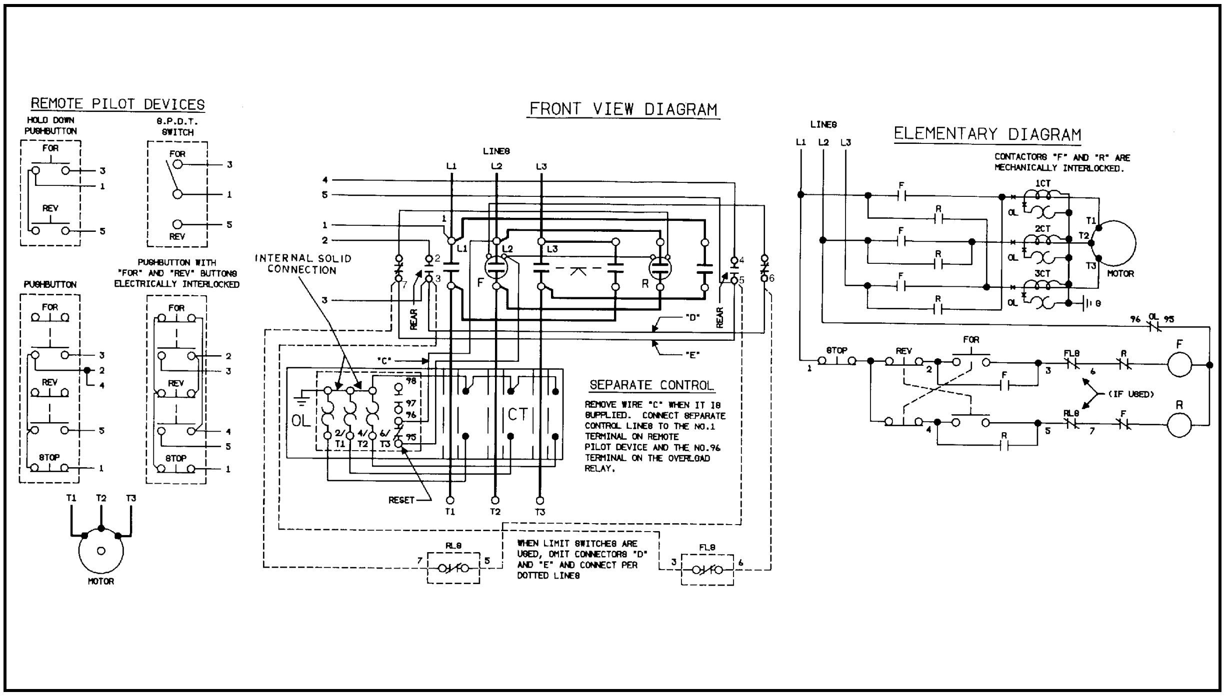
WHEN LIMIT SWITCHES ARE USED, OMIT CONNECTOR "D" AND "E" AND CONNECT PER DOTTED LINES.

SIZE 4

NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

REVERSING STARTERS (Continued)

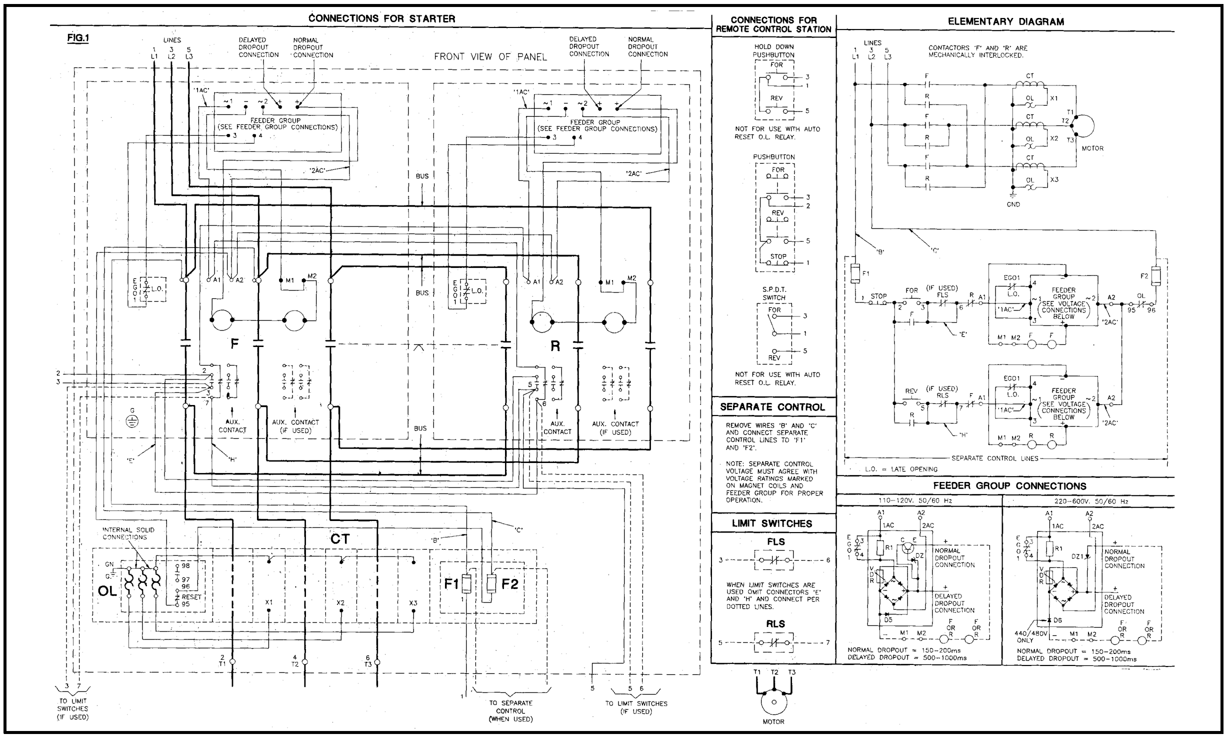


SEPARATE CONTROL

REMOVE WIRE "C" WHEN IT IS SUPPLIED. CONNECT SEPARATE CONTROL LINES TO THE NO.1 TERMINAL ON REMOTE PILOT DEVICE AND THE NO.96 TERMINAL ON THE OVERLOAD RELAY.

WHEN LIMIT SWITCHES ARE USED, OMIT CONNECTORS "D" AND "E" AND CONNECT PER DOTTED LINES

SIZE 5



NOT FOR USE WITH AUTO RESET O.L. RELAY.

NOT FOR USE WITH AUTO RESET O.L. RELAY.

SEPARATE CONTROL

REMOVE WIRES 'B' AND 'C' AND CONNECT SEPARATE CONTROL LINES TO 'F1' AND 'F2'.

NOTE: SEPARATE CONTROL VOLTAGE MUST AGREE WITH VOLTAGE RATINGS MARKED ON MAGNET COILS AND FEEDER GROUP FOR PROPER OPERATION.

WHEN LIMIT SWITCHES ARE USED OMIT CONNECTORS 'E' AND 'H' AND CONNECT PER DOTTED LINES.

NORMAL DROPOUT = 150–200ms
DELAYED DROPOUT = 500–1000ms

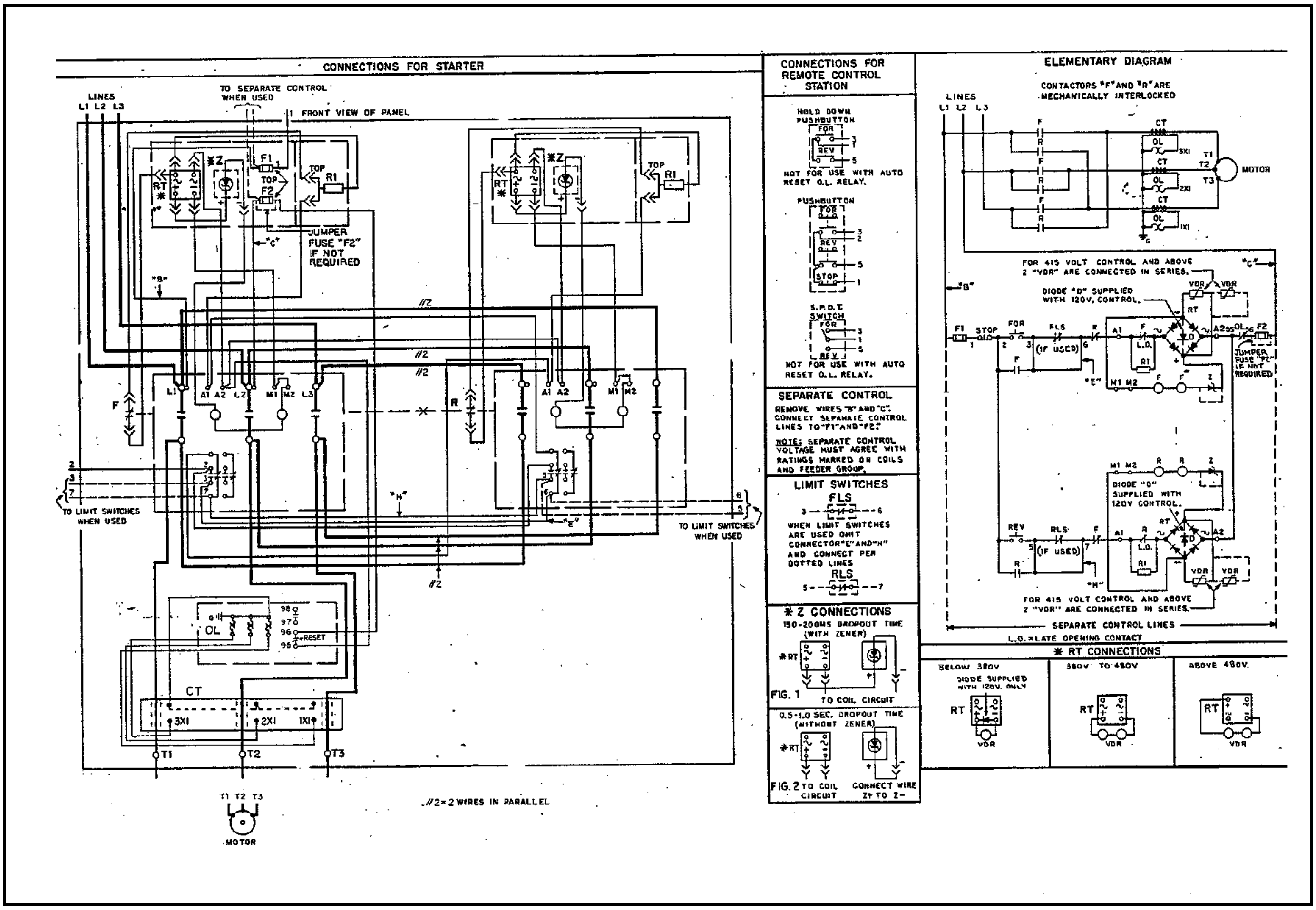
NORMAL DROPOUT = 150–200ms
DELAYED DROPOUT = 500–1000ms

SIZE 6

NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

REVERSING STARTERS (Continued)

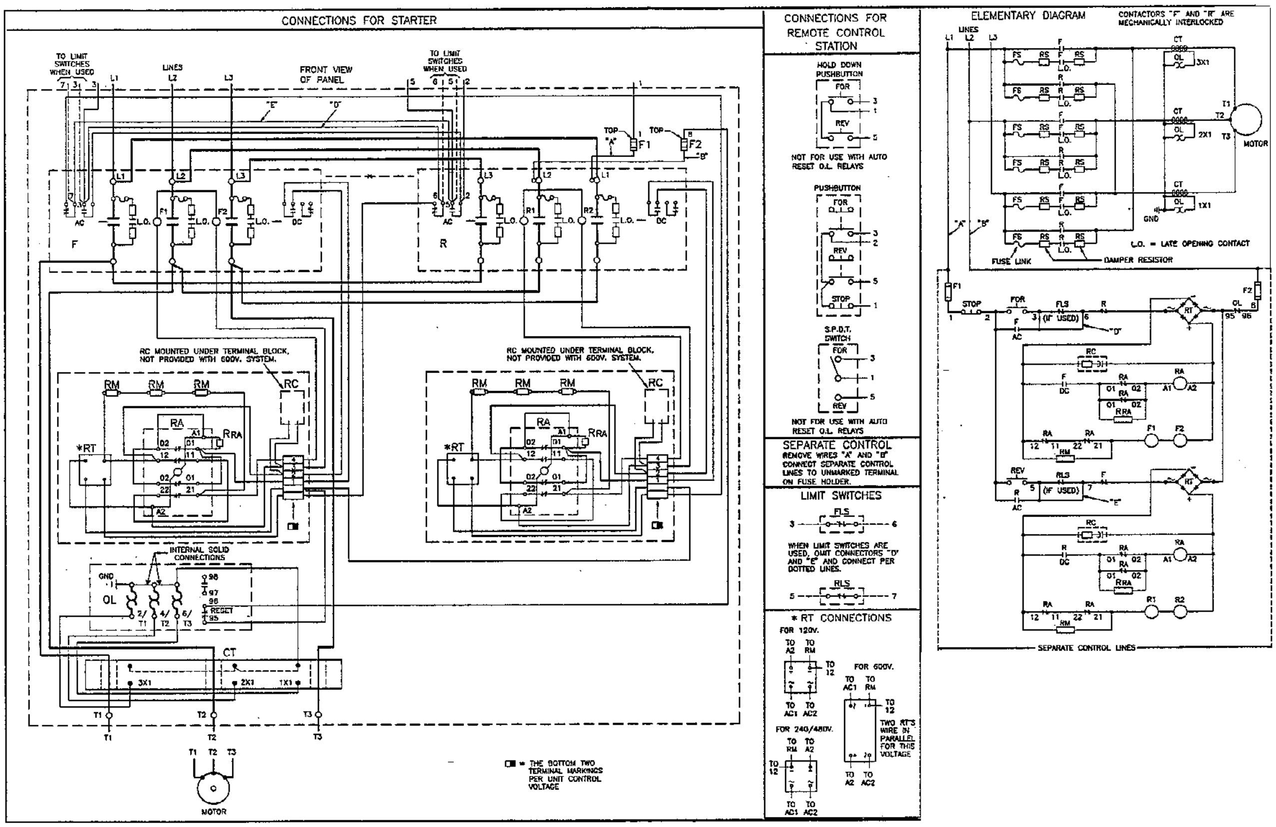


SIZE 7

NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

REVERSING STARTERS (Continued)

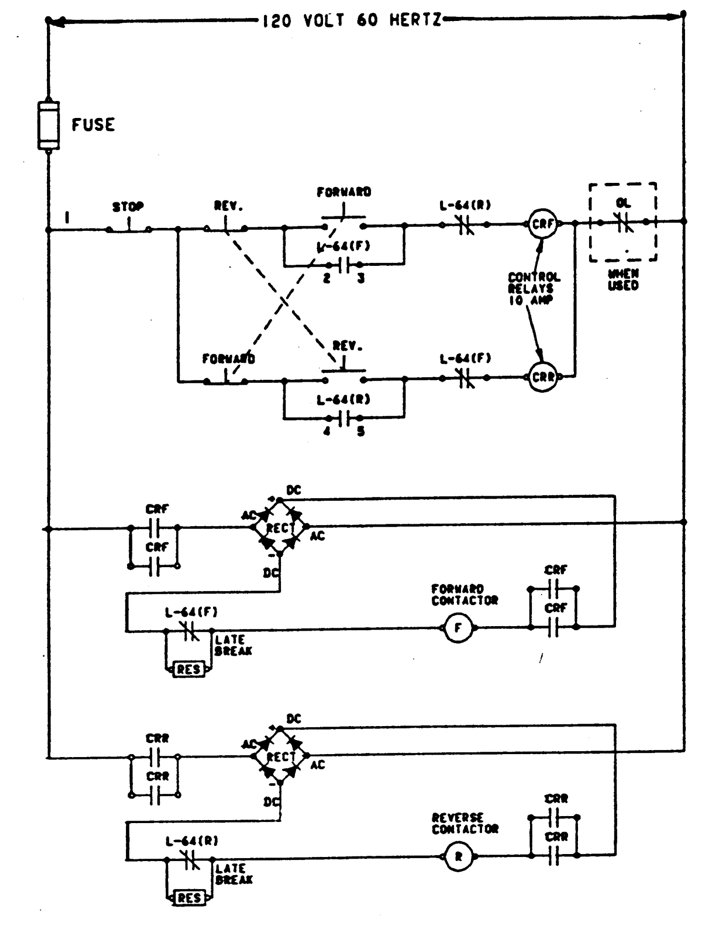


SIZE 8

NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

REVERSING STARTERS (Continued)



SIZE 9 — CONTROL CIRCUIT

NEMA, Contactors & Starters, (Freedom)

WIRING DIAGRAMS (Continued)

FIG.2 FUSIBLE CONTROL TRANSFORMER

REMOVE WIRE "C" (FIG.1) IF USED AND CONNECT AS SHOWN BELOW. (ALL OTHER STARTER WIRE REMAINS AS SHOWN IN FIG.1).

(CUSTOMER NOTE) REMOVE GREEN GROUND WIRE IF NOT REQ'D.

CONNECTIONS FOR DUAL VOLTAGE RATED TRANSFORMER - SEE TRANSFORMER NAMEPLATE

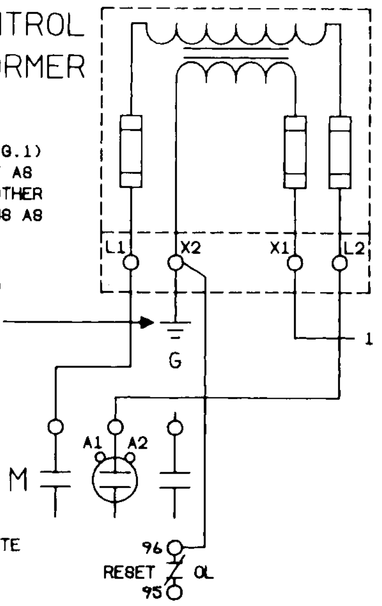


FIG.A START-STOP PUSHBUTTON

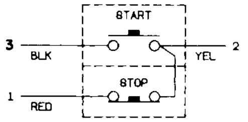


FIG.B 3-POSITION SELECTOR SWITCH

REMOVE LEAD FROM LEFT COIL TERMINAL TO TERMINAL NO.3

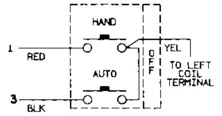
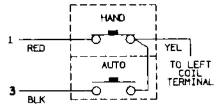


FIG.C 2-POSITION SELECTOR SWITCH

REMOVE LEAD FROM LEFT COIL TERMINAL TO TERMINAL NO.3



ACCESSORIES

FIG.D PILOT LIGHT

CONNECT TO COIL TERMINALS

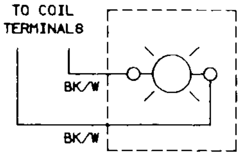
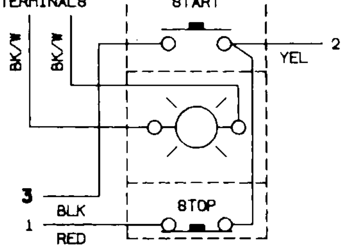


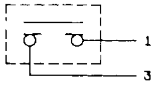
FIG.E START-STOP WITH PILOT LIGHT

CONNECT TO COIL TERMINALS



2 WIRE CONTROL

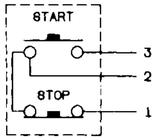
FOR FIG. NO.1, 2, B, C & D



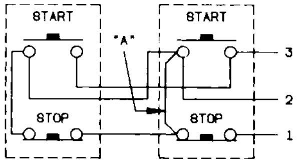
NOT FOR USE WITH AUTO RESET O.L. RELAYS

3 WIRE CONTROL

FOR FIG. NO.1, 2, & D

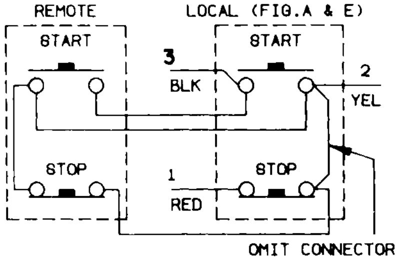


WHEN MORE THAN ONE PUSH BUTTON STATION IS USED, OMIT CONNECTOR "A" AND CONNECT PER SKETCH BELOW



COMBINED REMOTE AND LOCAL

FIG.1, 2, A & E



ACCESSORIES

Powering Business Worldwide

Instructional Leaflet **IL04210001E**
Effective April 2020
Supersedes November 2018

C440 NEMA Electronic Overload
- Self Powered

Dangerous Electrical Current!
Only skilled qualified persons may carry out the following operations.

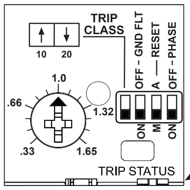
WARNING

Automatic or network reset is not intended for two-wire control devices.

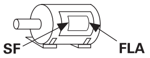
Un renclenchement automatique ou un de réseau ne convient pas aux dispositifs de contrôle a deux conducteurs.

Unit status	LED
Motor is running. Current < 1.15 Times Dial Seeting.	1 Flash/ 2 Seconds
Motor is running. Current ≥ 1.15 Times Dial Seeting.	2 flash/ 2 seconds
if the orange trip flag is visable, a trip has occurred.	No Flash
If the orange trip flag is not visable, motor is off or drawing < min FLA.	No flash

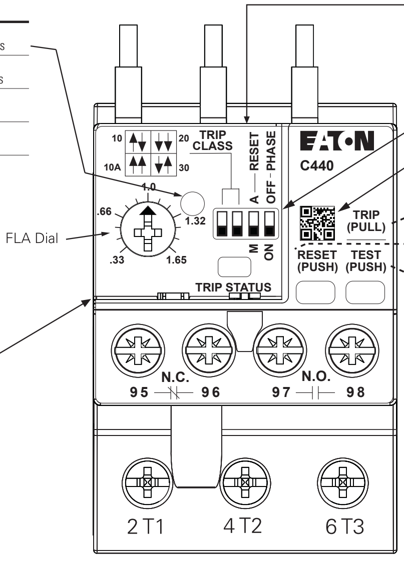
Ground Fault Unit
3Ø Systems only
GF 50% FLA Setting



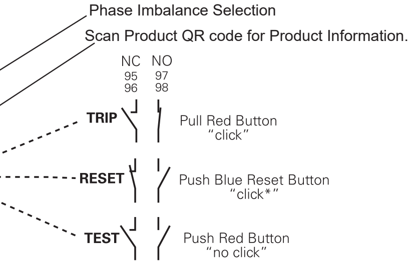
Motor Service Factor
Overload Tripping Current = 115%



Rotate FLA dial to current listed on motor nameplate for all motor Service Factors.



STANDARD UNIT 3Ø or 1Ø



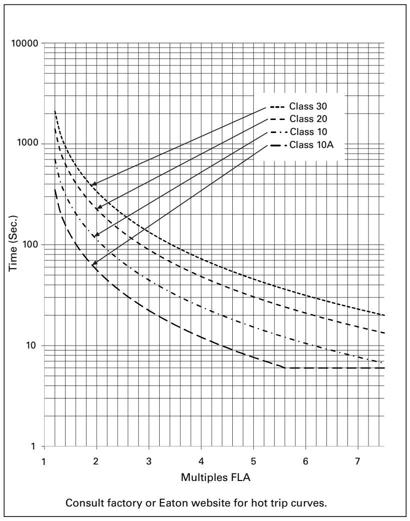
Pull Red Button "click"

Push Blue Reset Button "click*"

Push Red Button "no click"

* Approximately 1 lbf

Description	Terminal Capacity		Torque lb-in	Torque N-m
	AWG	mm²		
Control	2 x (18-12)	2 x (0,75-4)	7-11	0,8 - 1.2
Load 45 mm	1 x (12-10)	1 x (4-6)	20-25	2,3 - 2,8
	1 x (8-6)	1 x (6-16)	25-30	2,8 - 3,4
Laod 55 mm	1 x (6-1)	1 x (16-50)	25-30	2,8 - 3,4



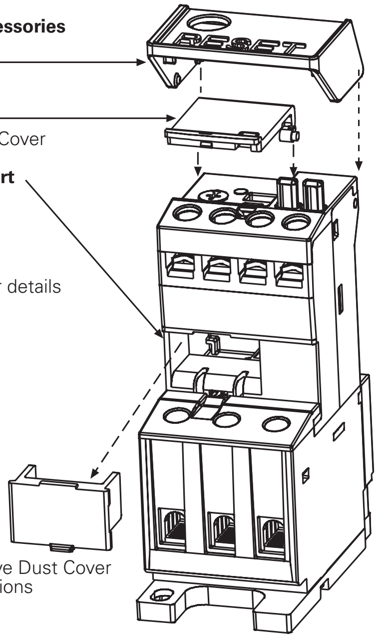
Consult factory or Eaton website for hot trip curves.

Optional Accessories

ZEB-XRB
Reset Bar

ZEB-XSC
Tamper Proof Cover

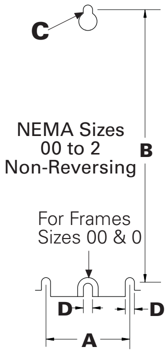
Expansion Port
Options:
C440-XCOM
ZEB-XRR-120
ZEB-XRR-24
See page 2 for details
- Modbus
- Devicenet
- Profibus
- I/O

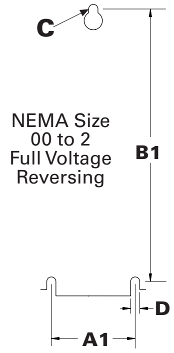


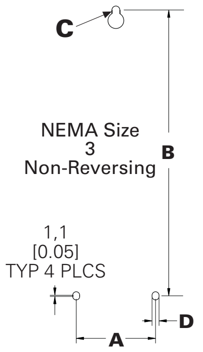
Remove Dust Cover
for options

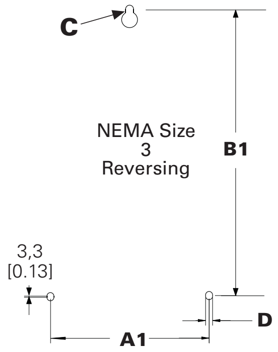
Powering Business Worldwide

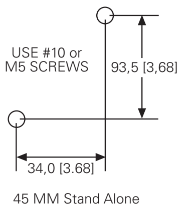
NEMA Starters	Partial Catalog Number	A mm (in)	A1 mm (in)	B mm (in)	B1 mm (in)	C mm (in)	D mm (in)
Freedom Size 00, 0	AN_9AN / AN_9BN	N/A	88,4 9 (3.50)	157,0 (6.18)	174,5 (6.87)	M5 (#10)	5.5 (0.22)
Freedom Size 1, 2 Freedom Size 1 FVR	AN_9DN / AN_9GN	50,8 (2.00)	133,3 (5.25)	165,1 (6.50)	143,0 (5.62)	M5 (#10)	5.5 (0.22)
Freedom Size 2 FVR	AN_9GN	N/A	133,3 (5.25)	N/A	168,3 (6.62)	M5 (#10)	5.5 (0.22)
Freedom Size 3	AN_9KN	76,2 (3.00)	177,8 (7.00)	274,6 (10.81)	274,6 (10.81)	M6 (1/4-20)	6,7 (0.27)

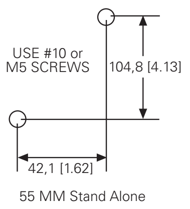


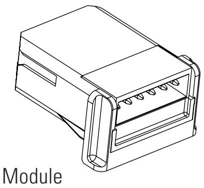
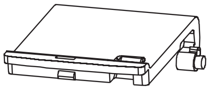
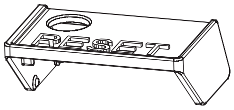
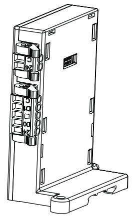


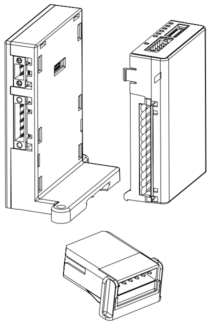








Description	Catalog Number	
Expansion Module (24V dc Remote Reset/Modbus RTU, RS485) - 6pin	C440-XCOM	 6pin Module
Remote Reset Module (120V ac) - 2pin	ZEB-XRR-120	
Remote Reset Module (24V ac) - 2pin	ZEB-XRR-24	
Tamper Proof FLA DIAL Cover	ZEB-XSC	
RESET BAR	ZEB-XRB	
Communication Adapter	C440-COM-ADP	

Communication Kits	Catalog No.	
Device Net Com module kit - 120V ac I/O	C440-DN-120	
Device Net Com module kit - 24V dc I/O	C440-DN-24	
Profibus Com module kit - 120V ac I/O	C440-DP-120	
Profibus Com module kit - 24V dc I/O	C440-DP-24	
Modbus Com module kit - 120V ac I/O	C440-MOD-120	
Modbus Com module kit - 24V dc I/O	C440-MOD-24	
Eithernet IP Com module kit - 120V ac I/O	Not Available	

Approved External CT to be used with 1-5A Stand Alone Overload

CT Package (60-300A)	ZEB-XCT300
CT Package (120-600A)	ZEB-XCT600
CT Package (200-1000A)	ZEB-XCT1000
CT Package (300-1500A)	ZEB-XCT1500

Eaton
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Cleveland, OH 44122
United States
Eaton.com

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April 2020

Powering Business Worldwide

Powering Business Worldwide

Safety Switches

Powering Business Worldwide

Section Table of Contents
Safety Switches

Powering Business Worldwide

Drawings

Safety Switch General Information

Global Specifications

System Voltage	600 VAC
Switch Type	Single Throw - Heavy Duty
Poles/Blades	3-Pole
Amperage	30
Protection	Non-Fusible with No Neutral
Enclosure Type	NEMA 4X (304 Stainless)
Special Paint	No Paint
Fuse Clips	"H" Fuse Clips
Switch Lugs	(1) 14-2
Fungus Proof Treatment	None
Lock-On Provision	None
Fuse Pullers	None
Control Pole	None
Ground Lugs	(1) 14-4
Stainless Mechanism	None
Mill Duty	None

Cover Controls

QUANTITY	DESCRIPTION

Nameplate

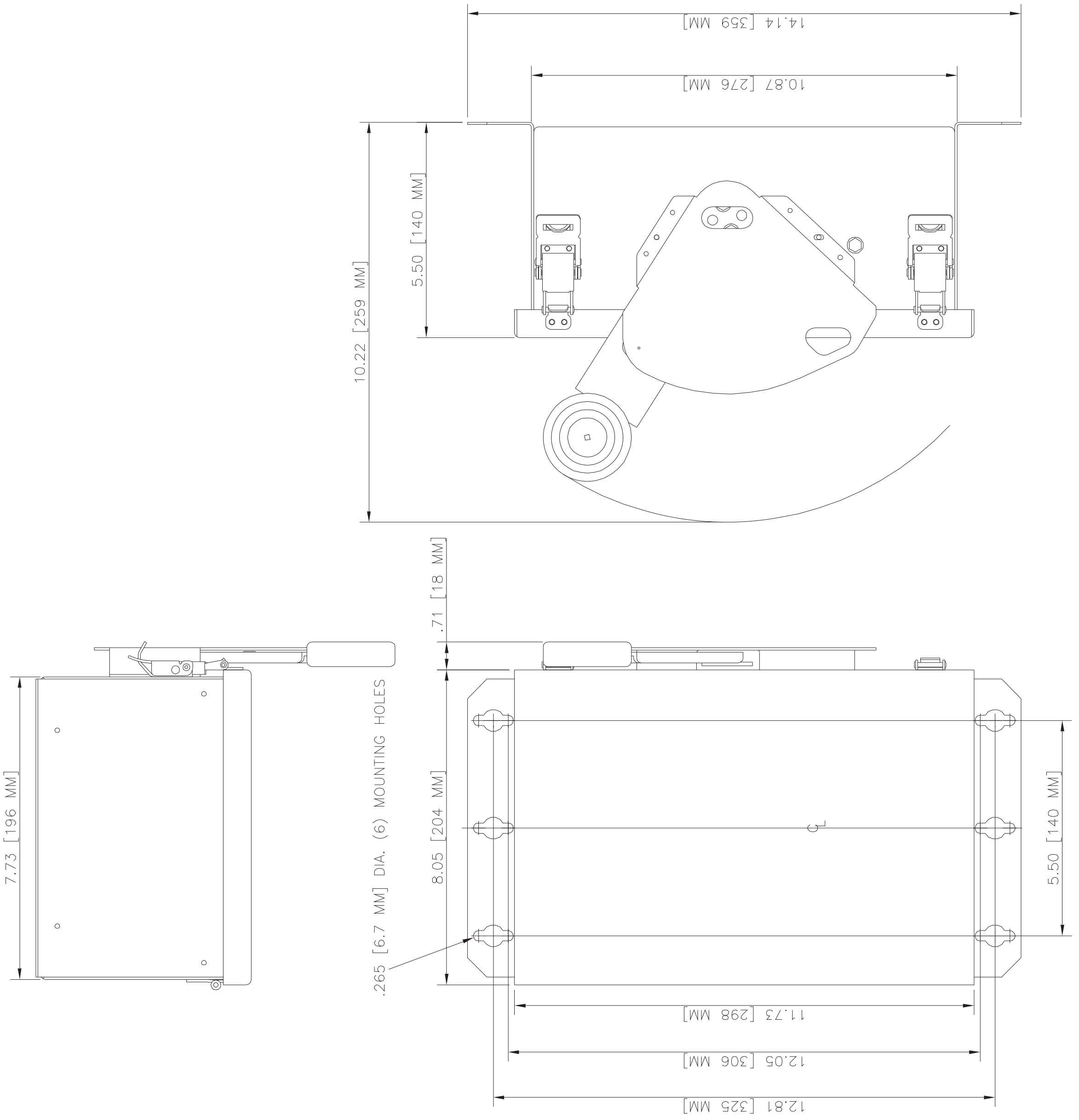
Field Installed Kits

QUANTITY	DESCRIPTION
1	Neutral / Ground Kit : DH030NK (Field Installed)

Safety Switch Catalog No.

DH361UWK

The information on this document is created by Eaton Corporation. It is disclosed in confidence and it is only to be used for the purpose in which it is supplied.	PREPARED BY SCOTT ARNOLD DATE 12/21/2023	**Eaton**		
	APPROVED BY DATE	JOB NAME Taunton WWTF PH2 DESIGNATION 30A NF N4X		
	VERSION 1.0.1.3	TYPE Safety Switch General Information	DRAWING TYPE Final	
NEG-ALT Number D7580427X2K2-R001	REVISION 0 DWG SIZE A	G.O. LBS0031682	ITEM 036	SHEET 1 of 1



TITLE
DIMENSIONS FOR 30 AND 60 AMP 3 POLE NON-FUSIBLE TYPES 4X AND 12

A	WS	RP	DS0533	11/13/01 D
B				E
C				F

DR. WARREN SIPE 2/11/97
APP. J. F. BISCHOF 2/11/97
CHK.
FIRST ASSY. WHERE LISTED

Cutler-Hammer EATON
C
95-1371
FILE AT PTQC

C_DIM REV. 10/21/94

GO/NEG-Alt-Date: LBS0031682-R001-12/21/2023		**Job Name:** Taunton WWTF PH2
Item Number: 036	**Catalog Number:** DH361UWK	**Designation:** 30A NF N4X

Safety Switch General Information

Global Specifications

System Voltage	600 VAC
Switch Type	Single Throw - Heavy Duty
Poles/Blades	3-Pole
Amperage	100
Protection	Non-Fusible with No Neutral
Enclosure Type	NEMA 4X (304 Stainless)
Special Paint	No Paint
Fuse Clips	"H" Fuse Clips
Switch Lugs	(1) 14-1/0
Fungus Proof Treatment	None
Lock-On Provision	None
Fuse Pullers	None
Control Pole	None
Ground Lugs	(1) 14-4
Stainless Mechanism	None
Mill Duty	None

Cover Controls

QUANTITY	DESCRIPTION

Nameplate

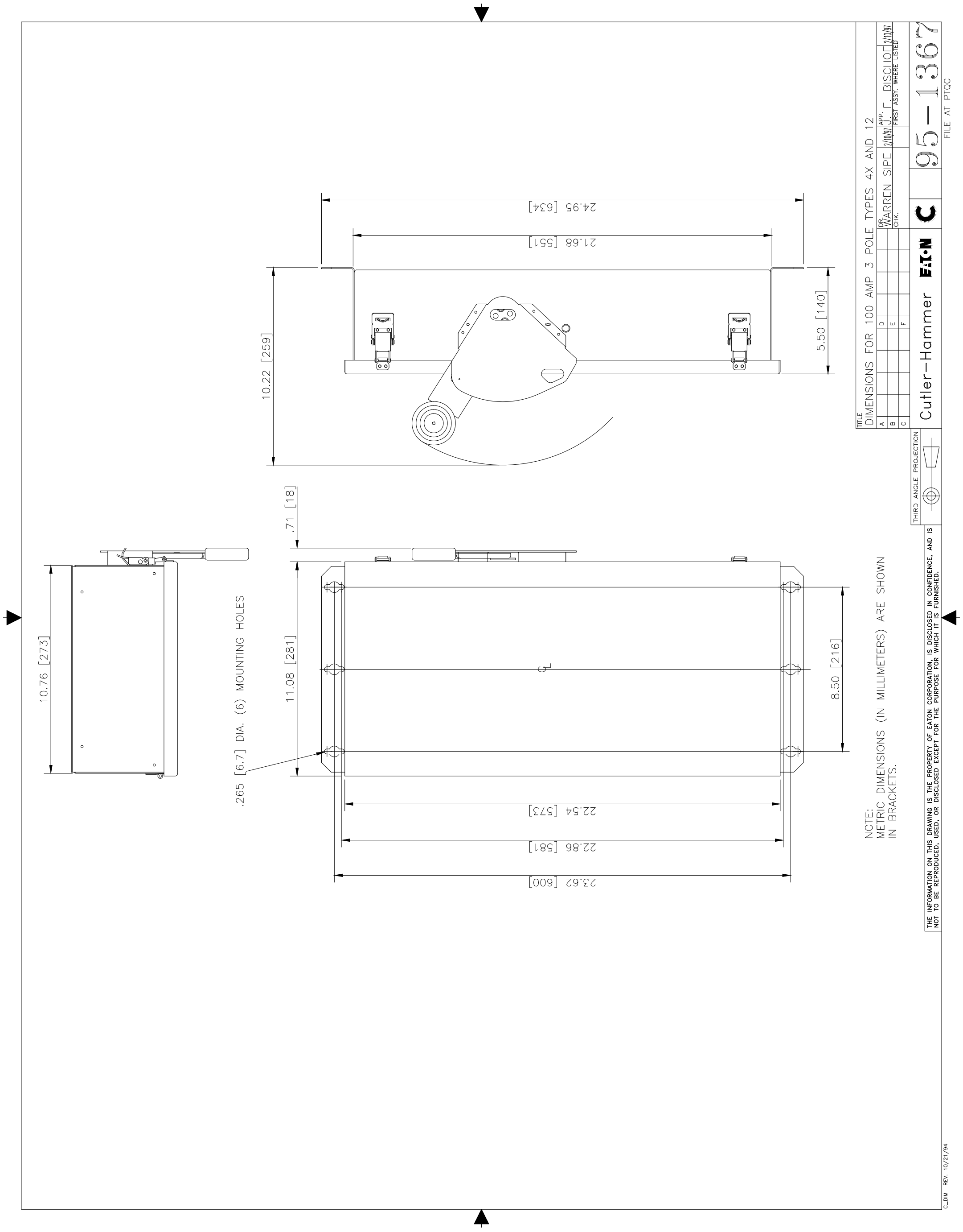
Field Installed Kits

QUANTITY	DESCRIPTION
1	Neutral / Ground Kit : DH100NK (Field Installed)

Safety Switch Catalog No.

DH363UWK

PREPARED BY SCOTT ARNOLD	DATE 12/21/2023	**Eaton**		
APPROVED BY	DATE	JOB NAME DESIGNATION	Taunton WWTF PH2 100A NF N4X	
VERSION 1.0.1.3		TYPE Safety Switch General Information	DRAWING TYPE Final	
NEG-ALT Number D7580427X2K2-R001	REVISION 0	DWG SIZE A	G.O. LBS0031682	ITEM 038
SHEET 1 of 1				



GO/NEG-Alt-Date: LBS0031682-R001-12/21/2023		**Job Name:** Taunton WWTF PH2
Item Number: 038	**Catalog Number:** DH363UWK	**Designation:** 100A NF N4X

Powering Business Worldwide

Instruction Data

Instruction Leaflet **IL008064EN** Effective February 2021

Operation and maintenance information for safety switches: General duty, heavy duty, and double throw

Contents

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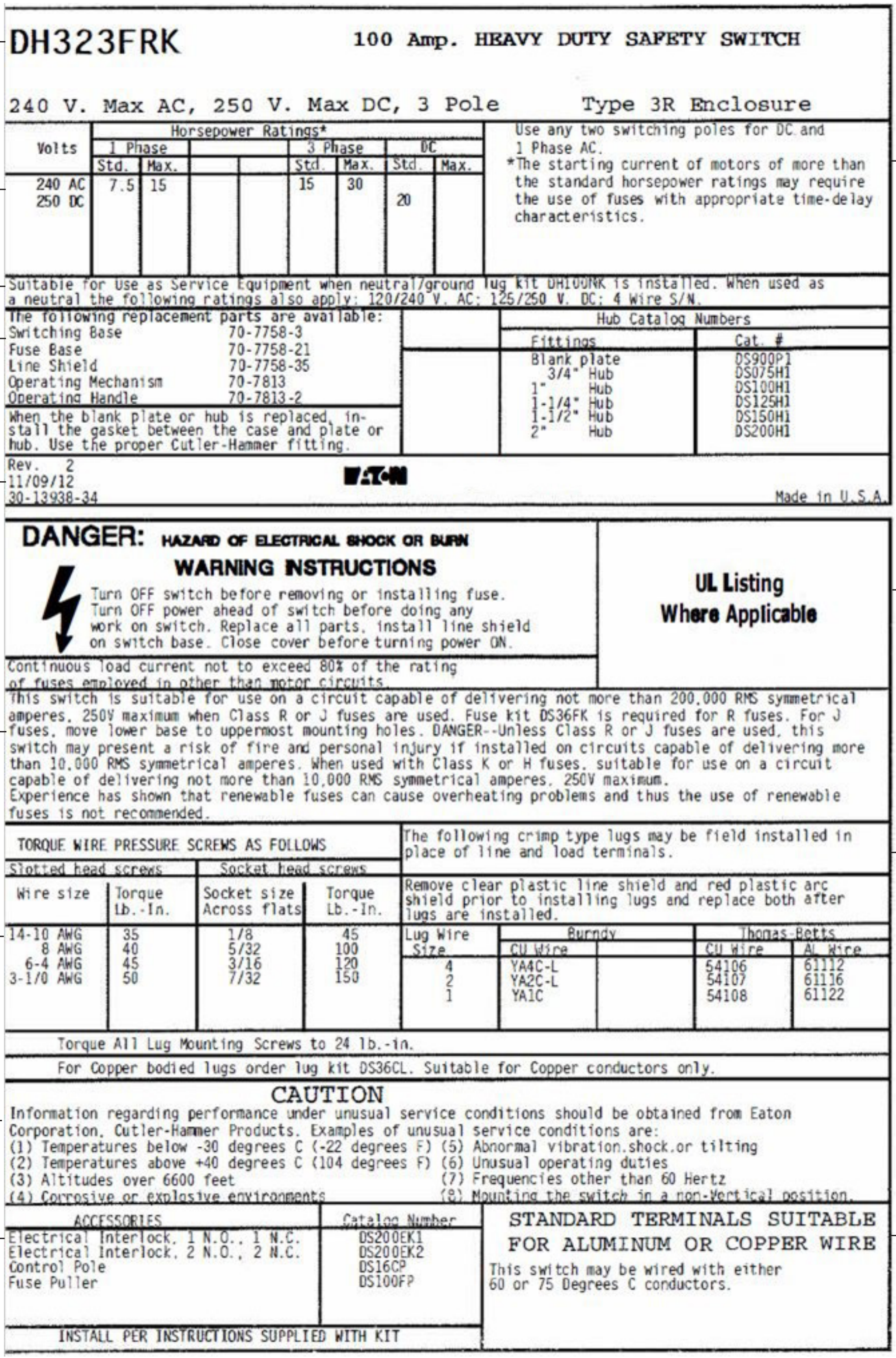


Catalog number
Max. voltage rating
Horsepower rating chart
Service entrance statement
Available replacement parts
Manufacturing date code
Short circuit and fuse adjustment or kit Info
Torque data
Abnormal service condition notice
Field installable accessories
Current and / or voltage rating notes
UL label location where installed
Optional crimp lugs
Terminal / lug ratings

DH323FRK 100 Amp. HEAVY DUTY SAFETY SWITCH

240 V. Max AC, 250 V. Max DC, 3 Pole Type 3R Enclosure

Volts	Horsepower Ratings*							
	1 Phase				3 Phase		DC	
	Std.	Max.			Std.	Max.	Std.	Max.
240 AC 250 DC	7.5	15			15	30	 20	

Use any two switching poles for DC and 1 Phase AC.
*The starting current of motors of more than the standard horsepower ratings may require the use of fuses with appropriate time-delay characteristics.

Suitable for Use as Service Equipment when neutral/ground lug kit DH100NK is installed. When used as a neutral the following ratings also apply: 120/240 V. AC; 125/250 V. DC; 4 Wire S/N.

The following replacement parts are available:

Switching Base	70-7758-3
Fuse Base	70-7758-21
Line Shield	70-7758-35
Operating Mechanism	70-7813
Operating Handle	70-7813-2

When the blank plate or hub is replaced, install the gasket between the case and plate or hub. Use the proper Cutler-Hammer fitting.

Hub Catalog Numbers

Fittings	Cat. #
Blank plate	DS900P1
3/4" Hub	DS075H1
1" Hub	DS100H1
1-1/4" Hub	DS125H1
1-1/2" Hub	DS150H1
2" Hub	DS200H1

Rev. 2
11/09/12
30-13938-34

EATON

Made in U.S.A.

DANGER: HAZARD OF ELECTRICAL SHOCK OR BURN

WARNING INSTRUCTIONS

Turn OFF switch before removing or installing fuse. Turn OFF power ahead of switch before doing any work on switch. Replace all parts, install line shield on switch base. Close cover before turning power ON.

UL Listing Where Applicable

Continuous load current not to exceed 80% of the rating of fuses employed in other than motor circuits.

This switch is suitable for use on a circuit capable of delivering not more than 200,000 RMS symmetrical amperes, 250V maximum when Class R or J fuses are used. Fuse kit DS36FK is required for R fuses. For J fuses, move lower base to uppermost mounting holes. DANGER--Unless Class R or J fuses are used, this switch may present a risk of fire and personal injury if installed on circuits capable of delivering more than 10,000 RMS symmetrical amperes. When used with Class K or H fuses, suitable for use on a circuit capable of delivering not more than 10,000 RMS symmetrical amperes, 250V maximum.
Experience has shown that renewable fuses can cause overheating problems and thus the use of renewable fuses is not recommended.

TORQUE WIRE PRESSURE SCREWS AS FOLLOWS

Slotted head screws		Socket head screws	
Wire size	Torque lb.-In.	Socket size Across flats	Torque Lb.-In.
14-10 AWG	35	1/8	45
8 AWG	40	5/32	100
6-4 AWG	45	3/16	120
3-1/0 AWG	50	7/32	150

The following crimp type lugs may be field installed in place of line and load terminals.

Remove clear plastic line shield and red plastic arc shield prior to installing lugs and replace both after lugs are installed.

Lug Wire Size	Burndy		Thomas-Betts	
	CU Wire		CU Wire	AL Wire
4	YA4C-L		54106	61112
2	YA2C-L		54107	61116
1	YA1C		54108	61122

Torque All Lug Mounting Screws to 24 lb.-in.

For Copper bodied lugs order lug kit DS36CL. Suitable for Copper conductors only.

CAUTION

Information regarding performance under unusual service conditions should be obtained from Eaton Corporation, Cutler-Hammer Products. Examples of unusual service conditions are:
(1) Temperatures below -30 degrees C (-22 degrees F)
(2) Temperatures above +40 degrees C (104 degrees F)
(3) Altitudes over 6600 feet
(4) Corrosive or explosive environments
(5) Abnormal vibration.shock.or tilting
(6) Unusual operating duties
(7) Frequencies other than 60 Hertz
(8) Mounting the switch in a non-Vertical position.

ACCESSORIES	Catalog Number
Electrical Interlock, 1 N.O., 1 N.C.	DS200EK1
Electrical Interlock, 2 N.O., 2 N.C.	DS200EK2
Control Pole	DS16CP
Fuse Puller	DS100FP

INSTALL PER INSTRUCTIONS SUPPLIED WITH KIT

STANDARD TERMINALS SUITABLE FOR ALUMINUM OR COPPER WIRE

This switch may be wired with either 60 or 75 Degrees C conductors.

Figure 1. Label for 100 amp. heavy duty safety switch.

Voltage ratings

Maximum AC voltage ratings for each switch are outlined on the switch's publication. Where DC voltage ratings are applicable, they are noted separately from the AC rating.

The standard maximum voltage ratings are outlined in **Table 1** for safety switches. The publication inside the switch will ultimately determine the switch's maximum voltage rating.

Table 1. Standard maximum voltage ratings.

Switch type	Maximum AC rating (with neutral installed)	Maximum DC rating
General duty	240 Vac (120 / 240 Vac)	250 Vdc
Heavy duty, 240 V	240 Vac (120 / 240 Vac)	250 Vdc
Heavy duty, 600 V, 2-pole	600 Vac (277 / 480 Vac, 600 Vac)	600 Vdc**
Heavy duty, 600 V, 3+ pole, fusible	600 Vac (277 / 480 Vac, 600 Vac)	-
Heavy duty, 600 V, 3+ pole, non-fusible (NF)	600 Vac (277 / 480 Vac, 600 Vac)	250 Vdc
Double throw, 240 V	240 Vac (120 / 240 Vac)	250 Vdc
Double throw, 600 V	600 Vac (277 / 480 Vac, 600 Vac)	250 Vdc

For 3+ pole switches, any two of the switching poles can be used for either DC or 1 Phase AC applications.

**600 Vdc rating requires two switching poles to be wired in series. Two-pole, 600 V rated heavy duty safety switches come with a factory installed jumper between two switching poles making the 2-pole switch capable of interrupting one 600 Vdc circuit. For additional DC options, refer to Eaton's line of DC solar switches. Heavy Duty switches over 600 A are not listed for 600 Vdc applications

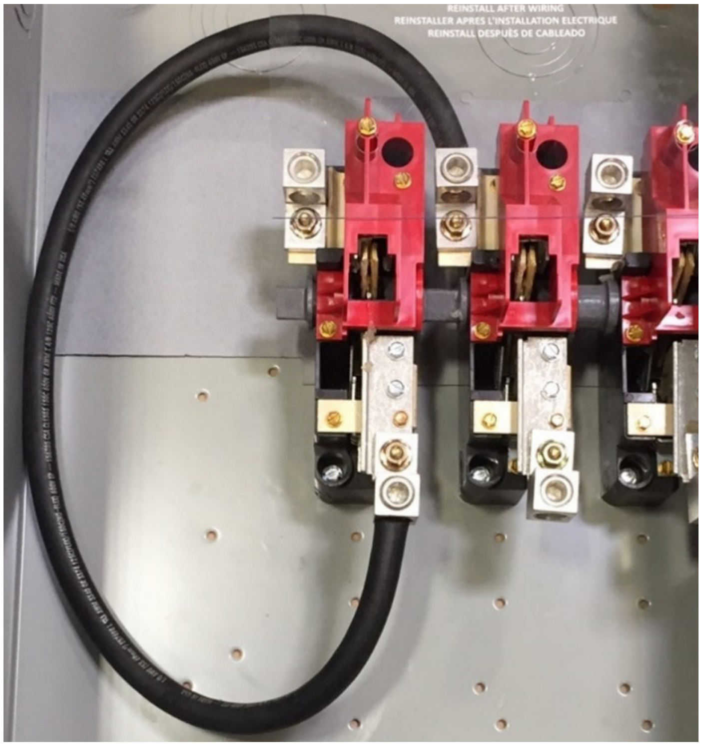


Figure 2. Sample 2-pole 600 V heavy duty safety switch.

For a 600 Vdc rating, the first two poles are wired in series with a factory installed jumper as outlined in this photo. Only the circuit connected to the line and load lugs of these poles wired in series are rated for 600 Vdc.

The 600 Vdc rating is only applied to 2-pole, 600 V rated heavy duty safety switches.

Enclosure ratings

The safety switch enclosure rating listed on the publication is both the UL and NEMA environmental rating of that switch.

Single Throw switches listed as Type 12 (3R) can be used as either depending on the installation of the factory installed drain screw in the bottom end-wall. Type 12 (3R) switches come from the factory as Type 12, if being used as Type 3R the drain screw should be removed in the field.

Installation of appropriately rated conduit entry hubs or fittings does not impact the enclosure rating of the switch when installed in accordance with the hub manufacturer's instructions. (Example: Type 4X rated hub installed on a Type 4X safety switch enclosure.)

The listing of acceptable hubs on the publication and in Eaton's Commercial Distribution catalog are not exhaustive of acceptable conduit entry fittings. Appropriately rated fittings from other manufacturers can be installed on Eaton safety switches.

Amperage ratings and continuous load current

Non-fusible safety switches are 100% rated devices.

Fusible switch current ratings are limited to 80% of the rating of the fuse for continuous loads other than motor circuits. This limitation applies even when "100% rated" Class L fuses are installed. The NEC allows the switch size calculation to use up to 100% of the fuse rating for non-continuous loads.

Horsepower ratings

Where horsepower ratings are applicable for a given switch, the maximum horsepower ratings are included in a table on the switch publication for all applicable voltage ratings. Maximum horsepower ratings are based on standard squirrel cage motors as outlined in the NEC motor tables.

The "Std." column notes the maximum horsepower rating of the switch using "standard" fuses and the "Max." column outlines the maximum horsepower rating of the switch when time delay fuses are installed (see **Table 2**).

Table 2. Horsepower ratings.

	Horsepower rating*			
	1 phase		3 phase	
Volts	Std.	Max.	Std.	Max.
480 AC	25	50	50	125
600 AC	30	50	60	150

*** These values are examples, see published ratings on your switch.**

Horsepower ratings for safety switches account for typical starting currents (inrush) and potential locked rotor current demands for typical motors. The starting current of motors of more than the standard horsepower ratings may require the use of fuses with appropriate time-delay characteristics.

The UL 98 standard for enclosed switches states that the switch is not to be used as the motor controller over 100 HP. Additionally, the largest horsepower ratings included in the UL 98 standard for switches is 250 HP at 240 V and 500 HP at 480 V or 600 V.

Service entrance requirements

At and below 800 A, all heavy duty, general duty, and double throw safety switches are rated for service entrance when a neutral kit is installed. Switches with factory installed neutrals will be marked "Suitable for Use as Service Equipment". If the switch does not ship with a factory installed neutral, the publication inside the switch will state which neutral kit would need to be field installed to make the switch suitable for service entrance.

All neutral kits, whether factory or field installed, will include neutral lugs, a bonding kit, and service disconnect sticker for field application when being used as the service entrance disconnect. Grounding lugs are included in safety switches as a standard.

At 1,200 A, heavy duty and double throw switches cannot be service entrance rated for many applications including 480 Vac where ground fault protection is required. Additionally, there is a requirement for arc energy reduction in 1,200 A fusible devices in some areas which is often supplemental to the overcurrent or short circuit protection afforded by fuses. Eaton has a separate line of shunt trip safety switches with integral arc-energy reduction and ground fault protection relay options for these service entrance applications.

Line shields

A clear plastic line shield is provided in heavy duty type switches including heavy duty type double throw switches to help prevent incidental contact with incoming line conductors. Line shields are an optional accessory for 200 A – 600 A general duty safety switches.

Grounding

All Eaton safety switches are provided with standard ground lugs. Optional ground lug kits are available to increase the grounding capacity and can be field or factory installed. The concentric and eccentric knock out rings on a safety switch are not UL listed for a reliable bonding connection. Grounding and bonding lugs are included with factory or field installable neutral assemblies.

Replacement parts

Some replacement parts are outlined on the publication inside the switch. Where replacement parts are available, they can be replaced in the field provided proper electrical safety procedures are followed to ensure an electrically safe work environment. Replacement parts are not approved for modifying the original configuration of a safety switch as this would violate the UL listing of the switch.

Additional replacement parts or updated catalog numbers may be available in Eaton's Safety Switch Renewal Parts Guide, publication number RP00801001E.

Short circuit ratings (fusible and non-fusible)

Non-fusible safety switches may be used on circuits capable of delivering no more than 10,000 RMS symmetrical amperes (AC) when properly protected by any overcurrent protective device rated no greater than the ampere rating of the switch. **Table 3** can be used to determine when upstream protection allows the switch to be applied in a circuit capable of delivering more than 10,000 RMS symmetrical amperes.

Table 3. Upstream protection application.

Eaton non-fusible safety switch amperage rating (1)	Maximum system voltage AC	Maximum short circuit rating	Upstream device (2)	
			Fuse class	Eaton breaker frame
30 and 60	600	10,000	H, K	Any circuit breaker
		14,000		FDB
		18,000		FD, EGE
		25,000		FDC, HFD, HFDE, EGH
		200,000	R, T, J	
100	480	10,000	H, K	Any circuit breaker
		35,000		EGH, EGS
		200,000	R, T, J	
	600	10,000	H, K	Any circuit breaker
		14,000		FDB
		18,000		FD, EGE
		25,000		FDC, HFD, HFDE, EGH
		200,000 (3)	R, T, J	
200	480	10,000	H, K	Any circuit breaker
		65,000		HFD, HFDE, HJD, JGH
		200,000	R, T, J	
	600	10,000	H, K	Any circuit breaker
		14,000		FDB
		18,000		FD, JD, JGE
		25,000		FDC, HFD, HFDE, HJD, JGH
		200,000	R, T, J	
400	480	200,000	R, T, J	
	600	10,000	H, K	Any circuit breaker
	600	100,000	R, T, J	
600	480	200,000	R, T, J	
	600	10,000	H, K	Any circuit breaker
	600	100,000	R, T, J	
800	480	200,000	L, T	
	600	10,000		Any circuit breaker
	600	100,000	L, T	
1,200	480	200,000	L, T	
	600	10,000		Any circuit breaker
	600	100,000	L, T	

Notes:

(1) For use on NEMA 1, 3R, 12/3R, and 4X switches.

(2) Fuse or circuit breaker rating is not to exceed switch rating.

(3) NEMA 12, 4/4X only. NEMA 1, 3R are 100 kAIC at 600 Vac.

Fusible switches are suitable for use on circuits delivering up to 100,000 RMS symmetrical amperes (AC) or 200,000 RMS symmetrical amperes (AC) depending on the configuration and voltage when the appropriate Class R, J, L, or T fusing is installed. The maximum short circuit rating of a fusible switch will be noted on the publication.

For general duty, heavy duty (30 A – 600 A), and double throw (30 A-200 A and 400 A at 240 V) Class "H" fuse clips are supplied as the standard. When Class "H" fuses are used, the switch is rated for a maximum of 10,000 A symmetrical.

DC short circuit ratings

Safety switches are suitable for use in DC circuits capable of delivering not more than 10,000 A direct current when protected by any UL listed or recognized overcurrent protective device. Fusible switches used in DC applications are also rated for 10 kA provided the installed fuse carries the appropriate DC voltage rating.

Fuse kits and provisions

Fusible safety switches are provided with provisions to accept one class and voltage rating of fuses. Where fuse sizes are differentiated based on maximum voltage rating, the fuse provisions in the safety switch will accommodate fuses with the same maximum AC voltage rating as the switch. **Table 4** outlines the standard fuse provisions for safety switches in addition to optional fuse provisions which can be achieved by re-configuring the switch or by the installation of an optional kit.

Table 4. Standard fuse provisions for safety switches.

General duty (DG) switches fuse class chart

Ampere	Voltage	Standard factory fuse class①	Optional R fuse kit②	Optional T fuse kit	Optional J fuse kit
30	240	H	DG030RB	n/a	n/a
60	240	H	DS16FK	n/a	n/a
100	240	H	DG100RB	n/a	n/a
200	240	H	DS46FK	n/a	n/a
400	240	H	DS56FK	DS526TK	n/a
600	240	H	DS66FK	DS626TK	DS600JK
Heavy duty (DH) switches fuse class chart					
30	240	H	DS12FK	n/a	Factory option only
30	600	H	DS16FK	n/a	Factory option only
60	240	H	DS16FK	n/a	DS22JK
60	600	H	DS26FK	n/a	Relocate clips ③
100	240/600	H	DS36FK	n/a	Relocate base ③
200	240	H	DS46FK	DS426TK	Relocate base ③
200	600	H	DS46FK	DS466TK	Relocate base ③
400	240	H	DS56FK	DS526TK	Relocate base ③
400	600	H	DS56FK	DS566TK	Relocate base ③
600	240	H	DS66FK	DS626TK	DS600JK
600	600	H	DS66FK	DS666TK	DS600JK
800	240	L	n/a	DS726TK	n/a
800	600	L	n/a	DS766TK	n/a
1,200	240	L	n/a	Relocate bases	n/a
1,200	600	L	n/a	n/a	n/a
Double throw (DT) switches fuse class chart					
30	240	H	DS12FK	n/a	Factory option only
30	600	H	DS16FK	n/a	Factory option only
60	240	H	DS16FK	n/a	Factory option only
60	600	H	DS26FK	n/a	Relocate bases ③
100	240/600	H	DS36FK	n/a	Relocate bases ③
200	240/600	H	DS46FK	n/a	Relocate bases ③
400	240	H	DS56FK	n/a	Relocate bases ③
400	600	T	n/a	standard	DT400JK
600	240 (stacked=N1/N3R)	J	n/a	DT626TK	Standard
600	600 (stacked=N1/N3R)	J	n/a	DT666TK	Standard
600	240 (N12/N4X)	T	n/a	standard	n/a
600	600 (N12/N4X)	T	n/a	standard	n/a
800	240	L	n/a	DS726TK	n/a
800	600	L	n/a	DS766TK	n/a
1,200	240	L	n/a	n/a	n/a
1,200	600	L	n/a	n/a	n/a

Note ① - Where Class H is indicated, Class R fuses will physically fit and can be installed.
Note ② - Class R fuse kits are used to reject Class H fuses, and allow only Class R fuses to be installed.
Note ③ - Relocation of fuse clips or fuse bases as required to achieve Class J fuse spacing. Class J fuse spacings are illustrated in Figure 3

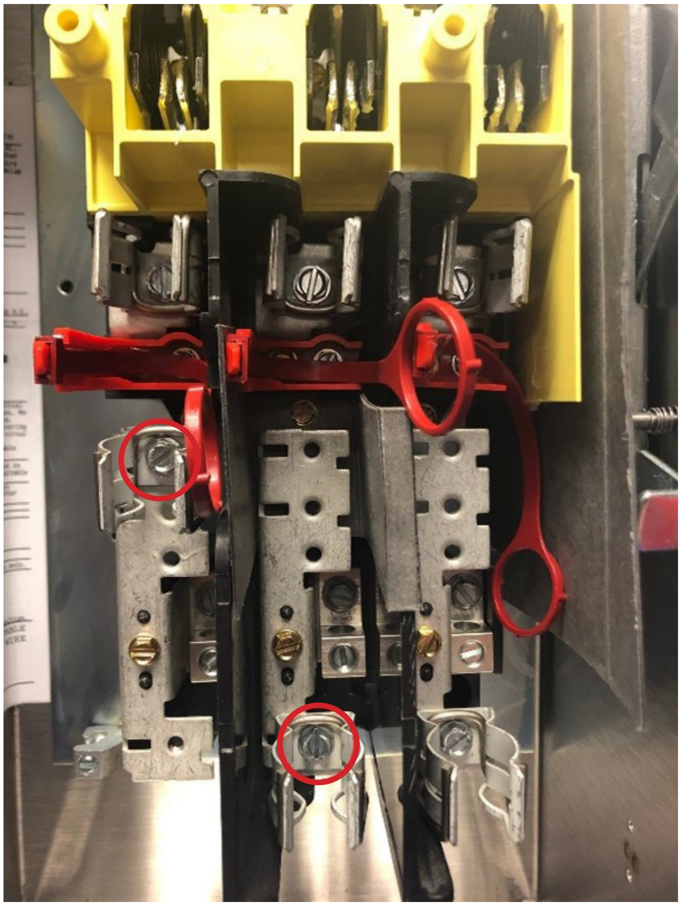


Photo shows how fuse clips should be moved from the standard lower position for Class H fuse spacing to the upper mounting location for Class J fuse installation

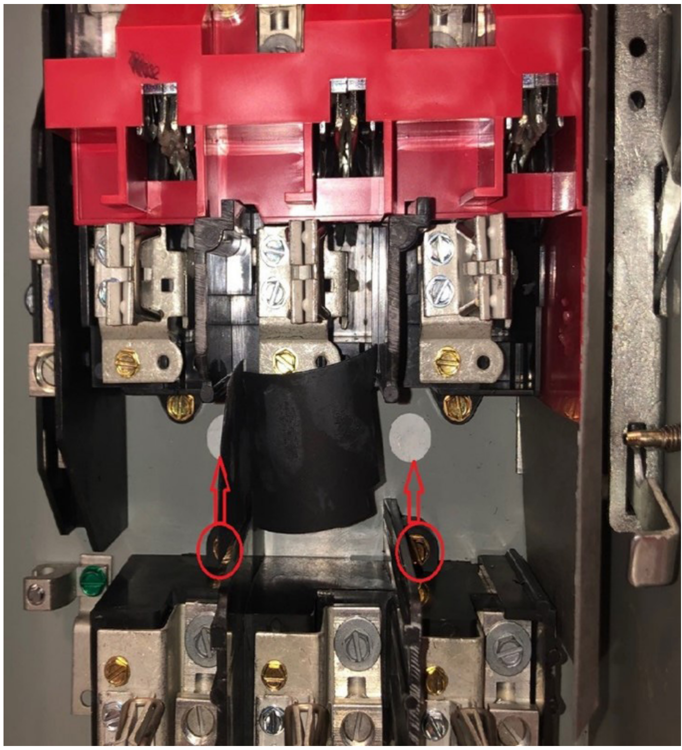


Photo shows how fuse clips should be moved from the standard lower position for Class H fuse spacing to the upper mounting location for Class J fuse installation

Figure 3. Relocation of fuse clips or fuse bases.

Experience has shown that renewable fuses can cause overheating problems and their use is not recommended in safety switches.

Standard lug information

Standard mechanical lugs included in safety switches are suitable for aluminum or copper wire, wire strand class B and C. Select terminals are acceptable for fine stranded cable, see Eaton publication IL008004EN for more information on the suitability of fine stranded cable. Wire sizing should be based on 60°C or 75°C (140°F or 167°F) conductor ratings only. The torque values for wire pressure in the provided mechanical lugs is outlined based on switch ampacity rating in **Tables 5 and 6.**

Table 5. Torque table for wire pressure screws 30 A - 1,200 A (general duty, heavy duty, and double throw).

Slotted head screws		Socket head screws	
Wire size	**Torque lb. - in.**	**Socket size across flats**	**Torque lb. – in.**
14-10 AWG	35	1/8	45
8 AWG	40	5/32	100
6-4 AWG	45	3/16	120
3-1/0 AWG	50	7/32	150
		1/4	200
		5/16	275
		3/8	375
		3/8 (400 A only)	500
		1/2	500

Table 6. Torque table for lug mounting screws.

Amperage	Lug description	Torque value
30 A – 100 A	All lug mounting screws	24 lb. - in.
200 A	Line and load lug mounting screws	8 lb.- ft.
200 A	Ground lug mounting screws	24 lb. - in.
400 A - 1,200 A	Line and load lug mounting screws	29 lb. - ft.
400 A - 1,200 A	Ground lug mounting screws	45 lb. - in.

Alternative lug options

Crimp lugs may be field installed in place of the standard mechanical type line and load terminals in some safety switches where outlined by the switch's publication. Suitable crimp lug manufacturer and part numbers are tabulated on the publication - installation of these crimp lugs ensures that proper mounting and anti-rotation can be retained. Copper wire must be used when crimp lugs are installed.

Some larger, heavy-duty safety switches which allow for the installation of crimp lugs also require a crimp lug landing pad kit. If this kit is required, its part number is outlined on the publication.

For applicable switches, the installation of crimp lugs requires the removal of the clear plastic line shield (where applicable), standard mechanical lugs, and red or yellow plastic arc shield. After installation of the crimp lug the arc shield and line shield should be re-installed.

Optional copper bodied mechanical type lugs are available for installation in place of the standard line and load terminals in some switches where outlined by the switch's publication. Copper wire must be used when copper bodied lugs are installed.

The mechanical lugs provided in safety switches are designed to comply with minimum wire bending space requirements in the enclosure for the maximum conductor capacity allowed by the installed lugs. Alternative lugs with larger than standard capacity are a factory only option as they require oversizing the enclosure to accommodate additional or larger conductors. Installation of alternative or oversized lugs not outlined on the switch's publication would violate the UL listing of the switch.

Mounting and environmental considerations

Information regarding performance under unusual service conditions should be obtained from Eaton Corporation. Examples of unusual service conditions are:

- Temperatures below -30°C (-22°F);
- Temperatures above 50°C (122°F);
- Altitudes over 6,600 ft. (2011.7 m);
- Corrosive or explosive environments;
- Abnormal vibration, shock, or tilting;
- Unusual operating duties;
- Frequencies other than 60 Hertz; or
- Mounting the switch in a non-vertical position.

Generally, the enclosure should be mounted on a flat surface or the mounting must be shimmed; the mounting points must be co-planar. For NEMA 3R applications the enclosure needs to be level to ensure proper draining of any condensation or collected moisture through the drain hole on the bottom end wall of the enclosure.

Field installable accessories

The installation of accessories listed on the publication does not impact the UL listing of the switch. An example of normal field installable accessories would be:

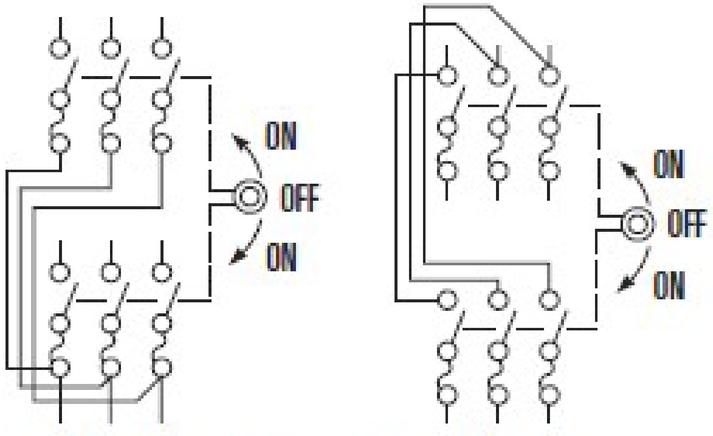
- Neutral kits;
- Electrical interlock (auxiliary contacts);
- Control pole;
- Fuse puller;
- Bonding kit;
- Ground lug kit;
- Optional fuse kit;
- Optional copper bodied lug kits; or
- Optional line shields.

Each kit should be installed in accordance with the instructions provided with that kit.

The installation of a "Lock-On" provision to allow padlocking a switch in the On position is available as a factory or field installable option. When installing the "Lock-On" provision in the field, the locator nib (indention) provided near the top of the shroud protecting the safety switch handle should be used as the center point for drilling out a hole to accommodate a padlock hasp.

Double throw wiring configurations

Fusible, double throw switches up to 400 A can be configured in the field for two sources and one load or two loads and one source depending on the location of internal factory provided jumpers. Should the switch need to be re-configured, use the wiring diagrams shown in **Figure 4** to change the location of the jumpers.



Fusible three-pole two sources

Fusible three-pole two loads

Figure 4. Typical fusible, double throw schematic diagram.

Standard fusible, double throw switches rated 600 A and above are configured for two sources and one load only and cannot be re-configured in the field. A factory only option for two loads and one source applications is available for 600 A and 800 A double throw switches.

Non-fusible, double throw switches can be used for two sources and one load or two loads and one source without being re-configured.

Inspection and preventative maintenance

Additional information regarding the inspection and preventative maintenance of general duty, heavy duty, or double throw safety switches can be found in the NEMA Standard Publication KS 3-2010 titled: “Guidelines for Inspection and Preventative Maintenance of Switches Used in Commercial and Industrial Applications”.

Notes:

The instructions for installation, testing, maintenance, or repair herein are provided for the use of the product in general commercial applications and may not be appropriate for use in nuclear applications. Additional instructions may be available upon specific request to replace, amend, or supplement these instructions to qualify them for use with the product in safety-related applications in a nuclear facility.

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Renewal Parts

Renewal Parts **RP00801001E**

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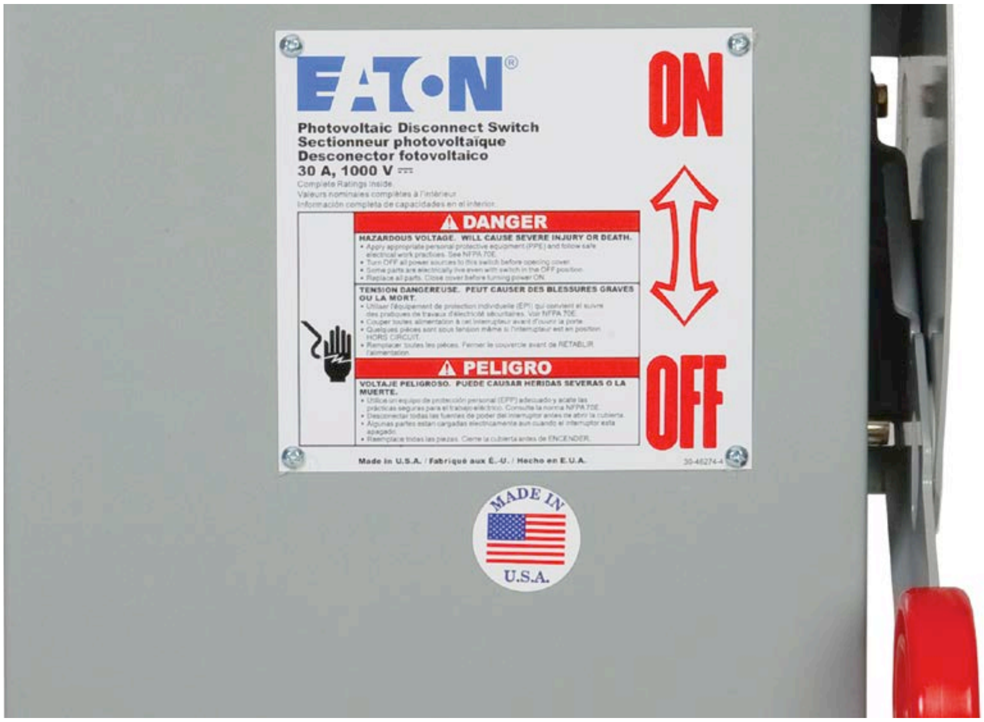
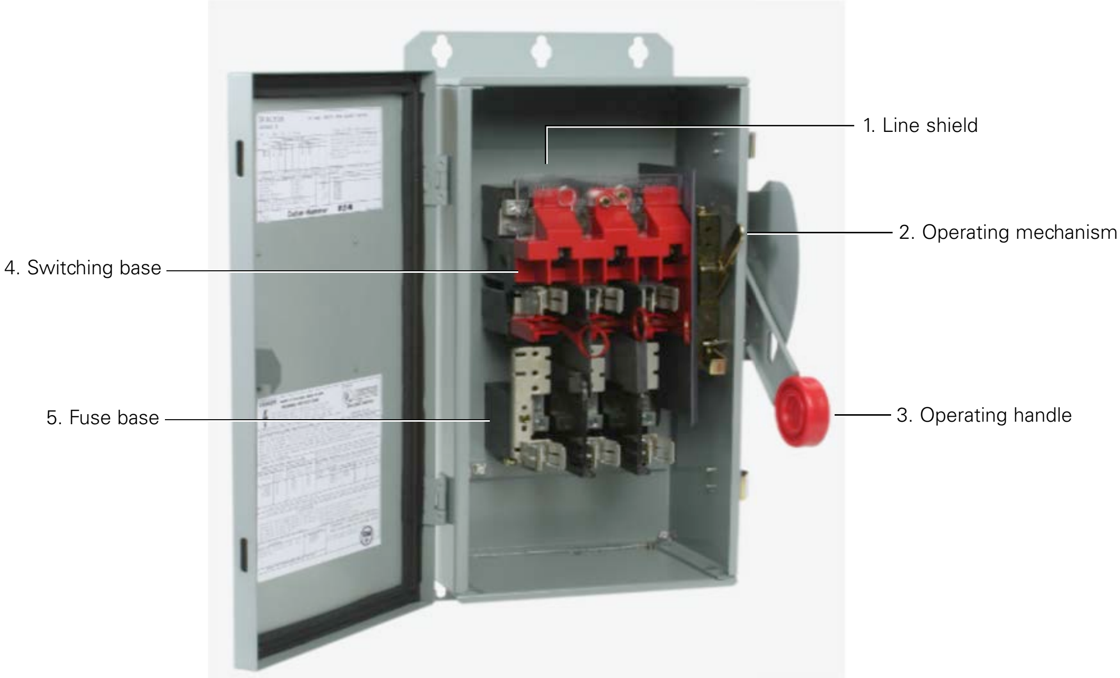
Safety switch renewal parts



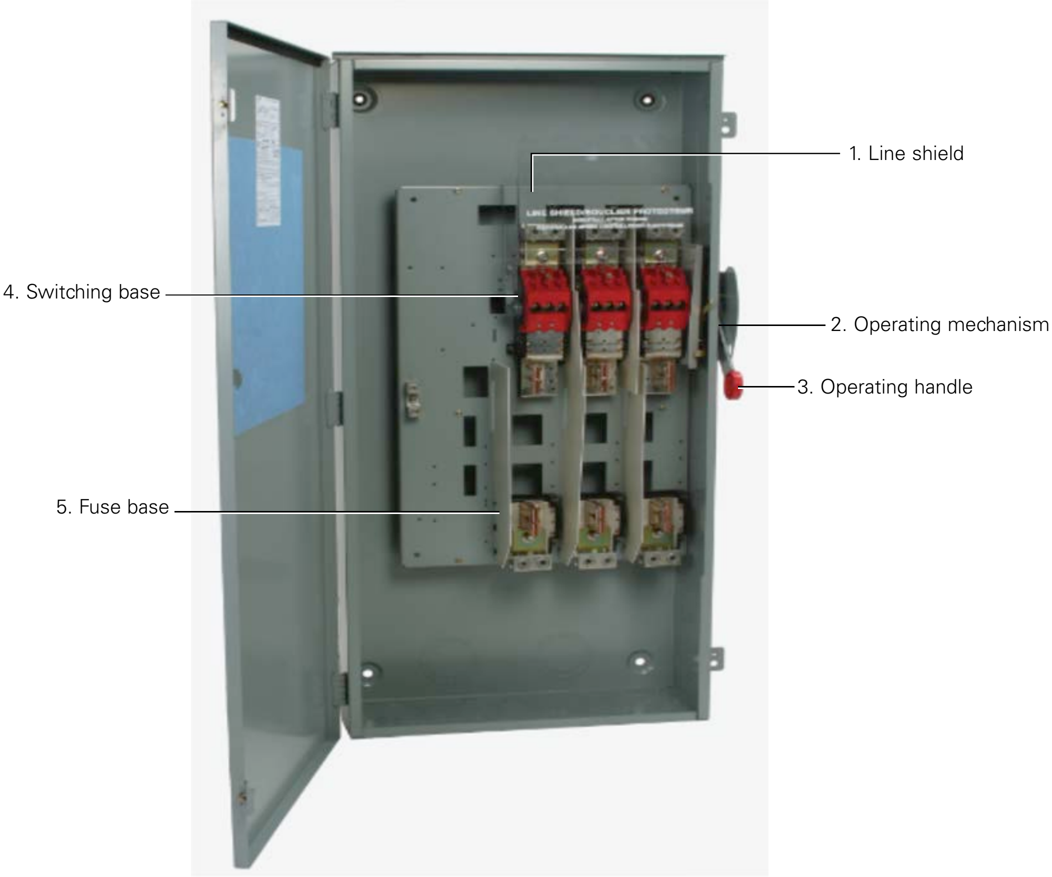
Contents

Powering Business Worldwide

Heavy-duty switch



30/60/100 A heavy-duty switch



200–1200 A heavy-duty safety switch

Table 1. Line shield

Switch ampere rating	Part number
General-duty two- and three-pole	
400	70-8063-8
600	70-8064-8
Heavy-duty two- and three-pole ①	
30–60	70-7758-34
100	70-7758-35
200	70-7759-11
400	70-8063-8
600–800	70-8064-8
1200	70-8453-4
Double-throw two- and three-pole ②	
30–100	70-7758-35
200	70-7759-11
400	70-8063-8
600	70-8064-8

① Two used for four- and six-pole configurations.

② Two used per switch.

Note: 30–200 A general-duty switches do not have line shields installed as standard from the factory.

30–100 A line shield

200–1200 A line shield

Table 2. Operating mechanism

Switch ampere rating	NEMA rating	Part number
Heavy-duty switches		
30–100 ①	NEMA® 1/3R/12/4X	70-7813
200	NEMA 1/3R/12/4X	70-7833-4
400	NEMA 1/3R/12/4X	70-7833-5
600–800	NEMA 1/3R/12/4X	70-7833-6
Stainless steel mechanism		
30–100 ①	NEMA 4X Enviroline	70-8304
200	NEMA 4X Enviroline	70-8305
400	NEMA 4X Enviroline	70-8305-2

① For internal window replacement mechanisms, see **Table 6**.

Note: Replacement mechanisms are not available for general-duty or double-throw switches.

30–100 A operating mechanism

200–1200 A operating mechanism

Table 3. Operating handle

Switch ampere rating	NEMA rating	Part number
General-duty switches		
200–600	NEMA 1 and 3R	70-7833-2
Heavy-duty switches		
30–100 ①	NEMA 1/3R/12	70-7813-2
30–100	NEMA 4X	70-7813-3
200–800	NEMA 1/3R/12	70-7833-2
200–800	NEMA 4X	70-7833-3
1200 ②	Consult factory	

① For internal window replacement handles, see **Table 6**.

② No replacement handles available for the flange style handle on 1200 A switches manufactured prior to 2015.

Note: Replacement handles are not available for general-duty or double-throw switches.

30–100 A operating handle

200–1200 A operating handle

30–100 A switching base

200–1200 A switching base

30–100 A fuse base

200–1200 A fuse base

Table 4. Heavy-duty fusible switches

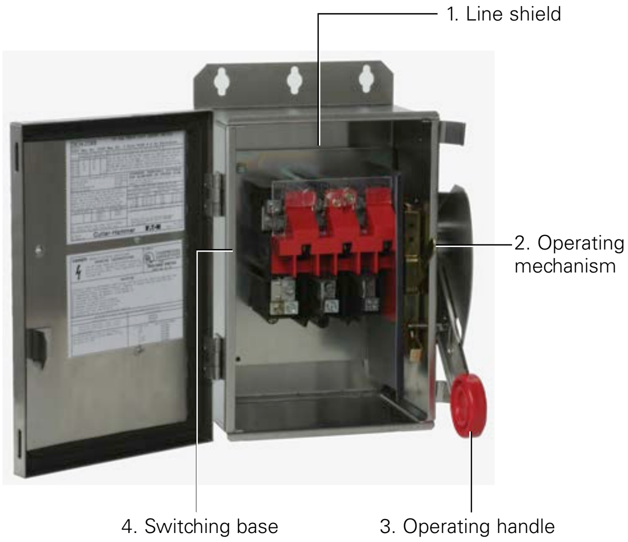
Amperes	NEMA rating	4. Switching base	5. Fuse base
Two-pole 240 V			
30	All	70-7758-16	70-7758-29
60	All	70-7758-36	70-7997-4
100	All	70-7758-7	70-7758-23
200	NEMA 1 and 3R	70-8266-3	70-7820-4 ①
200	NEMA 4X and 12	70-7759-7	70-7759-4 ①
400	All	70-8063-3	70-8063-7 ①
600	All	70-8064-3	70-8064-7 ①
800	All	70-8065-3	70-8065-7 ①
Three-pole 240 V			
30	All	70-7758-14	70-7758-26
60	All	70-7997	70-7997-5
100	All	70-7758-3	70-7758-21
200	NEMA 1 and 3R	70-8266	70-7820-4 ①
200	NEMA 4X and 12	70-7759	70-7759-4 ①
400	All	70-8063-4	70-8063-7 ①
600	All	70-8064-4	70-8064-7 ①
800	All	70-8065-4	70-8065-7 ①
1200	All	70-8821	70-8453-3 ①
Two-pole 600 V			
30	All	70-7758-17	70-7758-30
60	All	70-7997-3	70-7997-6
100	All	70-7558-9	70-7558-25
200	NEMA 1 and 3R	Consult factory	70-7820-4 ①
200	NEMA 4X and 12	Consult factory	70-7759-5 ①
400	All	70-8063-5	70-8063-7 ①
600	All	70-8064-5	70-8064-7 ①
800	All	70-8065-5	70-8065-7 ①
Three-pole 600 V			
30	All	70-7758-12	70-7758-27
60	All	70-7997-2	70-7997-7
100	All	70-7758-3	70-7758-21
200	NEMA 1 and 3R	70-8266	70-7820-4 ①
200	NEMA 4X and 12	70-7759	70-7759-5 ①
400	All	70-8063-6	70-8063-7 ①
600	All	70-8064-6	70-8064-7 ①
800	All	70-8065-6	70-8065-7 ①
1200	All	70-8821	70-8453-3 ①
Four-pole 240 V			
30	All	70-7758-16 ②	70-7758-29 ②
60	All	70-7758-36 ②	70-7997-4 ②
100	All	70-7758-7 ②	70-7758-23 ②
200	NEMA 1 and 3R	Consult factory	70-7820-4 ①
200	NEMA 4X and 12	70-7759-9	70-7759-4 ①
400	All	70-8270	70-8063-7 ①
600	All	70-8271	70-8064-7 ①
800	All	Consult factory	70-8065-7 ①
Four-pole 600 V			
30	All	70-7758-36 ②	70-7758-38 ②
60	All	70-7997-2 ②	70-7758-39 ②
100	All	70-7758-7 ②	70-7758-23 ②
200	NEMA 1 and 3R	Consult factory	70-7820-4 ①
200	NEMA 4X and 12	70-7759-9	70-7759-5 ①
400	All	70-8270-2	70-8063-7 ①
600	All	70-8271-2	70-8064-7 ①
800	All	Consult factory	70-8065-7 ①
Six-pole 600 V			
30	All	70-7758-12 ②	70-7758-27 ②
60	All	70-7758-2 ②	70-7758-20 ②
100	All	70-7758-3 ②	70-7758-21 ②
200	NEMA 1 and 3R	Consult factory	Consult factory
200	NEMA 4X and 12	Consult factory	70-7759-5 ①
400	All	Consult factory	70-8063-7 ①
600	All	Consult factory	70-8064-7 ①
800	All	Consult factory	70-8065-7 ①

① Order one per pole.

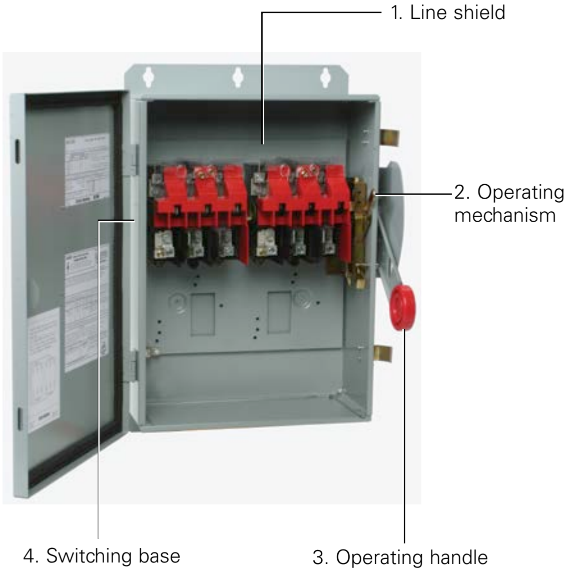
② Order two.

Note: General-duty replacement bases are not available.

Note: Please contact the TRC for technical questions concerning replacement parts at 1-877-386-2273, option 2 (Technical).



30–100 A heavy-duty non-fusible switch



30–100 A heavy-duty six-pole non-fusible switch

Table 5. Heavy-duty non-fusible switches

Amperes	NEMA rating	4. Switching base	5. Lower base ①
Two-pole 600 V			
30	All	70-7758-18	
60	All	70-7758-18	
100	All	70-7758-11	
200	NEMA 1 and 3R	70-8266-2	
200	NEMA 4X and 12	70-7759-2	70-7759-6 ②
400	All	70-8063	
600	All	70-8064	
800	All	70-8065	
Three-pole 600 V			
30	All	70-7758-13	
60	All	70-7758-13	
100	All	70-7758-5	
200	NEMA 1 and 3R	70-8266-2	
200	NEMA 4X and 12	70-7759-2	70-7759-6 ②
400	All	70-8063-2	
600	All	70-8064-2	
800	All	70-8065-2	
1200	All	70-8820	

Table 5. Heavy-duty non-fusible switches, continued

Amperes	NEMA rating	4. Switching base	5. Lower base ①
Four-pole 600 V			
30	All	70-7758-40	
60	All	70-7758-41	
100	All	70-7758-42	
200	NEMA 1 and 3R	Consult factory	
200	NEMA 4X and 12	70-7759-10	70-7759-6 ②
400	All	70-8270-3	
600	All	70-8271-3	
Six-pole 600 V			
30	All	70-7758-13 ③	
60	All	70-7758-13 ③	
100	All	70-7758-5 ③	
200	NEMA 1 and 3R	Consult factory	
200	NEMA 4X and 12	70-7759-13	70-7759-6 ②

① Only used in 200 A, NEMA 4X and NEMA 12 switch combinations.

② Order one per pole as needed.

③ Order two.

Note: Please contact the TRC for technical questions concerning replacement parts at 1-877-386-2273, option 2 (Technical).

Internal window replacement parts for safety switches with windows produced prior to May 2015

30–60 A internal window

Table 6. Internal window replacement parts

Switch ampere rating	NEMA rating	Part number
Operating mechanism		
30–100	NEMA 12 and 4X	70-7813-4
30–100	NEMA 4X Enviroline	70-8305
Operating handle		
30–100	NEMA 12	70-7833-2
30–100	NEMA 4X	70-7833-3

Table 7. Internal replacement window kits

Switch ampere rating	NEMA rating	Part number
30–60	NEMA 12 and 4X	70-8564
30–60	NEMA 4X Enviroline	70-8564-2
100	NEMA 12 and 4X	70-8564-3
100	NEMA 4X Enviroline	70-8564-4

Note: For internal window switches, use the replacement fuse bases listed on pages 4 and 5. Replacement bases are NOT interchangeable between standard switches and visible blade/exterior window switches.

Note: For Internal window replacement parts, use standard replacement parts unless otherwise specified in the table above.

Note: Please contact the TRC for technical questions concerning replacement parts at 1-877-386-2273, option 2 (Technical).

External window replacement parts

30–60 A external window

Table 8. External replacement window kits

Switch ampere rating	NEMA rating	Part number
30–60	NEMA 12	70-8889
30–60	NEMA 4X and 4X Enviroline	70-8889-2
100–1200	NEMA 12	70-8889-3
100–1200	NEMA 4X and 4X Enviroline	70-8889-4

Enhanced visible blade and exterior window replacement bases

Replacement bases shown below can ONLY replace bases in existing enhanced visible blade/exterior window style switches.


30–60 A exterior window switch


100–1200 A exterior window switch


30–100 A replacement switching base


200–1200 A replacement switching base

Table 9. Heavy-duty fusible switches

Amperes	NEMA rating	4. Switching base	5. Fuse base
Two-pole 240 V			
30	All	70-8835	70-7758-29
60	All	70-8838	70-7997-4
100	NEMA 4X and 12	70-8829	70-7758-23
200	NEMA 1 and 3R	70-8856	70-7820-4 ①
200	NEMA 4X and 12	70-8845	70-7759-4 ①
400	All	70-8864	70-8063-7 ①
600	All	70-8870	70-8064-7 ①
800	All	70-8876	70-8064-8 ①
Three-pole 240 V			
30	NEMA 4X and 12	70-8834	70-7758-26
60	All	70-8851	70-7997-5
100	All	70-8825	70-7758-21
200	NEMA 1 and 3R	70-8854	70-7820-4 ①
200	NEMA 4X and 12	70-8843	70-7759-4 ①
400	All	70-8865	70-8063-4 ①
600	All	70-8871	70-8064-7 ①
800	All	70-8877	70-8065-7 ①
1200	All	70-8887	70-8453-3 ①
Two-pole 600 V			
30	All	70-8836	70-7758-30
60	All	70-8853	70-7997-6
100	All	70-8830	70-7558-25
200	NEMA 1 and 3R	Consult factory	70-7820-4 ①
200	NEMA 4X and 12	Consult factory	70-7759-5 ①
400	All	70-8866	70-8063-7 ①
600	All	70-8872	70-8064-7 ①
800	All	70-8878	70-8065-7 ①
Three-pole 600 V			
30	All	70-8832	70-7758-27
60	All	70-8852	70-7997-7
100	All	70-8825	70-7758-21
200	NEMA 1 and 3R	70-8854	70-7820-4 ①
200	NEMA 4X and 12	70-8843	70-7759-5 ①
400	All	70-8867	70-8063-7 ①
600	All	70-8873	70-8064-7 ①
800	All	70-8879	70-8065-7 ①
1200	All	70-8887	70-8453-3 ①

Table 9. Heavy-duty fusible switches, continued

Amperes	NEMA rating	4. Switching base	5. Fuse base
Four-pole 240 V			
30	All	70-8835 ②	70-7758-29 ②
60	All	70-8838 ②	70-7997-4 ②
100	All	70-8829 ②	70-7758-23 ②
200	NEMA 1 and 3R	70-8856	70-7820-4 ①
200	NEMA 4X and 12	70-8846	70-7759-4 ①
400	All	70-8880	70-8063-7 ①
600	All	70-8883	70-8064-7 ①
800	All	Consult factory	70-8065-7 ①
Four-pole 600 V			
30	All	70-8838 ②	70-7758-38 ②
60	All	70-8839 ②	70-7758-39 ②
100	All	70-8829 ②	70-7758-23 ②
200	NEMA 1 and 3R	70-8857	70-7820-4 ③
200	NEMA 4X and 12	70-8846	70-7759-5 ③
400	All	70-8881	70-8063-7 ③
600	All	70-8884	70-8064-7 ③
800	All	Consult factory	70-8065-7 ③
Six-pole 600 V			
30	All	70-8832 ②	70-7758-27 ②
60	All	70-8824 ②	70-7758-20 ②
100	All	70-8825 ②	70-7758-21 ②
200	NEMA 1 and 3R	Consult factory	Consult factory
200	NEMA 4X and 12	Consult factory	70-7759-5 ③
400	All	Consult factory	70-8063-7 ③
600	All	Consult factory	70-8064-7 ③
800	All	Consult factory	70-8065-7 ③

① Order one per pole.

② Order two.

③ Order one per pole as needed.

Note: The replacement bases listed on pages 7 and 8 CANNOT be used as replacement bases in standard or interior window style safety switches. If the existing switch has a red colored arc shield, then the standard replacement base must be used. If the existing switch has a yellow colored arc shield, then a replacement base must be selected from the tables on pages 7 and 8.

Note: Please contact the TRC for technical questions concerning replacement parts at 1-877-386-2273, option 2 (Technical).

Enhanced visible blade and exterior window replacement bases

Replacement bases shown below can ONLY replace bases in existing enhanced visible blade/exterior window style switches.

Table 10. Heavy-duty non-fusible switches

Amperes	NEMA rating	4. Switching base	5. Lower base ①
Two-pole 600 V			
30	All	70-8837	
60	All	70-8837	
100	All	70-8831	
200	NEMA 1 and 3R	70-8855	
200	NEMA 4X and 12	70-8844	70-7759-6 ②
400	All	70-8862	
600	All	70-8868	
800	All	70-8874	
Three-pole 600 V			
30	All	70-8833	
60	All	70-8833	
100	All	70-8827	
200	NEMA 1 and 3R	70-8855	
200	NEMA 4X and 12	70-8844	70-7759-6 ②
400	All	70-8863	
600	All	70-8869	
800	All	70-8875	
1200	All	70-8886	
Four-pole 600 V			
30	All	70-8840 ③	
60	All	70-8841 ③	
100	All	70-8842 ③	
200	NEMA 1 and 3R	Consult factory	
200	NEMA 4X and 12	70-8847	70-7759-6 ②
400	All	70-8882	
600	All	70-8885	
800	All	Consult factory	
Six-pole 600 V			
30	All	70-8833 ③	
60	All	70-8833 ③	
100	All	70-8827 ③	
200	NEMA 1 and 3R	Consult factory	
200	NEMA 4X and 12	70-8848	70-7759-6 ②
400	All	Consult factory	
600	All	Consult factory	
800	All	Consult factory	

① Only used in 200 A, NEMA 4X and NEMA 12 switch combinations.

② Order one per pole.

③ Order two.

Note: Please contact the TRC for technical questions concerning replacement parts at 1-877-386-2273, option 2 (Technical).

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