Hart Engineering Corporation

SUBMITTAL:
11311-02

PROJECT: 9900. - Veolia/Taunton WWTF Phase 1 Improvements **DATE: 05/09/2022**

SUBMITTAL: 11311-02 - Plant Water System O&M Manual
REVISION: 0
STATUS: Eng
SPEC #: 11311

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Item	Revision	Description	Status	Date Sent	Date Returned
11311-02	0	Plant Water System O&M Manual	Eng	05/09/2022	
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: 05/09/2022

May 5, 2022

Operation & Maintenance Manual

Project : 1971214934

Taunton WWTF

Plant Water System

GRUNDFOS CBS, Inc
902 Koomey Road
US-Brookshire, TX. 77423
U.S.A.
Phone: (+1) 281 994 2700
www.grundfos.us

be think innovate

GRUNDFOS

TABLE OF CONTENTS

SECTION 1

GENERAL DOCUMENTS

TAUNTON WWTF
PLANT WATER SYSTEM

GENERAL INFORMATION

FOR PARTS AND SERVICE CONTACT:

Carlsen Systems, LLC
176 Amity Rd. #102
Woodbridge, CT 06525
www.carlsensystems.com
(203) 663-1314 (T)
info@carlsensystems.com

SCOPE OF SUPPLY

One (1) Grundfos packaged water booster system as follows:

- Skid split into two (2) sections
- Five (5) Grundfos CRNE 64-2 vertical multistage pumps, 30 HP motors with integral VFD
- 10” suction and discharge headers, stainless steel, 150# flanged connections
- 4” suction and discharge isolation valves for each pump
- 4” check valve for each pump
- Suction pressure transmitter, compound type
- Discharge pressure transmitter
- Suction and discharge pressure gauges
- Control panel, NEMA 4X SS enclosure (shipped loose)
- Power and communication cables, 20 FT (shipped loose for field installation)

SERIAL NUMBERS

Complete Packaged System: SN ---
Pumps:

- SN ---
- SN ---
- SN ---
- SN ---

MANUFACTURER CONTACT INFORMATION

Grundfos
902 Koomey Rd.
Brookshire, TX 77423
(281) 994-2700 (T)

TAUNTON WWTF
PLANT WATER SYSTEM

FUNCTIONAL DESCRIPTION

The packaged system consists of the following primary components:

- Five (5) Grundfos CRNE 64-2 vertical multistage pumps with 30 HP integral motor/VFD's
- Suction and discharge isolation valves for each pump
- Check valve for each pump
- Suction and discharge pressure transmitters
- Control panel with Grundfos CU352 controller

The Grundfos CU352 controller shall operate the five (5) vertical multistage pumps to maintain a constant discharge pressure (system setpoint). The system setpoint is adjustable via the operator interface.

The controller receives an analog signal [4-20mA] from the discharge pressure transducer on the discharge manifold, indicating the actual system pressure. Because suction pressure for this application is too low to be accurately measured by a transducer, the suction pressure is programmed into the controller as a constant.

As flow demand increases the pump speed will increase to maintain the system set-point pressure. When the operating pump(s) reach a percentage of full speed (default value is 96%, speed setpoint is adjustable), an additional pump will be started and will increase speed until the system setpoint is satisfied. When the system pressure is equal to the system setpoint, all pumps in operation shall reach equal operating speeds. As flow demand decreases the pump speed shall be reduced while system setpoint pressure is maintained. When all pumps in operation are running at low speed (adjustable speed setpoint), the system controller shall switch off pumps when fewer pumps are able to maintain system demand and satisfy the system setpoint.

The system controller is capable of switching pumps on and off to satisfy system demand without the use of flow switches, motor current monitors or temperature measuring devices.

All pumps in the system shall alternate automatically based on demand, running time and/or fault status. If flow demand is continuous (no flow shut-down does not occur), the system controller shall have the capability to alternate the pumps every 24 hours, every 48 hours or once per week. The interval and actual time of the pump change-over shall be field adjustable.

A compound pressure transducer is provided on the suction header. The controller includes both a low suction pressure warning setpoint and a low suction pressure alarm setpoint. Both setpoints are adjustable. A warning is issued if the suction pressure hits the warning setpoint. If the suction pressure drops to the alarm setpoint, an alarm is issued and the pumps will not run.

Limited Warranty

Products manufactured by GRUNDFOS PUMPS CORPORATION (Grundfos) are warranted to the original user only to be free of defects in material and workmanship for a period of 24 months from date of installation, but not more than 30 months from date of manufacture. Grundfos' liability under this warranty shall be limited to repairing or replacing at Grundfos' option, without charge, F.O.B. Grundfos' factory or authorized service station, any product of Grundfos' manufacture. Grundfos will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Products which are sold but not manufactured by Grundfos are subject to the warranty provided by the manufacturer of said products and not by Grundfos' warranty. Grundfos will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with Grundfos' printed installation and operating instructions.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of Grundfos' products from which it was purchased together with proof of purchase and installation date, failure date, and supporting installation data. Unless otherwise provided, the distributor or dealer will contact Grundfos or an authorized service station for instructions. Any defective product to be returned to Grundfos or a service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

GRUNDFOS WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM INSTALLATION, USE, OR ANY OTHER CAUSES. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH EXTEND BEYOND THOSE WARRANTIES DESCRIBED OR REFERRED TO ABOVE.

Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages and some jurisdictions do not allow limit actions on how long implied warranties may last. Therefore, the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

RECOMMENDED MAINTENANCE SCHEDULE

Maintenance Operation	Frequency	Notes/Description
Perform general inspection	Every month	Clean area around pumps and motors to remove any dust/debris. Inspect pump for abnormal noise or vibration. On controller home screen, record pressure setpoint (SP), process variable (PV), and suction pressure.
Lubricate Bearings	When bearing lubrication interval is reached as per the nameplate on the motor. Also lubricate any bearing that starts to make noise before the lubrication interval is reached. Lubricate bearings in accordance with lubrication instructions.	See lubrication instructions on page 32 of the IOM for the integrated motor/VFD's (Grundfos E-pumps with MLE frequency-controlled, asynchronous motors). **IMPORTANT: Use only Exxon Mobile Unirex N3 lithium grease. DO NOT use any other grease.**
Check current draw	Every 6 months	Record current draw at 100% speed (60 Hz). Record incoming phase-to-phase voltage.
Check pump performance	Every 12 to 24 months	Check pump shutoff head. Close discharge isolation valve at the end of the discharge header and operate pump at 100% speed (60 Hz). Record suction header pressure transducer reading and discharge header pressure transducer reading.

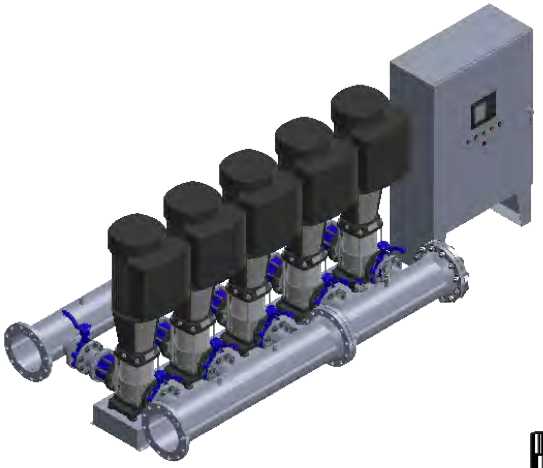
IMPORTANT SAFETY NOTES

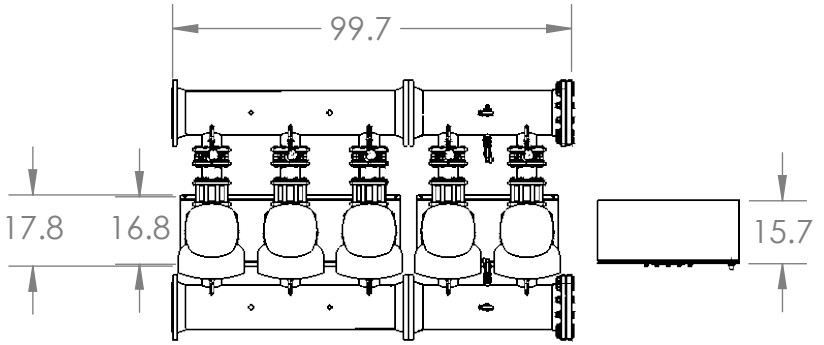
1) The procedures above should only be performed by qualified and properly trained personnel. Proper safety measures must be taken and proper personal protective equipment must be utilized. If qualified personnel are not available, contact your local authorized Grundfos distributor.

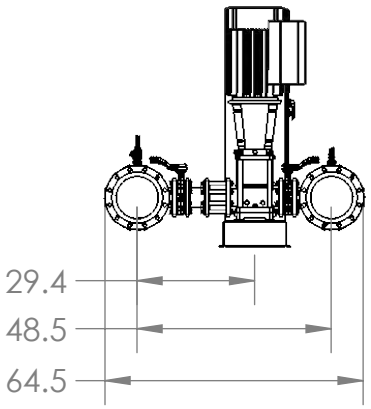
2) Always follow lockout/tagout procedures

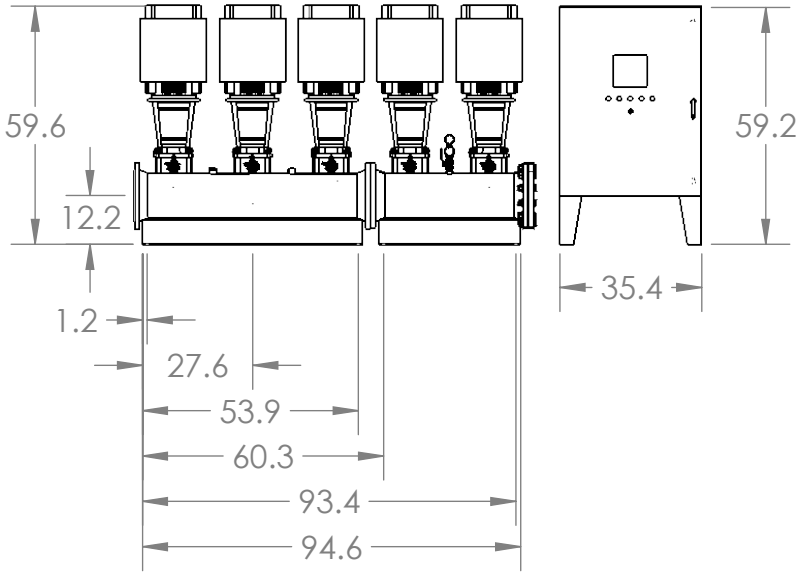
1. Manifolds 10" ANSI Class 150 AISI 316SS Schedule 10s ASTM A312 or ∅273.1mm x3mm
2. Base/Frame AISI 304SS
3. Standard system layout : panel right facing suction
4. 4" lug style ANSI 150# class butterfly valve
5. UL Type 4X rated electrical panel

Note: panel size will vary with options









GRUNDFOS

FRESNO, CALIFORNIA 93727 USA

Note:
All dimensions are ±0.5"
Not for Construction
All dimensions subject to changewithout notice.

Model:	HYDRO MPC E 5CRNE64-2				
Power:	3x460 60HZ 5x30HP				
Job:					Scale: 1:48
Dwg No: 8001531142	Rev: 0	Date: 10/8/2021	Drawer: 79690	Page: 1 of 1	

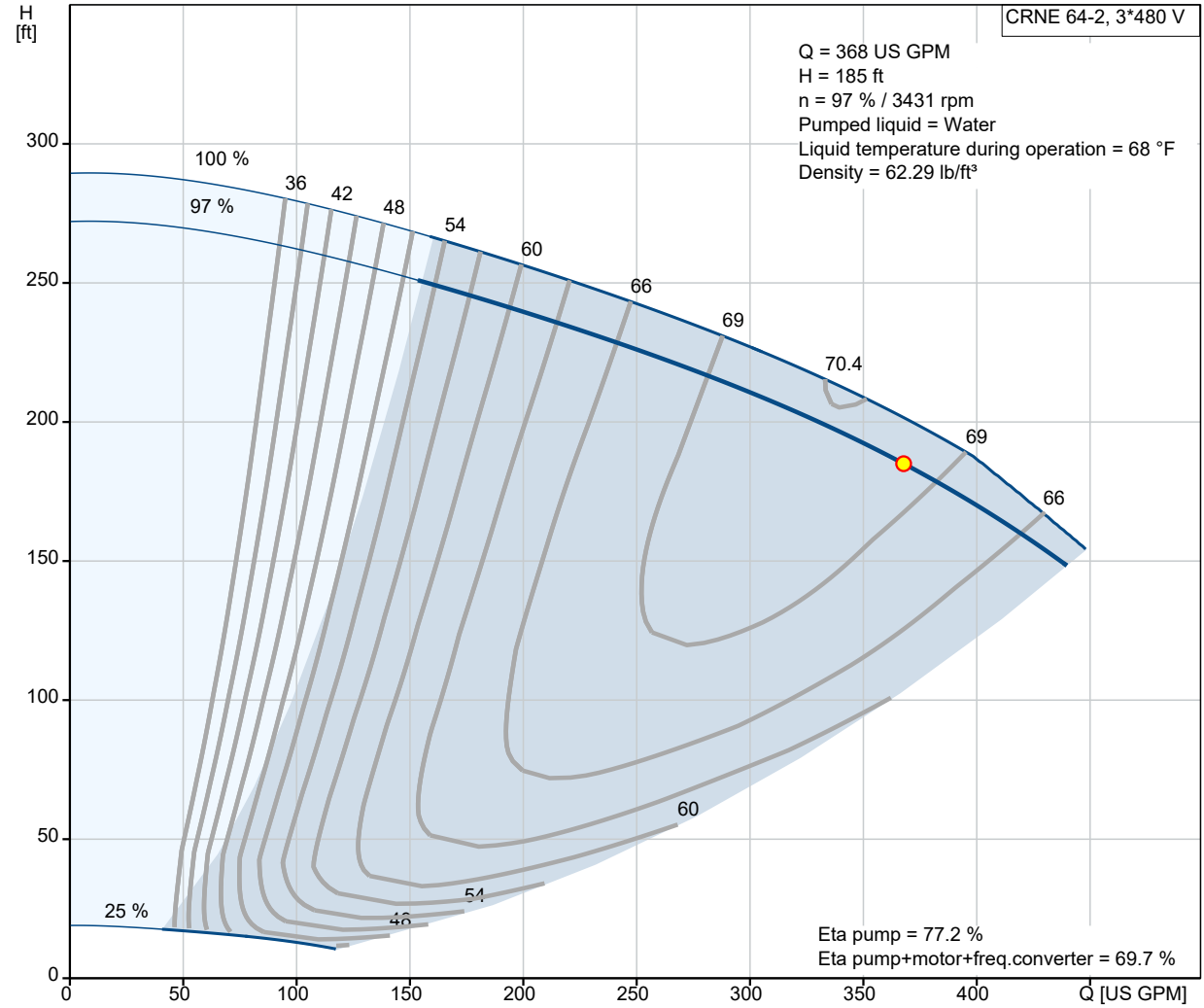
SECTION 2

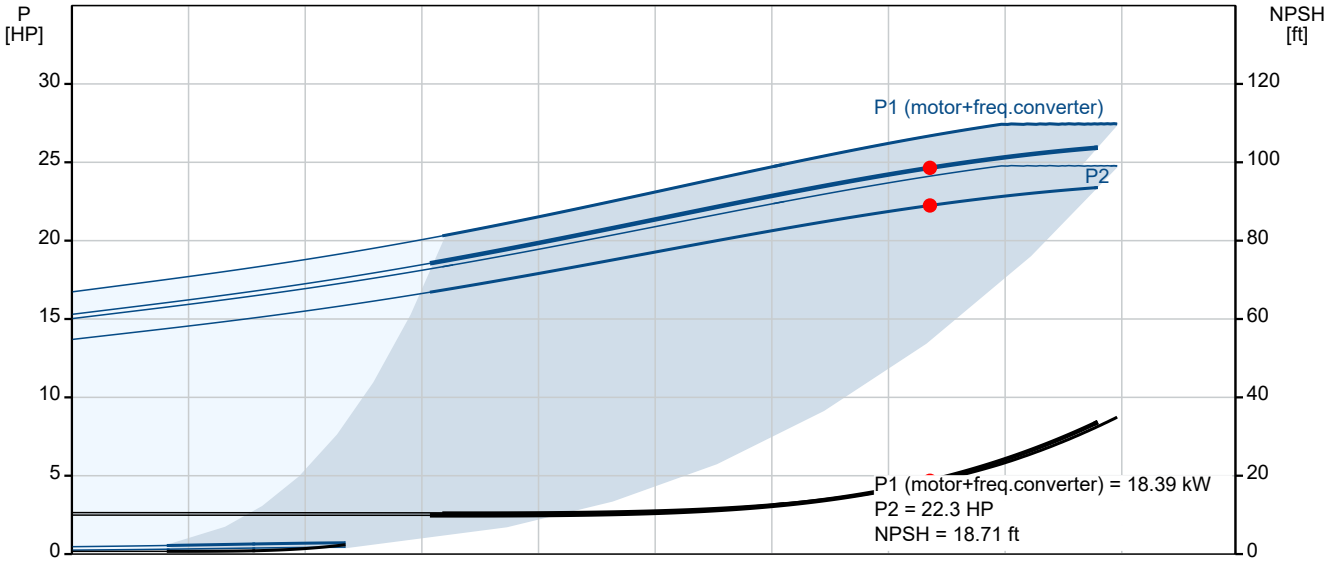
PUMPS

Company name:
Created by:
Phone:

Date: 26/10/2021

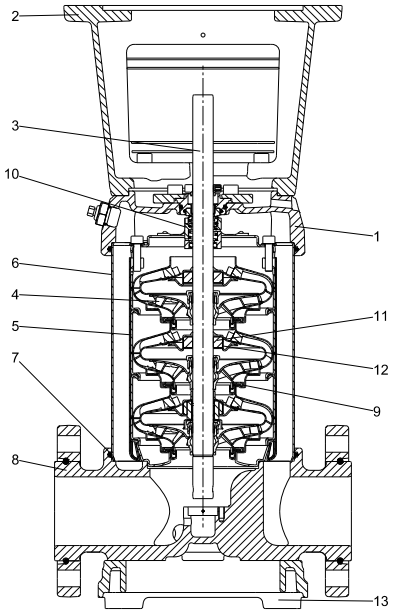
CRNE 64-2 A-G-A-E-HQQE 60 Hz





CRN 32, 45 and 64

TM06 9503 2417



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Materials, CRN

Pos.	Designation	Materials	DIN/EN	≈ AISI/ASTM
1	Pump head cover	Stainless steel	EN10283 1.4408	CF 8M equal to AISI 316
2	Motor stool	Grey cast iron[1)]	EN-GJL-200	ASTM 25B
3	Shaft	Stainless steel	EN10088 1.4462	-
4	Impeller	Stainless steel	EN10088 1.4401	AISI 316
5	Chamber	Stainless steel	EN10088 1.4401	AISI 316
6	Sleeve	Stainless steel	EN10088 1.4401	AISI 316
7	O-ring for sleeve	EPDM or FKM		-
8	Base	Stainless steel	EN10283 1.4408	CF 8M equal to AISI 316
9	Neck ring	Carbon-graphite- filled PTFE	-	-
10	Shaft seal (seal faces)	Silicon carbide/Silicon carbide	-	-
11	Bearing ring	Silicon carbide/Silicon carbide	-	-
12	Support bearing	Carbon-graphite- filled PTFE	-	-
13	Base plate	Ductile cast iron[1)]	EN-GJS-500-7	ASTM A536 70-50-05
	Rubber parts	EPDM or FKM	-	-

1) Stainless steel available on request.

GRUNDFOS

Company name: Grundfos
Created by:
Phone:

Date: 10/19/2021

Description	Value
General information:	
Product name:	CRN 64-2 A-G-A-E-HQQE
Product No.:	On request
EAN:	On request
Technical:	
Rated pump speed:	3521 rpm
Actual calculated flow:	336 US gpm
Resulting head of the pump:	212.1 ft
Maximum head:	290.4 ft
Actual impeller diameter:	5.59 in
Stages:	2
Impellers:	2
Number of reduced-diameter impellers:	0
Low NPSH:	N
Pump orientation:	Vertical
Shaft seal arrangement:	Single
Code for shaft seal:	HQQE
Approvals:	CE
Approvals for drinking water:	NSF/ANSI 61
Curve tolerance:	ISO9906:2012 3B
Pump version:	A
Model:	B
Materials:	
Base:	Stainless steel
Base:	EN 1.4408
Base:	AISI 316
Impeller:	Stainless steel
Impeller:	EN 1.4401
Impeller:	AISI 316
Material code:	A
Code for rubber:	E
Bearing:	SIC
Support bearing:	Graflon
Installation:	
Maximum operating pressure:	232.06 psi
Max pressure at stated temperature:	232 psi / 250 °F
Max pressure at stated temperature:	232 psi / -40 °F
Type of connection:	ANSI
Size of suction port:	4 inch
Size of outlet port:	4 inch
Pressure rating for connection:	PN 16
Flange rating inlet:	150 lb
Flange size for motor:	284TC
Connect code:	G
Liquid:	
Pumped liquid:	Water
Liquid temperature range:	-40 .. 248 °F
Selected liquid temperature:	68 °F
Density:	62.29 lb/ft³
Electrical data:	
Motor standard:	NEMA
Power (P2) required by pump:	30 HP
Controls:	
Frequency converter:	NONE
Others:	
DOE Pump Energy Index CL:	0.93
Net weight:	164 lb

Company name: Grundfos
Created by:
Phone:

Date: 10/19/2021

Description	Value
Gross weight:	182 lb
Shipping volume:	10.9 ft³
Sales region:	Namreg
Country of origin:	US
Custom tariff no.:	8413.70.2040

CR, CRI, CRN, CRT

Installation and operating instructions

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GRUNDFOS

Original installation and operating instructions.

CONTENTS

Warning

Prior to installation, read these installation and operating instructions. Installation and operation must comply with local regulations and accepted codes of good practice.

Warning

Electrical work: All electrical work should be performed by a qualified electrician in accordance with the latest edition of national, state, and local codes and regulations.

Warning

Shock Hazard: A faulty motor or wiring can cause electrical shock that could be fatal, whether touched directly or conducted through standing water. For this reason, proper grounding of the pump to the power supply's grounding terminal is required for safe installation and operation. In all installations, the above-ground metal plumbing should be connected to the power supply ground as described in Article 250-80 of the National Electrical Code.

1. Limited warranty

Products manufactured by GRUNDFOS PUMPS CORPORATION (Grundfos) are warranted to the original user only to be free of defects in material and workmanship for a period of 24 months from date of installation, but not more than 30 months from date of manufacture. Grundfos' liability under this warranty shall be limited to repairing or replacing at Grundfos' option, without charge, F.O.B. Grundfos' factory or authorized service station, any product of Grundfos' manufacture. Grundfos will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Products which are sold but not manufactured by Grundfos are subject to the warranty provided by the manufacturer of said products and not by Grundfos' warranty. Grundfos will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with Grundfos' printed installation and operating instructions.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of Grundfos' products from which it was purchased together with proof of purchase and installation date, failure date, and supporting installation data. Unless otherwise provided, the distributor or dealer will contact Grundfos or an authorized service station for instructions. Any defective product to be returned to Grundfos or a service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

GRUNDFOS WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM INSTALLATION, USE, OR ANY OTHER CAUSES. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH EXTEND BEYOND THOSE WARRANTIES DESCRIBED OR REFERRED TO ABOVE.

Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages and some jurisdictions do not allow limit actions on how long implied warranties may last. Therefore, the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

2. Symbols used in this document

Warning

If these safety instructions are not observed, it may result in personal injury.

Warning

If these instructions are not observed, it may lead to electric shock with consequent risk of serious personal injury or death.

Caution ***If these safety instructions are not observed, it may result in malfunction or damage to the equipment.***

Note ***Notes or instructions that make the job easier and ensure safe operation.***

3. Introduction

The CR range is based on the inline multistage centrifugal pump first pioneered by Grundfos. CR is available in four basic materials and over one million configurations. CR is suitable for pumping water and water-like liquids in industry, petrochemical plants, water treatment plants, commercial buildings, and many other applications. Some of the outstanding characteristics of CR are:

- superior efficiency
- reliability
- easy maintenance
- compact size and small footprint
- quiet operation.

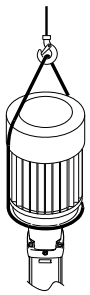
4. Shipment inspection

Examine the components carefully to make sure no damage has occurred to the pump during shipment. Ensure that the pump is NOT dropped or mishandled.

4.1 Lifting instructions

Caution ***Do not use the lifting eyes of the motor for lifting the entire pump and motor assembly.***

Lift pump assembly with lifting straps that pass through the motor stool. Ensure that the load is not applied to the pump shaft.



TM04 0339 0608

Fig. 1 Correct lifting of a CR pump

4.2 Ensure you have the right pump

Check the pump nameplate to make sure that it is the one you ordered.

- **CR:** Centrifugal pump; all parts in contact with the pumped liquid are made of standard cast iron and AISI 304 stainless steel
- **CRI:** Centrifugal pump; all parts in contact with the pumped liquid are made of AISI 304 stainless steel
- **CRN:** Centrifugal pump; all parts in contact with the pumped liquid are made of AISI 316 stainless steel
- **CRT:** Centrifugal pump; all parts in contact with the pumped liquid are made of titanium
- **CRE:** Centrifugal pump with a Grundfos MLE variable frequency drive motor.

4.3 Checking the condition of the pump

The packing in which your pump arrived is specially designed for your pump to prevent damage during shipment. As a precaution, leave the pump in the packing until you are ready to install it. Examine the pump for any damage that may have occurred during shipping. Examine any other parts of the shipment as well for any visible damage.

Note ***If the shipment consists of a complete unit (motor attached to pump end), the position of the coupling connecting the pump shaft to the motor shaft is set to factory specifications. No adjustment is required. If the shipment is a pump end without motor, follow the adjustment procedures in section 13. Replacing the motor.***

Pump without motor (CR, CRI, CRN 1s, 1, 3, 5, 10, 15, and 20 only):

If you purchased a pump end without motor, the shaft seal has been set from factory. Do not loosen the three set screws on the shaft seal when attaching the motor.

Pump without motor (CR, CRN 32, 45, 64, 90, 120, and 150 only):

If you purchased a pump end without motor, you must install the shaft seal. The shaft seal is protected in its own box inside the pump packing crate. To protect the shaft and bearings during shipment, a transport protector is used. Remove the transport protector prior to installation of the shaft seal. Read the seal installation instructions which are included in the pump packing.

4.4 Electrical requirements

Warning

Electrical work: All electrical work should be performed by a qualified electrician in accordance with the current national, state, and local codes and regulations.

Warning

Shock hazard: A faulty motor or faulty wiring can cause electric shock that could be fatal, whether the motor is touched directly or the current is conducted through standing water. For this reason, safe installation and operation require proper grounding of the pump to the power supply ground (earth) terminal.

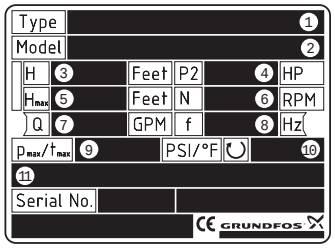
In all installations, connect the above-ground metal plumbing to the power supply ground terminal as described in Article 250-80 of the National Electrical Code.

Verify the power supply to make sure that the voltage, phases and frequency match those of the pump. The proper operating voltage and other electrical information appear on the motor nameplate. These motors are designed to run on - 10 %/+ 10 % of the rated nameplate voltage. For dual-voltage motors, the motor should be internally connected to operate on the voltage closest to the 10 % rating, i.e., a 208 V motor should be wired according to the 208 V wiring diagram. The wiring diagram can be found on either a plate attached to the motor or on a label inside the terminal box cover.

Caution ***Do not operate the pump if voltage variations are greater than - 10 % /+ 10 %.***

5. Identification

5.1 Nameplate data

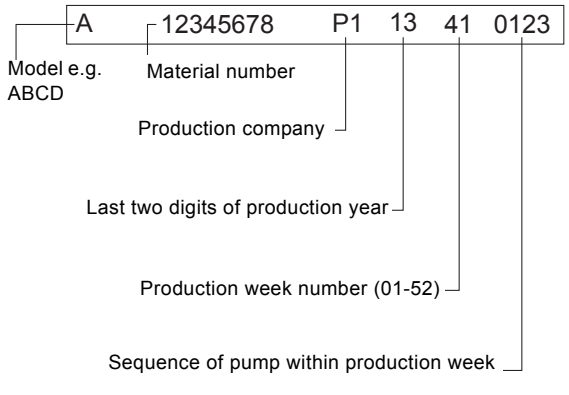


1. Type designation
2. Model, material number, production number
3. Head in feet at rated flow
4. Rated motor hp
5. Head at zero flow
6. Rated rpm
7. Rated flow
8. Rated frequency
9. Maximum pressure and maximum liquid temperature
10. Direction of rotation
11. Production country

TM04 3895 2609

Fig. 1 Example of nameplate CR, CRI, CRN, CRT

Specification of the model line in nameplates:



TM04 3904 3913

Fig. 2 Key to model line in nameplates

5.2 Type keys

5.2.1 CR, CRI, CRN 1s, 1, 3, 5, 10, 15, and 20

Example	CR	3-	10	A	FG	A	E	HQQE
Type range: CR, CRI, CRN								
Rated flow rate in [m^3/h] (x 5 gpm)								
Number of impellers								
Code for pump version								
Code for pipe connection								
Code for materials								
Code for rubber parts								
Code for shaft seal								

5.2.2 CR, CRN 32, 45, 64, 90, 120, and 150

Example	CR	32-	2-	1	A	G	A	E	KUBE
Pump range: CR, CRN									
Rated flow rate in [m^3/h] (x 5 gpm)									
Number of impellers									
Number of reduced-diameter impellers									
Code for pump version									
Code for pipe connection									
Code for materials									
Code for rubber parts									
Code for shaft seal									

5.2.3 CRT 2, 4, 8, and 16

Example	CRT	16-	30	/2	A	G	A	AUUE
Pump range: CRT								
Rated flow rate in [m^3/h] (x 5gpm)								
Number of stages x 10								
Code for impellers (used only if the pump has fewer impellers than stages)								
Code for pump version								
Code for pipe connection								
Code for materials								
Code for shaft seal and rubber parts								

5.2.4 Codes

Example		A	-G	-A	-E	-H	QQ	E
Pump version								
A	Basic version[1)]							
B	Oversize motor							
E	Certificate/approval							
F	CR pump for high temperatures (air-cooled top assembly)							
H	Horizontal version							
HS	High-pressure pump with high-speed MLE motor							
I	Different pressure rating							
J	Pump with different max. speed							
K	Pump with low NPSH							
M	Magnetic drive							
N	Fitted with sensor							
P	Undersize motor							
R	Horizontal version with bearing bracket							
SF	High-pressure pump							
T	Oversize motor (two flange sizes bigger)							
U	NEMA version[1)]							
X	Special version[2)]							
Pipe connection								
A	Oval flange, Rp thread							
B	Oval flange, NPT thread							
CA	FlexiClamp (CRI(E), CRN(E) 1, 3, 5, 10, 15, 20)							
CX	Triclamp (CRI(E), CRN(E) 1, 3, 5, 10, 15, 20)							
F	DIN flange							
G	ANSI flange							
J	JIS flange							
N	Changed diameter of ports							
P	PJE coupling							
X	Special version							
Materials								
A	Basic version							
D	Carbon-graphite filled PTFE (bearings)							
G	Wetted parts, AISI 316							
GI	All parts stainless steel, wetted parts, AISI 316							
I	Wetted parts, AISI 304							
II	All parts stainless steel, wetted parts, AISI 304							
K	Bronze (bearings)							
S	SiC bearings + PTFE neck rings							
X	Special version							
Code for rubber parts								
E	EPDM							
F	FXM							
K	FFKM							
V	FKM							

Example		A	-G	-A	-E	-H	QQ	E
Shaft seal								
A	O-ring seal with fixed driver							
B	Rubber bellows seal							
E	Cartridge seal with O-ring							
H	Balanced cartridge seal with O-ring							
K	Metal bellows cartridge seal							
O	Double seal, back-to-back							
P	Double seal, tandem							
X	Special version							
B	Carbon, synthetic resin-impregnated							
H	Cemented tungsten carbide, embedded (hybrid)							
Q	Silicon carbide							
U	Cemented tungsten carbide							
X	Other ceramics							
E	EPDM							
F	FXM							
K	FFKM							
V	FKM							

1) In August 2003 the NEMA version pump code was discontinued for all material numbers created by Grundfos manufacturing companies in North America. The NEMA version pump code will still remain in effect for existing material numbers. NEMA version pumps built in North America after this change will have either an A or a U as the pump version code depending on the date the material number was created.

2) If a pump incorporates more than two pump versions, the code for the pump version is X. X also indicates special pump versions not listed above.

6. Applications

Compare the pump's nameplate data or its performance curve with the application in which you plan to install it. Make sure the application falls within the following limits.

Type	Application/liquid
CR	Hot and chilled water, boiler feed, condensate return, glycols and solar thermal liquids.
CRI/CRN	Deionized, demineralized and distilled water. Brackish water and other liquids unsuitable for contact with iron or copper alloys. (Consult manufacturer for specific liquid compatibilities.)
CRN-SF	High-pressure washdown, reverse osmosis or other high-pressure applications.
CRT	Salt water, chloride based liquids and liquids approved for titanium.

7. Operating conditions

7.1 Ambient temperature and altitude

If the ambient temperature exceeds the maximum temperature limits of the pump or the pump is installed at an altitude exceeding the altitude values in the chart below, the motor must not be fully loaded due to the risk of overheating.

Overheating may result from excessive ambient temperatures or the low density and consequently low cooling effect of the air at high altitudes. In such cases, it may be necessary to use a motor with a higher rated output (P_2).

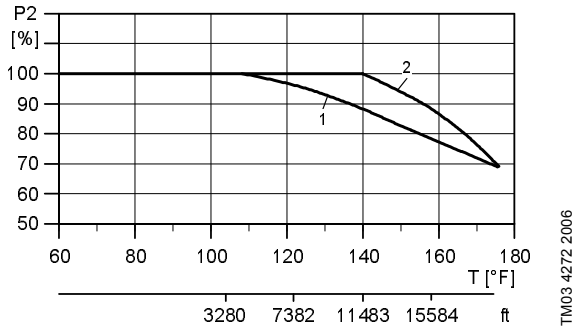


Fig. 3 Relationship between motor output (P_2) and ambient temperature/altitude

Legend

Pos.	Description
1	NEMA standard-efficiency motors
2	NEMA premium-efficiency motors

Example: From fig. 3 it appears that P_2 must be reduced to 88 % when a pump with a NEMA premium-efficiency ML motor is installed 15,584 feet above sea level. At an ambient temperature of 167 °F, P_2 of a standard-efficiency motor must be reduced to 74 % of rated output.

In cases where both the maximum temperature and the maximum altitude are exceeded, the derating factors must be multiplied. Example: 0.89 x 0.89 = 0.79.

7.2 Liquid temperatures

Pump	Liquid temperature
CR, CRI, CRN 1s, 3, 5, 10, 15, and 20	-4 - +248 °F (-20 - +120 °C)
CR, CRN 32, 45, 64, and 90*	-22 - +248 °F (-30 - +120 °C)
CR, CRN 120 and 150* (up to 60 hp)	-22 - +248 °F (-30 - +120 °C)
CR, CRN 120 and 150 (75 and 100 hp)	32-248 °F (0-120 °C)
CRT 2, 4, 8, 16	-4 - +248 °F (-20 - +120 °C)
CRN-SF	-4 - +221 °F (-15 - +105 °C)
Pumps with Cool-Top™	up to 356 °F (180 °C)

All motors are designed for continuous duty in 104 °F (40 °C) ambient air conditions. For higher ambient temperature conditions, consult Grundfos.

* We recommend xUBE shaft seals for temperatures above 200 °F. Pumps with KUHE hybrid shaft seals can only operate up to 200 °F (90 °C). Pumps with xUUE shaft seals can be operated down to -40 °F (-40 °C). ("x" is the seal type).

7.3 Minimum inlet pressures

All CR, CRI, CRN	NPSHR + 2 feet
CRN-SF	29 psi (2 bar)

7.4 Maximum inlet pressures

Pump type	Stages		Max. [psi (bar)]
	60 Hz	50 Hz	
CR, CRI, CRN 1s	2-27	2-36	145 (10)
CR, CRI, CRN 1	2-25	2-36	145 (10)
	27		217 (15)
CR, CRI, CRN 3	2-17	2-29	145 (10)
	19-25	31-36	217 (15)
CR, CRI, CRN 5	2-9	3-16	145 (10)
	10-24	18-36	217 (15)
CR, CRI, CRN 10	1-5	1-6	116 (8)
	6-17	7-22	145 (10)
CR, CRI, CRN 15	1-2	1-3	116 (8)
	3-12	4-17	145 (10)
CR, CRI, CRN 20	1	1-3	116 (8)
	2-10	4-17	145 (10)
CR, CRN 32	1-1 - 2	1-1 - 4	58 (4)
	3-2 - 6	5-2 - 10	145 (10)
	7-2 - 11-2	11-14	217 (15)
CR, CRN 45	1-1 - 1	1-1 - 2	58 (4)
	2-2 - 3	3-2 - 5	145 (10)
	4-2 - 8-1	6-2 - 13-2	217 (15)
CR, CRN 64	1-1	1-1 - 2-2	58 (4)
	1 - 2-1	2-1 - 4-2	145 (10)
	2 - 5-2	4-1 - 8-1	217 (15)
CR, CRN 90		1-1 - 1	58 (4)
	1-1 - 1	2-2 - 3-2	145 (10)
	2-2 - 4-1	3-6	217 (15)
CR, CRN 120	1-1 - 1	1 - 2-1	145 (10)
	2-2 - 3	2 - 5-1	217 (15)
	4-1 - 5-1	6-1 - 7	290 (20)
CR, CRN 150	1-1	1-1 - 1	145 (10)
	1-2	2-1 - 4-1	217 (15)
	3-2 - 4-2	5-2 - 6	290 (20)
CRT 2	2-6	2-11	145 (10)
	7-18	13-26	217 (15)
CRT 4	1-7	1-12	145 (10)
	8-16	14-22	217 (15)
CRT 8	1-16	1-20	145 (10)
CRT 16	2-10	2-16	145 (10)
CRN-SF	all	all	72 (5)*
			362 (25)**

* While pump is off or during start-up.

** During operation.

7.5 Maximum operating pressures

250 °F (194 °F for CRN-SF)

Pump type/ connection	Stages		Max. [psi (bar)]
	60 Hz	50 Hz	
CR, CRI, CRN 1s			
Oval flange	1-17	1-23	232 (16)
FGJ, PJE	1-27	1-36	362 (25)
CR, CRI, CRN 1			
Oval flange	1-17	1-23	232 (16)
FGJ, PJE	1-27	1-36	362 (25)
CR, CRI, CRN 3			
Oval flange	1-17	1-23	232 (16)
FGJ, PJE	1-27	1-36	362 (25)
CR, CRI, CRN 5			
Oval flange	1-16	1-22	232 (16)
FGJ, PJE	1-24	1-36	362 (25)
CR, CRI 10			
Oval flange CR	1-6		145 (10)
Oval flange, CRI	1-10	1-16	232 (16)
FGJ, GJ, PJE	1-10	1-16	232 (16)
FGJ, GJ, PJE	12-17	17-22	362 (25)
CRN 10			
All	1-17	1-22	362 (25)
CR, CRI 15			
Oval flange	1-5	1-7	145 (10)
FGJ, GJ, PJE	1-8	1-10	232 (16)
FGJ, GJ, PJE	9-12	12-17	362 (25)
CRN 15			
All	1-12	1-17	362 (25)
CR, CRI 20			
Oval flange	1-5	1-7	145 (10)
FGJ, GJ, PJE	1-7	1-10	232 (16)
FGJ, GJ, PJE	8-10	12-17	362 (25)
CRN 20			
All	1-10	1-17	362 (25)
CR, CRN 32			
	1-1 - 5	1-1 - 7	232 (16)
	6-2 - 11-2	8-2 - 14	435 (30)
CR, CRN 45			
	1-1 - 4-2	1-1 - 5	232 (16)
	4-2 - 8-1	6-2 - 13-2	435 (30)
CR, CRN 64			
	1-1 - 3	1-1 - 5	232 (16)
	4-2 - 5-2	6-2 - 8-1	435 (30)
CR, CRN 90			
	1-1 - 3	1-1 - 4	232 (16)
	4-2 - 4-1	5-2 - 6	435 (30)
CR, CRN 120			
	1-1 - 3		232 (16)
	4-2 - 5-2	1-1 - 5-2	435 (30)
CR, CRN 150			
	1-1 - 3		232 (16)
	4-1 - 4-2	1-1 - 4-2	435 (30)
CRT 2	2-18	2-26	305 (21)
CRT 4	1-16	1-22	305 (21)
CRT 8	1-8	1-12	232 (16)
	10-16	14-20	362 (25)
CRT 16	1-8	1-8	232 (16)
	10-12	10-16	362 (25)

Consult Grundfos in case of other operating conditions.

8. Installation

Warning

Do not turn on the power supply until the pump is properly installed.

8.1 Pump location

Locate the pump in a dry, well-ventilated, frost-free area which is not subject to extreme variation in temperature.

Make sure the pump is mounted at least 6 inches (150 mm) clear of any obstruction or hot surfaces.

The motor requires an adequate air supply to prevent overheating and adequate vertical space to remove the motor for repair.

In open systems requiring suction lift, locate the pump as close to the liquid source as possible to reduce friction loss in pipes.

8.2 Foundation

Use concrete or similar foundation material to provide a secure, stable mounting base for the pump.

See table below for bolt hole center line dimensions for the various pump types.

Secure the pump to the foundation using all four bolts and shim pump base to assure the pump is vertical and all four pads on the base are properly supported (uneven surfaces can result in pump base breakage when mounting bolts are tightened).

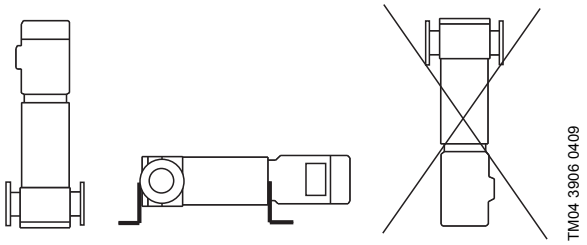


Fig. 4 Pump position

The pump can be installed vertically or horizontally. See fig. 4.

Ensure that an adequate supply of cool air reaches the motor cooling fan. The motor must never fall below the horizontal plane.

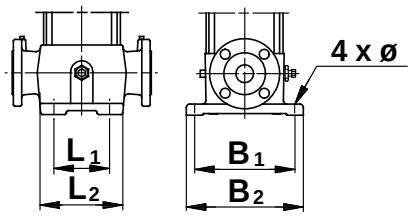
Arrows on the pump base show the direction of flow of liquid through the pump.

To minimize possible noise from the pump, it is advisable to fit expansion joints on either side of the pump and anti-vibration mountings between the foundation and the pump.

Note ***Make sure the vent plug is located in the uppermost position.***

Fit isolating valves on either side of the pump to avoid draining the system if the pump needs to be cleaned, repaired or replaced.

Base and bolt hole center line dimensions



Pump type	L1		L2		B1		B2		ø	
	[inches]	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]	[mm]
CR 1s, 1, 3, 5	3 15/16	100	5 11/16	145	7 1/16	180	8 11/16	220	1/2	13
CRI, CRN 1s 1, 3, 5 CRT 2, 4	3 15/16	100	5 7/8	150	7 1/16	180	8 11/16	220	1/2	13
CR 10, 15, 20	5 1/8	130	6 15/16	176	8 7/16	215	10 1/16	256	9/16	13.5
CRN 10, 15, 20 CRT 8, 16	5 1/8	130	7 7/8	200	8 7/16	215	9 3/4	248	1/2	13
CR 32	6 11/16	170	8 3/4	223	9 7/16	240	11 3/4	298	9/16	14
CRN 32	6 11/16	170	8 7/8	226	9 7/16	240	11 3/4	298	9/16	14
CR 45, 64	7 1/2	190	9 3/4	248	10 1/2	266	13 1/16	331	9/16	14
CRN 45, 64	7 1/2	190	9 7/8	251	10 1/2	266	13 1/16	331	9/16	14
CR, CRN 90	7 13/16	199	10 1/4	261	11	280	13 11/16	348	9/16	14
CR, CRN 120, 150	10 13/16	275	13 9/16	344	14 15/16	380	18 9/16	472	11/16	18

8.3 Pump mounting

Warning

CR, CRI, CRN pumps are shipped with covered suction and discharge ports. Remove the covers before the pipes are connected to the pump.

8.3.1 Recommended installation torques

Pump type	Recommended foundation torque [ft-lbs]	Recommended flange torque [ft-lbs]
CR, CRI, CRN 1s/1/3/5 and CRT 2/4	30	37-44
CR, CRI, CRN 10/15/20 and CRT 8/16	37	44-52
CR, CRN 32/45/64/90/120/150	52	52-59

8.4 Suction pipe

The suction pipe should be adequately sized and run as straight and short as possible to keep friction losses to a minimum (minimum of four pipe diameters straight run prior to the suction flange). Avoid using unnecessary fittings, valves or accessory items. Use butterfly valves in the suction line only when it is necessary to isolate a pump because of a flooded suction condition. This would occur if the water source is above the pump. See fig. 5 and fig. 6. Flush piping prior to pump installation to remove loose debris.

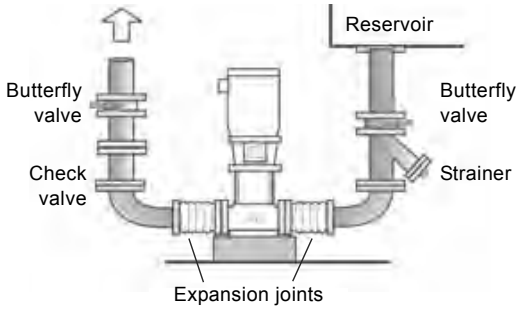


Fig. 5 Flooded suction

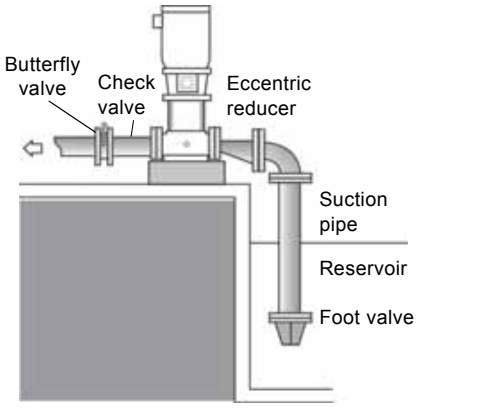


Fig. 6 Suction lift*

* The suction pipe should have a fitting on it for priming. CRN-SF pumps cannot be used for suction lift.

8.4.1 Suction pipe sizes

The following recommended suction pipe sizes are the smallest sizes which should be used with any specific CR pump type.

Verify the suction pipe size in each installation to ensure that good pipe practices are being observed and excess friction losses are not encountered.

High temperatures may require larger diameter pipes to reduce friction and improve NPHSA.

Pump type		Min. suction pipe size
CR, CRI, CRN 1s, 1, 3; CRT 2	1"	Nominal diameter acc. to ANSI schedule 40
CR, CRI, CRN 5; CRT 4	1 - 1/4"	Nominal diameter acc. to ANSI schedule 40
CR, CRI, CRN 10, 15, 20; CRT 8, 16	2"	Nominal diameter acc. to ANSI schedule 40
CR, CRN 32	2 - 1/2"	Nominal diameter acc. to ANSI schedule 40
CR, CRN 45	3"	Nominal diameter acc. to ANSI schedule 40
CR, CRN64, 90	4"	Nominal diameter acc. to ANSI schedule 40
CR, CRN 120, 150	5"	Nominal diameter acc. to ANSI schedule 40

8.5 Discharge pipe

We suggest to install a check valve and a isolating valve in the discharge pipe.

Pipe, valves and fittings should be at least the same diameter as the discharge pipe or sized in accordance with good piping practices to reduce excessive flow velocities and friction losses in pipes.

Caution ***The pressure rating of pipes, valves and fittings must be equal to or greater than the maximum system pressure.***

Before installing the pump, pressure check the discharge piping to at least the maximum pressure the pump is capable of generating or as required by codes or local regulations.

Whenever possible, avoid high pressure-loss fittings, such as elbows or branch tees directly on either side of the pump. The piping should be adequately supported to reduce thermal and mechanical stresses on the pump.

According to good installation practices, clean the system thoroughly and flush it of all foreign materials and sediment prior to pump installation. Furthermore, never install the pump at the lowest point of the system due to the natural accumulation of dirt and sediment. If there is excessive sediment or suspended particles, we recommend that a strainer or filter is used. Grundfos recommends that pressure gauges are installed on suction and discharge flanges or in pipes to monitor pump and system performance.

Warning

To avoid problems with water hammer, do not use quick-closing valves in CRN-SF applications.

8.6 Bypass

Install a bypass in the discharge pipe if there is any risk that the pump may operate against a closed valve in the discharge line. Flow through the pump is required to ensure that adequate cooling and lubrication of the pump is maintained.
See *7.3 Minimum inlet pressures* for minimum flow rates.

Elbows should be at least 12" from the bypass opening to prevent erosion.

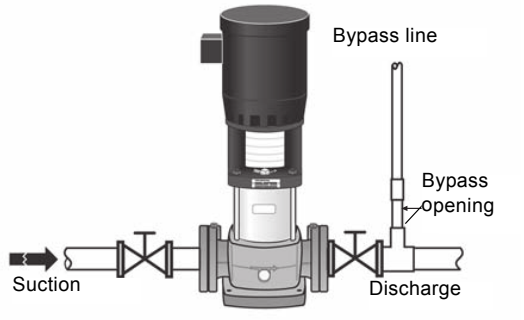


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Fig. 7 Recommended bypass arrangement

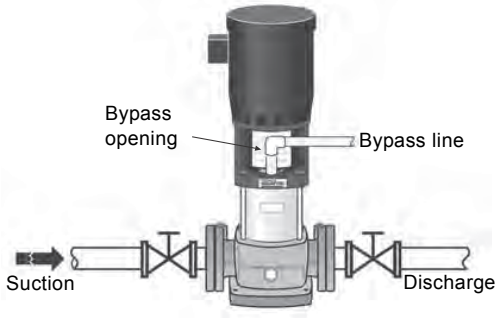

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Fig. 8 Optional bypass arrangement

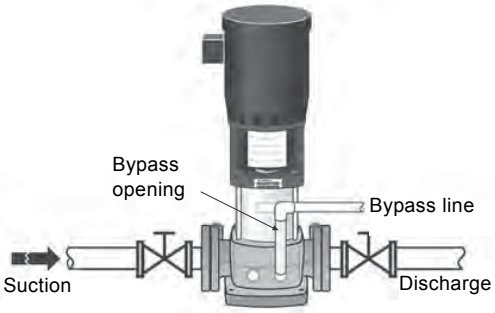

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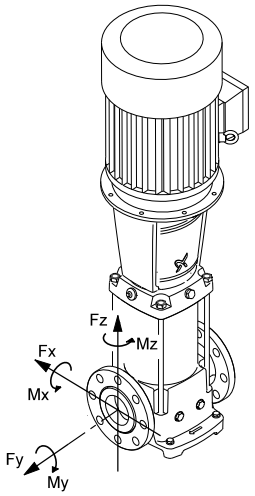
Fig. 9 Optional bypass arrangement for CR, CRN 32, 45, 64 and CR 90, 120 and 150 only

8.7 Flange forces and torques

If not all loads reach the maximum permissible value stated in the tables after fig. 10, one of these values may exceed the normal limit. Contact Grundfos for further information.



Y-direction: Direction of chamber stack
Z-direction: 90 ° from inlet/outlet
X-direction: Inlet/outlet

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Fig. 10 Flange forces and torques

Flange	CR, CRI, CRN	Force [F]		
		Y-direction [lb]	Z-direction [lb]	X-direction [lb]
1 1/4"	1s to 5	171	263	175
2"	10, 15 and 20	303	371	337
2 1/2"	32	382	466	422
3"	45	461	562	506
4"	64 and 90	607	753	674
5", 6"	120 and 150	607	753	674

Flange	CR, CRI, CRN	Torque [M]		
		Y-direction [ft-lb]	Z-direction [ft-lb]	X-direction [ft-lb]
1 1/4"	1s to 5	605	715	900
2"	10, 15 and 20	738	848	1,033
2 1/2"	32	793	904	1,106
3"	45	848	959	1,180
4"	64 and 90	922	1,069	1,291
5", 6"	120 and 150	922	1,069	1,291

8.8 Minimum continuous duty flow rates [gpm]

Pump type	min. °F to 176 °F (min. °C to 80 °C)	at 210 °F (at 99 °C)	at 248 °F (at 120 °C)	at 356 °F (at 180 °C)
CR, CRI, CRN 1s	0.5	0.7	1.2	1.2*
CR, CRI, CRN 1	0.9	1.3	2.3	2.3*
CR, CRI, CRN 3	1.6	2.4	4.0	4.0*
CR, CRI, CRN 5	3.0	4.5	7.5	7.5*
CR, CRI, CRN 10	5.5	8.3	14	14*
CR, CRI, CRN 15	9.5	14	24	24*
CR, CRI, CRN 20	11	17	28	28*
CR, CRN 32	14	21	35	35*
CR, CRN 45	22	33	55	55*
CR, CRN 64	34	51	85	85*
CR, CRN 90	44	66	110	110*
CR, CRN 120	60	90	N/A	N/A
CR, CRN 150	75	115	N/A	N/A
CRT 2	1.3	2.0	3.3	N/A
CRT 4	3.0	4.5	7.5	N/A
CRT 8	4.0	6.0	10	N/A
CRT 16	8.0	12	20	N/A

* Grundfos Cool-Top® is only available in the following pump types:

Pump type	CR 1s	CR 1	CR 3	CR 5	CR 10	CR 15	CR 20	CR 32	CR 45	CR 64	CR 90
Standard (CR)								•	•	•	•
I version (CRI)	•	•	•	•	•	•	•				
N version (CRN)	•	•	•	•	•	•	•	•	•	•	•

8.9 Check valves

A check valve may be required on the discharge side of the pump to prevent the pump inlet pressure from being exceeded.

When a pump with no check valve is stopped because there is no demand on the system (all valves are closed), the high system pressure on the discharge side of the pump will "find" its way back to the inlet of the pump.

This is especially critical for CRN-SF applications because of the very high discharge pressures involved. As a result, most CRN-SF installations require a check valve on the discharge piping.

8.10 Temperature rise

It may sometimes be necessary to stop the flow through a pump during operation.

When the flow is stopped, the power to the pump is transferred to the pumped liquid as heat, causing a temperature rise in the liquid.

The result is risk of overheating and consequent damage to the pump. The risk depends on the temperature of the pumped liquid and for how long the pump is operating without flow. See the following temperature rise table.

Pump type	Time for temperature rise of 18 °F (10 °C)	
	Seconds	Minutes
CR 1s, 1, 3	210	3.5
CR 5	240	4.0
CR 10	210	3.5
CR 15	150	2.5
CR 20	120	2.0
CR 32, 45, 64, 90, 120, 150	60	1.0

Conditions/reservations

The listed times are subject to the following conditions/ reservations:

- No exchange of heat with the surroundings.
- The pumped liquid is water with a specific heat capacity of 1.0 $^{Btu}/_{lb.}$ °F (4.18 $^{kJ}/_{kg}$ °C).
- Pump parts (chambers, impellers and shaft) have the same heat capacity as water.
- The water in the base and the pump head is not included.

These reservations should give sufficient safety margin against excessive temperature rise.

The maximum temperature must not exceed the pump maximum temperature rating.

8.11 Electrical connection

Warning

The safe operation of this pump requires that it is grounded in accordance with the National Electrical Code and local codes and regulations. Connect the ground conductor to the grounding screw in the terminal box and then to the ACCEPTABLE grounding point. All electrical work must be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code and local codes and regulations.

8.12 Motors

Grundfos CR pumps are supplied with heavy-duty, 2-pole (3600 rpm), ODP (open drip-proof) or TEFC (totally enclosed fan cooled), NEMA C frame motors selected to our rigid specifications.

Motors with other enclosure types and for other voltages and frequencies are available on a special-order basis.

CRN-SF pumps are supplied with an IEC (metric) type motor with a reverse thrust bearing.

If you replace the pump, but keep a motor previously used on another CR pump, be sure to read *12. Maintaining the motor* for proper adjustment of the coupling height.

8.13 Position of terminal box

The motor terminal box can be turned to any of four positions in steps of 90 °.

To rotate the terminal box, remove the four bolts securing the motor to the pump but do not remove the coupling. Turn the motor to the desired position; replace and securely tighten the four bolts. See fig. 11.

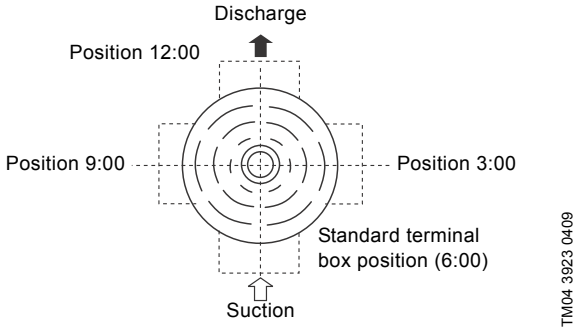

Fig. 11 Motor terminal box positions (top view)

8.14 Field wiring

Lead sizes should be based on the current carrying properties of conductors required by the latest edition of the National Electrical Code or local regulations. Direct-on-line (DOL) starting is approved due to the extremely short run-up time of the motor and the low moment of inertia of the pump and motor. If DOL starting is not acceptable and reduced starting current is required, use an auto transformer, resistance starter or soft starter. We suggest to use a fused disconnect for each pump in case standby pumps are installed.

8.15 Motor protection

8.15.1 Single-phase motors

All CR pumps with single phase motors, except 10 hp, are equipped with multi-voltage, squirrel cage induction motors which include built-in thermal protection.

8.15.2 Three-phase motors

CR pumps with three-phase motors must be used with the proper size and type of motor-protective circuit breaker to ensure the motor is protected against damage from low voltage, phase failure, current unbalance and overloads.

Use a properly sized circuit breaker with manual reset and ambient-temperature compensated extra-quick trip in all three phases. The overload protection should be set and adjusted to the full-load current rating of the motor. Under no circumstances should the overload protection be set to a higher value than the full-load current shown on the motor nameplate. This will void the warranty.

Set overload protection for auto transformers and resistance starters in accordance with the recommendations of the manufacturer.

Three-phase MLE motors (CRE-pumps) require only fuses as circuit breaker. They do not require a motor-protective circuit breaker. Check for phase unbalance (worksheet is provided. See section *18. Worksheet for three-phase motors*).

Caution ***Standard allowable phase unbalance is 5 %.***

8.15.3 CRN-SF

The CRN-SF is typically operated in series with a feed pump. Because the maximum allowable inlet pressure of the CRN-SF increases from 73 psi (when pump is off and during start-up) to 365 psi (during operation), use a control device to start the CRN-SF pump one second before the feed pump starts. Similarly, the CRN-SF must stop one second after the feed pump stops. See CRN-SF start-up timeline below.

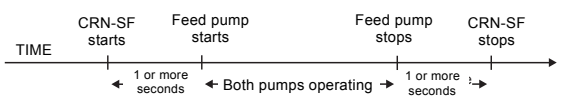

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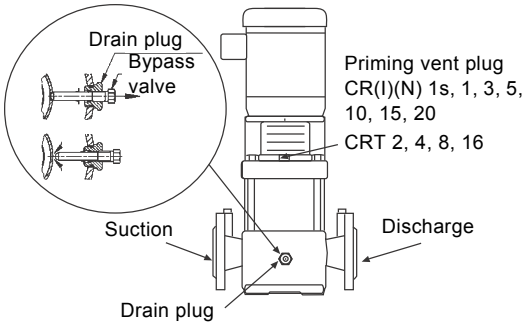
Fig. 12 CRN-SF start-up

9. Commissioning

9.1 Priming

To prime the pump in a closed system or an open system where the water source is above the pump, close the pump isolating valve(s) and open the priming plug on the pump head. See fig. 13, fig. 14, and fig. 15.



TM04 3922 3613

Fig. 13 Position of plugs and bypass valve

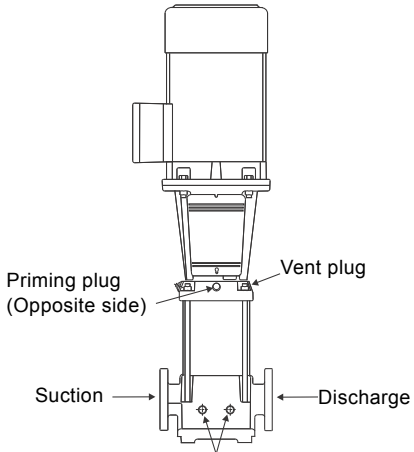


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Fig. 14 Position of plugs CR, CRN 32, 45, 64, 90, 120, 150

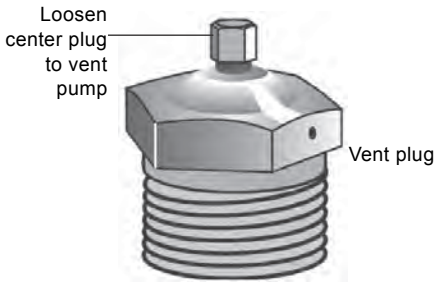

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Fig. 15 Vent plug

In open systems where the water level is below the pump inlet, the suction pipe and pump must be filled with liquid and vented before starting the pump.

1. Close the discharge isolating valve and remove the priming plug.
2. Pour water through the priming hole until the suction pipe and pump are completely filled with liquid. If the suction pipe does not slope downwards away from the pump, the air must be purged while priming the pump.
3. Replace the priming plug and tighten securely.

9.2 Startup

1. Gradually open the isolating valve in the suction line until a steady stream of airless water runs out of the priming hole.
2. Close the plug and tighten securely.
3. Completely open the isolating valves.

For pumps with Cool-Top®, see section *16. Startup of pump with air-cooled top (Cool-Top®)*.

Follow these steps:

1. Switch off the power supply.
2. Check to make sure the pump has been filled and vented.
3. Remove the coupling guard and rotate the pump shaft by hand to make sure it turns freely.
4. Verify that the electrical connections are in accordance with the wiring diagram on the motor.
5. Switch on the power and observe the direction of rotation. When viewed from above, the pump should rotate counter-clockwise (clockwise for CRN-SF).
6. To reverse the direction of rotation, first switch off the power supply.
7. On three-phase motors, interchange any two phases of the power supply.
   On single-phase motors, see wiring diagram on the nameplate. Change wiring as required.
8. Switch on the power again and check for proper direction of rotation. Once direction of rotation has been verified, switch off the power again. Do not attempt to reinstall the coupling guards while the motor is on. Replace the coupling guard if the direction of rotation is correct. When the guards are in place, the power can be switched on again.

Note

For CR, CRI, CRN 1s to 5 it is advisable to open the bypass valve during start-up. See fig. 13. The bypass valve connects the suction and discharge sides of the pump, thus making the filling procedure easier. Close the bypass valve when operation is stable.

Caution

Motors should not be run unloaded or uncoupled from the pump at any time; damage to the motor bearings will occur.

Do not start the pump before priming or venting the pump. See fig. 15. Never let the pump run dry.

10. Operation

10.1 Operating parameters

CR multi-stage centrifugal pumps installed in accordance with these instructions and sized for correct performance will operate efficiently and provide years of service. The pumps are water-lubricated and do not require any external lubrication or inspection. The motors may require periodic lubrication as described in section *12. Maintaining the motor*.

Under no circumstances should the pump be operated for any prolonged periods of time without flow through the pump. This can result in motor and pump damage due to overheating. A properly sized relief valve should be installed to allow sufficient liquid to circulate through the pump to provide adequate cooling and lubrication of the pump bearings and seals.

10.2 Pump cycling

Pump cycling should be checked to ensure the pump is not starting more often than the following max. starts per hour:

Grundfos ML motors:

- 200 times per hour on 1/3 to 5 hp models
- 100 times per hour on 7 1/2 to 15 hp models
- 40 times per hour on 20 to 30 hp models.

Baldor motors:

- 20 times per hour on 1/3 to 5 hp models
- 15 times per hour on 7 1/2 to 15 hp models
- 10 times per hour on 20 to 100 hp models.

Rapid cycling is a major cause of premature motor failure due to overheating of the motor. If necessary, adjust controller to reduce the frequency of starts and stops.

10.3 Boiler feed installations

If the pump is used as a boiler feed pump, make sure the pump is capable of supplying sufficient water throughout its entire evaporation and pressure ranges. Where modulating control valves are used, a bypass around the pump must be installed to ensure pump lubrication. See section *7.3 Minimum inlet pressures*.

10.4 Frost protection

If the pump is installed in an area where frost could occur, the pump and system should be drained during freezing temperatures to avoid damage. To drain the pump, close the isolating valves, remove the priming plug and drain plug at the base of the pump. Do not refit the plugs until the pump is to be used again. Always replace the drain plug with the original or an exact replacement. Do not replace with a standard plug. Internal recirculation will occur, reducing the output pressure and flow.

11. Maintaining the pump

Depending on the conditions and operating time, make the following checks at regular intervals:

- Check that the pump meets the required performance and is operating smoothly and quietly.
- Check that there are no leaks, particularly at the shaft seal.
- Check that the motor is not overheating.
- Remove and clean all strainers or filters in the system.
- Check that the tripping function of the motor overload protection works.
- Check the operation of all controls.
- If the pump is not operated for unusually long periods, maintain the pump in accordance with these instructions. In addition, if the pump is not drained, the pump shaft should be manually rotated or run for short periods of time at monthly intervals.
- In severe-duty applications, pump life may be extended by performing one of the following actions:
  - Drain the pump after each use.
  - Flush the pump with water or other liquid that is compatible with the pump materials and process liquid.
  - Disassemble the pump and thoroughly rinse or wash components in contact with the pumped liquid with water or other liquid that is compatible with the pump materials and process liquid.

If the pump fails to operate or there is a loss of performance, see to *section 17. Diagnosing specific problems*.

12. Maintaining the motor

Warning

Before starting work on the motor, make sure that all power supplies to the motor have been switched off and that they cannot be accidentally switched on. Electric shock can cause serious or fatal injury. Only qualified personnel should attempt installation, operation, and maintenance of this equipment.

12.1 Motor inspection

Inspect the motor approximately every 500 hours of operation or every three months, whichever occurs first. Keep the motor clean and the ventilation openings clear.

Go through the following steps during each inspection:

1. Check that the motor is clean. Check that the interior and exterior of the motor are free of dirt, oil, grease, water, etc. Oily residue, paper, pulp, textile lint, etc. can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure.
2. Use an ohmmeter periodically to ensure that the winding insulation is OK. Record the ohmmeter readings, and immediately investigate any significant drop in insulation resistance.
3. Check all electrical connections to be sure that they are tightened securely.

12.2 Motor lubrication

Electric motors are pre-lubricated from factory and do not require additional lubrication at start-up. Motors without external grease zerks have sealed bearings that cannot be re-lubricated.
Motors with grease zerks should only be lubricated with approved types of grease. Do not over-grease the bearings. Over-greasing will cause increased bearing heat and can result in bearing or motor failure. Do not mix oil-based grease and silicon grease in motor bearings.

Bearing grease will lose its lubricating ability over time.
The lubricating ability of a grease depends primarily on the type of grease, the size of the bearings, the speed at which the bearings operate and the severity of the operating conditions.

Good results can be obtained if the following recommendations are used in your maintenance program. It should also be noted that multistage pumps, pumps running to the left of the performance curve, and certain pump ranges may have higher thrust loads. Pumps with high thrust loads should be greased according to the next service interval level.

Warning

The grease outlet plug MUST be removed before adding new grease.

12.3 Recommended lubricant

Severity of duty	Ambient temperature (max.)	Environment	Approved types of grease
Standard	104 °F (40 °C)	Clean, little corrosion	Grundfos ML motors are greased for life, or the grease type will be stated on the nameplate. Baldor motors are greased with Polyrex EM (Exxon Mobile).
Severe	122 °F (50 °C)	Moderate dirt, corrosion	
Extreme	> 122 °F (50 °C) or class H insulation	Severe dirt, abrasive dust, corrosion	

12.4 Lubricating chart (for motors with grease zerks)

New motors that have been stored for a year or more should be regreased according to the following table:

NEMA (IEC) frame size	Service intervals [hours]			Weight of grease [oz (grams)]	Volume of grease [in^3 (teaspoons)]
	Standard duty	Severe duty	Extreme duty		
Up to and incl. 210 (132)	5500	2750	550	0.30 (8.4)	0.6 (2)
Over 210 up to and incl. 280 (180)	3600	1800	360	0.61 (17.4)	1.2 (3.9)
Over 280 up to and incl. 360 (225)	2200	1100	220	0.81 (23.1)	1.5 (5.2)
Over 360 (225)	2200	1100	220	2.12 (60.0)	4.1 (13.4)

See page 32 of the integrated motor/VFD IOM for lubrication requirements

12.5 Lubricating procedure

Caution

Keep grease free from dirt to avoid damage to motor bearings. If the environment is extremely dirty, contact Grundfos, the motor manufacturer, or an authorized service center for additional information.

Do not mix dissimilar types of grease.

1. Clean all grease zerks. If the motor does not have grease zerks, the bearing is sealed and cannot be greased externally.
2. If the motor is equipped with a grease outlet plug, remove it. This will allow the old grease to be displaced by the new grease. If the motor is stopped, add the recommended amount of grease. If the motor is to be lubricated while running, add a slightly greater quantity of grease.
3. Add grease SLOWLY taking approximately one minute until new grease appears at the shaft hole in the flange or grease outlet plug. Never add more than 1 1/2 times the amount of grease shown in the lubricating chart.

Note

If new grease does not appear at the shaft hole or grease outlet, the outlet passage may be blocked. Contact Grundfos service center or certified motor shop.

4. Let motors equipped with a grease outlet plug run for 20 minutes before replacing the plug.

13. Replacing the motor

Caution

Motors used on CR pumps are specifically selected to our rigid specifications. Replacement motors must be of the same frame size, should be equipped with the same or better bearings and have the same service factor. Failure to follow these recommendations may result in premature motor failure.

If the motor is damaged due to bearing failure, burning or electrical failure, observe the following instructions as to how to remove the motor and how to mount the replacement motor.

Warning

Before starting work on the motor, make sure that the mains switch has been switched off. It must be ensured that the power supply cannot be accidentally switched on.

13.1 Disassembly

Proceed as follows:

1. Disconnect the power supply leads from the motor. Remove the coupling guards.

Note

For CR 1s, 1, 3, 5, 10, 15, and 20: Do not loosen the three hexagon socket head cap screws securing the shaft seal.

2. Use the proper metric hexagon key to loosen the four cap screws in the coupling. Remove coupling halves completely. On CR 1s-CR 20, the shaft pin can be left in the pump shaft. CR, CRN 32, 45, 64, 90, 120, and 150 do not have a shaft pin.
3. Use the correct size spanner to loosen and remove the four mounting bolts joining motor and pump.
4. Lift the motor straight up until the shaft has cleared the motor stool.

13.2 Assembly

Proceed as follows:

1. Remove key from motor shaft, if present, and discard.
2. Thoroughly clean the surfaces of the motor and pump mounting flanges. The motor and shaft must be clean of all oil or grease and other contaminants where the coupling attaches. Place the motor on top of the pump.
3. Turn the terminal box to the desired position by rotating the motor.
4. Insert the four mounting bolts, then tighten diagonally and evenly:
   – for 3/8" bolts (1/2 - 2 hp), torque = 17 ft-lb
   – for 1/2" bolts (3 - 40 hp), torque = 30 ft-lb
   – for 5/8" bolts (50 - 100 hp), torque = 59 ft-lb
   – follow instructions for particular pump model in sections *13.2.2 CR 1s, 1, 3, and 5* to *13.2.5 CR, CRN 32, 45, 64, 90, 120, and 150*.

13.2.1 Torque specifications

Torque specifications for CR, CRI, CRN 1s, 1, 3, 5, 10, 15, and 20 CRT 2, 4, 8, and 16

Coupling screw size	Minimum torque
M6	10 ft-lb
M8	23 ft-lb
M10	46 ft-lb

13.2.2 CR 1s, 1, 3, and 5

1. Insert shaft pin into shaft hole.
2. Mount the coupling halves onto shaft and shaft pin.
3. Fit the coupling screws and leave loose. Check that the gaps on either side of the coupling are even and that the motor shaft keyway is centered in the coupling half as shown in fig. 16.
4. Tighten the screws to the correct torque. See section *13.2.1 Torque specifications*.

13.2.3 CR 10, 15 and 20

1. Insert shaft pin into shaft hole.
2. Insert plastic shaft seal spacer beneath shaft seal collar.
3. Mount the coupling halves onto shaft and shaft pin.
4. Fit the coupling screws and leave loose. Check that the gaps on either side of the coupling are even and that the motor shaft keyway is centered in the coupling half as shown in fig. 16.
5. Tighten the screws to the correct torque. See section *13.2.1 Torque specifications*.
6. Remove plastic shaft seal spacer and hang it on inside of coupling guard.

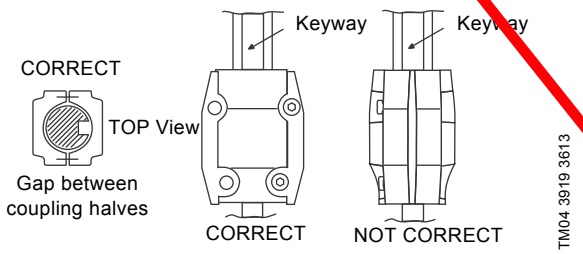

Fig. 16 Coupling adjustment all CR, CRI, CRN, CRT

13.2.4 CRT 2, 4, 8 and 16

1. Mount coupling halves. Make sure the shaft pin is located in the pump shaft.
2. Put the cap screws loosely back into the coupling halves.
3. Using a large screwdriver, raise the pump shaft by placing the tip of the screwdriver under the coupling and carefully raising the coupling to its highest point. See fig. 17.

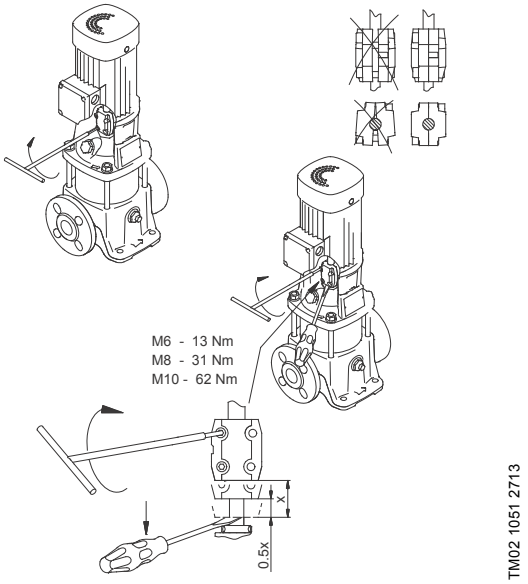

Fig. 17 Coupling adjustment CRT 2, 4, 8, and 16

Note ***The shaft can only be raised approximately 0.20 inches (5 mm).***

4. Now lower the shaft halfway back the distance you just raised it and tighten the coupling screws (finger tight) while keeping the coupling gap equal on both sides. When the screws are tight enough to keep the coupling in place, then cross-tighten the screws.
   - Note the clearance below the coupling.
   - Raise the coupling as far as it will go.
   - Lower it halfway back down (1/2 the distance you just raised it).
   - Tighten screws (see torque specifications).

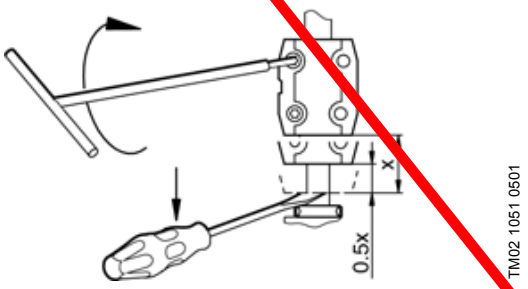

Fig. 18 Coupling adjustment clearance CRT 2, 4, 8, and 16

13.2.5 CR, CRN 32, 45, 64, 90, 120, and 150

1. Make sure pump shaft is all the way down. Tighten the set screws on the mechanical shaft seal.
2. Place the plastic adjusting fork under the cartridge seal collar. See fig. 19.

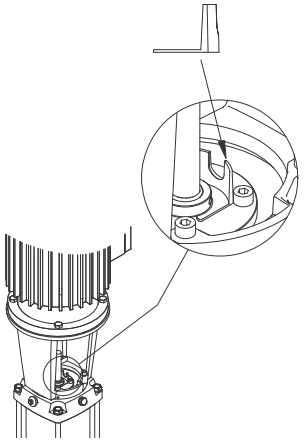

Fig. 19 Coupling adjustment CR, CRN 32, 45, 64, 90, 120, and 150

3. Fit the coupling on the shaft so that the top of the pump shaft is flush with the bottom of the coupling chamber. See fig. 20.

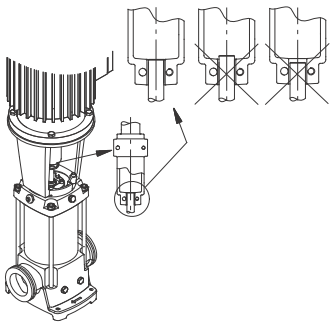

Fig. 20 Coupling adjustment, CR, CRN 32, 45, 64, 90, 120, and 150

Caution ***To avoid damaging the coupling halves, ensure that the motor shaft keyway is centered in the coupling half as shown in fig. 16.***

4. Lubricate the coupling screws with an anti-seize, lubricating compound. Tighten the coupling screws (finger tight) while keeping the coupling gap equal on both sides and the motor shaft keyway centered in the coupling half as shown in fig. 16. When the screws are tight enough to keep the coupling in place, then cross-tighten the screws.
5. Tighten coupling screws to 62 ft-lbs (75 and 100 hp motors to 74 ft-lbs). Remove the adjusting fork from under the cartridge seal collar and replace it to the storage location. See fig. 21.

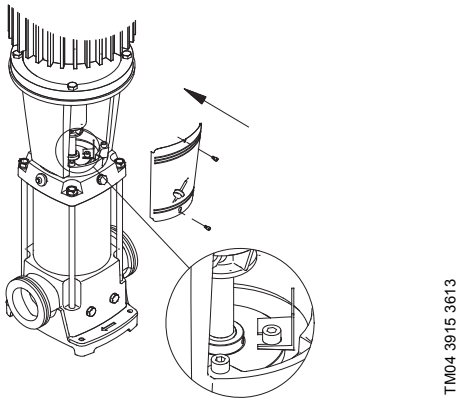

Fig. 21 Adjusting fork storage CR, CRN 32, 45, 64, 90, 120, and 150

6. Check to see that the gaps between the coupling halves are equal. Loosen and readjust, if necessary.
7. Make sure the pump shaft can be rotated by hand. If the shaft cannot be rotated or it jams, disassemble and check for misalignment.
8. Prime the pump.
9. Follow the wiring diagram on the motor label for the correct motor wiring combination which matches your supply voltage. Once this has been confirmed, reconnect the power supply leads to the motor.
10. Check the direction of rotation by bump-starting the motor. Direction of rotation must be left to right (counter-clockwise) when looking directly at the coupling.
11. Switch off the power, then mount the coupling guards. When the coupling guards have been mounted, the power can be switched on again.

14. Parts list

Grundfos offers an extensive parts list for each CR pump model. A parts list typically covers the following items:

- a diagram of pump parts which we recommend to have on hand for future maintenance
- a list of prepacked service kits covering the pump components most likely to be exposed to wear over time
- complete chamber stacks needed to replace the rotating assembly of each model.

These parts lists are available separately from the Grundfos literature warehouse or as a set with extensive service instructions in the Grundfos CR Service Manuals.

TM05 9272 3613

Fig. 22 Prepacked chamber stack kits

TM04 3916 1609

Fig. 23 Prepacked flange kits

14.1 Spare parts

Grundfos offers an extensive list of spare parts for CR pumps. For a current list of these parts, see Grundfos All Product Spare Parts/Service Kits Price List, part number L-SK-SL-002.

15. Preliminary electrical tests

Warning

When working with electrical circuits, use caution to avoid electrical shock. It is recommended that rubber gloves and boots be worn, and metal terminal boxes and motors are grounded before any work is done. For your protection, always disconnect the pump from its power source before handling.

15.1 Supply voltage

15.1.1 How to measure the supply voltage

Use a voltmeter (set to the proper scale) to measure the voltage at the pump terminal box or starter. On single-phase units, measure between power leads L1 and L2 (or L1 and N for 115 volt units). On three-phase units, measure between:

- Power leads L1 and L2
- Power leads L2 and L3
- Power leads L3 and L1.

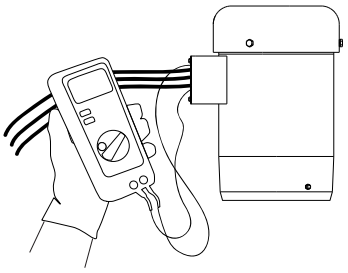

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Fig. 24 Measuring supply voltage

15.1.2 Meaning of supply voltage measurement

When the motor is under load, the voltage should be within + 10 %/- 10 % of the nameplate voltage. Larger voltage variation may cause winding damage. Large variations in the voltage indicate a poor electrical supply and the pump should not be operated until these variations have been corrected. If the voltage constantly remains high or low, the motor should be changed to the correct supply voltage.

15.2 Current

15.2.1 How to measure the current

Use an ammeter (set on the proper scale) to measure the current on each power lead at the terminal box or starter. See the motor nameplate for amp draw information. Current should be measured when the pump is operating at constant discharge pressure.

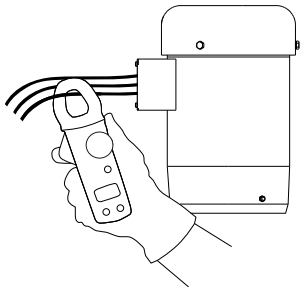

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Fig. 25 Measuring current

15.2.2 Meaning of current measurement

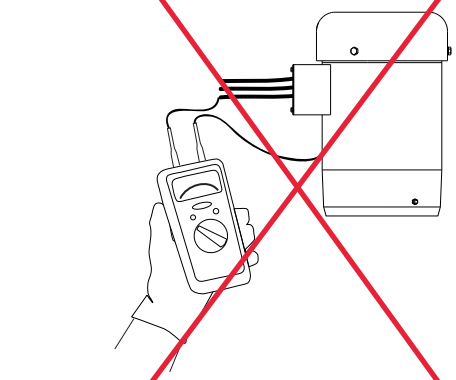
If the amp draw exceeds the listed service factor amps (SFA) or if the current unbalance is greater than 5 % between each leg on three-phase units, check for the following faults:

Fault	Remedy
Burned contacts in the motor-protective circuit breaker.	Replace contacts.
Loose terminals in motor-protective circuit breaker or terminal box or possibly defective lead.	Tighten terminals or replace lead.
Too high or too low supply voltage.	Reestablish correct supply voltage.
Motor windings are short-circuited or grounded. (Check winding and insulation resistances).	Remove cause of short circuit or grounding.
Pump is damaged causing motor overload.	Replace defective pump parts.

15.3 Insulation resistance

15.3.1 How to measure the insulation resistance

Turn off power and disconnect the supply power leads in the pump terminal box. Using an ohmmeter, set the scale selector to R x 100K and zero-adjust the meter.
Measure and record the resistance between each of the terminals and ground.



TM04 3907 2609

Fig. 26 Measuring insulation resistance

15.3.2 Meaning of insulation resistance measurement

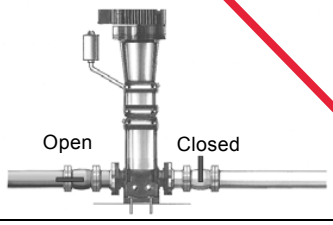
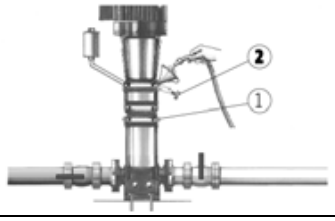
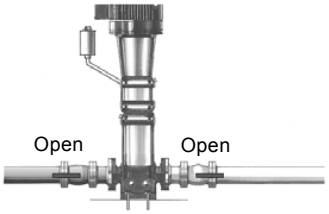
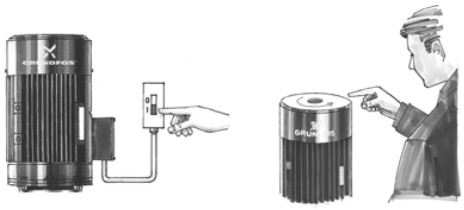
Motors of all hp, voltage, phase and cycle duties have the same value of insulation resistance. Resistance values for new motors must exceed 1,000,000 ohms. If they do not, the motor should be repaired or replaced.

16. Startup of pump with air-cooled top (Cool-Top®)

Caution ***Do not start the pump until it has been filled with liquid and vented.***

Warning

Pay attention to the direction of the vent hole and ensure that the escaping liquid does not cause injury to persons or damage to the motor or other components. In hot-liquid installations, pay special attention to the risk of injury caused by scalding hot liquid. We recommend you to connect a drain pipe to the 1/2" air vent in order to lead the hot water/steam to a safe place.

Step		Action
1	 TM02 4151 5001	The air-cooled top should only be started up with cold liquid. Close the isolating valve on the discharge side and open the isolating valve on the suction side of the pump.
2	 TM02 4153 1503	Remove the priming plug from the air-cooled chamber (pos. 2) and slowly fill the chamber with liquid. When the chamber is completely filled with liquid, replace the priming plug and tighten securely.
3	 TM02 5907 1503	Open the isolating valve on the discharge side of the pump. The valve may have to be partially closed when the pump is started if there is no counter pressure (i.e. boiler not up to pressure).
4	 TM01 1406 3702 - TM01 1405 4497	Start the pump and check the direction of rotation. See the correct direction of rotation of the pump on the motor fan cover. If the direction of rotation is wrong, interchange any two of the incoming power supply leads. After 3 to 5 minutes, the air vent has been filled with liquid. Note ***During start-up of a cold pump with hot liquid, it is normal that a few drops of liquid are leaking from the sleeve.***

17. Diagnosing specific problems

Warning

Before removing the terminal box cover and before removing/dismantling the pump, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

Problem	Possible cause	Remedy
1. The pump does not run.	a) No power to motor.	Check voltage to motor terminal box. If no voltage to motor, check starter panel for tripped circuits and reset circuits.
	b) Fuses blown or circuit breaker tripped.	Turn off power and remove fuses. Check for continuity with ohmmeter. Replace blown fuses or reset circuit breaker. If new fuses blow or circuit breaker trips, the electrical installation, motor and wires must be checked.
	c) Motor starter overload protection burned or tripped out.	Check for voltage on line and load side of starter. Replace or reset burned motor protection. Inspect starter for other damage. If protection trips again, check the supply voltage and starter holding coil.
	d) Starter does not energize.	Energize control circuit and check for voltage to the holding coil. If no voltage, check control circuit fuses. If voltage, check holding coil for short circuits. Replace bad coil.
	e) Defective control devices.	Check that all safety and pressure switches function correctly. Inspect contacts in control devices. Replace worn or defective parts or control devices.
	f) Motor is defective.	Turn off power and disconnect wiring. Measure the lead-to-lead resistances with ohmmeter (RX-1). Measure lead-to-ground values with ohmmeter (RX-100K). Record measured values. If an open or grounded winding is found, remove motor and repair or replace it.
	g) Defective capacitor (single-phase motors).	Turn off power and discharge capacitor. Check with ohmmeter (RX-100K). When the meter is connected to the capacitor, the needle should jump towards 0 ohms and slowly drift back to infinity (h). Replace capacitor if defective.
	h) Pump is blocked or seized.	Turn off power and manually rotate pump shaft. If shaft does not rotate easily, check coupling setting and adjust as necessary. If shaft rotation is still tight, remove pump and inspect. Disassemble and repair the pump.

Problem	Possible cause	Remedy
2. The pump runs but at reduced performance or does not deliver water.	a) Wrong direction of rotation.	Check wiring for proper connections. Correct wiring.
	b) Pump is not primed or is air-bound.	Turn pump off, close isolation valve(s) and remove priming plug. Check liquid level. Refill the pump, replace plug and start the pump. Long suction lines must be filled before starting the pump.
	c) Strainers, check or foot valves are clogged.	Remove strainer, screen or check valve and inspect. Clean and replace. Reprime pump.
	d) Suction lift too large.	Install compound pressure gauge at the suction side of the pump. Start pump and compare reading to performance data. Reduce suction lift by lowering pump, increase suction line size or removing high friction loss devices.
	e) Suction and/or discharge pipes leaking. (Pump spins backwards when turned off)	Air in suction pipe. Suction pipe, valves and fittings must be airtight. Repair any leaks and retighten all loose fittings.
	f) Pump worn.	Install pressure gauge, start pump, gradually close the discharge valve and read pressure at shutoff. Convert measured pressure (in psi) to head (in feet): (Measured psi x 2.31 ft/psi = ___ ft). Refer to the specific pump curve for shutoff head for that pump model. If head is close to curve, pump is probably OK. If not, remove pump and inspect.
	g) Pump impeller or guide vane is clogged.	Disassemble and inspect pump passageways. Remove any foreign materials found.
	h) Incorrect drain plug installed.	If the proper drain plug is replaced with a standard plug, water will recirculate internally. Replace with proper plug.
	i) Improper coupling setting.	Check/reset the coupling. See page 18.
3. Pump cycles too much	a) Pressure switch is not properly adjusted or is defective.	Check that pressure switch is set and functions correctly. Check voltage across closed contacts. Readjust switch or replace if defective.
	b) Level control is not properly adjusted or is defective.	Check that level control is set and functions correctly. Readjust setting (refer to level control manufacturer's data). Replace if defective.
	c) Insufficient air charging or leaking tank or piping.	Pump air into tank or diaphragm chamber. Check diaphragm for leaks. Check tank and piping for leaks with soap and water solution. Check air-to-water volume. Repair as necessary.
	d) Tank is too small.	Check tank size and air volume in tank. Tank volume should be approximately 10 gallons for each gpm of pump performance. The normal air volume is 2/3 of the total tank volume at the pump cut-in pressure. Replace tank with one of correct size.
	e) Pump is oversized.	Install pressure gauges on or near pump suction and discharge ports. Start and run pump under normal conditions, record gauge readings. Convert psi to feet (Measured psi x 2.31 ft/psi = ____ ft) Refer to the specific pump curve for that model, ensure that total head is sufficient to limit pump delivery within its design flow range. Throttle pump discharge flow if necessary.

Problem	Possible cause	Remedy
4. Fuses blow or circuit breakers or overload relays trip	a) Tank is too small.	Check voltage at starter panel and motor. If voltage varies more than - 10 %/+ 10 %, contact power company. Check wire sizing.
	b) Motor overload protection set too low.	Cycle pump and measure amperage. Increase size of overload protection or adjust trip setting to maximum motor nameplate (full load) current.
	c) Three-phased current is imbalanced.	Check current draw on each lead to the motor. Must be within - 5 %/+ 5 %. If not, check motor and wiring. Rotating all leads may eliminate this problem.
	d) Motor short-circuited or grounded.	Turn off power and disconnect wiring. Measure the lead-to-lead resistance with an ohmmeter (RX-1). Measure lead-to-ground values with an ohmmeter (RX-100K). Record values. If an open or grounded winding is found, remove the motor, repair and/or replace.
	e) Wiring or connections are faulty.	Check proper wiring and loose terminals. Tighten loose terminals. Replace damaged wires.
	f) Pump is blocked or seized.	Turn off power and manually rotate pump shaft. If shaft does not rotate easily, check coupling setting and adjust as necessary. If shaft rotation is still tight, remove pump and inspect. Disassemble and repair the pump.
	g) Defective capacitor (single-phase motors).	Turn off power and discharge capacitor. Check with ohmmeter (RX-100K). When the meter is connected to the capacitor, the needle should jump towards 0 ohms and slowly drift back to infinity (∞). Replace capacitor if defective.
	h) Motor overload protection devices at higher ambient temperature than motor.	Use a thermometer to check the ambient temperature near overload protection devices and motor. Record these values. If ambient temperature at motor is lower than at overload protection devices, especially where temperature at overload protection devices is above 104 °F (40 °C), replace standard protection devices with ambient compensated protection devices.

18. Worksheet for three-phase motors

Below is a worksheet for calculating current unbalance on a three-phase hookup. Use the calculations below as a guide.

Note

Current unbalance should not exceed 5 % at service factor load or 10 % at rated input load. If the unbalance cannot be corrected by rolling the leads, the source of the unbalance must be located and corrected. If, on the three possible hookups, the leg farthest from the average stays on the same power lead, most of the unbalance is coming from the power source. However, if the reading farthest from the averages moves with the same motor lead, the primary source of unbalance is on the "motor side" of the starter. In this instance, consider if the cause can be a damaged cable, an untight cable splice, a poor connection, or a faulty motor winding.

Explanation and examples	
Here is an example of current readings at maximum pump loads on each leg of a three-wire hookup. You must make calculations for all three hookups. To begin, add up all three readings for hookup numbers 1, 2, and 3.	**Hookup 1** T1 = 51 amps T2 = 46 amps T3 = 53 amps TOTAL = 150
Divide the total by three to obtain the average.	**Hookup 1** 50 amps 3 | 150 amps
Calculate the greatest current difference from the average.	**Hookup 1** 50 amps — 46 amps 4 amps
Divide this difference by the average to obtain the percentage of the unbalance. In this case, the current unbalance for **Hookup 1** is 8 %.	**Hookup 1** .08 or 8 % 50 | 4.00 amps

Blank worksheet

Hookup 1	Hookup 2	Hookup 3
L_1 to T_1 = ___ amps	L_1 to T_3 = ___ amps	L_1 to T_2 = ___ amps
L_2 to T_2 = ___ amps	L_2 to T_1 = ___ amps	L_2 to T_3 = ___ amps
L_3 to T_3 = ___ amps	L_3 to T_2 = ___ amps	L_3 to T_1 = ___ amps
TOTAL = ___ amps	TOTAL = ___ amps	TOTAL = ___ amps
___ amps 3 | ___ amps	___ amps 3 | ___ amps	___ amps 3 | ___ amps
___ amps ___ amps ___ amps	___ amps ___ amps ___ amps	___ amps ___ amps ___ amps
___ or ___ % ___ | ___ amps	___ or ___ % ___ | ___ amps	___ or ___ % ___ | ___ amps

19. Disposal

This product or parts of it must be disposed of in an environmentally sound way:

1. Use the public or private waste collection service.
2. If this is not possible, contact the nearest Grundfos company or service workshop.

Subject to alterations.

Company name:
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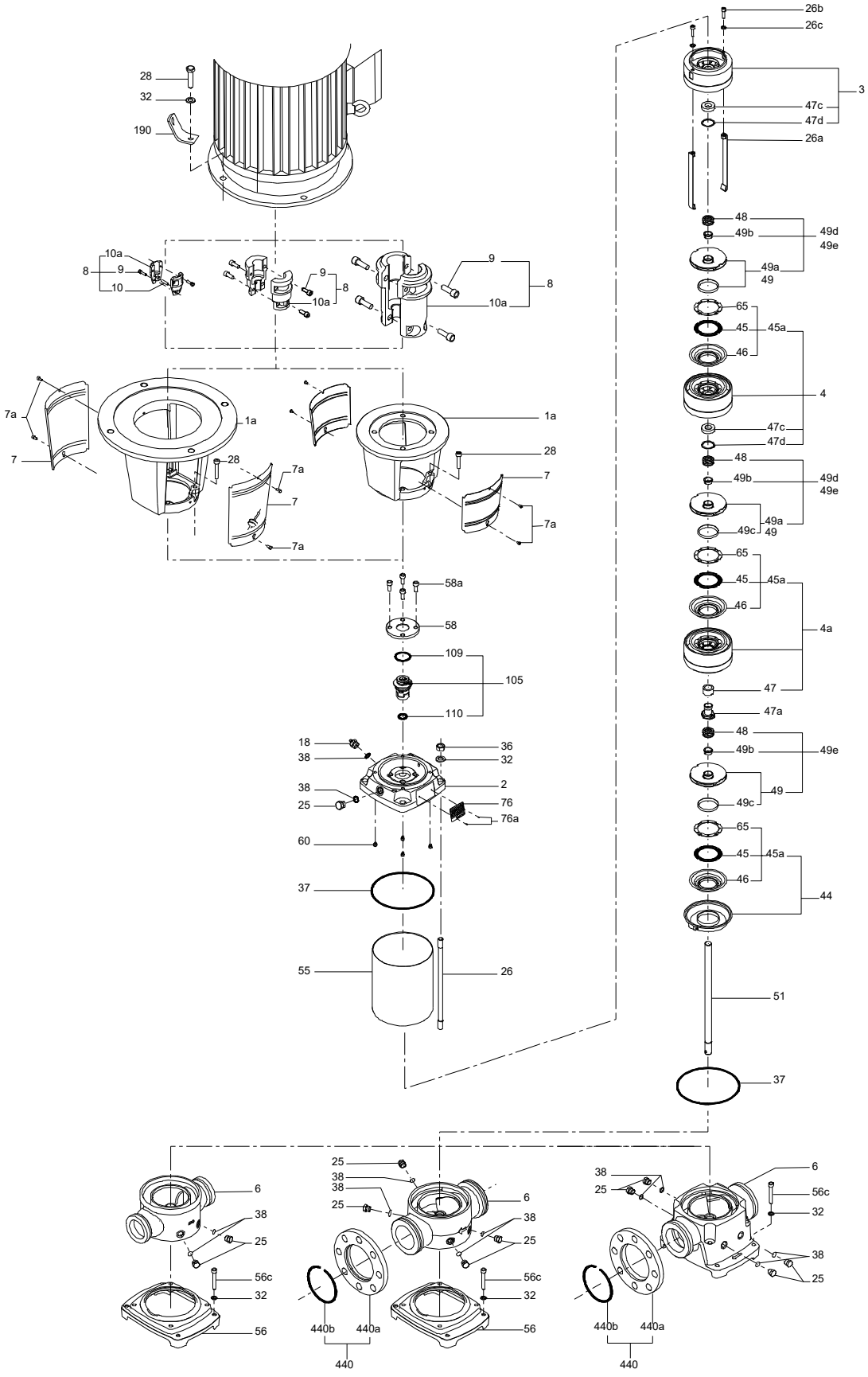
Phone:

Date: 05/05/2022

(tm069487 for LACR model B standard)



TM069487

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Date: 05/05/2022

Spare parts CRNE 64-2, Product No. 98183946
Produced After 1410 (production year and week number)

	Pos	Description	Annotation	Classification Data	Part no.	Qty.	Unit
-		Base			96587697	1	pcs
	6	Base				1	
-		Kit, Coupling			92591181	1	pcs
		Adjusting fork				1	
-	8	Coupling cpl.				1	
	10a	Coupling					
	9	Hex socket head cap screw		Designation: DIN 912		4	
				Length (mm): 25			
				Thread: M10			
-		Kit, Coupling guard			96505135	1	pcs
	7a	Socket button head screw				4	
	7	Coupling guard				2	
-		Kit, Gaskets			96416599	1	pcs
		Adjusting fork				1	
	37	O-ring				2	
	38	O-ring				2	
	38	O-ring				4	
	60	Spring				4	
	109	O-ring				1	
	110	O-ring		Diameter: 21,2		1	
				Material type: EPDM			
				Thickness: 3,55			
-		Kit, Lower bearing			96416580	1	pcs
		Hex socket head cap screw		Length (mm): 50		1	
				Thread: M8			
		Service tool				1	
		Adjusting fork				1	
	31	Hex socket head cap screw				1	
	32	Washer		Designation: DIN 125A		1	
				Internal diameter: 6,4			
				Outer diameter: 12,0			
				Thickness: 1,6			
	47b	Bearing ring, rotating				1	
	47b	Bearing ring, stationary				1	
	66	Wedge lock washer				1	
	66	Washer				1	
	67	Hex socket head cap screw		Designation: DIN 912		1	
				Length (mm): 16			
				Thread: M8			
-		Kit, Plug			96505136	1	pcs
-	18	Air vent screw				1	
		Spindle					
		Plug					
	25	Plug				4	
	25	Plug				1	
	38	O-ring				2	
	38	O-ring				4	
	38	O-ring		Diameter: 16,3		2	
				Material type: FKM			
				Thickness: 2,4			
	38	O-ring		Diameter: 16,3		4	
				Material type: FKM			
				Thickness: 2,4			

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Phone:

Date: 05/05/2022

Pos	Description	Annotation	Classification Data	Part no.	Qty.	Unit
38	O-ring		Diameter: 16,3		6	
			Material type: FKM			
			Thickness: 2,4			
-	Kit, Shaft seal HQQE			96525458	1	pcs
	Grinding device				1	
- 105	Shaft seal		Material type: HQQE		1	
	Adjusting fork					
109	O-ring					
110	O-ring		Diameter: 21,5			
			Material type: EPDM			
			Thickness: 4,25			
-	Kit, Wear parts			96416735	1	pcs
	Adjusting fork				1	
45	Seal ring				2	
45	Seal ring				2	
49c	Wear ring				2	
65	Top f/neck ring				2	
65	Top f/neck ring				2	
-	Motor				1	pcs
-	Kit, Bearing cpl.			96796812	1	
153	Angular-contact bearing		Designation: 7310B			
154	Ball bearing					
158	Waved washer					
159	V-ring					
-	Kit, Bearing plate			96796809	1	
155.a	Cover					
208a	Gasket					
208	Hex socket head cap screw		Designation: DIN912			
			Length (mm): 40			
			Thread: M5			
-	Kit, Connector plugs			96348923	1	
	Connector plug 5-pole					
	Connector plug 4-pole					
	Connector plug 4-pole					
	Connector plug 3-pole					
	Connector plug 3-pole					
	Connector plug 3-pole					
	Connector plug 3-pole					
	Connector plug					
- 273	Kit, Control board			96348918	1	
	Service kit instruction					
	Controlboard					
-	Kit, Eyebolt			96796712	1	
189	Eyebolt					
-	Kit, Fan cover			96830826	1	
151	Fan cover					
152.a	Rubber bush					
152	Hex head cap screw					
196	Diaphragm					
-	Kit, Flange			96831195	1	
	Flange					
159.b	Seal ring					
185.b	Nut					
185	Hex socket head cap screw					
186	Drain plug					
195a	Grease nipple					
-	Kit, Funct. module - adv. I/O			96348936	1	
263	Add-on module, cpl. w/plugs					
-	Kit, Funct. module -Geni/RS485			96348932	1	

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	Pos	Description	Annotation	Classification Data	Part no.	Qty.	Unit
	263	Add-on module, cpl. w/plugs					
-		Kit, Gaskets			96798508	1	
	184	O-ring		Diameter: 235			
	275	Kit, Inverter board			96348920	1	
-		Kit, Lubrication nipple			96796671	1	
	195b	Grease nipple					
	195a	Grease nipple					
-		Kit, ND-end shield cpl.			96796810	1	
	156a	End shield NDE					
	158	Waved washer					
	159	V-ring					
	185.c	Nut					
	185.a	Hex socket head cap screw					
	195b	Grease nipple					
-		Kit, Opr. panel			96348924	1	
	259	Operation panel					
	274	Kit, Rectifier board			96348921	1	
-		Kit, Terminal box			96348914	1	
		Cover					
	164	Cover cpl.					
	166	Pan head thread forming screw					
	166	Pan head thread forming screw					
	251	Terminal box					
	277	Blind cover					
	283	Motor cover cpl.					
	284	Cover					
-		Kit, Varistor			96348917	1	
	279.b	Pan head thread forming screw					
	279	Varistor					
	1a	Motor stool			99430476	1	pcs
	2	Pump head			96587726	1	pcs
-	3	Upper chamber cpl.			98634150	1	pcs
	47c	Bush			99321194	1	
-	4a	Intermediate chamber cpl.			99262947	1	pcs
	45a	Neck ring cpl.			96547434	1	
	45a	Neck ring cpl.			98678220	1	
	47	Bearing			99964632	1	
	47	Bearing			99928986	1	
	7a	Socket button head screw			96549696	4	pcs
	7	Coupling guard			96603279	2	pcs
	9	Hex socket head cap screw		Designation: DIN 912	99789390	4	pcs
				Length (mm): 25			
				Thread: M10			
+	18	Air vent screw			96547461	1	pcs
+	18	Air vent screw			95061351	1	pcs
	25	Plug			96536013	1	pcs
	26c	Washer		Designation: DIN 125A	99262704	2	pcs
				Thickness: 1,6			
	26c	Washer		Designation: DIN 125A	99886930	2	pcs
				Thickness: 1,6			
	26b	Hex socket head cap screw			98931380	2	pcs
	26a	Strap cpl.		Length (mm): 174,5	98983897	2	pcs
				Thread: M8			
	26	Staybolt		Length (mm): 396	98976741	4	pcs
				Thread: M16			
	28	Hex socket head cap screw		Designation: DIN 912	96536147	4	pcs
				Length (mm): 50			
				Thread: M10			

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	Pos	Description	Annotation	Classification Data	Part no.	Qty.	Unit
	32	Washer		Designation: DIN 125 A2	99944260	4	pcs
				Internal diameter: 17			
				Outer diameter: 30			
				Thickness: 3			
	36	Nut		Thread: M16	99944257	4	pcs
	37	O-ring			96536142	1	pcs
	37	O-ring		Diameter: 216	96536144	1	pcs
				Material type: FKM			
				Thickness: 4			
	38	O-ring			99198815	4	pcs
	38	O-ring		Diameter: 16,3	99198813	2	pcs
				Material type: FKM			
				Thickness: 2,4			
	38	O-ring			99412727	4	pcs
	38	O-ring		Diameter: 16,3	99412883	2	pcs
				Material type: FKM			
				Thickness: 2,4			
-	44	Suction interconnector cpl.			98634153	1	pcs
	45	Seal ring			96536030	1	
	65	Top f/neck ring			96536014	1	
+	47a	Bearing cpl.			99270649	1	pcs
+	47a	Bearing cpl.			96535951	1	pcs
-	49e	Impeller cpl.			98394372	2	pcs
	48	Nut			99262680	1	
	48	Nut			99262683	1	
	48	Nut			96536016	1	
	49b	Split cone			96536010	1	
	49c	Wear ring			96535879	1	
	51	Shaft			98506333	1	pcs
	55	Outer sleeve			96587888	1	pcs
	58	Cover			98893158	1	pcs
	60	Spring			96536032	4	pcs
-	105	Shaft seal		Material type: HQQE	96984070	1	pcs
		Adjusting fork			96587896	1	
	109	O-ring			99651108	1	
	109	O-ring			96547586	1	
	440b	Lock ring			96547435	1	pcs

CR, CRI, CRN 32-90 Model B

Standard model

Service instructions

Service Manual for Pump Wet End Only

For integrated motor/VFD service, contact local Grundfos distributor:
Carlsen Systems
203-663-1314
info@carlsensystems.com

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Original service instructions.

CONTENTS

Warning

Prior to service work, read these service instructions carefully. Installation and service work must comply with local regulations and accepted codes of good practice.

Observe the safety instructions in the installation and operating instructions for the product.

1. Symbols used in this document

Warning

If these safety instructions are not observed, it may result in personal injury.

Warning

If these instructions are not observed, it may lead to electric shock with consequent risk of serious personal injury or death.

Caution ***If these safety instructions are not observed, it may result in malfunction or damage to the equipment.***

Note ***Notes or instructions that make the job easier and ensure safe operation.***

2. General information

Position numbers of parts (digits) refer to drawings and parts lists; position numbers of tools (letters) refer to section *3. Service tools*.

Warning

If there is a risk of getting into contact with the pumped liquid, use personal protective equipment.

Observe local regulations.

Before dismantling

Warning

Switch off the power supply and make sure that it cannot be accidentally switched on.

Check that other pumps or sources do not force flow through the pump even if the pump is stopped. This will cause the motor to act like a generator, resulting in voltage on the pump.

- Close the isolating valves, if fitted, and make sure that they cannot be accidentally opened.
- Before starting work on the product, let the product and pumped liquid cool off.

Before assembly

- Clean and check all parts.
- Replace defective parts with new parts.
- Always replace gaskets and O-rings.

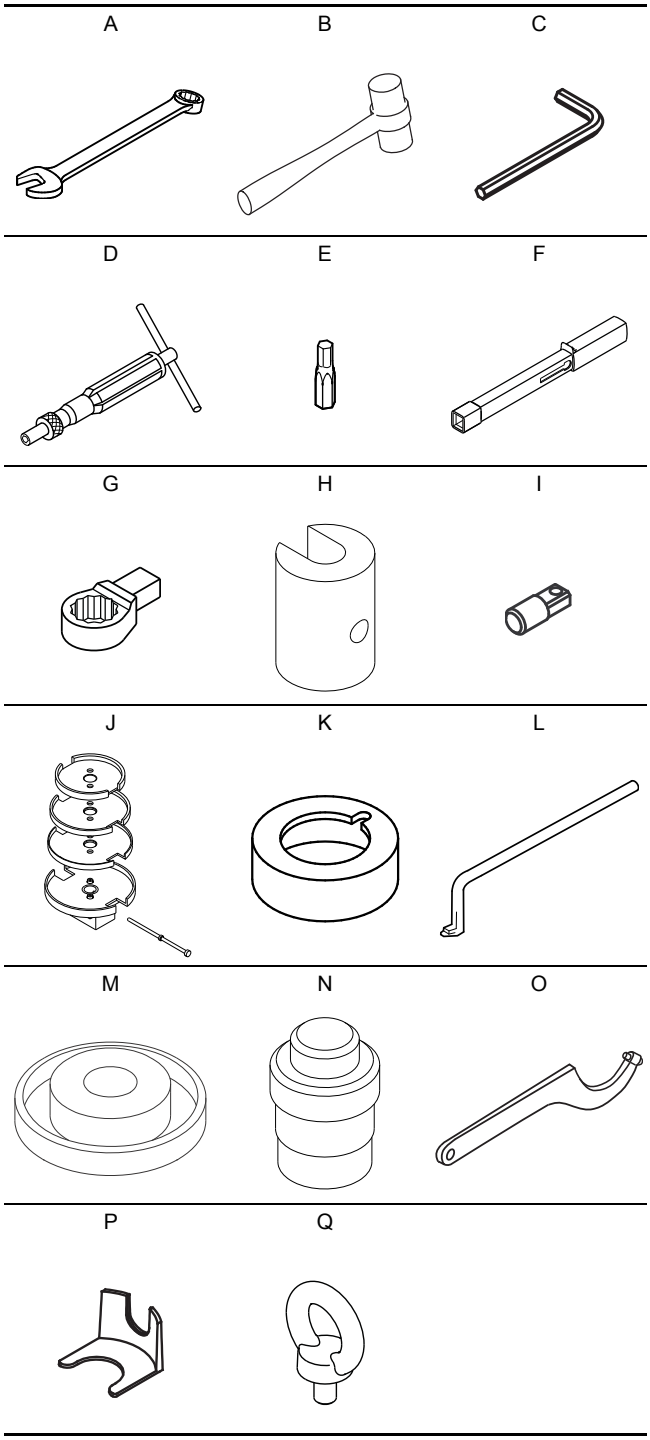
During assembly

- Tighten screws and nuts according to section *4. Torques*.
- Lubricate rings and screws according to section *5. Lubricants*.

After assembly

- If analog or digital inputs, the relay output or the CIM module has been removed from the pump, you must check the communication with external units after service.

3. Service tools



Pos.	Designation	For pos.	Tool size	Product No
A	Ring/open-end spanner	18, 23	24	SV0122
		28	8	SV0273
		36	24	SV0122
B	Rubber hammer			SV0349
C	Hexagon key	9	8	SV0032
		113	3	-
		28	8	SV0032
		58a	8	SV0032
D	Torque screwdriver	113, 7a	1-6 Nm	SV0435 SV0438
E	Hexagon bit	9	8	-
		113	3	-
		28	8	-
F	Torque wrench	9, 18, 23, 28, 36, 58	20-100 Nm	SV0269
G	Ring insert tool	18, 23	24	SV0524
		28	8	SV0411
		36	24	SV0524
H	Key for split cone nut	48	34	SV0004
I	Tap for key for split cone nut	48-K	∅14 mm 9 x 12 mm	SV0403
J	Holder with pin for dismantling and assembly	80	-	CR(N) 32 SV0003-3
				CR(N) 45 SV0003-4
				CR(N) 64 SV0003-5
				CR(N) 90 SV0003-2
K	Holder for wear ring	49c	-	CR(N) 32 SV0043
				CR(N) 45 SV0044
				CR(N) 64 SV0045
				CR(N) 90 SV0046
L	Puller for wear ring	49c	-	SV0239
M	Punch for complete neck ring	45a	-	CR(N) 32 SV0025
				CR(N) 45 SV0027
				CR(N) 64 SV0028
				CR(N) 90 SV0029
N	Punch for bush	47c-47d	-	98369955
O	Hook spanner	49-49a	-	SV0031
P	Adjusting fork	105	22	985924
Q	Eye bolt	28b		ID2779

4. Torques

Pos.	Description	Dimensions	Torque (Nm)
7a	Coupling guard screws	-	6
9	Coupling screws	M10 x 25 mm	85
18	Air vent screws	-	35
23	Drain plugs	1/2"	
26b	Screws for straps	-	15
28	Motor stool screws	M10 x 50 mm	62
36	Pump head nuts	M16	100
48	Spit cone nut	-	70
58a	Seal carrier screws	M10 x 25 mm	62
113	Shaft seal set screws	-	6

5. Lubricants

Pos.	Description	Lubricant	Product No
9	Coupling screws	THREAD-EZE	00SV9997
28	Motor stool screws		
58a	Seal carrier screws		
51	Shaft	Soapy water	-
105	Shaft seal		
37	O-ring pump housing	Rocol Sapphire Aqua-Sil	00RM2924
47	Bearing ring		
109	O-ring shaft seal		
110	O-ring shaft seal		

6. Pump dismantling

Position numbers refer to the drawings in section *11. Exploded views*.

6.1 Motor

Caution ***To prevent the motor from tipping over, hold it straight when using a lifting device.***

1. Remove screws (pos. 7a) and coupling guards (pos. 7).
2. Remove screws (pos. 9) and coupling (pos. 8). It may be necessary to loosen the coupling with a rubber hammer.
3. Attach lifting device to eyebolts (pos. 28b).
4. Remove screws (pos. 28). Lift and remove motor and motor stool (pos. 1a).

6.2 Shaft seal and pump head

5. Remove screws (pos. 58a) and retainer (pos. 58).
6. Clean end of shaft (pos. 51).
7. Slacken set screws (pos. 113) of shaft seal (pos. 105).
8. Carefully press shaft seal out of pump head (pos. 2) using two slot screwdrivers, and pull it off the shaft. See fig. 1.

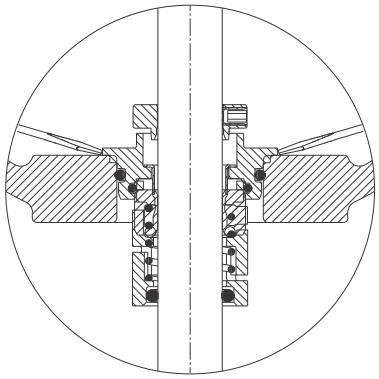


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Fig. 1 Removing upper shaft seal

9. Remove nuts (pos. 36) and washers (pos. 66a).
10. Remove pump head (pos. 2). It may be necessary to loosen it with a rubber hammer.

6.3 Chamber stack

6.3.1 Fitting chamber stack on the holder

11. Place the holder for dismantling and assembly in a vice and tighten it. See fig. 2 for right positioning.
12. Pull the chamber stack out of the outer sleeves (pos. 55) and place it in the holder according to fig. 2. Make sure the chamber stack engages with the holder.
13. Fit the locking pin in the hole marked "Dismantling".

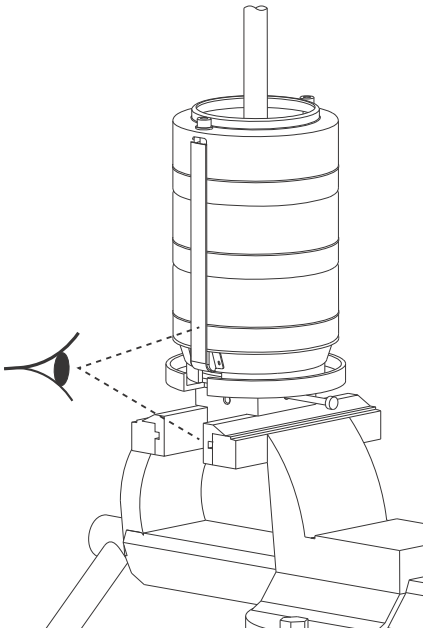

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Fig. 2 Positioning the chamber stack in the holder

14. Remove screws (pos. 26b) and washers (pos. 26c).
15. Remove straps (pos. 26a).

6.3.2 Dismantling chambers

Depending on their construction, dismantle the chambers according to the instructions below. The symbols refer to section *10. Order of assembly for chambers and impellers*.

Single chamber

Fig. 3 Single chamber

1. Pull apart the rotating spring of the bearing (pos. 47a) and remove the bearing.
2. Hold impeller (pos. 49) with the hook spanner, and slacken split cone nut (pos. 48) using the key for split cone nut. Knock the nut to loosen the impeller from the split cone (pos. 49b).
3. Pull the split cone nut, split cone and impeller off the shaft.

Top chamber and chamber without bearing

Fig. 4 Left: top chamber; right: chamber without bearing

1. Loosen chamber (pos. 3) from the chamber below using a screwdriver, and remove it.
2. Hold impeller (pos. 49) with the hook spanner, and slacken split cone nut (pos. 48) using the key for split cone nut. Turn the key around, and knock the nut to loosen the impeller from split cone (pos. 49b).
3. Pull the split cone nut, split cone and impeller off the shaft.

Chamber with bearing

Fig. 5 Chamber with bearing

1. Loosen chamber (pos. 4a) from the chamber below or inlet part (pos.44) using a screwdriver.
2. Loosen bearing ring (pos. 47a) from split cone nut (pos. 48) and pull it off the shaft.
3. Hold impeller (pos. 49) with the hook spanner, and slacken split cone nut (pos. 48) using the key for split cone nut. Turn the key around, and knock the nut to loosen the impeller from split cone (pos. 49b).
4. Pull the split cone nut, split cone and impeller off the shaft.
5. When the last impeller has been removed, inlet part (pos. 44) can be lifted off the holder.

7. Checking chamber parts

Position numbers refer to the drawings in section *11. Exploded views*.

Check the distance between parts 1 and 2. See the table below. If the distance is superior to the maximum tolerance indicated, replace the parts.

Fig.	Part 1		Part 2		Max. tolerance [mm]
	Pos.	Description	Pos.	Description	
6	47c	Bush	51	Shaft	1.0
7	47	Bearing ring	47a	Driver	0.3

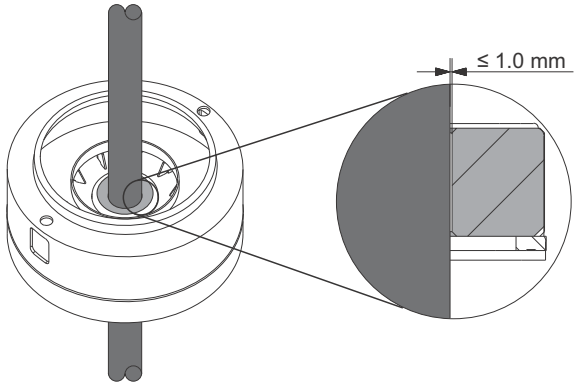

Fig. 6 Tolerance between bush and shaft

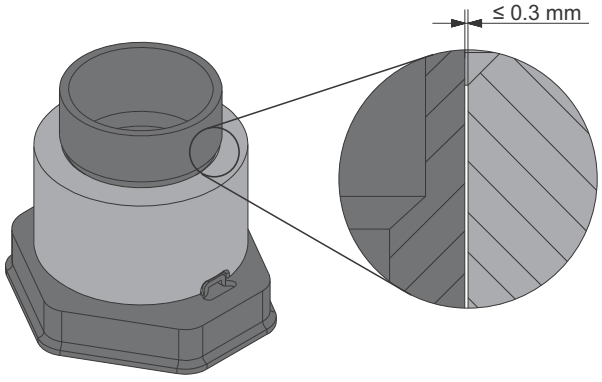

Fig. 7 Tolerance between bearing ring and driver

8. Replacing chamber parts

Position numbers refer to the drawings in section *11. Exploded views*.

8.1 Complete neck ring (pos. 45a)

8.1.1 Dismantling

1. Push the complete neck ring up and free from chamber (pos. 4/4a) or inlet part (pos. 44) using a screwdriver. See fig. 8.

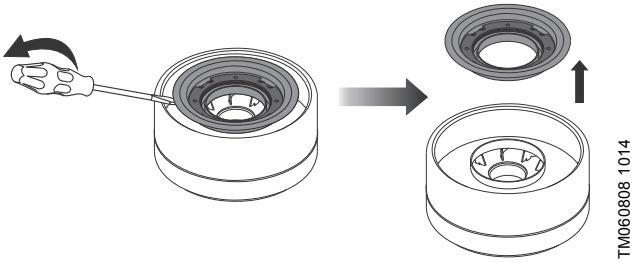

Fig. 8 Removing complete neck ring

2. Push neck ring retainer (pos. 65) up and free from cup (pos. 46) using a screwdriver, and remove neck ring (pos. 45). See fig. 9.

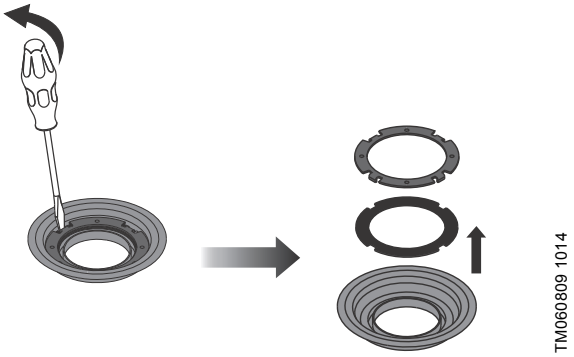

Fig. 9 Removing neck ring

8.1.2 Assembly

1. Place neck ring (pos. 45) in cup (pos. 46).
2. Fit neck ring retainer (pos. 65) with the four driving dogs pointing downwards. Turn the neck ring retainer until it engages with the neck ring.
3. Knock/press the neck ring retainer home against the cup using the punch for complete neck ring. Check that the measurement is within the tolerance range. See fig. 10.

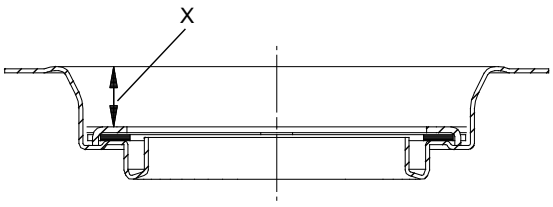

Fig. 10 Measure distance between retainer and top of cup

Pump	Nominal height, X [mm]	Tolerance range [mm]
CR(N) 32	10.1	± 0.2
CR(N) 45	15.5	
CR(N) 64	11.5	
CR(N) 90	12.1	

Note ***It should be possible to move the neck ring freely (sideways) between the neck ring retainer and the cup.***

4. Fit the complete neck ring in chamber (pos. 4/4a) or inlet part (pos. 44) and knock/press it home using the punch for complete neck ring.

8.2 Wear ring (pos. 49c)

8.2.1 Dismantling

1. Fit the holder on the impeller. The wear ring should come out in the centre of the holder. See fig 11.
2. Place the impeller and holder on a flat surface, the wear ring uppermost.
3. Push the wear ring up and free of the impeller using the puller. See fig. 11.

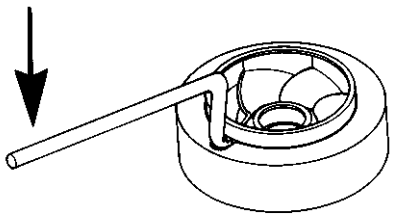

Fig. 11 Removing wear ring

8.2.2 Assembly

Press wear ring (pos. 49c) carefully down over impeller skirt (pos. 49/49a).

Caution ***Make sure to push the ring straight down against the impeller skirt. Make sure not to damage the impeller.***

8.3 Bush (pos. 47c) and retaining ring (pos. 47d)

8.3.1 Dismantling

Place the chamber on a flat surface, and press the bush and retaining ring down using the punch for bush.

8.3.2 Assembly

Place the chamber on a level and solid surface with complete neck ring (pos. 45a) facing downwards, and press the bush and retaining ring home against the chamber using the punch for bush.

9. Pump assembly

Position numbers refer to the drawings in section *11. Exploded views*.

9.1 Chamber stack

9.1.1 Fitting the inlet part

1. Place the holder for dismantling and assembly in a vice and tighten it.
2. Place the shaft and inlet part (pos. 44) in the holder according to fig. 12. Make sure that the inlet part engages with the holder.

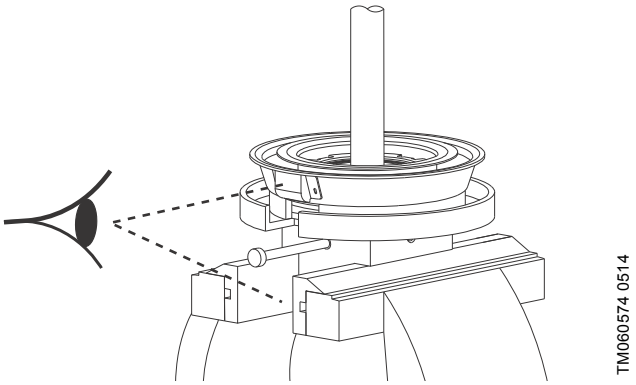

Fig. 12 Placing the shaft and inlet part in the holder

3. Fit the locking pin in the hole marked "Assembly".
1. Fit impeller (pos. 49) onto the shaft and press it home in the inlet part.
2. Fit split cone (pos. 49b) and knock it into the impeller hub using the key for split cone nut.
3. Hold the impeller with the hook spanner and tighten split cone nut (pos. 48).
4. Remove the shaft from the holder and check that the impeller flushes with the shaft groove. See fig. 13.

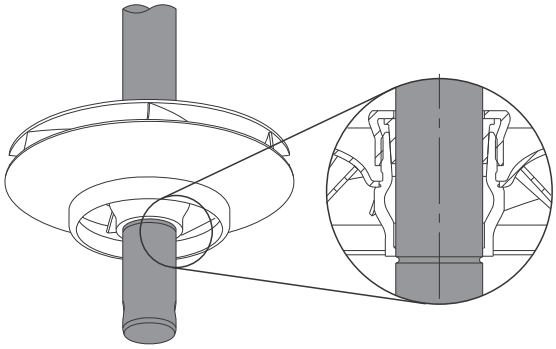

Fig. 13 Checking that the impeller flushes with the shaft groove

5. Refit the shaft in the holder, and fit the locking pin in the "Assembly" hole.

9.1.2 Assembling chambers

Depending on their construction, dismantle the chambers according to the instructions below. The symbols refer to section *10. Order of assembly for chambers and impellers*.

Note ***Mount the reduced impeller(s), if any, last in the top chamber(s).***

Chamber without bearing

Fig. 14 Chamber without bearing

1. Fit impeller (pos. 49) and press it home.
2. Fit split cone (pos. 49b) and knock it into the impeller hub using the key for split cone nut.
3. Hold the impeller with the hook spanner. Fit and tighten split cone nut (pos. 48).
4. Fit chamber (pos. 4a) and press it home against the chamber below.

Chamber with bearing

Fig. 15 Chamber with bearing

1. Fit impeller (pos. 49) and press it home.
2. Fit split cone (pos. 49b) and knock it into the impeller hub using the key for split cone nut.
3. Hold the impeller with the hook spanner. Fit and tighten split cone nut (pos. 48).
4. Slide bearing ring (pos. 47a) over the split cone nut. It must engage with the split cone nut.
5. Fit chamber (pos. 4a) and press it home against the chamber below or inlet part (pos. 44).

Caution ***Be careful when pressing the chambers down the shaft. The bearings are fragile and cannot stand blows or contact with the shafts.***

Top chamber

Fig. 16 Top chamber

1. Fit impeller (pos. 49) and press it home.
2. Fit split cone (pos. 49b) and knock it into the impeller hub using the key for split cone nut.
3. Hold the impeller with the hook spanner. Fit and tighten split cone nut (pos. 48).
4. Fit chamber (pos. 3a). Turn it so that the holes for straps are aligned to the fixing lugs for straps on the inlet part.
5. Press the chamber home against the chamber below.
6. Fit straps (pos. 26a), washers (pos. 26c), and cross-tighten screws (pos. 26b).

Single chamber

Fig. 17 Single chamber

1. Fit impeller (pos. 49) and press it home.
2. Fit split cone (pos. 49b) and knock it into the impeller hub using the key for split cone nut.
3. Hold the impeller with the hook spanner. Fit and tighten split cone nut (pos. 48).
4. Slide bearing ring (pos. 47a) over the split cone nut. It must engage with the split cone nut.
5. Fit chamber (pos. 3). Turn it so that the holes for straps are aligned to the fixing lugs for straps on the inlet part.
6. Press the chamber home against inlet part (pos. 44).
7. Fit straps (pos. 26a) and washers (pos. 26c), and cross-tighten screws (pos. 26b).

9.2 Pump head and shaft seal

1. Replace rubber springs (pos. 60) and O-ring (pos. 37).
2. Fit pump head (pos. 2) on outer sleeves (pos. 55).
3. Fit washers (pos. 66a) and cross-tighten nuts (36).
4. Carefully press shaft seal (pos. 105) down the shaft and in the pump head.
5. Fit retainer (pos. 58) and cross-tighten screws (58a).
6. Press the pump shaft home and tighten set screws (pos. 113).
7. Lift the pump shaft and insert the adjusting fork between the shaft seal driver and its retainer. See fig. 18.

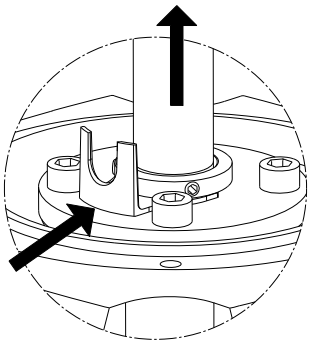

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Fig. 18 Fitting adjusting forks

9.3 Motor

Caution ***To prevent the motor from tipping over, hold it straight when using a lifting device.***

1. Attach the lifting device to the eyebolts. Lift and fit the motor and motor stool on upper pump head (pos. 2).
2. Cross-tighten screws (pos. 28).
3. Fit coupling (pos. 8), according to fig. 19 and 20, and tighten screws (pos. 9).

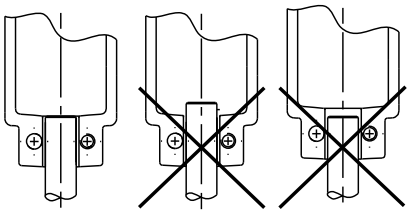

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Fig. 19 Fitting coupling

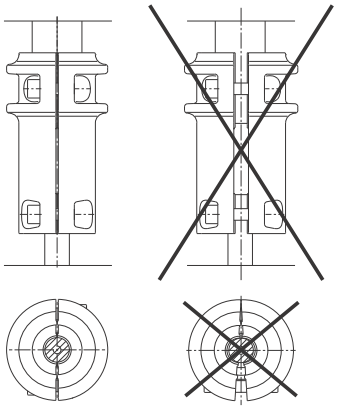

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Fig. 20 Adjusting coupling

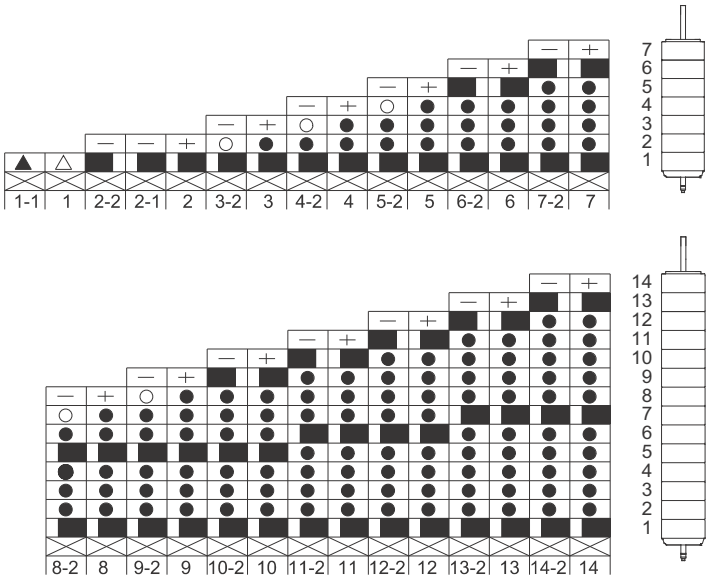
4. Remove the adjusting fork, and place it under one of screws (pos. 58a).
5. Check that the pump shaft can rotate freely.
6. Fit coupling guards (pos. 7) and screws (pos. 7a).

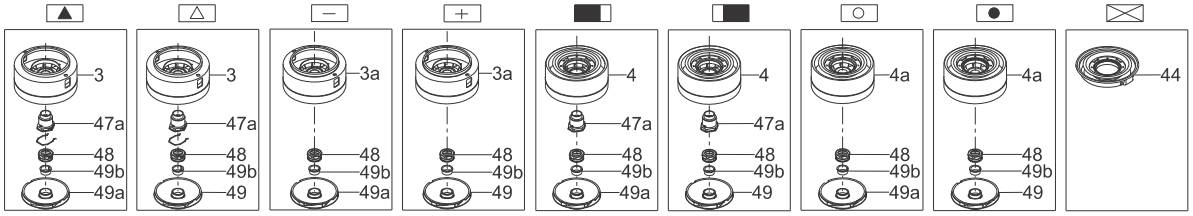
10. Order of assembly for chambers and impellers

The assembly of the pump is illustrated in the following drawings. Each symbol corresponds to a different chamber.

Note ***Pos. 49 is the standard size impeller. Pos. 49a is a reduced impeller (2/3 of standard size).***

10.1 CR, CRI, CRN 32





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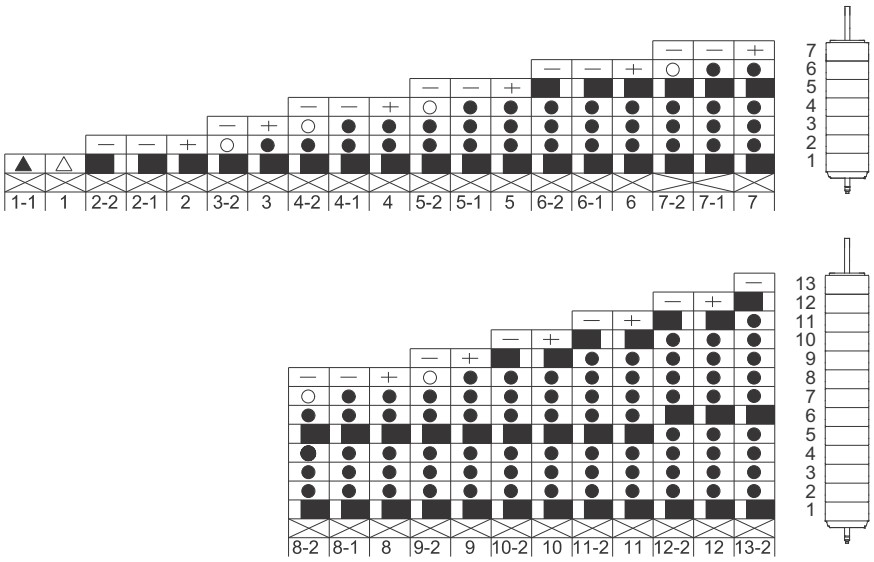
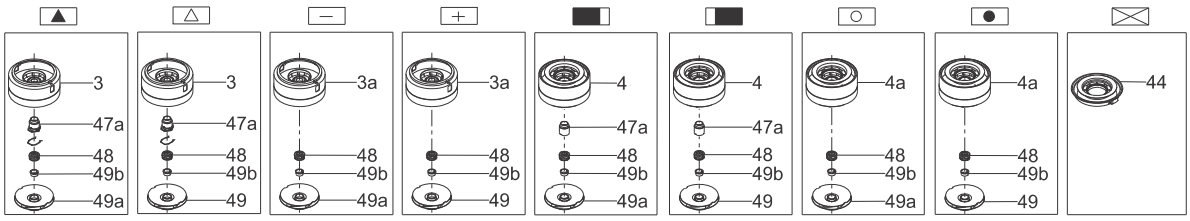
10.2 CR, CRI, CRN 45





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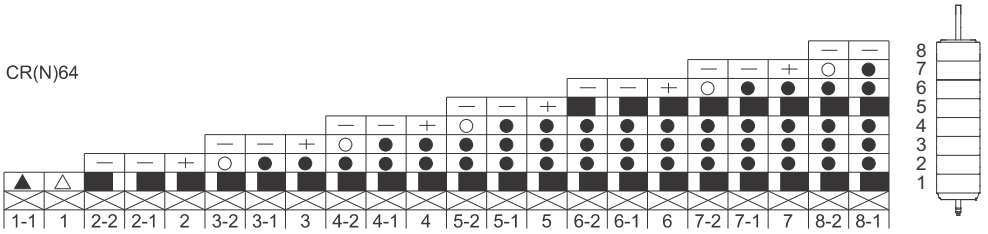
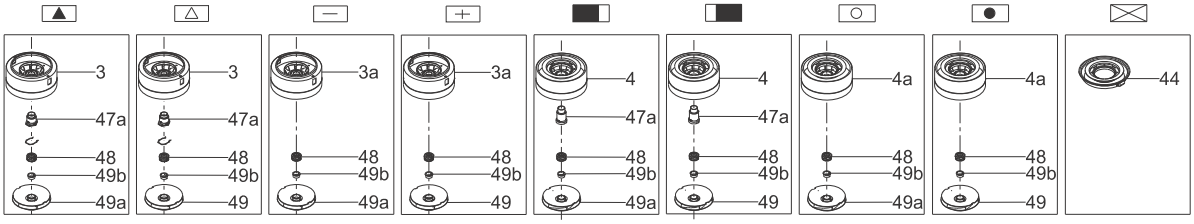
10.3 CR, CRI, CRN 64





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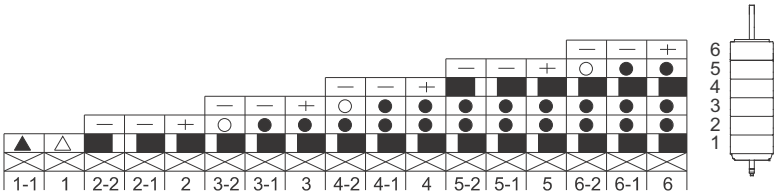
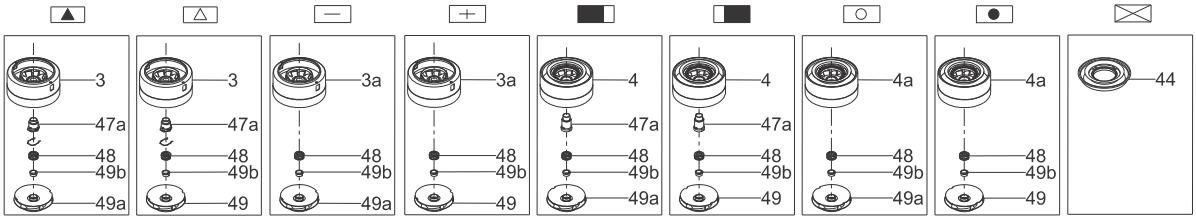
10.4 CR, CRI, CRN 90





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11. Exploded views

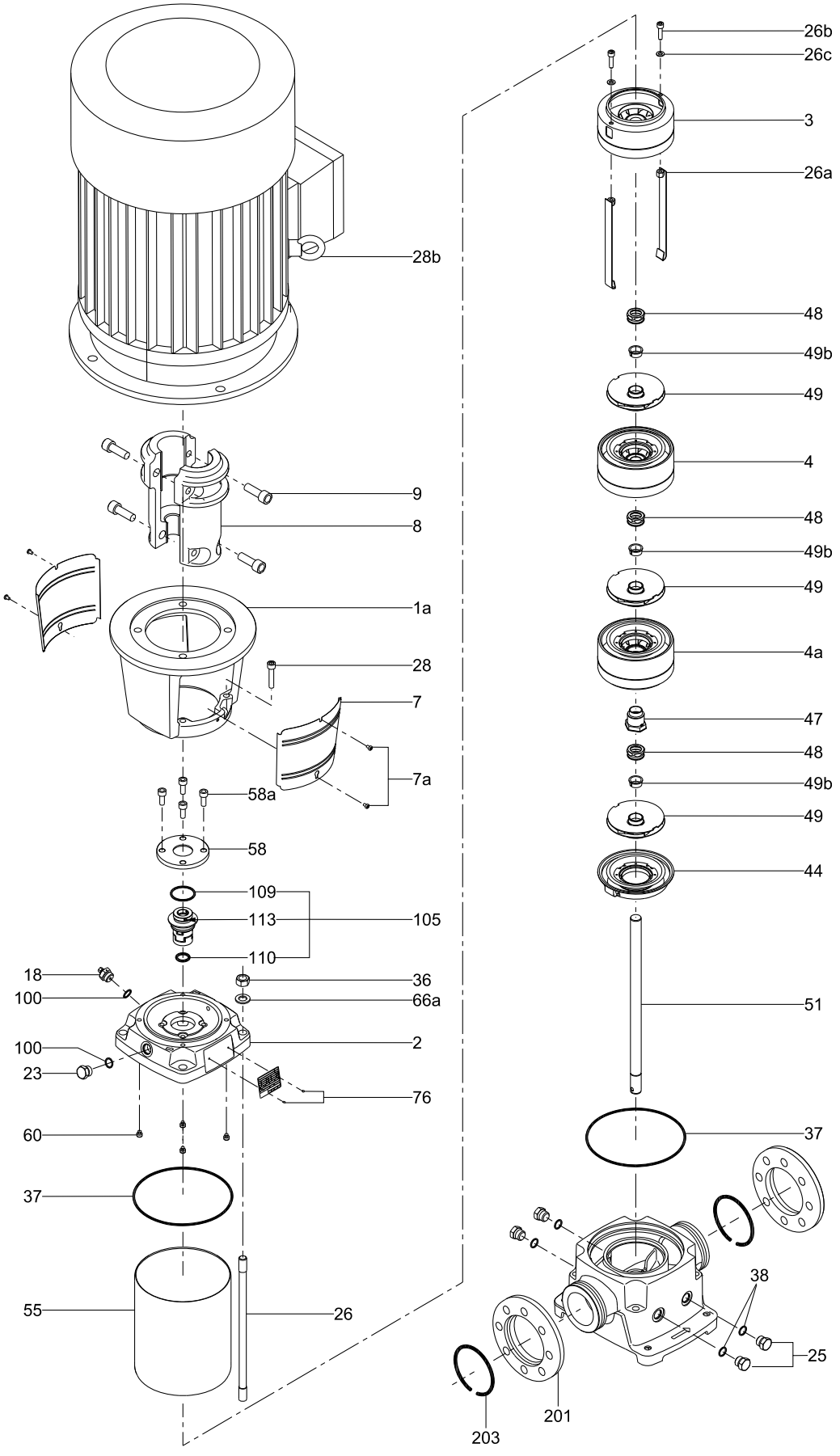

Fig. 21 Exploded view, CR, CRI, CRN 32, model B

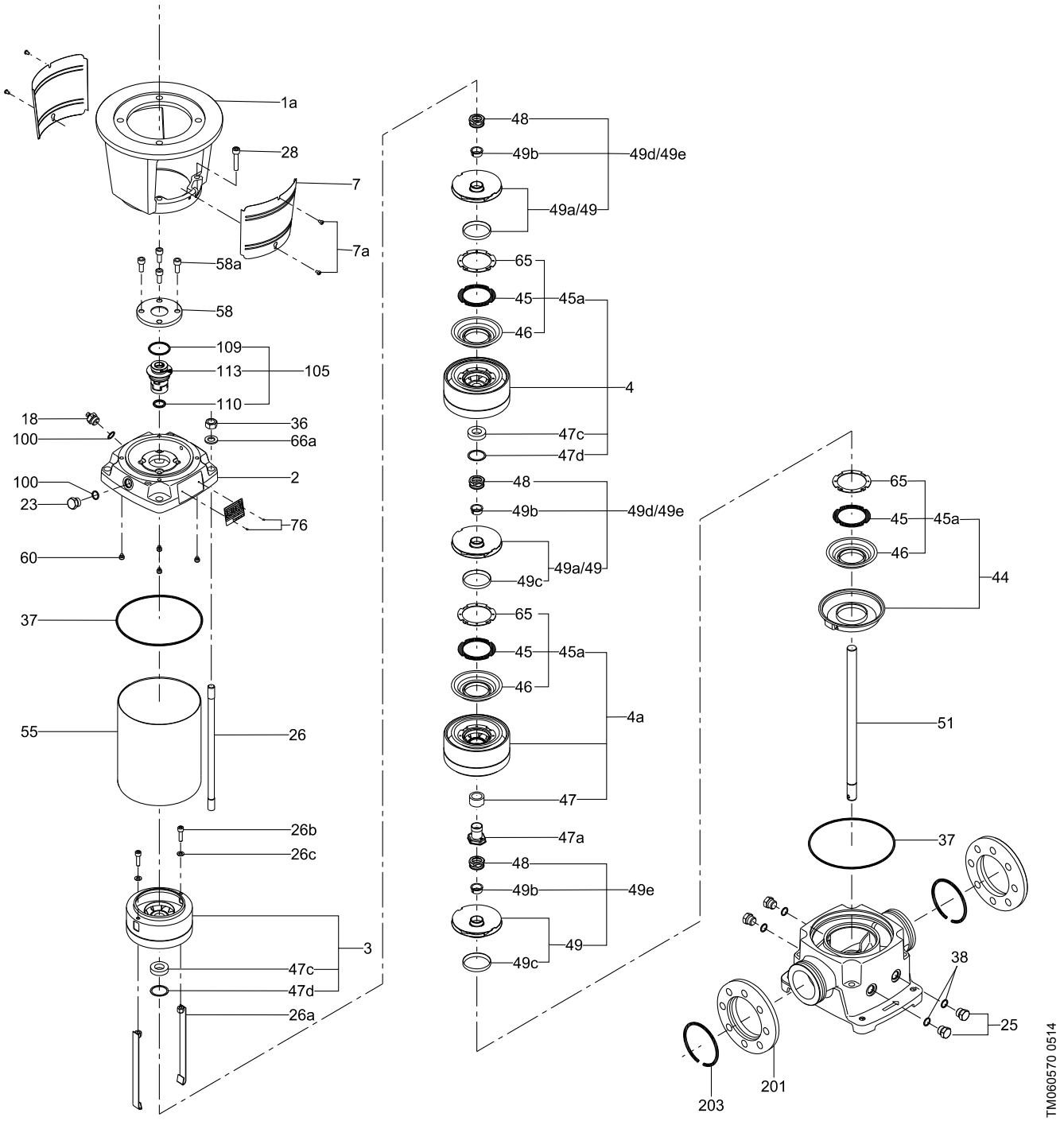

Fig. 22 Exploded view (detailed), CR, CRI, CRN 32, model B

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CRE, CRIE, CRNE, SPKE, CRKE, MTRE

Grundfos E-pumps with MLE frequency-controlled, asynchronous motors

Installation and operating instructions

CRE, CRIE, CRNE, SPKE, CRKE, MTRE

Original installation and operating instructions

These installation and operating instructions describe Grundfos CRE, CRIE, CRNE, CRKE, SPKE, MTRE.

Sections 1-4 give the information necessary to be able to unpack, install and start up the product in a safe way.

Sections 5-11 give important information about the product, as well as information on service, fault finding and disposal of the product.

CONTENTS

Read this document before installing the product. Installation and operation must comply with local regulations and accepted codes of good practice

1. Limited warranty

Products manufactured by Grundfos Pumps Corporation (Grundfos) are warranted to the original user only to be free of defects in material and workmanship for a period of 24 months from date of installation, but not more than 30 months from date of manufacture .Grundfos' liability under this warranty shall be limited to repairing or replacing at Grundfos' option, without charge, F.O.B. Grundfos' factory or authorized service station, any product of Grundfos manufacture. Grundfos will not be liable for any costs of removal, installation, transportation, or any other charges that may arise in connection with a warranty claim.

Products which are sold, but not manufactured by Grundfos, are subject to the warranty provided by the manufacturer of said products and not by Grundfos' warranty.

Grundfos will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with Grundfos' printed installation and operating instructions and accepted codes of good practice. The warranty does not cover normal wear and tear.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of Grundfos' products from which it was purchased together with proof of purchase and installation date, failure date and supporting installation data. Unless otherwise provided, the distributor or dealer will contact Grundfos or an authorized service station for instructions. Any defective product to be returned to Grundfos or a service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

Grundfos will not be liable for any incidental or consequential damages, losses, or expenses arising from installation, use, or any other causes. There are no express or implied warranties, including merchantability or fitness for a particular purpose, which extend beyond those warranties described or referred to above. Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages and some jurisdictions do not allow limitations on how long implied warranties may last. Therefore, the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

Products which are repaired or replaced by Grundfos or authorized service center under the provisions of these limited warranty terms will continue to be covered by Grundfos warranty only through the remainder of the original warranty period set forth by the original purchase date.

2. General information

These installation and operating instructions are a supplement to installation and operating instructions for the corresponding standard pumps CR, CRI, CRN, CRK, SPK, MTR. For instructions not mentioned specifically here, please see installation and operating instructions for the standard pump.

2.1 Hazard statements

The symbols and hazard statements below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious personal injury.

WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious personal injury.

CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate personal injury.

The hazard statements are structured in the following way:

SIGNAL WORD

Description of hazard

Consequence of ignoring the warning.

- Action to avoid the hazard.

2.2 Notes

The symbols and notes below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

Observe these instructions for explosion-proof products.

A blue or grey circle with a white graphical symbol indicates that an action must be taken.

A red or grey circle with a diagonal bar, possibly with a black graphical symbol, indicates that an action must not be taken or must be stopped.

If these instructions are not observed, it may result in malfunction or damage to the equipment.

Tips and advice that make the work easier.

2.3 General description

Grundfos E-pumps have standard motors with integrated frequency converter. The pumps are for single-phase or three-phase power supply connection.

2.3.1 Pumps without factory-fitted sensor

The pumps have a built-in PI controller and can be set up for an external sensor enabling control of the following parameters:

- pressure
- differential pressure
- temperature
- differential temperature
- flow rate
- liquid level in a tank.

From factory, the pumps have been set to control mode uncontrolled. The PI controller can be activated by means of R100.

2.3.2 Pumps with pressure sensor

The pumps have a built-in PI controller and are set up with a pressure sensor enabling control of the pump discharge pressure.

The pumps are set to control mode controlled. The pumps are typically used to hold a constant pressure in variable-demand systems.

2.3.3 Settings

The description of settings apply both to pumps without factory-fitted sensor and to pumps with a factory-fitted pressure sensor.

Setpoint

The desired setpoint can be set in three different ways:

- directly on the pump control panel
- via an input for external setpoint signal
- by means of Grundfos wireless remote control R100.

Other settings

All other settings can only be made by means of the R100.

Important parameters such as actual value of control parameter, power consumption, etc. can be read via the R100.

If special or customized settings are required, use Grundfos PC Tool E-products. Contact your local Grundfos company for more information.

3. Installing the product

3.1 Mechanical installation

The pump must be secured to a solid foundation by means of bolts through the holes in the flange or baseplate.

In order to retain the UL/cUL approval, follow the additional installation procedures found in the *Appendix*.

3.1.1 Motor cooling

To ensure sufficient cooling of motor and electronics, observe the following requirements:

- Make sure that sufficient cooling air is available.
- Keep the temperature of the cooling air below 104 °F (40 °C).
- Keep cooling fins and fan blades clean.

3.2 Outdoor installation

When installed outdoors, the pump must be provided with a suitable cover to avoid condensation on the electronic components. See fig. 1.

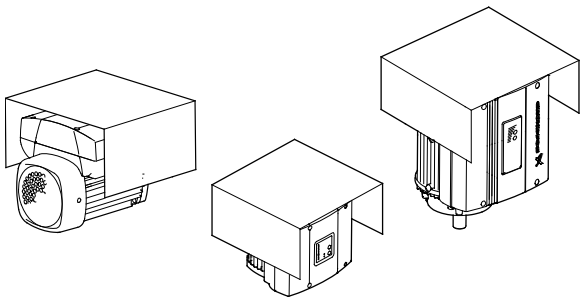

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Fig. 1 Examples of covers

Remove the drain plug pointing downwards in order to avoid moisture and water build-up inside the motor.

Vertically mounted pumps are IP55 after removal of the drain plug. Horizontally mounted pumps change enclosure class to IP54.

In order to retain the UL mark, additional requirements apply to the equipment. See *Appendix*.

3.3 Electrical connection

For description of how to connect E-pumps electrically, see the following pages:

3.4 Three-phase pumps, 20-30 hp, page 7.

3.4 Three-phase pumps, 20-30 hp

DANGER

Electric shock

Death or serious personal injury

- The user or the installer is responsible for the installation of correct grounding and protection according to current national and local standards. All operations must be carried out by qualified personnel.

DANGER

Electric shock

Death or serious personal injury

- Never make any connections in the pump terminal box unless all electric supply circuits have been switched off for at least 5 minutes.
- Note for instance that the signal relay may be connected to an external supply which is still connected when the power supply is disconnected.

WARNING

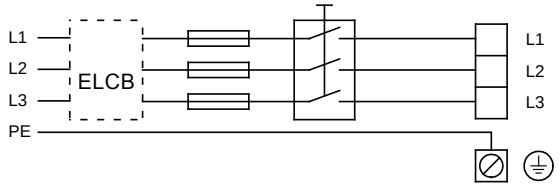
Hot surface

Death or serious personal injury

- The surface of the terminal box may be above 158 °F (70 °C) when the pump is operating.

3.4.1 Preparation

Before connecting the E-pump to the power supply, take the issues illustrated in the figure below into consideration.



TM00 9270 4696

Fig. 2 Power supply-connected pump with power switch, backup fuses, additional protection and protective grounding

3.4.2 Protection against electric shock - indirect contact

DANGER

Electric Shock

Death or serious personal injury

- The pump must be grounded in accordance with national regulations.
- As the leakage current of 20-30 hp motors is > 10 mA, take extra precautions when grounding these motors.

EN 61800-5-1 specifies that the pump must be stationary and installed permanently when the leakage current is > 10 mA.

One of the following requirements must be fulfilled:

- A single protective ground lead (7 AWG minimum copper)

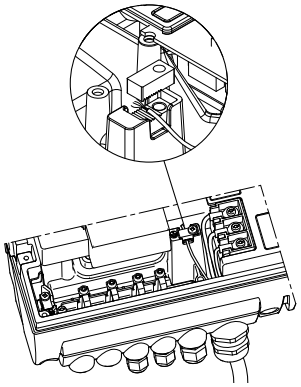


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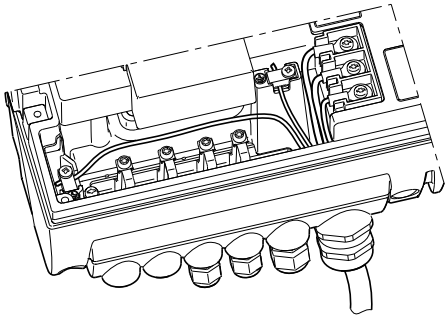
Fig. 3 Connection of a single protective ground lead using one of the leads of a 4-core power cable (7 AWG minimum)

- Two protective ground leads of the same cross-sectional area as the power supply leads, with one lead connected to an additional ground terminal in the terminal box.



TM03 8606 2007

Fig. 4 Connection of two protective ground leads using two of the leads of a 5-core power supply cable

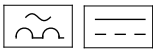
Protective ground leads must always have a yellow/green (PE) or yellow/green/blue (PEN) color marking.

3.4.3 Backup fuses

For recommended fuse sizes, see section *8.1.1 Supply voltage*.

3.4.4 Additional protection

If the pump is connected to an electric installation where an ground leakage circuit breaker (ELCB) is used as additional protection, the circuit breaker must be of a type marked with the following symbols:


ELCB

This circuit breaker is **type B.**

The total leakage current of all the electrical equipment in the installation must be taken into account.

For leakage current of the motor in normal operation, see section *8.1.3 Leakage current.*

During start and at asymmetrical supply systems, the leakage current can be higher than normal and may cause the ELCB to trip.

3.4.5 Motor protection

The pump requires no external motor protection. The motor incorporates thermal protection against slow overloading and blocking (IEC 34-11, TP 211).

3.4.6 Protection against voltage transients

The pump is protected against voltage transients in accordance with EN 61800-3 and is capable of withstanding a VDE 0160 pulse.

The pump has a replaceable varistor which is part of the transient protection.

Over time this varistor will be worn and need to be replaced. When the time for replacement has come, R100 and PC Tool E-products will indicate this as a warning. See section *7. Servicing the product.*

3.4.7 Supply voltage

3 x 460-480 V - 10 %/+ 10 %, 50/60 Hz, PE.

The supply voltage and frequency are marked on the pump nameplate. Make sure that the motor is suitable for the power supply of the installation site.

The wires in the terminal box must be as short as possible. Excepted from this is the protective ground lead which must be so long that it is the last one to be disconnected in case the cable is inadvertently pulled out of the cable entry.

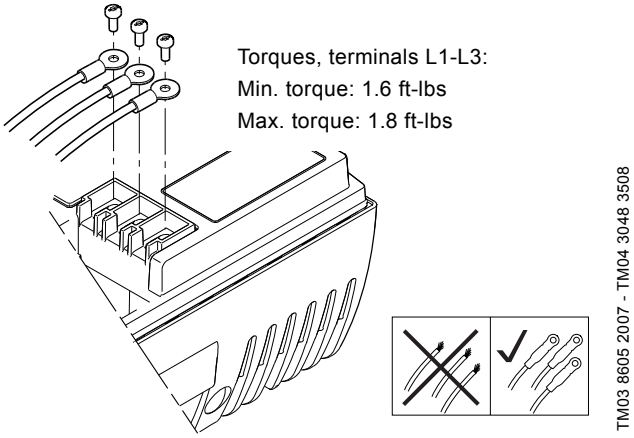


Fig. 5 Power connection

Cable glands

Cable glands comply with EN 50626.

- 1 x M40 cable gland
- 1 x M20 cable gland
- 2 x M16 cable gland
- 2 x M16 knock-out cable entries.

If the supply cable is damaged, it must be replaced by qualified personnel.

Grid types

Three-phase E-pumps can be connected to all grid types.

Could result in personal injury

– Do not connect three-phase E-pumps to a power supply with a voltage between phase and ground of more than 440 V.

3.4.8 Start/stop of pump

The number of starts and stops via the power supply must not exceed 4 times per hour.

When the pump is switched on via the power supply, it will start after approx. 5 seconds.

If a higher number of starts and stops is desired, use the input for external start/stop when starting/stopping the pump.

When the pump is switched on via an external on/off switch, it will start immediately.

3.4.9 Connections

If no external on-off switch is connected, connect terminals 2 and 3 using a short wire.

As a precaution, the wires to be connected to the following connection groups must be separated from each other by reinforced insulation in their entire lengths:

Group 1: Inputs

- start/stop terminals 2 and 3
- digital input terminals 1 and 9
- setpoint input terminals 4, 5 and 6
- sensor input terminals 7 and 8
- GENIbus terminals B, Y and A

All inputs (group 1) are internally separated from the power-conducting parts by reinforced insulation and galvanically separated from other circuits.

All control terminals are supplied with protective extra-low voltage (PELV), thus ensuring protection against electric shock.

Group 2: Output (relay signal, terminals NC, C, NO)

The output (group 2) is galvanically separated from other circuits. Therefore, the supply voltage or protective extra-low voltage can be connected to the output as desired.

Group 3: Power supply (terminals L1, L2, L3)

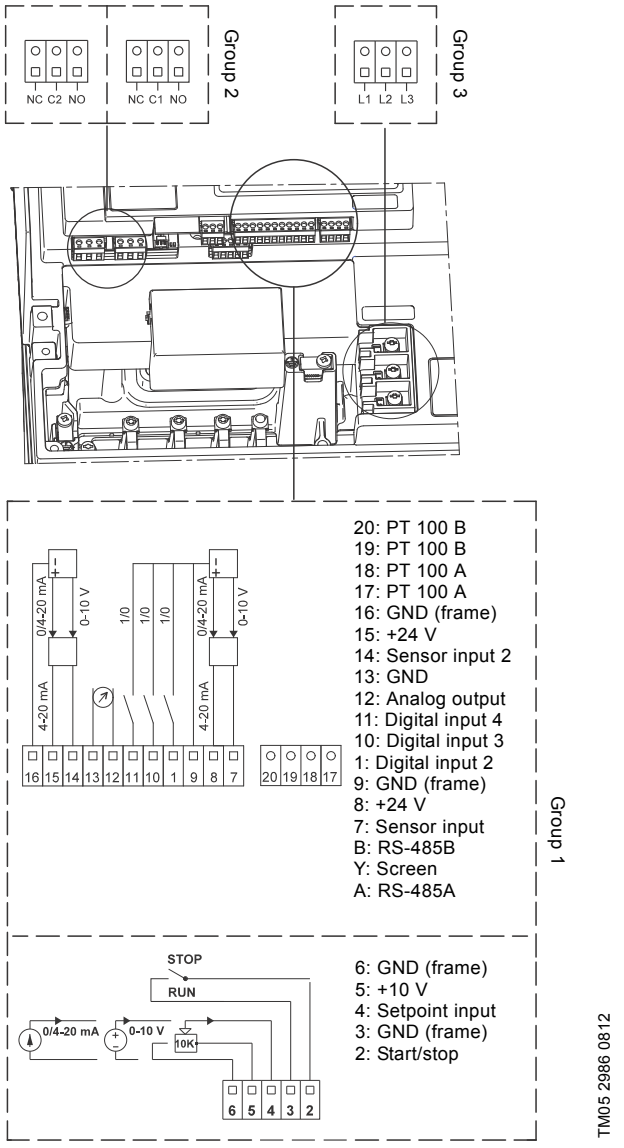


Fig. 6 Connection terminals

A galvanic separation must fulfill the requirements for reinforced insulation including creepage distances and clearances specified in EN 61800-5-1.

3.4.10 Signal cables

- Use screened cables with a conductor cross-section of min. 28 AWG and max. 16 AWG for external on/off switch, digital input, setpoint and sensor signals.
- Connect the screens of the cables to frame at both ends with good frame connection. The screens must be as close as possible to the terminals. See fig. 7.

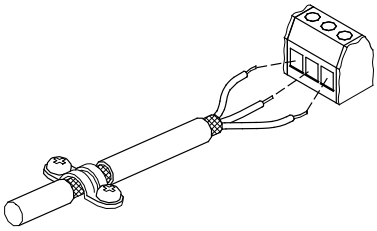


Fig. 7 Stripped cable with screen and wire connection

- Always tighten screws for frame connections whether a cable is fitted or not.
- Make the wires in the pump terminal box as short as possible.

3.5 E-pump electrical connections

3.5.1 Connection of E-pump to Danfoss pressure sensor MBS3000

The blue wire of the pressure sensor is connected to the #7 terminal of the E-pump. The brown wire of the pressure sensor is connected to the #8 terminal of the E-pump.

See section *3.4.10 Signal cables* for additional details.

Fig. 8 Danfoss pressure sensor

3.5.2 Connection of E-pump to LiqTec®

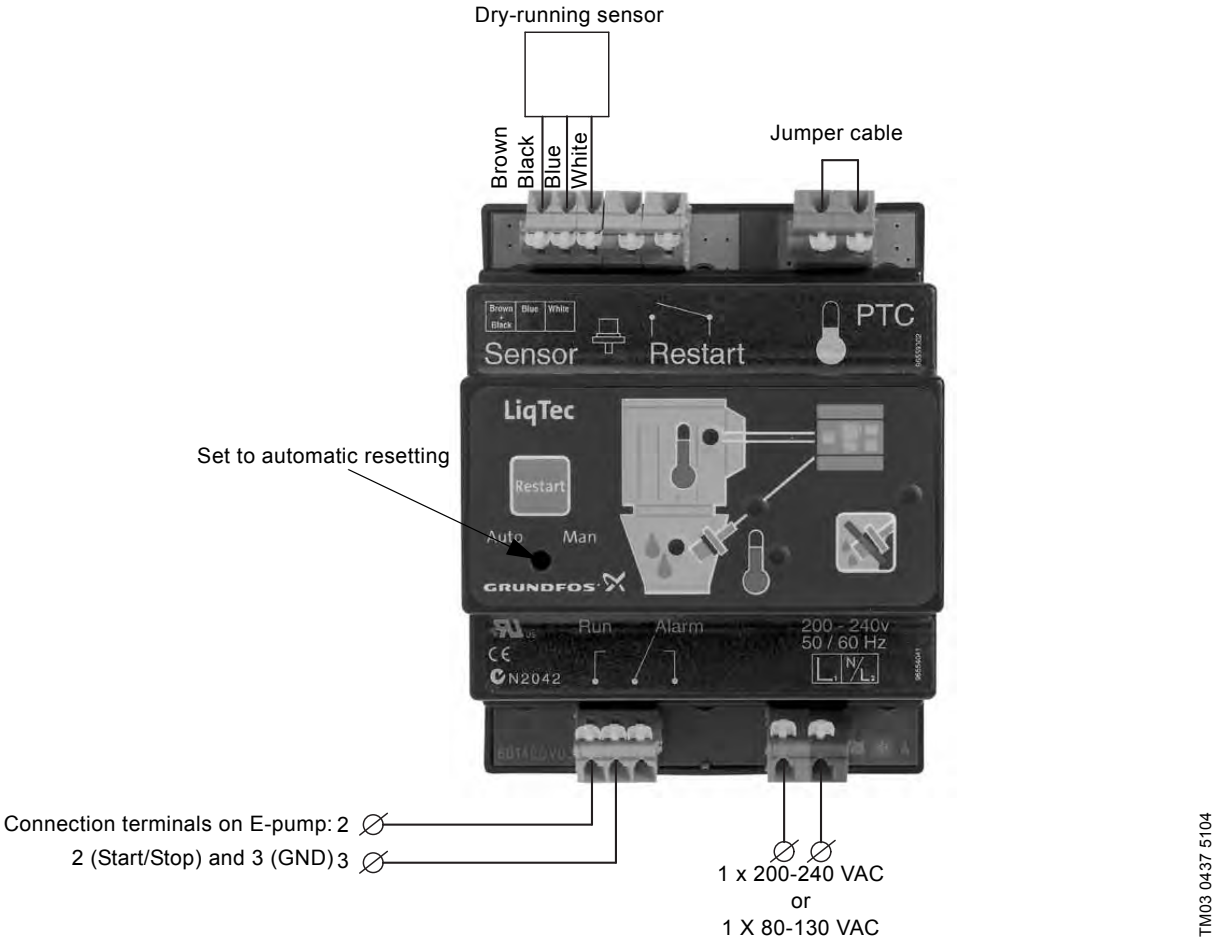


Fig. 9 Connection of E-pump to LiqTec

3.6 Bus connection cable

3.6.1 New installations

For the bus connection, use a screened 3-core cable with a conductor cross-section of 28-16 AWG.

- If the pump is connected to a unit with a cable clamp which is identical to the one on the pump, connect the screen to this cable clamp.
- If the unit has no cable clamp as shown in fig. 10, leave the screen unconnected at this end.

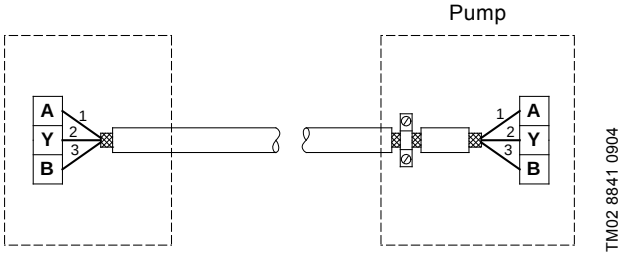


Fig. 10 Connection with screened 3-core cable

3.6.2 Replacing an existing pump

- If a screened 2-core cable is used in the existing installation, connect it as shown in fig. 11.

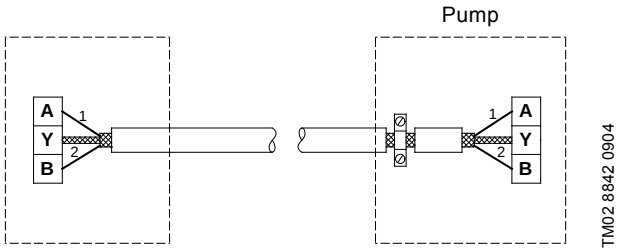


Fig. 11 Connection with screened 2-core cable

- If a screened 3-core cable is used in the existing installation, follow the instructions in section *3.6.1 New installations.*

3.7 Modes

Grundfos E-pumps are set and controlled according to operating and control modes.

3.7.1 Overview of modes

Operating modes	Normal	Stop	Min.	Max.
Control modes	Uncontrolled	Controlled		
	Constant curve	Constant pressure[1)]		

1) For this control mode the pump is equipped with a pressure sensor. The pump may also be equipped with a temperature sensor in which case the description would be constant temperature in control mode controlled.

3.7.2 Operating mode

When the operating mode is set to Normal, the control mode can be set to controlled or uncontrolled. See section *3.7.3 Control mode.*

The other operating modes that can be selected are Stop, Min. or Max.

- Stop: the pump has been stopped
- Min: the pump is operating at its minimum speed
- Max: the pump is operating at its maximum speed.

Figure 12 is a schematic illustration of min. and max. curves.

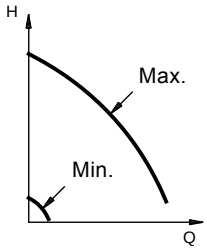


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Fig. 12 Min. and max. curves

The max. curve can for instance be used in connection with the venting procedure during installation.

The min. curve can be used in periods in which a minimum flow is required.

If the power supply to the pump is disconnected, the mode setting will be stored.

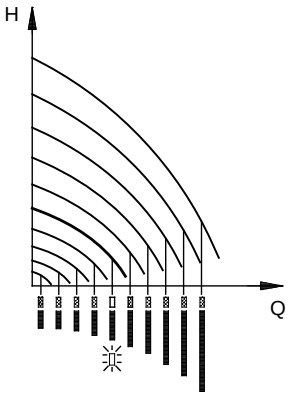
The remote control R100 offers additional possibilities of setting and status displays. See section *5.5 Setting by means of R100*.

3.7.3 Control mode

Pumps without factory-fitted sensor

The pumps are factory-set to control mode **uncontrolled**.

In control mode uncontrolled, the pump will operate according to the constant curve set, fig. 13.



TM00 7746 1304

Fig. 13 Pump in control mode **uncontrolled** (constant curve)

3.7.4 Pumps with pressure sensor

The pump can be set to one of two control modes, i.e. controlled and uncontrolled, fig. 14.

In control mode **controlled**, the pump will adjust its performance, i.e. pump discharge pressure, to the desired setpoint for the control parameter.

In control mode **uncontrolled**, the pump will operate according to the constant curve set.

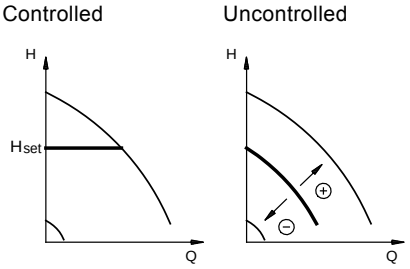


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Fig. 14 Pump in control mode **controlled** (constant pressure) or **uncontrolled** (constant curve)

4. Control functions

4.1 Displays in general

In the following explanation of the functions, one or two displays are shown.

One display

Pumps without or with factory-fitted sensor have the same function.

Two displays

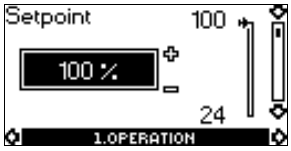
Pumps without or with factory-fitted pressure sensor have different functions and factory settings.

4.2 Menu OPERATION

The first display in this menu is this:

4.2.1 Setpoint

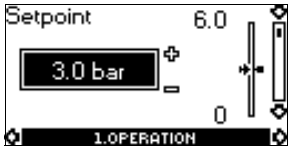
Without sensor (uncontrolled)



- Setpoint set
- Actual setpoint
- Actual value

Set the setpoint in %.

With pressure sensor (controlled)



- Setpoint set
- Actual setpoint
- Actual value

Set the desired pressure in bar.

In control mode **uncontrolled**, the setpoint is set in % of the maximum performance. The setting range will lie between the min. and max. curves.

In control mode **controlled**, the setting range is equal to the sensor measuring range.

If the pump is connected to an external setpoint signal, the value in this display will be the maximum value of the external setpoint signal. See section *4.8 External setpoint signal.*

Setpoint and external signal

The setpoint cannot be set if the pump is controlled via external signals (Stop, Min. curve or Max. curve). R100 will give this warning: External control!

Check if the pump is stopped via terminals 2-3 (open circuit) or set to min. or max. via terminals 1-3 (closed circuit).

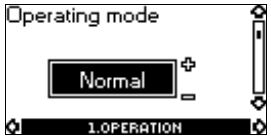
See fig. 23.

Setpoint and bus communication

The setpoint cannot be set either if the pump is controlled from an external control system via bus communication. R100 will give this warning: Bus control!

To override bus communication, disconnect the bus connection. See fig. 23.

4.2.2 Operating mode



Set one of the following operating modes:

- Normal (duty)
- Stop
- Min.
- Max.

The operating modes can be set without changing the setpoint setting.

4.2.3 Fault indications

In E-pumps, faults may result in two types of indication: alarm or warning.

An "alarm" fault will activate an alarm indication in R100 and cause the pump to change operating mode, typically to stop. However, for some faults resulting in alarm, the pump is set to continue operating even if there is an alarm.

A "warning" fault will activate a warning indication in R100, but the pump will not change operating or control mode.

The indication, Warning, only applies to three-phase pumps.

Alarm

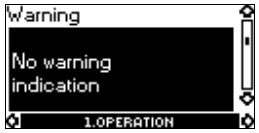
In case of alarm, the cause will appear in this display.

Possible causes:

- No alarm indication
- Too high motor temperature
- Undervoltage
- Mains voltage asymmetry (20-30 hp)
- Overvoltage
- Too many restarts (after faults)
- Overload
- Underload
- Sensor signal outside signal range
- Setpoint signal outside signal range
- External fault
- Duty/standby, Communication fault
- Dry running
- Other fault.

If the pump has been set up to manual restart, an alarm indication can be reset in this display if the cause of the fault has disappeared.

Warning (only three-phase pumps)



In case of warning, the cause will appear in this display.

Possible causes:

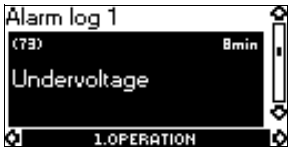
- No warning indication.
- Sensor signal outside signal range.
- Relubricate motor bearings, see section *7.2 Relubrication of motor bearings*.
- Replace motor bearings, see section *7.3 Replacement of motor bearings*.
- Replace varistor, see section *7.4 Replacement of varistor (only 20-30 hp).*

A warning indication will disappear automatically once the fault has been remedied.

4.2.4 Fault log

For both fault types, alarm and warning, the R100 has a log function.

Alarm log



In case of "alarm" faults, the last five alarm indications will appear in the alarm log. "Alarm log 1" shows the latest fault, "Alarm log 2" shows the latest fault but one, etc.

The example above gives this information:

- the alarm indication Undervoltage
- the fault code (73)
- the number of minutes the pump has been connected to the power supply after the fault occurred, 8 min.

Warning log

In case of "warning" faults, the last five warning indications will appear in the warning log. "Warning log 1" shows the latest fault, "Warning log 2" shows the latest fault but one, etc.

The example above gives this information:

- the warning indication Relubricate motor bearings
- the fault code (240)
- the number of minutes the pump has been connected to the power supply since the fault occurred, 30 min.

4.3 Menu STATUS

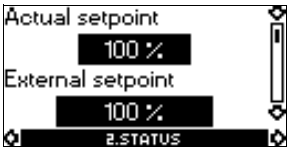
The displays appearing in this menu are status displays only. It is not possible to change or set values.

The displayed values are the values that applied when the last communication between the pump and the R100 took place. If a status value is to be updated, point the R100 at the control panel and press "OK". If a parameter, e.g. speed, should be called up continuously, press "OK" constantly during the period in which the parameter in question should be monitored.

The tolerance of the displayed value is stated under each display. The tolerances are stated as a guide in % of the maximum values of the parameters.

4.3.1 Actual setpoint

Without sensor (uncontrolled)



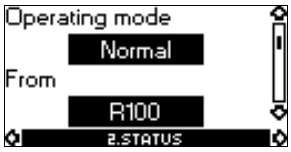
Tolerance: ± 2 %.

With pressure sensor (controlled)

Tolerance: ± 2 %.

This display shows the actual setpoint and the external setpoint in % of the range from minimum value to the setpoint set. See section *4.8 External setpoint signal.*

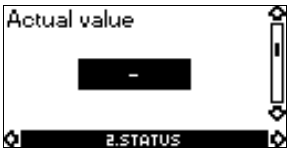
4.3.2 Operating mode



This display shows the actual operating mode (Normal (duty), Stop, Min., or Max.). Furthermore, it shows where this operating mode was selected (R100, Pump, Bus, External or Stop func.). For further details about the stop function (Stop func.), see section *4.4.8 Stop function.*

4.3.3 Actual value

Without sensor (uncontrolled)



With pressure sensor (controlled)

This display shows the value actually measured by a connected sensor.

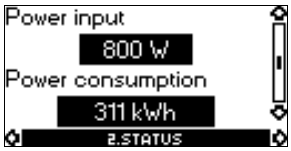
If no sensor is connected to the pump, "-" will appear in the display.

4.3.4 Speed

Tolerance: ± 5 %

The actual pump speed will appear in this display.

4.3.5 Power input and power consumption



Tolerance: ± 10 %

This display shows the actual pump input power from the power supply. The power is displayed in W or kW.

The pump power consumption can also be read from this display. The value of power consumption is an accumulated value calculated from the pump's birth and it cannot be reset.

4.3.6 Operating hours

Tolerance: ± 2 %

The value of operating hours is an accumulated value and cannot be reset.

4.3.7 Lubrication status of motor bearings (only 20-30 hp)

This display shows how many times the motor bearings have been relubricated and when to replace the motor bearings.

When the motor bearings have been relubricated, confirm this action in the INSTALLATION menu. See section *4.4.14 Confirming relubrication/replacement of motor bearings (only three-phase pumps).* When relubrication is confirmed, the figure in the above display will be increased by one.

4.3.8 Time till relubrication of motor bearings

This display shows when to relubricate the motor bearings. The controller monitors the operating pattern of the pump and calculates the period between bearing relubrications. If the operating pattern changes, the calculated time till relubrication may change as well.

The displayable values are these:

- in 2 years
- in 1 year
- in 6 months
- in 3 months
- in 1 month
- in 1 week
- Now!

4.3.9 Time till replacement of motor bearings

When the motor bearings have been relubricated a prescribed number of times stored in the controller, the display in section *4.3.8 Time till relubrication of motor bearings* will be replaced by the display below.

This display shows when to replace the motor bearings. The controller monitors the operating pattern of the pump and calculates the period between bearing replacements.

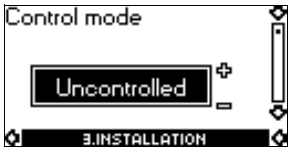
The displayable values are these:

- in 2 years
- in 1 year
- in 6 months
- in 3 months
- in 1 month
- in 1 week
- Now!

4.4 Menu INSTALLATION

4.4.1 Control mode

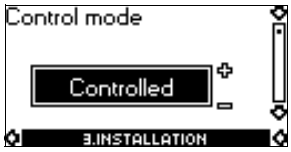
Without sensor (uncontrolled)



Select one of the following control modes (see fig. 14):

- Controlled
- Uncontrolled.

With pressure sensor (controlled)



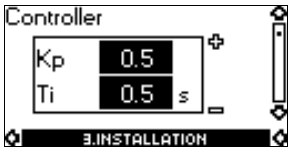
Select one of the following control modes (see fig. 14):

- Controlled
- Uncontrolled.

If the pump is connected to a bus, the control mode cannot be selected via the R100. See section *4.9 Bus signal*.

4.4.2 Controller

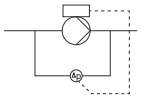
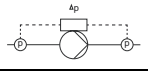
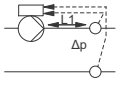
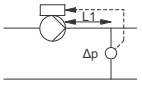
E-pumps have a factory default setting of gain (K_p) and integral time (T_i). However, if the factory setting is not the optimum setting, the gain and the integral time can be changed in the display below.



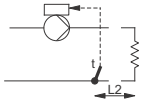
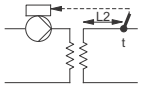
- The gain (K_p) can be set within the range from 0.1 to 20.
- The integral time (Ti) can be set within the range from 0.1 to 3600 s. If 3600 s is selected, the controller will function as a P controller.
- Furthermore, it is possible to set the controller to inverse control, meaning that if the setpoint is increased, the speed will be reduced. In the case of inverse control, the gain (Kp) must be set within the range from -0.1 to -20.

Guidelines for setting of PI controller

The tables below show the recommended controller settings:

Constant differential pressure	K_p	T_i
	0.5	0.5
		
	0.5	L1 < 5 m: 0.5 L1 > 5 m: 3 L1 > 10 m: 5
		

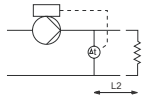
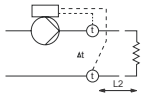
L1: distance in meters between pump and sensor.

Constant temperature	K_p		T_i
	Heating system[1)]	Cooling system[2)]	
	0.5	-0.5	10 + 5L2
	0.5	-0.5	30 + 5L2

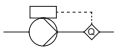
1) In heating systems, an increase in pump performance results in a rise in temperature at the sensor.

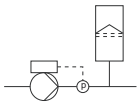
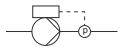
2) In cooling systems, an increase in pump performance results in a drop in temperature at the sensor.

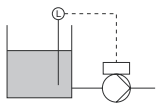
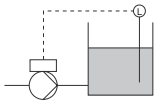
L2: distance in meters between heat exchanger and sensor.

Constant differential temperature	K_p	T_i
	-0.5	10 + 5L2
		

L2: Distance [m] between heat exchanger and sensor.

Constant flow rate	K_p	T_i
	0.5	0.5

Constant pressure	K_p	T_i
	0.5	0.5
	0.5	0.5

Constant level	K_p	T_i
	-20	0
	20	0

General rules of thumb

If the controller is too slow-reacting, increase the gain.

If the controller is hunting or unstable, dampen the system by reducing the gain or increasing the integral time.

How to set the PI controller

For most applications, the factory setting of the controller constants K_p and T_i will ensure optimum pump operation. However, in some applications an adjustment of the controller may be needed.

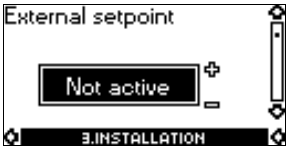
Proceed as follows:

1. Increase the gain (K_p) until the motor becomes unstable. Instability can be seen by observing if the measured value starts to fluctuate. Furthermore, instability is audible as the motor starts hunting up and down.
   Some systems, such as temperature controls, are slow-reacting, meaning that it may be several minutes before the motor becomes unstable.
2. Set the gain (K_p) to half of the value which made the motor unstable. This is the correct setting of the gain.
3. Reduce the integral time (T_i) until the motor becomes unstable.
4. Set the integral time (T_i) to twice the value which made the motor unstable. This is the correct setting of the integral time.

General rules of thumb:

- If the controller is too slow-reacting, increase K_p.
- If the controller is hunting or unstable, dampen the system by reducing K_p or increasing T_i.

4.4.3 External setpoint



The input for external setpoint signal can be set to different signal types.

Select one of the following types:

- 0-10 V
- 0-20 mA
- 4-20 mA
- Not active.

If Not active is selected, the setpoint set by means of the R100 or on the control panel will apply.

If one of the signal types is selected, the actual setpoint is influenced by the signal connected to the external setpoint input. See section *4.8 External setpoint signal*

4.4.4 Signal relay

Pumps of 20-30 hp have two signal relays. Signal relay 1 is factory set to Alarm and signal relay 2 to Warning.

In one of the displays below, select in which one of three or six operating situations the signal relay should be activated.

20-30 hp

- Ready
- Alarm
- Operation
- Pump running
- Warning
- Relubricate.

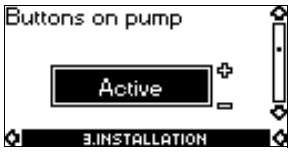
20-30 hp

- Ready
- Alarm
- Operation
- Pump running
- Warning
- Relubricate.

Fault and Alarm cover faults resulting in Alarm. Warning covers faults resulting in Warning. Relubricate covers only that one individual event. For distinction between alarm and warning, see section *4.2.3 Fault indications*.

For further information, see section *4.11 Indicator lights and signal relay*.

4.4.5 Buttons on pump

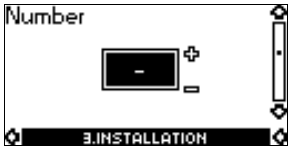


The operating buttons ⊙ and ⊙ on the control panel can be set to these values:

- Active
- Not active.

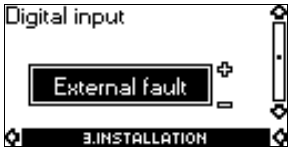
When set to Not active (locked), the buttons do not function. Set the buttons to Not active if the pump should be controlled via an external control system.

4.4.6 Pump number



A number between 1 and 64 can be allocated to the pump. In the case of bus communication, a number must be allocated to each pump.

4.4.7 Digital inputs



The digital inputs of the pump can be set to different functions.

Select one of the following functions:

- Min. (min. curve)
- Max. (max. curve)
- External fault
- Flow switch
- Dry running (from external sensor) (only three-phase pumps).

The selected function is activated by closing the contact between terminals 1 and 9, 1 and 10 or 1 and 11.

See also section *4.7 Digital input*.

***Min.*:**

When the input is activated, the pump will operate according to the min. curve.

***Max.*:**

When the input is activated, the pump will operate according to the max. curve.

***External fault*:**

When the input is activated, a timer will be started. If the input is activated for more than 5 seconds, the pump will be stopped and a fault will be indicated. If the input is deactivated for more than 5 seconds, the fault condition will cease and the pump can only be restarted manually by resetting the fault indication.

***Flow switch*:**

When this function is selected, the pump will be stopped when a connected flow switch detects low flow.

It is only possible to use this function if the pump is connected to a pressure sensor.

If the input is activated for more than 5 seconds, the stop function incorporated in the pump will take over. See section *4.4.8 Stop function*.

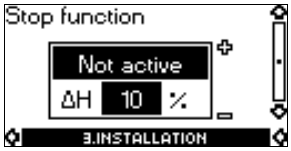
Dry running

When this function is selected, lack of inlet pressure or water shortage can be detected. This requires the use of an accessory, such as these:

- a Grundfos Liqtec® dry-running sensor
- a pressure switch installed on the suction side of a pump
- a float switch installed on the suction side of a pump.

When lack of inlet pressure or water shortage (Dry running) is detected, the pump will be stopped. The pump cannot restart as long as the input is activated.

4.4.8 Stop function



The stop function can be set to these values:

- Active
- Not active.

When the stop function is active, the pump will be stopped at very low flows. The controller will stop the pump to protect the pump as follows:

- avoid unnecessary heating of the pumped liquid
- reduce wear of the shaft seals
- reduce noise from operation.

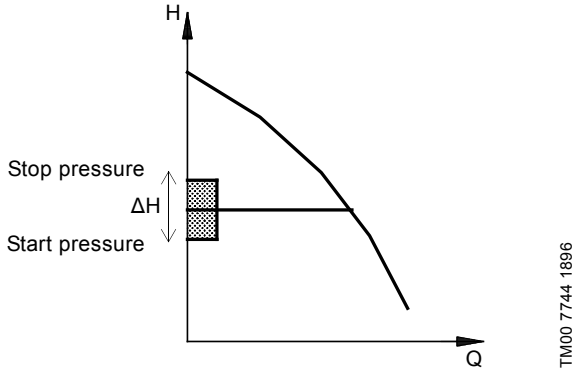


Fig. 15 Difference between start and stop pressures (ΔH)

ΔH is factory-set to **10 % of actual setpoint**.

ΔH can be set within the range from 5 % to 30 % of actual setpoint.

Low flow can be detected in two different ways:

1. A built-in "low-flow detection function" which functions if the digital input is not set up for flow switch.
2. A flow switch connected to the digital input.

1. Low-flow detection function

The pump will check the flow regularly by reducing the speed for a short time. If there is no or only a small change in pressure, this means that there is low flow. The speed will be increased until the stop pressure (actual setpoint + 0.5 x ΔH) is reached and the pump will stop. When the pressure has fallen to the start pressure (actual setpoint - 0.5 x ΔH), the pump will restart.

When restarting, the pumps will react differently according to pump type:

Three-phase pumps

1. If the flow is higher than the low-flow limit, the pump will return to continuous operation at constant pressure.
2. If the flow is still lower than the low-flow limit, the pump will continue in start/stop operation. It will continue in start/stop operation until the flow is higher than the low-flow limit; when the flow is higher than the low-flow limit, the pump will return to continuous operation.

2. Flow switch

When the digital input is activated for more than 5 seconds because there is low flow, the speed will be increased until the stop pressure (actual setpoint + 0.5 x ΔH) is reached, and the pump will stop. When the pressure has fallen to start pressure, the pump will start again. If there is still no flow, the pump will quickly reach stop pressure and stop. If there is flow, the pump will continue operating according to the setpoint.

Operating conditions for the stop function

It is only possible to use the stop function if the system incorporates a pressure sensor, a non-return valve and a diaphragm tank.

The non-return valve must always be installed before the pressure sensor. See fig. 16 and 17.

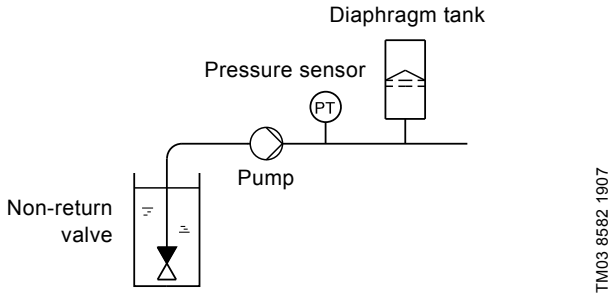


Fig. 16 Position of the non-return valve and pressure sensor in system with suction lift operation

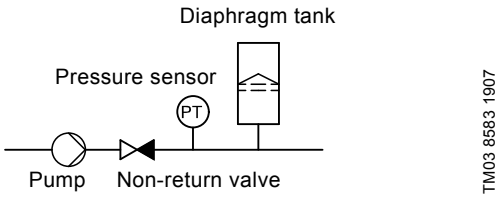


Fig. 17 Position of the non-return valve and pressure sensor in system with positive inlet pressure

Diaphragm tank

The stop function requires a diaphragm tank of a certain minimum size. The tank must be installed immediately after the pump and the precharge pressure must be 0.7 x actual setpoint.

Recommended diaphragm tank size:

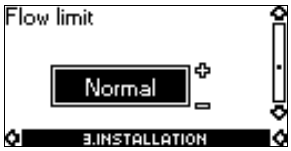
Rated flow of pump [gpm (m^3h)]	CRE pump	Typical diaphragm tank size [gal (liter)]
0-26 (0 - 5.9)	1s, 1, 3	2 (7.6)
27-105 (6.1 - 23.8)	5, 10, 15	4.4 (16.7)
106-176 (24.2 - 40)	20, 32	14 (53.0)
177-308 (40.2 - 70.0)	45	34 (128.7)
309-440 (70.2 - 99.9)	64, 90	62 (234.7)
441-750 (100-170)	120, 150	86 (325.5)

If a diaphragm tank of the above size is installed in the system, the factory setting of ΔH is the correct setting.

If the tank installed is too small, the pump will start and stop too often. This can be remedied by increasing ΔH.

4.4.9 Flow limit for the stop function

– Flow limit for the stop function only works if the system is not set up for flow switch.



In order to set at which flow rate the system is to go from continuous operation at constant pressure to start/stop operation, select among these four values of which three are preconfigured flow limits:

- Low
- Normal
- High
- Custom.

The default setting of the pump is Normal, representing approx. 10 % of the rated flow rate of the pump.

If a lower flow limit than normal is desired or the tank size is smaller than recommended, select Low.

If a higher flow than normal is wanted or a large tank is used, set the limit to High.

The value Custom can be seen in R100 but it can only be set by means of the PC Tool E-products. Custom is for customized set-up and optimizing to the process.

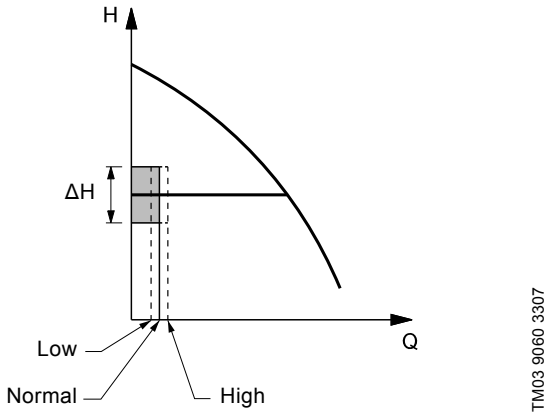
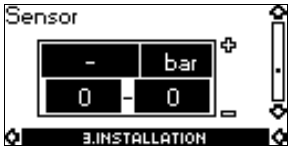


Fig. 18 Three preconfigured flow limits, *Low*, *Normal* and *High*

4.4.10 Sensor

Without sensor (uncontrolled)



With pressure sensor (controlled)

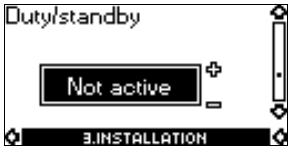
The setting of the sensor is only relevant in the case of controlled operation.

Select among the following values:

- Sensor output signal
  0-10 V
  0-20 mA
  4-20 mA.
- Unit of measurement of sensor:
  bar, mbar, m, kPa, psi, ft, m^3/h, m^3/s, l/s, gpm, °C, °F, %,
- Sensor measuring range.

4.4.11 Duty/standby

The duty/standby function applies to two pumps connected in parallel and controlled via GENIbus.



The duty/standby function can be set to these values:

- Active
- Not active.

When the function is set to Active, the following applies:

- Only one pump is running at a time.
- The stopped pump (standby) will automatically be cut in if the running pump (duty) has a fault. A fault will be indicated.
- Changeover between the duty pump and the standby pump will take place every 24 hours.

Activate the duty/standby function as follows:

1. Install and prime the two pumps according to the installation and operating instructions supplied with the pumps.
2. Check that the power supply is connected to the first pump according to the installation and operating instructions.
3. Use Grundfos R100 to set the duty/standby to Not active in the installation menu.
4. Use Grundfos R100 to set the Operating mode to Stop in the operation menu.
5. Use Grundfos R100 to set the other displays as required for the pump application (such as setpoint).
6. Disconnect the power supply to both pumps.
7. Installation of the AYB cable (91125604):
   a. Remove the plug from each MLE terminal box with a flat head screw driver. See fig. 19.
   b. Screw a new cable gland into each MLE terminal box with a crescent wrench. See fig. 19.
   c. Loosen the new cable gland caps and push the cable ends through the cable glands and into MLE motors.
   d. Remove the AYB connector plug from the first MLE motor. See fig. 20.
   e. Connect the black wire to the A terminal of the AYB connector plug.
   f. Connect the orange wire to the Y terminal of the AYB connector plug.
   g. Connect the red wire to the B terminal of the AYB connector plug.
   h. Reconnect the AYB connector plug to the first MLE motor.
   i. Tighten the cable gland cap to secure the cable. See fig. 19.
   j. Repeat steps d to i for the second MLE motor.
8. Connect the power supply to the two pumps according to the installation and operation instructions.
9. Use Grundfos R100 to check that the Operating mode is set to Normal in the operation menu of the second pump.
10. Use Grundfos R100 to set the other displays as required for the pump application (such as Setpoint).
11. Use Grundfos R100 to set the duty/standby to Active in the installation menu of the second pump. Please note the second pump will search for the first pump and automatically set the duty/standby to Active in the installation menu.
12. The second pump will operate for the first 24 hours. The two pumps will then alternate operation every 24 hours.

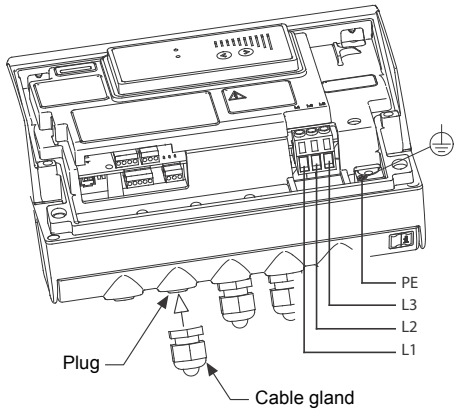


Fig. 19 Removing the plug and connecting cable gland to the terminal box

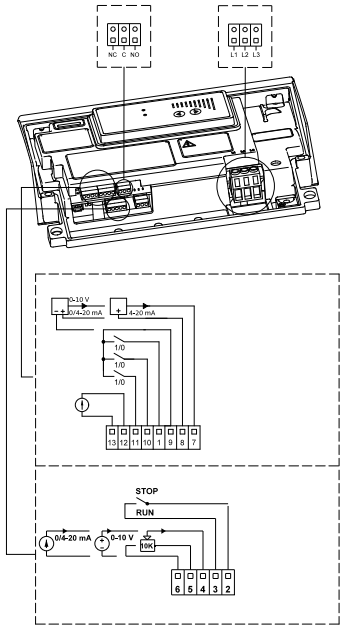


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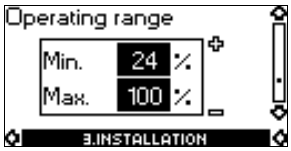
Fig. 20 AYB connector plug

4.4.12 Operating range



How to set the operating range:

- Set the min. curve within the range from max. curve to 12 % of maximum performance. The pump is factory-set to 24 % of maximum performance.
- Set the max. curve within the range from maximum performance (100 %) to min. curve.

The area between the min. and max. curves is the operating range.

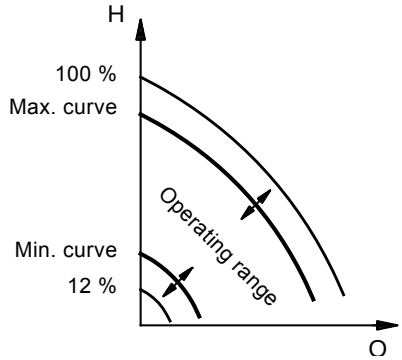


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Fig. 21 Setting of the min. and max. curves in % of maximum performance

4.4.13 Motor bearing monitoring (only three-phase pumps)

The motor bearing monitoring function can be set to these values:

- Active
- Not active.

When the function is set to Active, a counter in the controller will start counting the mileage of the bearings. See section *4.3.7 Lubrication status of motor bearings (only 20-30 hp)*.

– The counter will continue counting even if the function is switched to Not active, but a warning will not be given when it is time for relubrication.
– When the function is switched to Active again, the accumulated mileage will again be used to calculate the relubrication time.

4.4.14 Confirming relubrication/replacement of motor bearings (only three-phase pumps)

This function can be set to these values:

- Relubricated (only 20-30 hp)
- Replaced
- Nothing done.

When the bearing monitoring function is Active, the controller will give a warning indication when the motor bearings are due to be relubricated or replaced. See section *4.2.3 Fault indications*.

When the motor bearings have been relubricated or replaced, confirm this action in the above display by pressing OK.

Relubricated cannot be selected for a period of time after confirming relubrication.

4.4.15 Standstill heating (only three-phase pumps)

The standstill heating function can be set to these values:

- Active
- Not active.

When the function is set to Active, an AC voltage will be applied to the motor windings. The applied voltage will ensure that sufficient heat is generated to avoid condensation in the motor.

4.5 Typical display settings for constant-pressure E-pumps

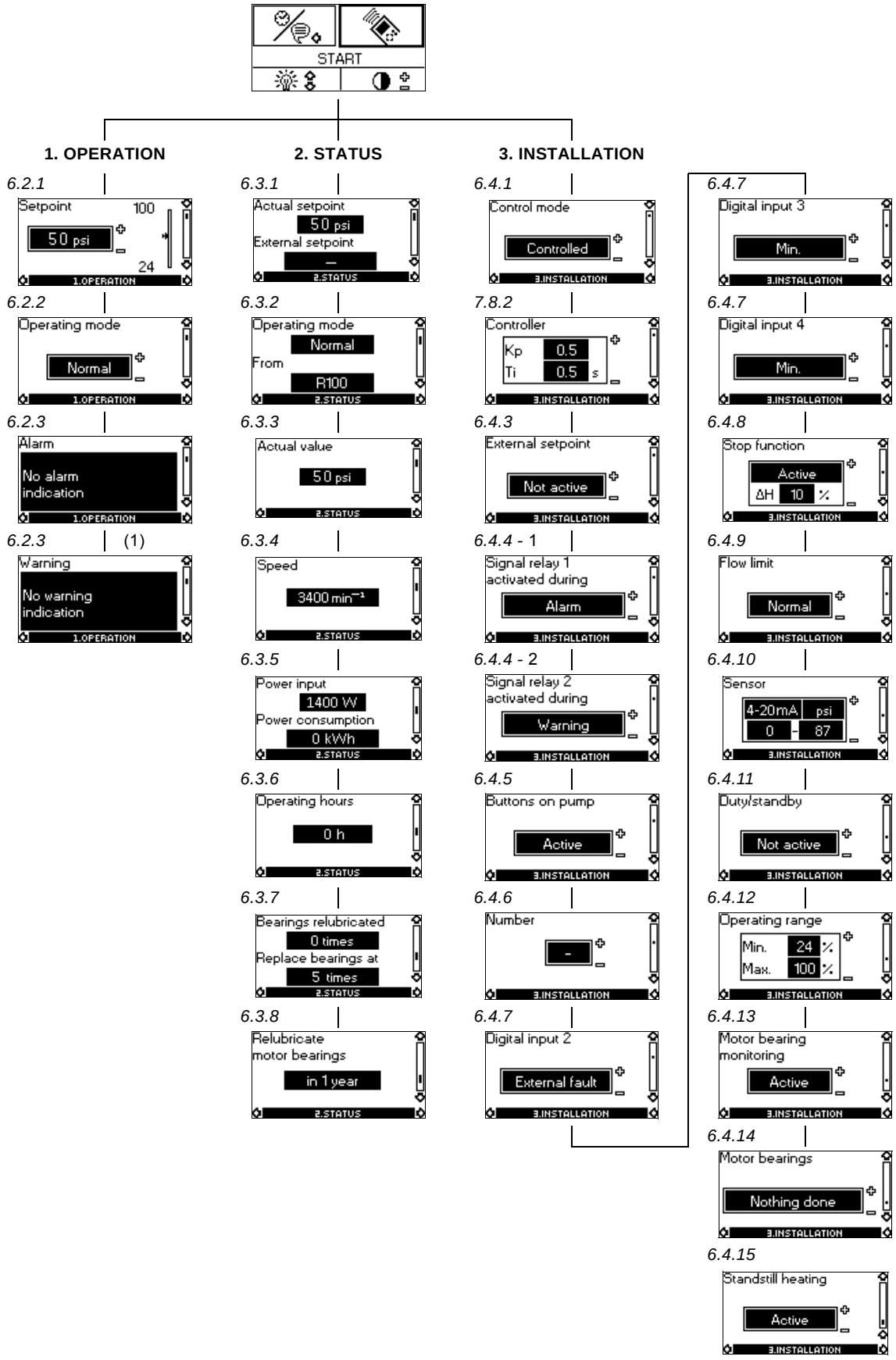


Fig. 22 Menu overview

4.6 Typical display settings for analog-input E-pumps

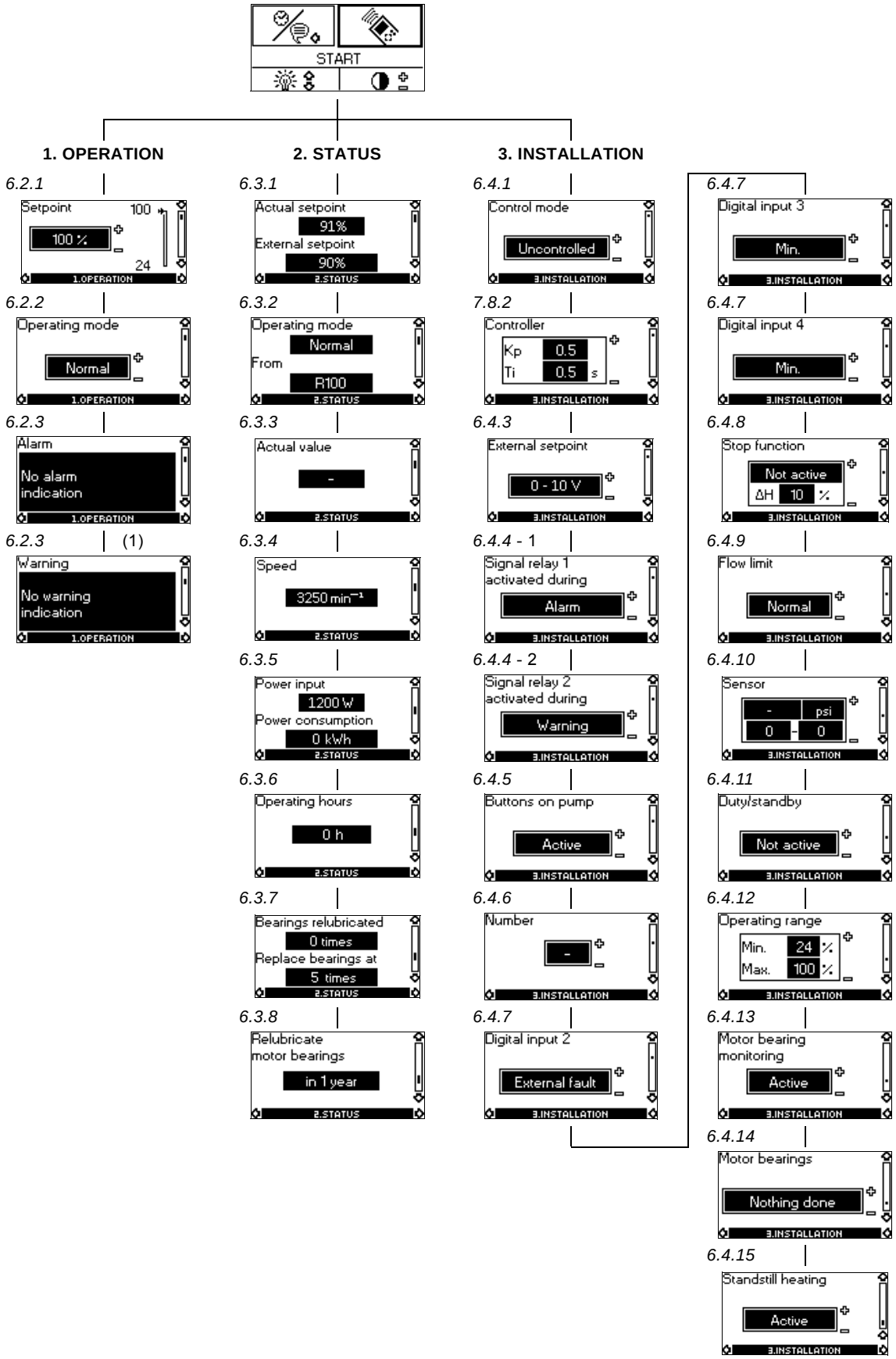


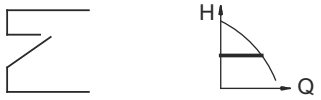
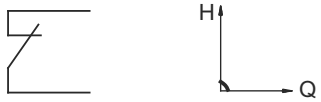
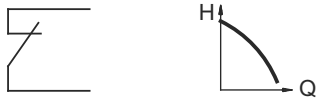
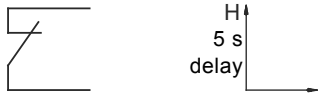
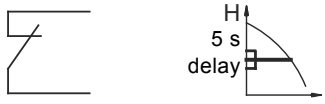
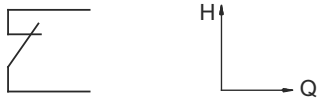
Fig. 23 Menu overview

4.7 Digital input

By means of the R100, one of the following functions can be selected for the digital input:

- Normal duty
- Min. curve
- Max. curve
- External fault
- Flow switch
- Dry running.

Functional diagram: Input for digital function

Digital function (terminals 1 and 9) (terminals 9 and 10) (terminals 9 and 11)	
	**Normal duty**
	**Min. curve**
	**Max. curve**
	**External fault**
	**Flow switch**
	**Dry running**

4.8 External setpoint signal

The setpoint can be remote-set by connecting an analogue signal transmitter to the input for the setpoint signal (terminal 4).

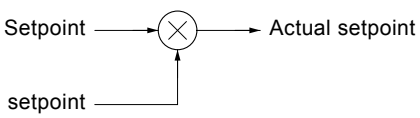


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Fig. 24 Actual setpoint as a product (multiplied value) of setpoint and external setpoint

Select the actual external signal, 0-10 V, 0-20 mA, 4-20 mA, via the R100. See section *4.4.3 External setpoint*.

If control mode **uncontrolled** is selected by means of the R100, the pump can be controlled by any controller.

In control mode **controlled**, the setpoint can be set externally within the range from the lower value of the sensor measuring range to the setpoint set on the pump or by means of the R100.

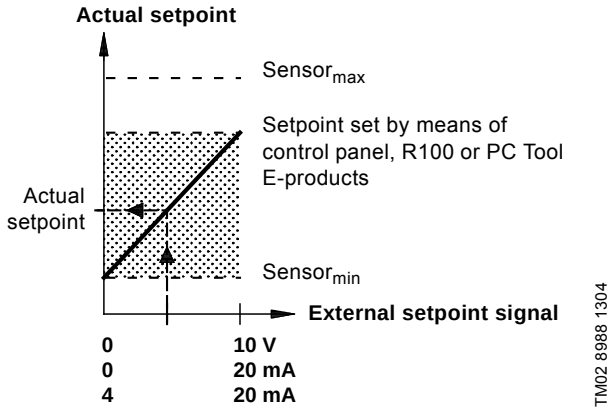

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Fig. 25 Relation between the actual setpoint and the external setpoint signal in control mode controlled

Example: At a sensor$_{min}$ value of 0 psi, a setpoint set of 50 psi and an external setpoint of 80 % (an 8 V analog signal to Terminal 4 if using an analog signal of 0-10 V), the actual setpoint will be as follows:

$$\text{Actual setpoint} = (\text{setpoint} - \text{sensor}_{min}) \times \%_{\text{external setpoint}} + \text{sensor}_{min}$$
$$= (50 - 0) \times 80\ \% + 0$$
$$= 40 \text{ psi}$$

In control mode **uncontrolled**, the setpoint can be set externally within the range from the min. curve to the setpoint set on the pump or by means of the R100. Typically the setpoint is set to 100 % when the control mode is uncontrolled (see section *4.6 Typical display settings for analog-input E-pumps*).

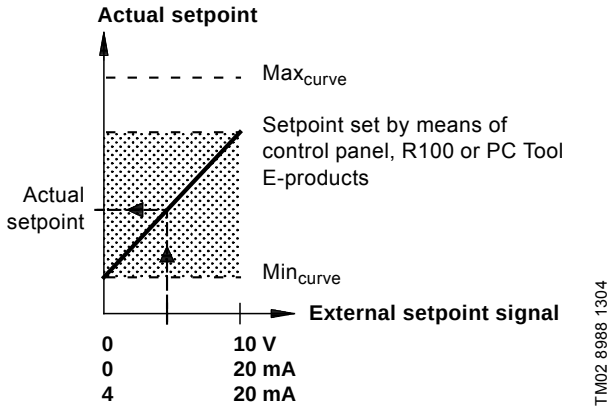

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Fig. 26 Relation between the actual setpoint and the external setpoint signal in control mode uncontrolled

4.9 Bus signal

The pump supports serial communication via an RS-485 input. The communication is carried out according to Grundfos bus protocol, GENIbus protocol, and enables connection to a building management system or another external control system.

Operating parameters, such as setpoint, operating mode, etc. can be remote-set via the bus signal. At the same time, the pump can provide status information about important parameters, such as actual value of control parameter, input power, fault indications, etc.

Contact Grundfos for further details.

If a bus signal is used, the number of settings available via the R100 will be reduced.

4.10 Other bus standards

Grundfos offers various bus solutions with communication according to other standards.

Contact Grundfos for further details.

4.11 Indicator lights and signal relay

The operating condition of the pump is indicated by the green and red indicator lights fitted on the pump control panel and inside the terminal box. See fig. 27.

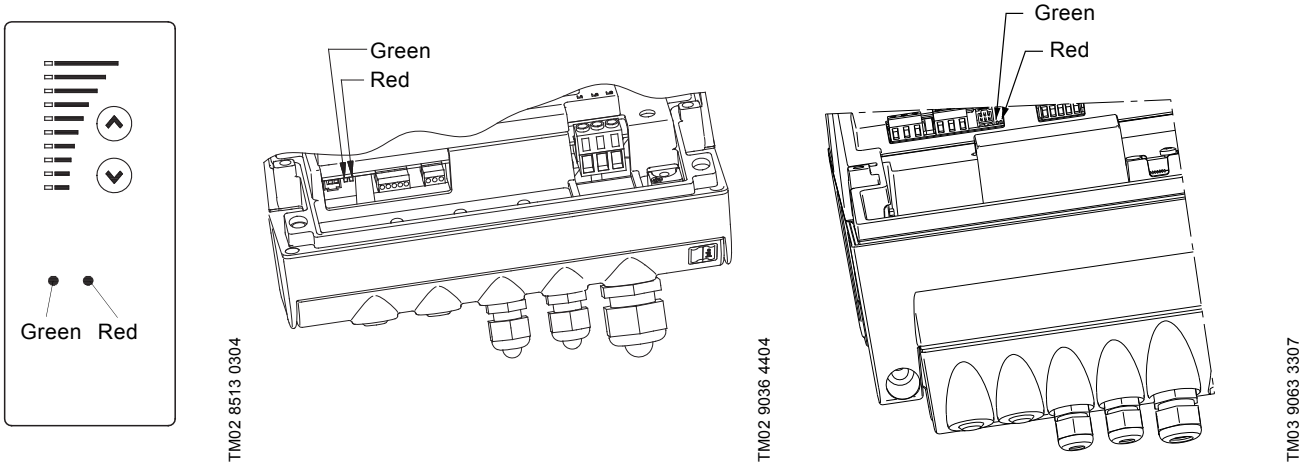
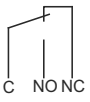
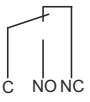
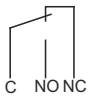
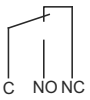
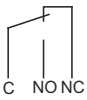
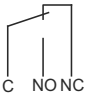
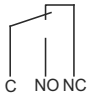


Fig. 27 Position of indicator lights

Besides, the pump incorporates an output for a potential-free signal via an internal relay.

For signal relay output values, see section *4.4.4 Signal relay*.

The functions of the two indicator lights and the signal relay are as shown in the following table:

Indicator lights		Signal relay activated during:				Description
Fault (red)	Operation (green)	Fault/Alarm, Warning and Relubricate	Operating	Ready	Pump running	
Off	Off					The power supply has been switched off.
Off	Permanently on					The pump is operating.
Off	Permanently on					The pump is stopped by the stop function.
Off	Flashing					The pump has been set to stop.
Permanently on	Off					The pump has stopped because of a Fault/Alarm or is running with a Warning or Relubricate indication. If the pump was stopped, restarting will be attempted (it may be necessary to restart the pump by resetting the Fault indication). If the cause is "external fault", the pump must be restarted manually by resetting the Fault indication.
Permanently on	Permanently on					The pump is operating, but it has or has had a Fault/Alarm allowing the pump to continue operation or it is operating with a Warning or Relubricate indication. If the cause is "sensor signal outside signal range", the pump will continue operating according to the 70 % curve and the fault indication cannot be reset until the signal is inside the signal range. If the cause is "setpoint signal outside signal range", the pump will continue operating according to the min. curve and the fault indication cannot be reset until the signal is inside the signal range.
Permanently on	Flashing					The pump has been set to stop, but it has been stopped because of a Fault.

Resetting of fault indication

A fault indication can be reset in one of the following ways:

- Briefly press the button ⊛ or ⊛ on the pump. This will not change the setting of the pump.
  A fault indication cannot be reset by means of ⊛ or ⊛ if the buttons have been locked.
- Switch off the power supply until the indicator lights are off.
- Switch the external start/stop input off and then on again.
- Use the R100. See section, *4.2.3 Fault indications.*

When the R100 communicates with the pump, the red indicator light will flash rapidly.

5. Setting the product

5.1 Factory setting

5.1.1 Pumps without factory-fitted sensor

The pumps have been factory-set to control mode uncontrolled. The setpoint value corresponds to 100 % of the maximum pump performance (see data sheet for the pump).

5.1.2 Pumps with pressure sensor

The pumps have been factory-set to control mode controlled. The setpoint value corresponds to 50 % of the sensor measuring range (see sensor nameplate).

5.2 Setting by means of control panel

The pump control panel, see fig. 28, incorporates the following buttons and indicator lights:

- Buttons, ⌃ and ⌄, for setpoint setting.
- Light fields, yellow, for indication of setpoint.
- Indicator lights, green (operation) and red (fault).

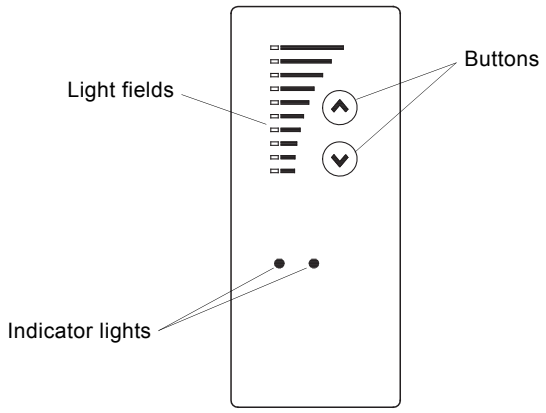


Fig. 28 Control panel, three-phase pumps, 20-30 hp

5.3 Setting of operating mode

Settings available:

- Normal
- Stop
- Min.
- Max.

Start/stop of pump

Start the pump by continuously pressing ⌃ until the desired setpoint is indicated. This is operating mode Normal.

Stop the pump by continuously pressing ⌄ until none of the light fields are activated and the green indicator light flashes.

Setting to Min.

Press ⌄ continuously to change to the min. curve of the pump (bottom light field flashes). When the bottom light field is on, press ⌄ for 3 seconds until the light field starts flashing.

To return to uncontrolled or controlled operation, press ⌃ continuously until the desired setpoint is indicated.

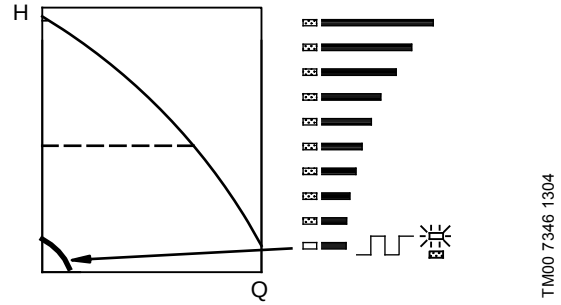


Fig. 29 Min. curve duty

Setting to Max.

Press ⌃ continuously to change to the max. curve of the pump (top light field flashes). When the top light field is on, press ⌃ for 3 seconds until the light field starts flashing.

To return to uncontrolled or controlled operation, press ⌄ continuously until the desired setpoint is indicated.

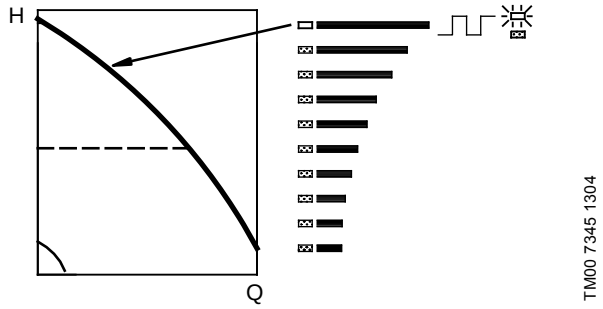


Fig. 30 Max. curve duty

5.4 Setpoint setting

Set the desired setpoint by pressing the button ⊙ or ⊙.

The light fields on the control panel will indicate the setpoint set. See examples in the following sections: *5.4.1 Pump in control mode controlled (pressure control)* and *5.4.2 Pump in control mode uncontrolled*.

5.4.1 Pump in control mode controlled (pressure control)

Example

Figure 31 shows that the light fields 5 and 6 are activated, indicating a desired setpoint of 3 bar. The setting range is equal to the sensor measuring range (see sensor nameplate).

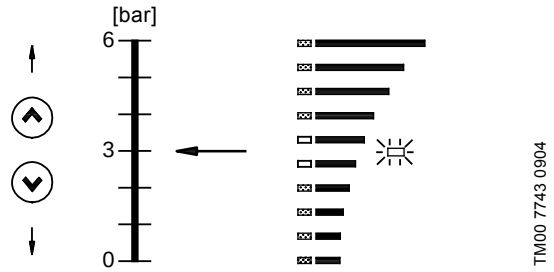


Fig. 31 Setpoint set to 3 bar, pressure control

5.4.2 Pump in control mode uncontrolled

Example

In control mode uncontrolled, the pump performance is set within the range from min. to max. curve. See fig. 32.

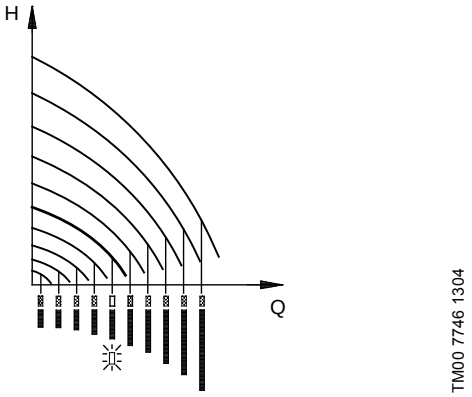


Fig. 32 Pump performance setting, control mode uncontrolled

5.5 Setting by means of R100

The pump is designed for wireless communication with Grundfos remote control R100.

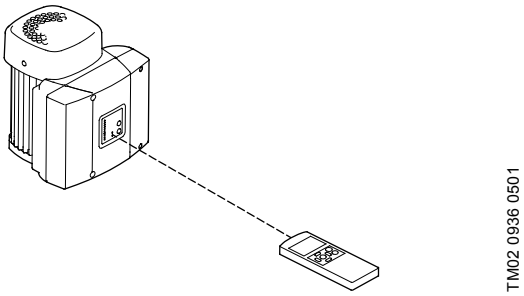


Fig. 33 R100 communicating with the pump via infra-red light

During communication, the R100 must be pointed at the control panel. When the R100 communicates with the pump, the red indicator light will flash rapidly. Keep pointing the R100 at the control panel until the red LED diode stops flashing.

The R100 offers setting and status displays for the pump.

The displays are divided into four parallel menus (see fig. 22):

0. GENERAL (see operating instructions for the R100)
1. OPERATION
2. STATUS
3. INSTALLATION

The figure above each individual display in fig. 22 refers to the section in which the display is described.

Fig. 34 Menu overview

5.6 Grundfos GO

The pump is designed for wireless radio or infrared communication with Grundfos GO.

Grundfos GO enables setting of functions and gives access to status overviews, technical product information and actual operating parameters.

Grundfos GO offers the following mobile interfaces (MI).

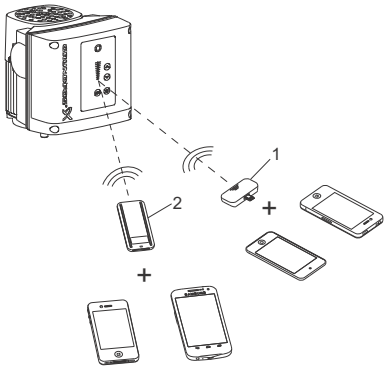


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Fig. 35 Grundfos GO communicating with the pump via radio or infrared connection (IR)

Pos.	Description
1	Grundfos MI 204: Add-on module enabling radio or infrared communication. You can use MI 204 in conjunction with an Apple iPhone or iPod with Lightning connector, such as fifth generation or later iPhone or iPod. MI 204 is also available together with an Apple iPod touch and a cover.
2	Grundfos MI 301: Separate module enabling radio or infrared communication. You can use the module in conjunction with an Android or iOS-based smart device with Bluetooth connection.

5.6.1 Communication

When Grundfos GO Remote communicates with the pump, the indicator light in the middle of the Grundfos Eye will flash green.

Communication must be established using one of these communication types:

- radio communication
- infrared communication.

Radio communication

Radio communication can take place at distances up to 30 meters. It is necessary to enable communication by pressing or OK on the pump control panel.

Infrared communication

When communicating via infrared light, Grundfos GO Remote must be pointed at the pump control panel.

5.6.2 Navigation

Navigation can be done from the dashboard. See fig. 36.

Dashboard

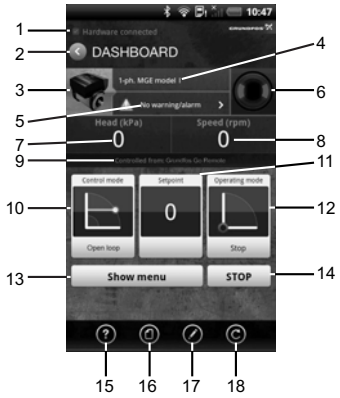

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Fig. 36 Example of dashboard

Pos.	Description	Action
1	Connection indicator	This text appears when Grundfos GO Remote app has connected to an MI 201, MI 202 or MI 301. If the hardware is not connected, it will not be possible to communicate with a Grundfos product.
2	Back button	Returns to the previous display.
3	Product information	Provides technical information about the product.
4	Product name	Name of the product communicating with Grundfos GO Remote.
5	Alarms and warnings	Shows alarms and warnings.
6	Grundfos Eye	Shows the operating condition of the product.
7	Primary status value	Shows the primary status value.
8	Secondary status value	Shows the secondary status value.
9	Control source	Shows by which interface the product is controlled.
10	Control mode	Shows the control mode of the product.
11	Actual setpoint value	Shows the actual setpoint value.
12	Operating mode	Shows the operating mode.
13	Show menu	Gives access to other menus.
14	Stop	Stops the product.
Tool bar		
15	Help	The help function describes the menus making it easy for the user to change settings, etc.
16	Documentation	Gives access to installation and operating instructions and quick guides.
17	Report	Enables the creation of user-defined reports.
18	Update	Enables update of Grundfos GO Remote app.

5.7 Setting by means of PC Tool E-products

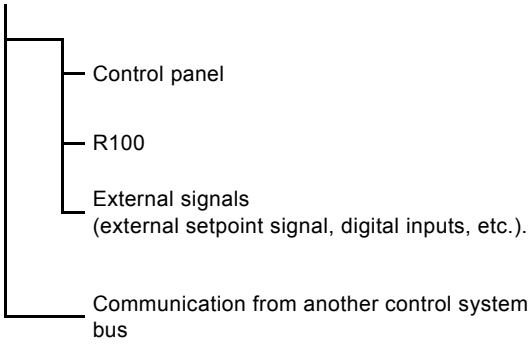
Special setup requirements differing from the settings available via the R100 require the use of Grundfos PC Tool E-products. This again requires the assistance of a Grundfos service technician or engineer. Contact your local Grundfos company for more information.

5.8 Priority of settings

The priority of settings depends on two factors:

1. control source
2. settings.

1. Control source



5.8.1 2. Settings

- Operating mode Stop
- Operating mode Max. (Max. curve)
- Operating mode Min. (Min. curve)
- Setpoint setting.

An E-pump can be controlled by different control sources at the same time, and each of these sources can be set differently. Consequently, it is necessary to set an order of priority of the control sources and the settings.

If two or more settings are activated at the same time, the pump will operate according to the function with the highest priority.

5.8.2 Priority of settings without bus communication

Priority	Control panel or R100	External signals
1	Stop	
2	Max.	
3		Stop
4		Max.
5	Min.	Min.
6	Setpoint setting	Setpoint setting

Example: If the E-pump has been set to operating mode Max. (Max. frequency) via an external signal, such as digital input, the control panel or R100 can only set the E-pump to operating mode Stop.

5.8.3 Priority of settings with bus communication

Priority	Control panel or R100	External signals	Bus communication
1	Stop		
2	Max.		
3		Stop	Stop
4			Max.
5			Min.
6			Setpoint setting

Example: If the E-pump is operating according to a setpoint set via bus communication, the control panel or R100 can set the E-pump to operating mode Stop or Max., and the external signal can only set the E-pump to operating mode Stop.

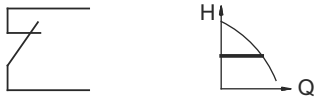
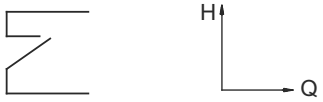
5.9 External forced-control signals

The pump has inputs for external signals for these forced-control functions:

- Start/stop of pump
- Digital function.

5.9.1 Start/stop input

Functional diagram: Start/stop input:

Start/stop (terminals 2 and 3)	
	**Normal duty**
	**Stop**

6. Taking the product out of operation

6.1 Emergency operation (only 20-30 hp)

DANGER

Electric Shock

Death or serious personal injury

– Never make any connections in the pump terminal box unless all electric supply circuits have been switched off for at least 5 minutes.

– Note for instance that the signal relay may be connected to an external supply which is still connected when the power supply is disconnected.

If the pump is stopped and you cannot start the pump immediately after normal remedies, the reason could be a faulty frequency converter. If this is the case it is possible to maintain emergency operation of the pump.

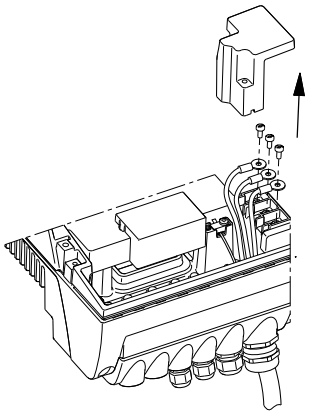
Before change over to emergency operation we recommend you to:

- check that the power supply is OK
- check that control signals are working (start/stop signals)
- check that all alarms are reset
- make a resistance test on the motor windings (disconnect the motor leads from the terminal box).

If the pump remains stopped it is possible that the frequency converter is faulty.

To establish emergency operation proceed as follows:

1. Disconnect the three power supply leads, L1, L2, L3, from the terminal box, but leave the protective ground lead(s) in position on the PE terminal(s).



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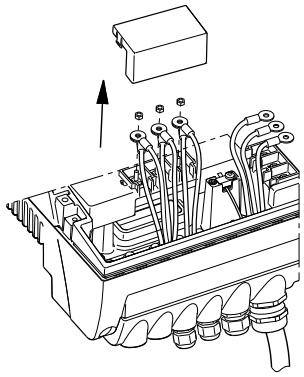
2. Disconnect the motor supply leads, U/W1, V/U1, W/V1, from the terminal box.



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3. Connect the leads as shown in fig. 37.

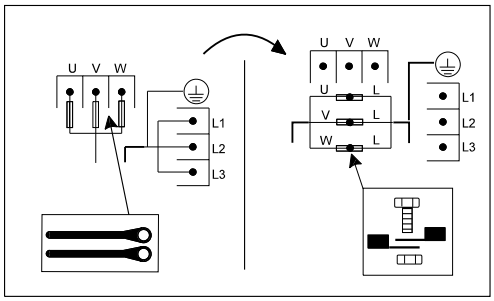

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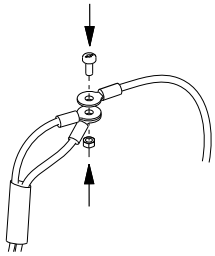
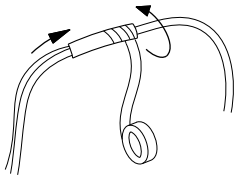
Fig. 37 How to switch an E-pump from normal operation to emergency operation

Use the screws from the power supply terminals and the nuts from the motor terminals.



TM03 9121 3407

4. Insulate the three leads from each other by means of insulating tape or the like.



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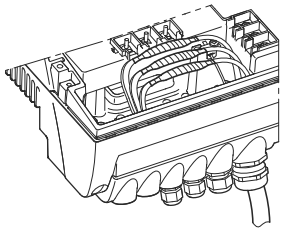

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DANGER

Electric Shock

Death or serious personal injury

- Do not bypass the frequency converter by connecting the power supply leads to the U, V and W terminals.
- This may cause hazardous situations for personnel as the high voltage potential of the power supply may be transferred to touchable components in the terminal box.

Check the direction of rotation when starting up after switching to emergency operation.

5. A motor starter is required.

6.2 Insulation resistance

20-30 hp

- Do not measure the insulation resistance of an installation incorporating E-pumps using high voltage megging equipment, as this may damage the built-in electronics.
- The motor leads can be disconnected separately and the insulation resistance of the motor windings can be tested.

7. Servicing the product

7.1 Cleaning of the motor

Keep the motor cooling fins and fan blades clean to ensure sufficient cooling of the motor and electronics.

7.2 Relubrication of motor bearings

20-30 hp pumps

The motor bearings are of the open type and must be relubricated regularly. The motor bearings are prelubricated on delivery. The built-in bearing monitoring function will give a warning indication on the R100 when the motor bearings are due to be relubricated.

When relubricating the first time, use the double quantity of grease as the lubricating channel is still empty.

Frame size	Quantity of grease [ounces]	
	Drive end (DE)	Non-drive end (NDE)
MLE 160	.44	.44
MLE 180	.51	.51

The recommended grease type is a lithium-based lubricating grease. Use ExxonMobil Unirex N3 grease

7.3 Replacement of motor bearings

20-30 hp motors have built-in bearing monitoring function which will give a warning indication on the R100 when the motor bearings are due to be replaced.

7.4 Replacement of varistor (only 20-30 hp)

The varistor protects the pump against voltage transients. If voltage transients occur, the varistor will be worn over time and need to be replaced. The more transients, the more quickly the varistor will be worn. When it is time to replace the varistor, R100 and PC Tool E-products will indicate this as a warning.

A Grundfos technician is required for replacement of the varistor. Contact your local Grundfos company for assistance.

7.5 Service parts and service kits

For further information on service parts and service kits, visit www.grundfos.com, select country, select Grundfos Product Center.

8. Technical data

8.1 Three-phase pumps, 20-30 hp

8.1.1 Supply voltage

3 x 460-480 V - 10 %/+ 10 %, 50/60 Hz - 3 %/+ 3 %, PE.

Cable: Max. 10 mm^2 / 8 AWG.

Use min. 158 °F (70 °C) copper conductors only.

Recommended fuse sizes

Motor size [hp]	Max. [A]
20	36
25	43
30	51

Standard as well as quick-blow or slow-blow fuses may be used.

8.1.2 Overload protection

The overload protection of the E-motor has the same characteristic as an ordinary motor protector. As an example, the E-motor can stand an overload of 110 % of I_{nom} for 1 min.

8.1.3 Leakage current

Ground leakage current > 10 mA.

The leakage currents are measured in accordance with EN 61800-5-1.

8.1.4 Inputs/output

Start/stop

External potential-free contact.

Voltage: 5 VDC.

Current: < 5 mA.

Screened cable: 0.5 - 1.5 mm^2 / 28-16 AWG.

Digital

External potential-free contact.

Voltage: 5 VDC.

Current: < 5 mA.

Screened cable: 0.5 - 1.5 mm^2 / 28-16 AWG.

Setpoint signals

- Potentiometer
  0-10 VDC, 10 kΩ (via internal voltage supply).
  Screened cable: 0.5 - 1.5 mm^2 / 28-16 AWG.
  Maximum cable length: 328 ft.
- Voltage signal
  0-10 VDC, R_i > 50 kΩ.
  Tolerance: + 0 %/- 3 % at maximum voltage signal.
  Screened cable: 0.5 - 1.5 mm^2 / 28-16 AWG.
  Maximum cable length: 1640 ft.
- Current signal
  DC 0-20 mA/4-20 mA, R_i = 250 Ω.
  Tolerance: + 0 %/- 3 % at maximum current signal.
  Screened cable: 0.5 - 1.5 mm^2 / 28-16 AWG.
  Maximum cable length: 1640 ft.

Sensor signals

- Voltage signal
  0-10 VDC, R_i > 50 kΩ (via internal voltage supply).
  Tolerance: + 0 %/- 3 % at maximum voltage signal.
  Screened cable: 0.5 - 1.5 mm^2 / 28-16 AWG.
  Maximum cable length: 1640 ft.
- Current signal
  DC 0-20 mA/4-20 mA, R_i = 250 Ω.
  Tolerance: + 0 %/- 3 % at maximum current signal.
  Screened cable: 0.5 - 1.5 mm^2 / 28-16 AWG.
  Maximum cable length: 1640 ft.

Internal power supplies

- 10 V power supply for external potentiometer:
  Max. load: 2.5 mA.
  Short-circuit protected.
- 24 V power supply for sensors:
  Max. load: 40 mA.
  Short-circuit protected.

Signal relay output

Potential-free changeover contact.
Maximum contact load: 250 VAC, 2 A, cos φ 0.3 - 1.
Minimum contact load: 5 VDC, 10 mA.
Screened cable: 0.5 - 2.5 mm^2 / 28-12 AWG.
Maximum cable length: 1640 ft.

Bus input

Grundfos bus protocol, GENIbus protocol, RS-485.
Screened 3-core cable: 0.2 - 1.5 mm^2 / 28-16 AWG.
Maximum cable length: 1640 ft.

8.2 Other technical data

EMC (electromagnetic compatibility to EN 61800-3)

Motor [hp]	Emission/immunity
20 25 30	**Emission:** The motors are category C3, corresponding to CISPR11, group 2, class A, and may be installed in **industrial areas** (second environment). If equipped with an external Grundfos EMC filter, the motors are category C2, corresponding to CISPR11, group 1, class A, and may be installed in **residential areas** (first environment). When the motors are installed in residential areas, supplementary measures may be required as the motors may cause radio interference. Motor sizes 25, and 30 hp comply with EN 61000-3-12 provided that the short-circuit power at the interface point between the user's electrical installation and the public power supply network is greater than or equal to the values stated below. It is the responsibility of the installer or user to ensure, by consultation with the power supply network operator, if necessary, that the motor is connected to a power supply with a short-circuit power greater than or equal to these values:

Motor size [hp]	Short-circuit power [kVA]
20	-
25	2700
30	3000

20 hp motors do not comply with EN 61000-3-12.

By installing an appropriate harmonic filter between the motor and the power supply, the harmonic current content will be reduced. In this way, the 20 hp motor will comply with EN 61000-3-12.

Immunity:

The motors fulfill the requirements for both the first and second environment.

Contact Grundfos for further information.

Enclosure class

- Three-phase pumps, 20-30 hp: IP55 (IEC 34-5)

Insulation class

F (IEC 85)

Ambient temperature

During operation:

- Minimum: -4 °F (-20 °C)
- Maximum: +104 °F (40 °C) without derating

During storage/transport:

- -13 °F (-25 °C) to +158 °F (70 °C) (20-30 hp)

Relative air humidity

Maximum 95 %.

Sound pressure level

Single-phase pump s:

< 70 dB(A).

Sound pressure level

Motor [hp]	Speed stated on the nameplate	Sound pressure level
20	3400-3600	70
25		74
30		78

9. Disposing of the product

This product or parts of it must be disposed of in an environmentally sound way:

1. Use the public or private waste collection service.
2. If this is not possible, contact the nearest Grundfos company or service workshop.

SECTION 3

CONTROL PANEL

GRUNDFOS

Panel Part Number:
5332808945

Description

Control MPC E

5 X 30HP
3 X 480V

Selected Options: System Fault Light, Audible Alarm, Surge Protection, Pump Run Light, Normal/Emergency Switch, Service Disconnect Switch, IO351B SCADA, Individual Fault lights, Interior Panle Light

Rev	A	Control MPC E 5 X 30HP 3 X 480V		Document ID	GRUNDFOS
Date	10/14/2021			080221DC1-SUBM	Panel Part Number: 5332808945
Status	Approved				

Feeder Circuit Protection:

Feeder circuit protection to be provided by others. Type and size to be based on local, state and national electrical codes

SCCR Rating: 100 kA RMS Symmetric, 480V

UL Type Rating: 4X

Largest Motor FLA and Panel Maximum FLA:

Motor Horsepower	30HP
Motor FLA	36.5FLA
Panel Max. FLA	183.5FLA

Wire Type	Color	Abbr.
+12/24VDC Power/PLC Input(s)	Blue	BU
-12/24VDC Power/PLC Input(s)	Blue w/White Stripe	BUWH
115VAC Primary Line Power	Black	BK
115VAC Neutral	White	WH
Ground/PE	Green/Yellow Stripe	GNYE
Analog Inputs	Orange	OG
Analog Outputs	Orange	OG
Digital Inputs (CU Components)	Violet	VT
Ground for Digital Inputs (CU Components)	Violet w/White Stripe	VTWH
Digital Outputs	Yellow	YE
Power L1	Black	BK
Power L2	Orange	OG
Power L3	Red	RD
Power Neutral	White	WH
All Other Wiring	Brown	BN

Safety / Application Notes:

** Please Reference the "BOOSTERPAQ - HYDRO MPC" Installation and Operation Instructions "BEFORE" Applying power to Panel.

** Power supply wires in front of main disconnect switch have dangerous voltage even though the main disconnect switch is off.

** Control panel must be connected professionally to the earth / ground.

** GRUNDFOS MLE motors have an integrated variable frequency drive (VFD) which provides motor overload protection. If a system utilizes MLE motors, the motor overload protection is provided by the VFD and does not require any additional motor overload protection.

Cross Reference Definition

(##-##)
Sheet-Row

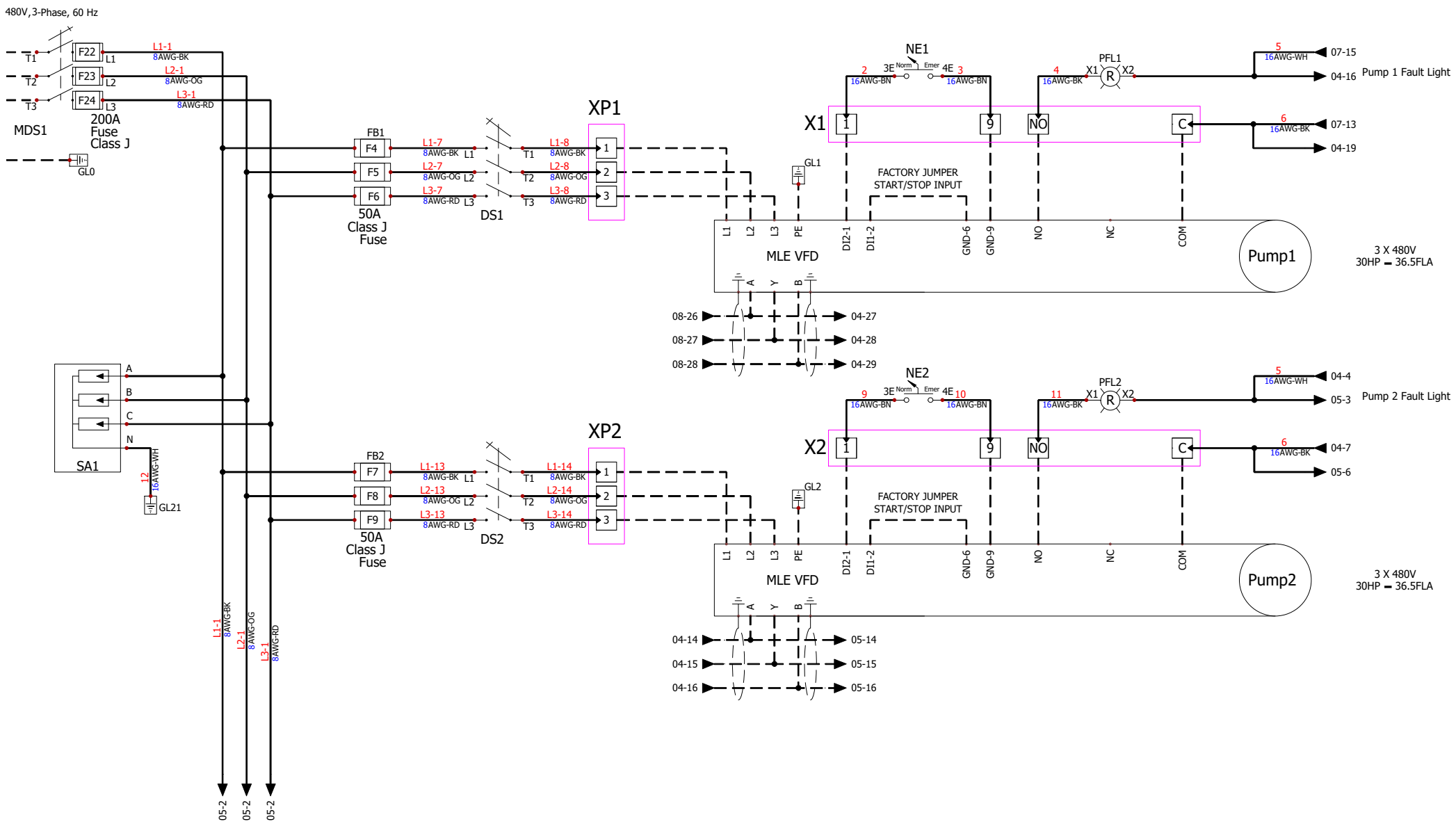
Wire Types

Internal Panel Wire
External Wire

Rev	A	Control MPC E 5 X 30HP 3 X 480V		Document ID	GRUNDFOS
Date	10/14/2021			080221DC1-SUBM	Panel Part Number: 5332808945
Status	Approved				SHEET: 2/15

1-Table of Contents

Rev	A	Control MPC E 5 X 30HP 3 X 480V		Document ID	GRUNDFOS
Date	10/14/2021			080221DC1-SUBM	Panel Part Number: 5332808945
Status	Approved				SHEET: 3/15



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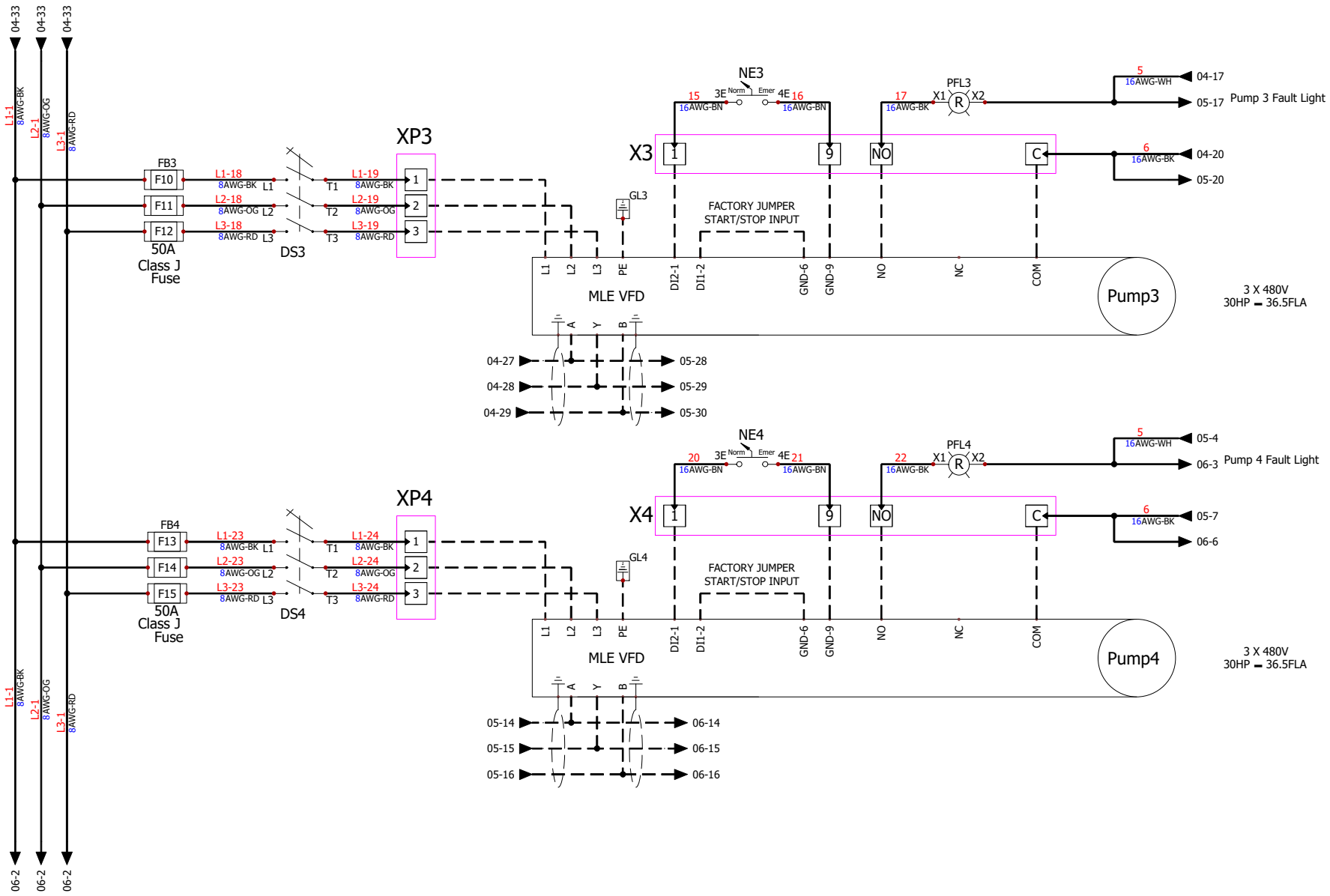
Date	10/14/2021			080221DC1-SUBM	Panel Part Number: 5332808945
Status	Approved				SHEET: 4/15



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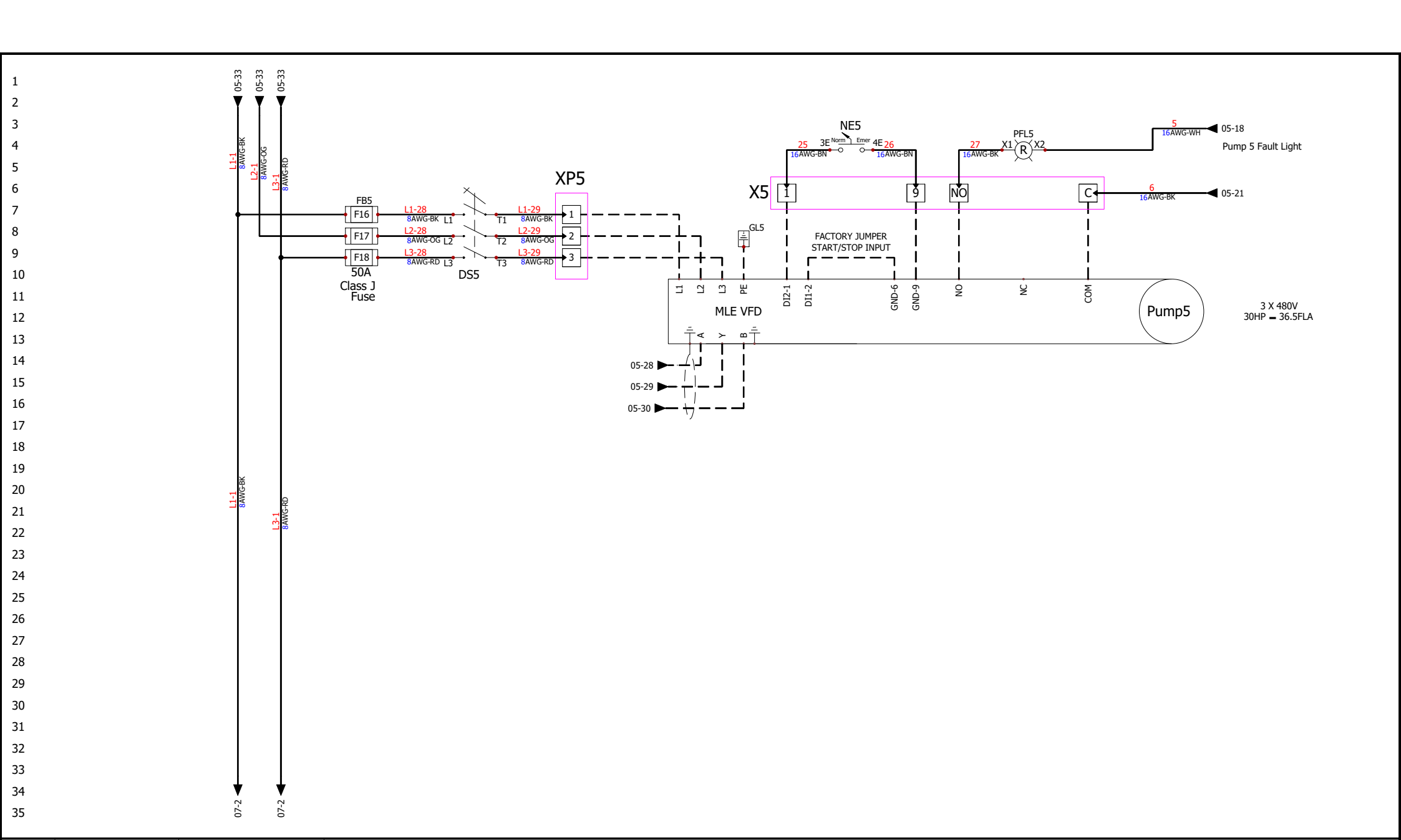
Date	10/14/2021			080221DC1-SUBM	Panel Part Number: 5332808945
Status	Approved				SHEET: 5/15



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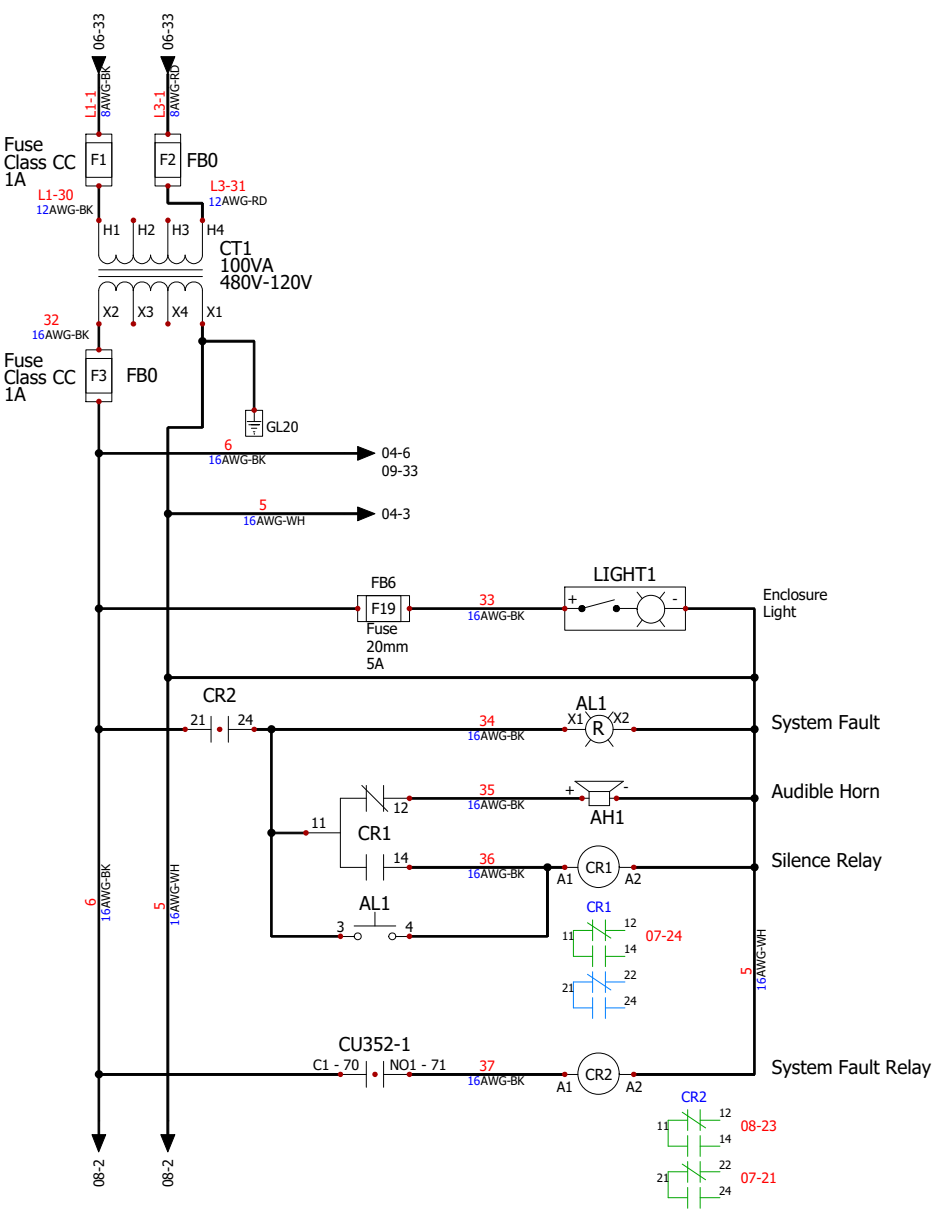
Date	10/14/2021			080221DC1-SUBM	Panel Part Number: 5332808945
Status	Approved				SHEET: 6/15



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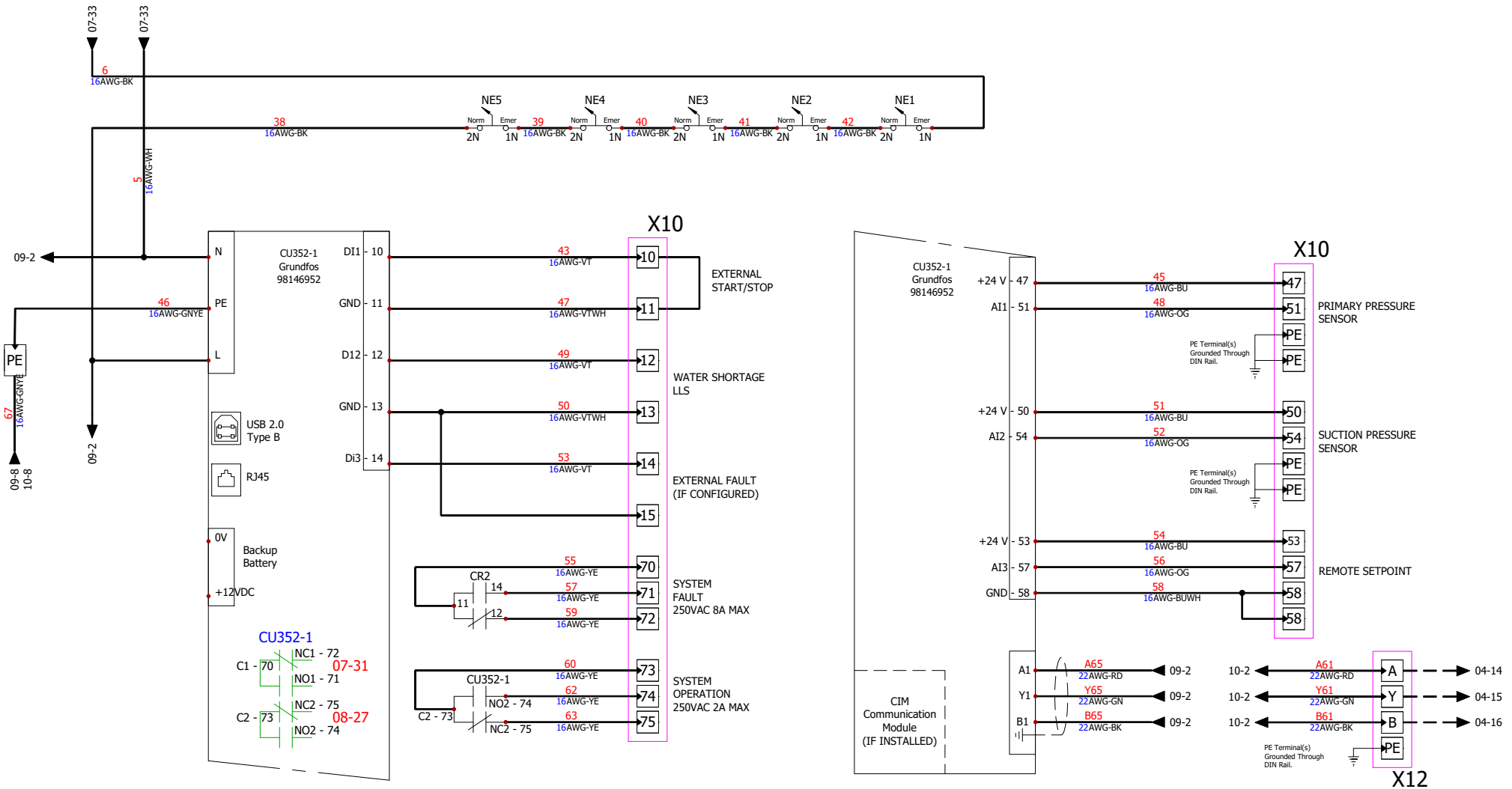
Date	10/14/2021			080221DC1-SUBM	Panel Part Number: 5332808945
Status	Approved				SHEET: 7/15



CIM COMMUNICATION MODULE TERMINATIONS

CIM		Terminal 1	Terminal 2	Terminal 3	Terminal 4
CIM 110	LON	LON terminal A	LON terminal B	LON terminal for cable screen	N/A
CIM 150	PROFIBUS DP	PROFIBUS terminal B	PROFIBUS terminal A	PROFIBUS terminal DGND	+5VDC
CIM 200	Modbus RTU	Modbus terminal D1	Modbus terminal D0	Modbus terminal common/GND	N/A
CIM 300	BACnet MS/TP	BACnet Plus terminal	BACnet Minus terminal	BACnet Ground terminal	N/A
CIM 500	BACnet IP, Modbus TCP, PROFINET IO	RJ45	RJ45		

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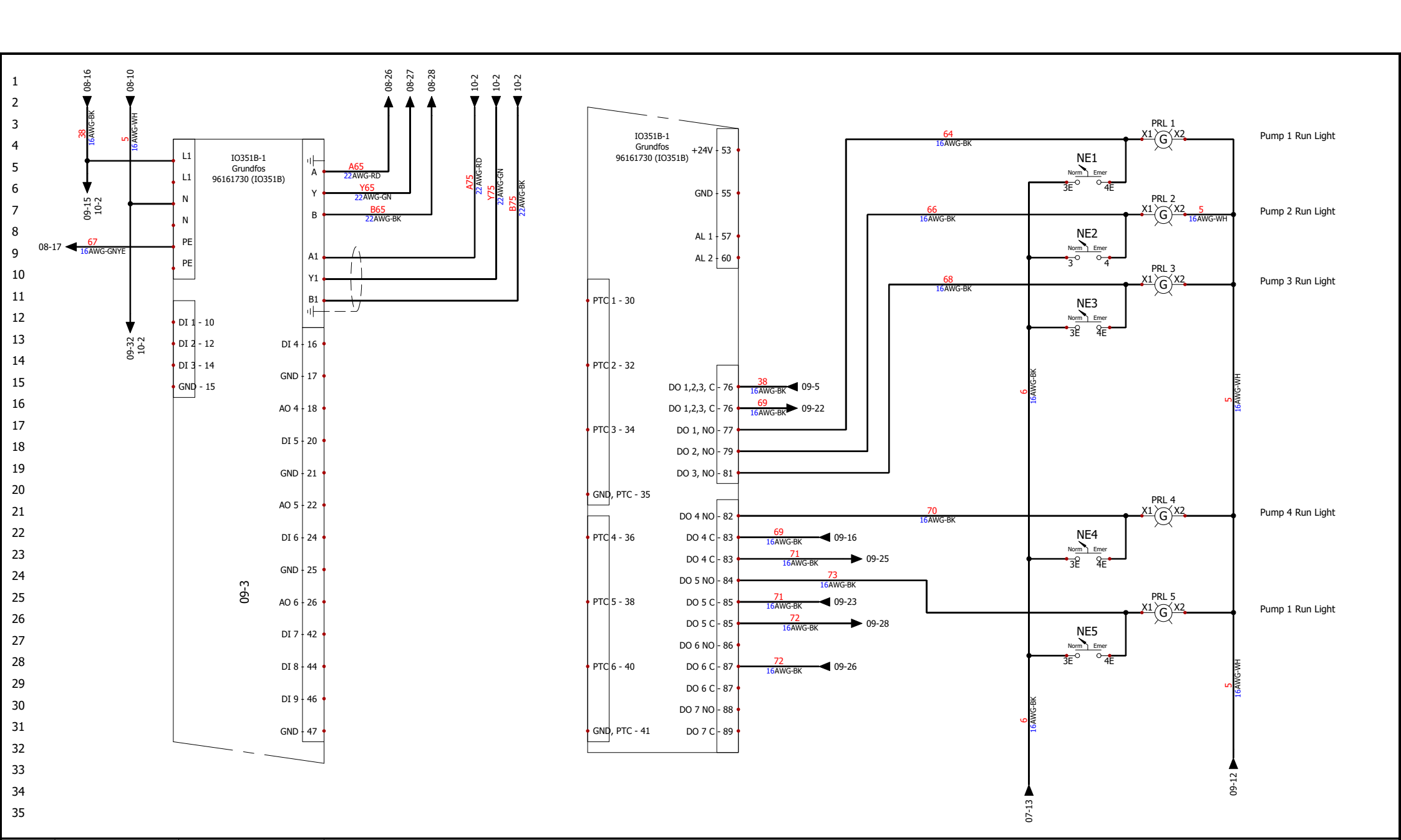
Date	10/14/2021				SHEET: 8/15
Status	Approved				



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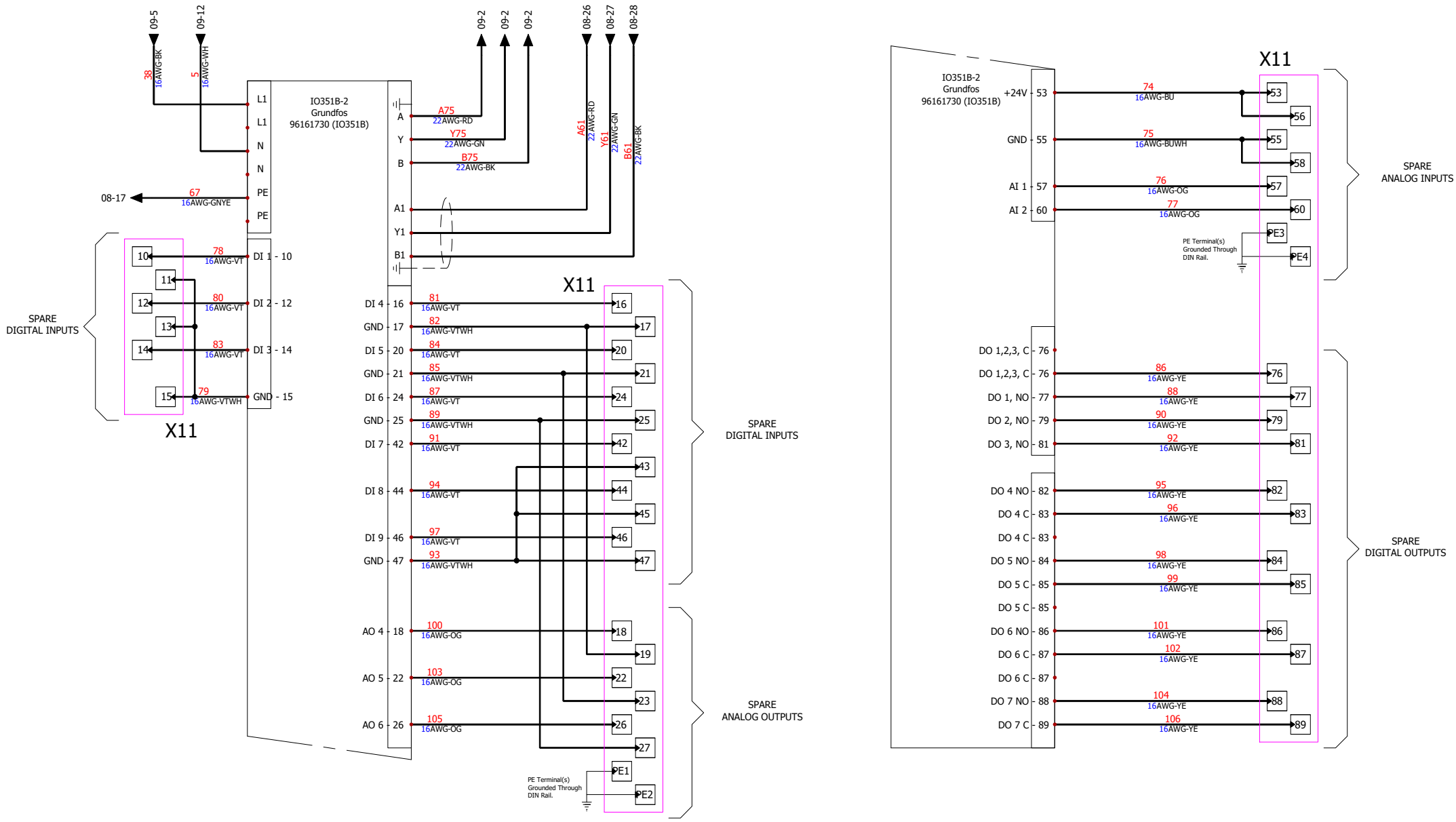
Date	10/14/2021			080221DC1-SUBM	Panel Part Number: 5332808945
Status	Approved				SHEET: 9/15



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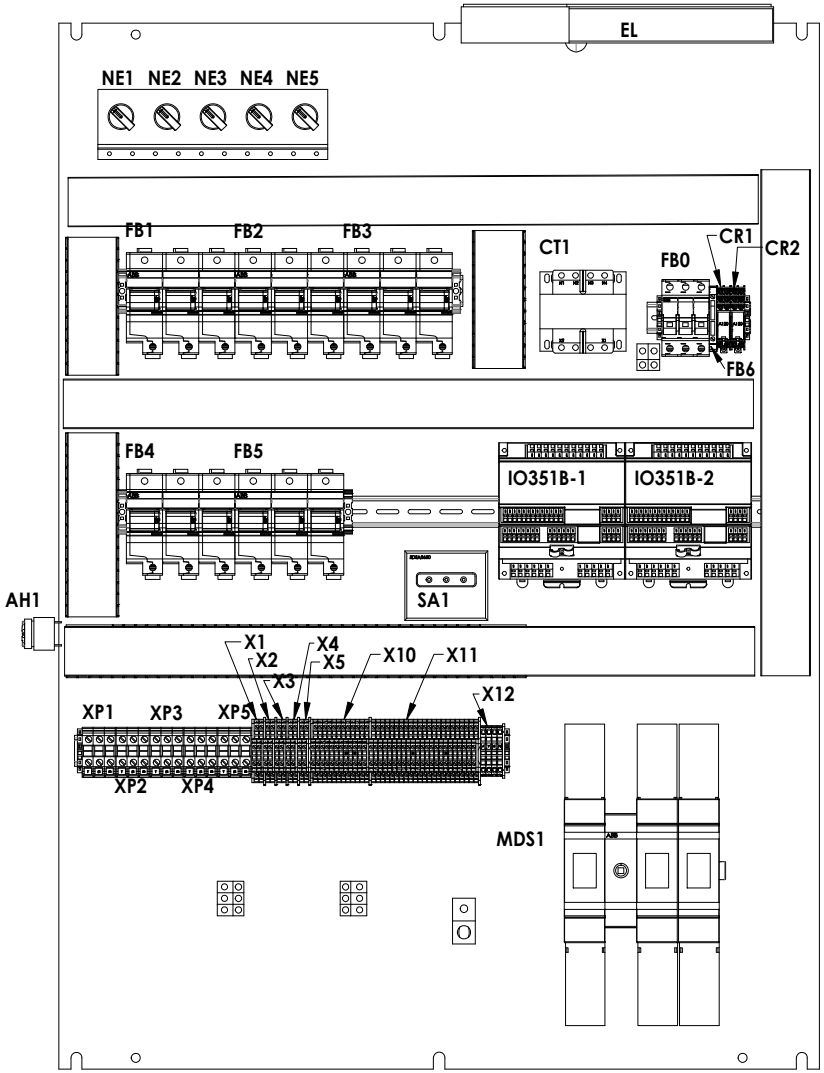
Date	10/14/2021			080221DC1-SUBM	Panel Part Number: 5332808945
Status	Approved				SHEET: 10/15



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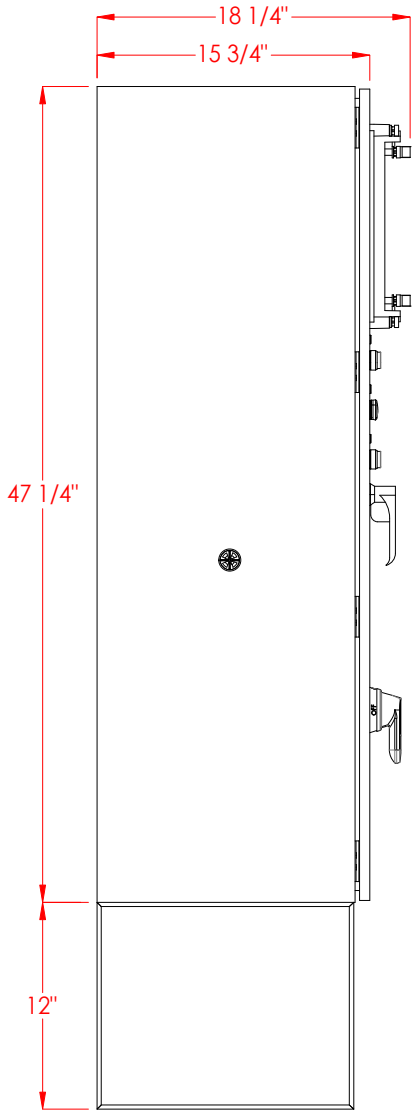
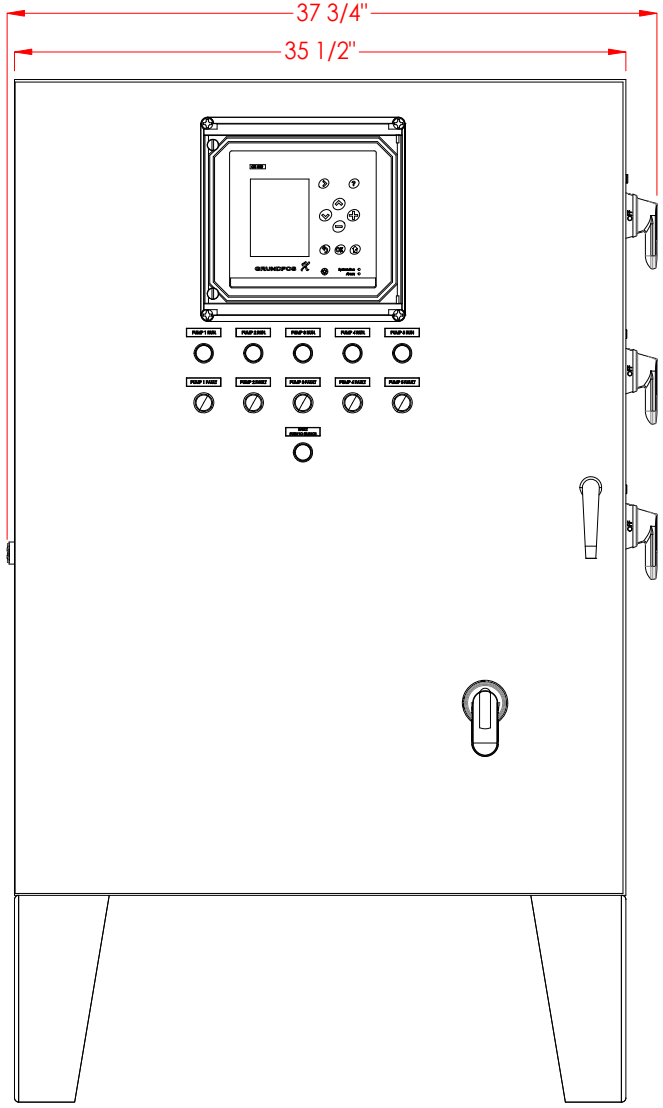
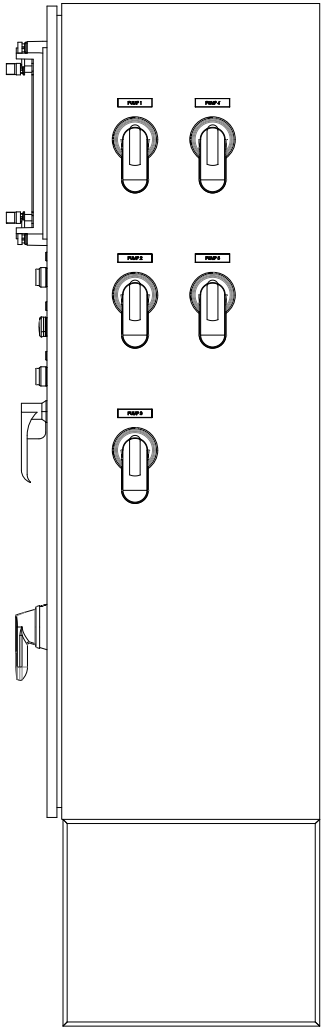
Date	10/14/2021			080221DC1-SUBM	Panel Part Number: 5332808945
Status	Approved				SHEET: 11/15







CLEARANCE FROM FRONT OF ENCLOSURE MUST BE 36"
CLEARANCE FROM DISCONNECT HANDLES MUST BE 6"

Rev	A	Control MPC E 5 X 30HP 3 X 480V	This drawing and its content is the property of GRUNDFOS. It may not be copied for third parties or competitors. Changes are only to be made by GRUNDFOS.	Document ID	GRUNDFOS
Date	10/14/2021			080221DC1-SUBM	Panel Part Number: 5332808945
Status	Approved				SHEET: 12/15

Article Number	Mark	Manufacturer	Reference	Description	Quantity	Component Type
13-16-26-1241	FB0	ABB	E9330CCS	Fuse Block; 3P, 30 A, Class CC, Indicator, Padlockable	1	Fuse Block 3-pole
13-16-26-1226	FB1, FB2, FB3, FB4, FB5	ABB	E9360JS	Fuse Block; 3P, 60 A, Class J, Indicator, Padlockable in Open Position	5	Fuse Block 3-pole
13-16-66-1615	DS1, DS2, DS3, DS4, DS5, MDS1	ABB	OHY80L6	Disconnect Handle; Red/Yellow, 30/60/100/250A, Type 4, 4X, 3R, 12	6	Service Disconnect, Main Disconnect
13-16-66-1506	DS1, DS2, DS3, DS4, DS5, MDS1	ABB	OHZX10	Alignment Ring; Use on all Pistol Grip Handles	6	Service Disconnect, Main Disconnect
13-16-66-1434	MDS1	ABB	OS200J12F	Disconnect Switch; 200A, Fuseable, 600V, 3-Pole, Class J, Center Shaft	1	Main Disconnect
13-16-66-1436	MDS1	ABB	OSS200G1L3	Touch safe Cover for Disconnect switch; 200A, 600V, 3-Pole, UL98	1	Main Disconnect
13-16-66-1439	MDS1	ABB	OSS200G1S3	Touch safe Cover for Disconnect switch; 200A, 600V, 3-Pole, UL98	1	Main Disconnect
13-16-66-1383	DS1, DS2, DS3, DS4, DS5	ABB	OT63FT3 (Old# OT45ET3)	Disconnect Switch; 60A, 600V, 3-Pole, Front Mount	5	Service Disconnect
13-16-66-1610	DS1, DS2, DS3, DS4, DS5, MDS1	ABB	OXP6X500	Disconnect Shaft; 19.7", 6x500	6	Service Disconnect, Main Disconnect
13-16-86-1021	MDS1	ABB	OZXA-175	Terminal Lug Kit; Load Side, 100/200A Disconnects, (6) 6-14AWG, 3 Pack	1	Main Disconnect
13-16-86-1137	MDS1	ABB	OZXA-200/3P	Terminal Lug Kit; Line Side, 3 Pack. for OT200U switch.	1	Main Disconnect
13-16-26-1263	F4, F5, F6, F7, F8, F9, F10, F11, F12, F13, F14, F15, F16, F17, F18	F.Shaw	A4J50	Fuse; 50A, 600V, Class J	15	Fuse
XX-XX-XX-5832	F22, F23, F24	F.Shaw	A4J200	Fuse; 200A, 600V, Class J	3	Fuse
13-16-26-1060	F1, F2, F3	F.Shaw	ATQR1	Fuse; 1A, 600V, 13/32" x 1 1/2", Class CC	3	Fuse
13-16-26-1010	F19	F.Shaw	GGM5	Fuse; 5A, 125V, 20mm	2	
13-16-56-1029	AH1	Floyd Bell	SP-1081	Alarm; 120V, 95db, Reduced Sensitivity, Extra Fast Warble, Panel Mount	1	Audible Horn
13-16-39-1090	IO351B-1, IO351B-2	Grundfos	96161730 (IO351B)	(CM) Logic Module; Grundfos "B" MPC IO Expansion module	2	IO351B SCADA
13-16-39-1093	CU352-1	Grundfos	98146952	(CM) Logic Module; Grundfos MPC Controller (CU352)	1	CU352
13-16-46-1073	CR1, CR2	Idec	RJ2S-CL-A120	Relay; 120V, DPDT, 8A, Indicator	2	Silence Relay, System Fault Relay

Article Number	Mark	Manufacturer	Reference	Description	Quantity	Component Type
13-16-46-1283	CR1, CR2	Idec	SJ2S-07LW	Socket; 8 Pin, DIN/Pnl Mt, for RJ Relays	2	Silence Relay, System Fault Relay
13-16-86-1016	GL0	IESCO	TA250	Ground Lug; 6AWG-250KCMIL, 1" stud size, 2000V	1	Ground Lug
65-BRKT-5HOA	SWB1	Orenco	65-BRKT-5HOA	Bracket; HOA or N/E Switch, x5	1	NE Bracket
65-BRKT-SD-01	DS1, DS2, DS3, DS4, DS5	Orenco	65-BRKT-SD-01	Side Disconnect Bracket for 4X Handle	5	Service Disconnect
65-TB-PT-85A	XP1 1	Orenco	65-TB-PT-85A	Terminal Blocks; Single Pump Pass-Through, 85A	1	Pump Power Terminal Blocks
13-66-11-1130	SAB1	OSI	13-66-11-1130	Bracket; Surge Arrestor	1	SA Bracket
65-LIGHT-1R-032	AL1	OSI	65-light-1R-032	Push Button Light; Fault, Push to Silence	1	System Fault
65-SWITCH-2-12	NE1, NE2, NE3, NE4, NE5	OSI	65-SWITCH-2-12	Switch; Two Position, 1-NO, 1-NC	5	Normal/Emergency Switch
65-TB-CU352-DB	X10 1	OSI	65-TB-CU352-DB	Terminal Blocks; Double Stack, X10 CU352 Terminals	1	CU352 Terminal Blocks
65-TB-GENI	X12 1	OSI	65-TB-GENI	Terminal Blocks; X12 Geni Bus Terminals	1	Geni Bus Terminal Blocks
65-TB-IO351B-FULL-DB	X11 1	OSI	65-TB-IO351B-FULL-DB	Terminal Blocks; IO351B SCADA, Full Set	1	
65-TB-PT-85A	XP4 1, XP2 2, XP3 3, XP5 4	OSI	65-TB-PT-85A	Terminal Blocks; Single Pump Pass-Through, 85A	4	Pump Power Terminal Blocks
65-TB-SINGLE-PUMP-DB	X1 1, X2 1, X3 1, X5 1, X4 1	OSI	65-TB-SINGLE-PUMP-DB	Terminal Blocks; MLE Pump Control	5	Pump Control Terminal Blocks
13-16-71-1055	FB6	Phoenix	3004100	Fuse Block; 1P, 250V, 20mm, UK5, 26-10AWG	1	
13-16-71-1465	PE 1	Phoenix	3044157 (Type UT6-PE)	Terminal Block; Ground, for terminal width 8.2 mm	1	
13-16-86-1680	GL1, GL2, GL3, GL4, GL5, GL20, GL21	Raco	TA2-Bulk	Ground Lug; 2AWG, Burndy	7	Ground Lug
13-21-11-1265	L1	Rittal	FSK12164	Floor Stand Kit; 12"x16", 304 Stainless Steel, 12 ga, RAL 7035, for AE & WM	1	Main electrical closet
XX-XX-XX-6772	L1	Rittal	WM483616N4	Enclosure; 48x36x16, 304SS, NEMA4X, 3PT, Back Panel included	1	Main electrical closet
13-16-81-1442	CT1	Schneider Electric	9070T100D20	Transformer; 100VA, P/208/230/460V, S/115V	1	
13-16-61-1010	SA1	Schneider Electric	SDSA 3650	Surge Arrestor; 3 Phase, 600V, WYE	1	Surge Arrestor

Article Number	Mark	Manufacturer	Reference	Description	Quantity	Component Type
13-16-36-1423	PFL1, PFL2, PFL3, PFL4, PFL5	Siemens	3SU11036AA201AA0	Pilot Light; Red, 110 VAC, Complete	5	Pump 1 Fault Light, Pump 2 Fault Light, Pump 3 Fault Light, Pump 4 Fault Light, Pump 5 Fault Light
13-16-36-1421	PRL 1, PRL 2, PRL 3, PRL 4, PRL 5	Siemens	3SU11036AA401AA0	Pilot Light; Green, 110 VAC Complete	5	Pump 1 Run Light , Pump 2 Run Light , Pump 3 Run Light , Pump 4 Run Light
13-16-36-1357	NE2, NE3, NE4, NE5	Siemens	3SU14001AA101BA0	Contact Block; 1 NO, front mounting	4	Normal/Emergency Switch
13-16-36-1326	LIGHT1	Stego	02527.1-12	Enclosure Light; Fluorescent, 120 VAC, magnetic with motion sensor, no receptacle	1	Enclosure Light
13-21-11-1702	L1	Vynckier	A41-DTCOVERKIT	Window Kit; Polyester cover with hinged transparent door, 11.88"x11.88"x1.77", 4X	1	Main electrical closet

Grundfos CU352 Controller
Instructions for Common Control Functions

Change System Operating Mode

From the Home screen, hit the right arrow to enter the “Operation” screen
For “Operating Mode”, select either “Normal” or “Stop”

Operate Pumps in Auto or Manual

From the Home screen, hit the right arrow to enter the “Operation” screen
Select “Further Settings” at the bottom of the screen
Select “Individual Pump Control”
Select either “Auto” or “Manual” control.

- “Manual” control is available at either maximum speed, minimum speed, or user defined speed (“Normal” mode).

Change System Pressure Setpoint

From the Home screen, hit the right arrow to enter the “Operation” screen
Select “Further Settings” at the bottom of the screen
Select “Individual Pump Control”

Hydro MPC with CU352 Pump Controller

Installation and operating instructions

CLASSIFIED C UL US
WATER QUALITY

Single & Multi-Pump Systems
ANSI / NSF61
65GM
Max. use Temp. 23°C / 73°F
Annex G

Declaration of conformity

Declaration of Conformity

We, Grundfos, declare under our sole responsibility that the products Hydro MPC, to which this declaration relates, are in conformity with these Council directives on the approximation of the laws of the EC member states:

—Machinery Directive (2006/42/EC).

Standards used: EN 809: 1998 and EN 60204-1: 2006.

—EMC Directive (2004/108/EC).

Attestation of conformity: Certificate Hydro MPC 2: 2009.

Bjerringbro, 29th December 2009

Svend Aage Kaae
Technical Director

Original installation and operating instructions.

CONTENTS

Warning

Prior to installation, read these installation and operating instructions. Installation and operation must comply with local regulations and accepted codes of good practice.

1. Limited warranty

Products manufactured by GRUNDFOS PUMPS CORPORATION (Grundfos) are warranted to the original user only to be free of defects in material and workmanship for a period of 24 months from date of installation, but not more than 30 months from date of manufacture. Grundfos' liability under this warranty shall be limited to repairing or replacing at Grundfos' option, without charge, F.O.B. Grundfos' factory or authorized service station, any product of Grundfos' manufacture. Grundfos will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Products which are sold but not manufactured by Grundfos are subject to the warranty provided by the manufacturer of said products and not by Grundfos' warranty. Grundfos will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with Grundfos' printed installation and operating instructions.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of Grundfos' products from which it was purchased together with proof of purchase and installation date, failure date, and supporting installation data. Unless otherwise provided, the distributor or dealer will contact Grundfos or an authorized service station for instructions. Any defective product to be returned to Grundfos or a service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

GRUNDFOS WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM INSTALLATION, USE, OR ANY OTHER CAUSES. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH EXTEND BEYOND THOSE WARRANTIES DESCRIBED OR REFERRED TO ABOVE.

Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages and some jurisdictions do not allow limit actions on how long implied warranties may last. Therefore, the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

2. Symbols used in this document

Warning

If these safety instructions are not observed, it may result in personal injury.

Warning

If these instructions are not observed, it may lead to electric shock with consequent risk of serious personal injury or death.

Caution ***If these safety instructions are not observed, it may result in malfunction or damage to the equipment.***

Note ***Notes or instructions that make the job easier and ensure safe operation.***

3. Product introduction

As standard, Hydro MPC booster systems consist of two to six CR(E) pumps coupled in parallel and mounted on a common base frame with all the necessary fittings and a control cabinet.

Note ***A diaphragm tank is required in most installations.***

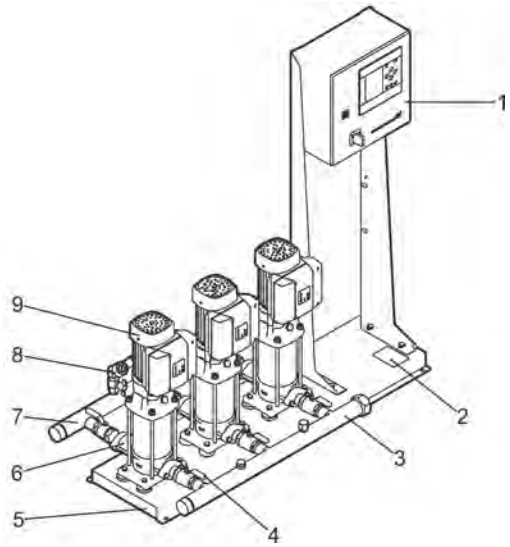


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Fig. 1 Hydro MPC booster system

Pos.	Description	Quantity
1	Control panel	1
2	Nameplate	1
3	Suction manifold (stainless steel)	1
4	Isolating valve	2 per pump
5	Base frame (stainless steel)	1
6	Non-return valve	1 per pump
7	Discharge manifold (stainless steel)	1
8	Pressure transmitter/pressure gauge	1
9	Pump	2 - 6

3.1 Control variant

Hydro MPC booster systems are divided into three groups based on the control variant:

Control variant	Description
-E	Two to six electronically speed-controlled pumps. Hydro MPC-E systems equipped with CRE pumps include integrated frequency drive/motors. Horsepower range of CRE pumps depend on incoming power voltage, see note below. ~~Hydro MPC-E equipped with CR pumps are connected to Grundfos CUE variable frequency drive (one per pump).~~
-F	Two to six CR pumps connected to a Grundfos CUE frequency drive. The speed-controlled operation alternates between the pumps.
-S	Two to six constant speed CR pumps.

Note: Horsepower range of CRE pumps depends on incoming power voltage.

- 1 x 230V / 60 Hz, 0.5 → 1.5 Hp
- 3 x 208-230V / 60 Hz, 1.5 → 7.5 HP
- 3 x 460V / 60 Hz, 1 → 30 Hp

See also section *5. Overview of control variants*.

Hydro MPC booster systems always include application-optimized software for setting the booster system to the application in question.

4. Identification

4.1 Nameplate

The nameplate is fitted on the base frame. See position 2 in fig. 1.

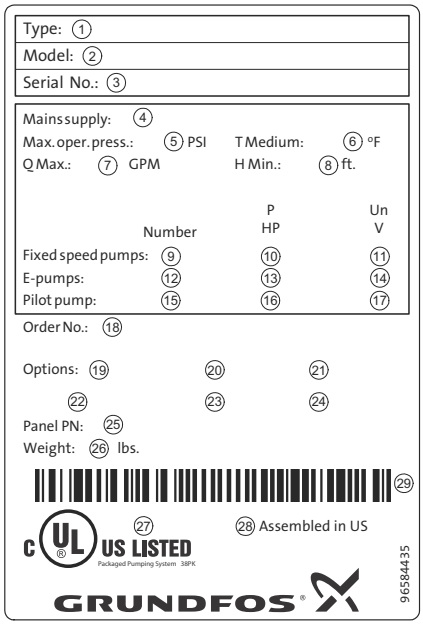

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Fig. 2 Nameplate

Pos.	Description
1	Type designation
2	Model
3	Serial number
4	Supply voltage
5	Maximum operating pressure [psi]
6	Liquid temperature [°F]
7	Maximum flow rate [gpm]
8	Minimum head [ft]
9	Number of fixed speed pumps
10	Motor power [HP] of fixed speed pumps
11	Rated voltage [V] of fixed speed pumps
12	Number of pumps with frequency drive
13	Motor power [HP] of pumps with frequency drive
14	Rated voltage [V] of pumps with frequency drive
15	Number of pilot pumps
16	Motor power [HP] of pilot pumps
17	Rated voltage [V] of pilot pumps
18	Order number
19-24	Options
25	Panel part number
26	Weight in lbs.
27	Approval mark
28	Production location and date code
29	Barcode

4.2 Software label

The software label is placed on the back of the CU 352 controller.

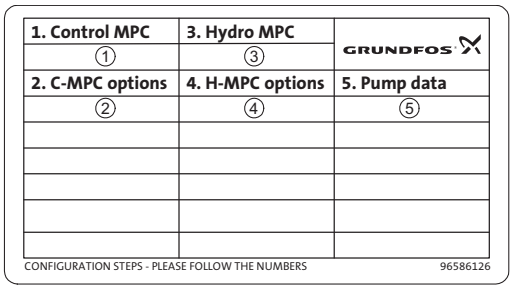

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Fig. 3 Software label

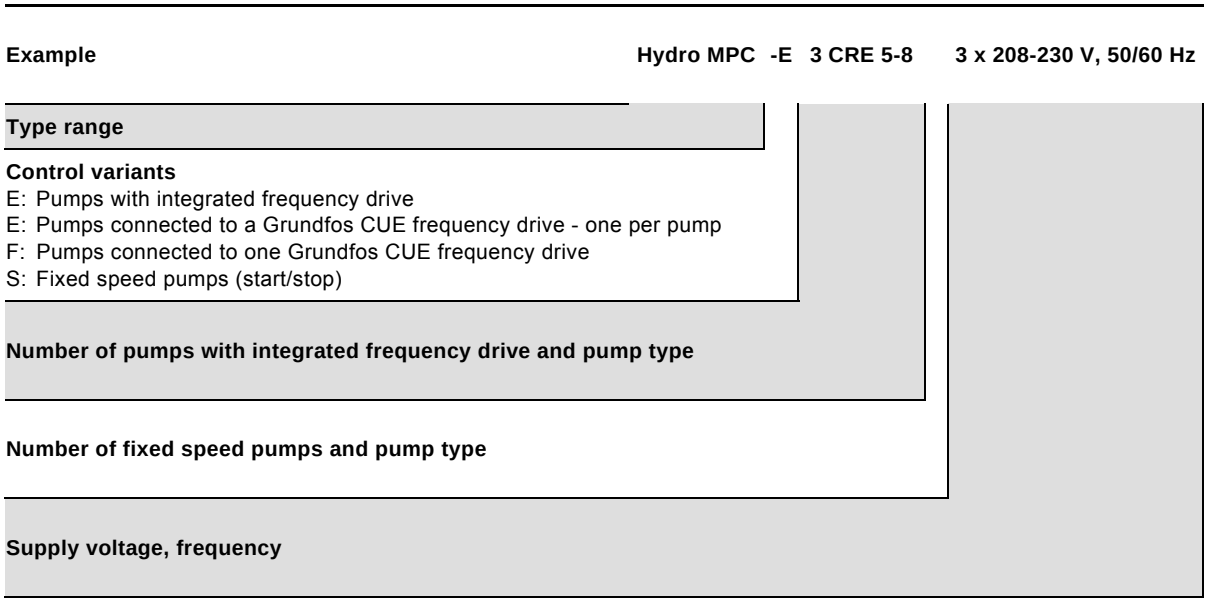
Pos.	Description
1	Control MPC - GSC file number
2	Control MPC options - GSC file numbers
3	Hydro MPC - GSC file number *
4	Hydro MPC options - GSC file numbers *
5	Pump data - GSC file numbers **

* Applies only to booster systems.

** Applies only to CR and CRE pumps.

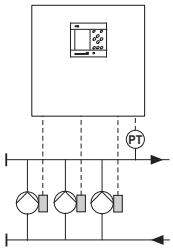
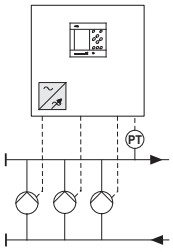
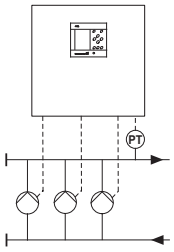
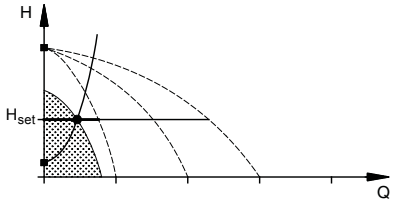
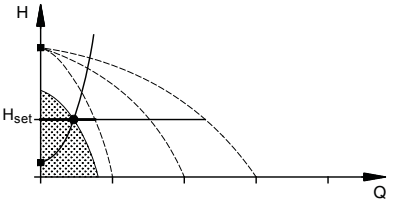
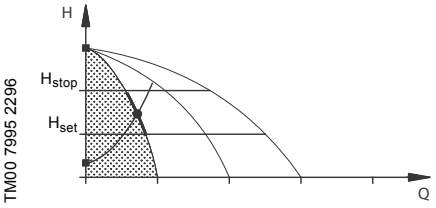
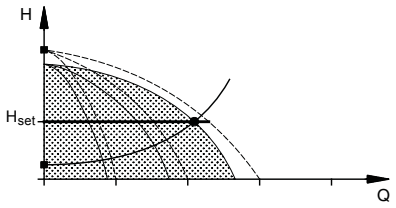
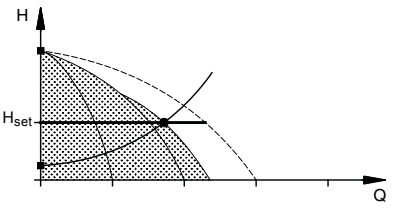
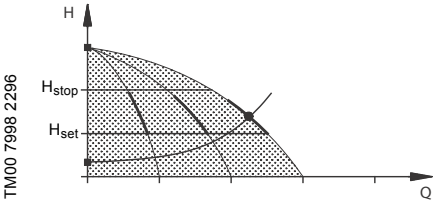
Note ***A GSC (Grundfos Standard Configuration) file is a configuration data file.***

4.3 Type key


Example
Hydro MPC -E 3 CRE 5-8 3 x 208-230 V, 50/60 Hz
Type range
Control variants
E: Pumps with integrated frequency drive
E: Pumps connected to a Grundfos CUE frequency drive - one per pump
F: Pumps connected to one Grundfos CUE frequency drive
S: Fixed speed pumps (start/stop)
Number of pumps with integrated frequency drive and pump type
Number of fixed speed pumps and pump type
Supply voltage, frequency

5. Overview of control variants

The table shows examples.

Systems with speed-controlled pumps	Systems with pumps connected to one CUE frequency converter	Systems with fixed speed pumps
Hydro MPC-E	**Hydro MPC-F**	**Hydro MPC-S**
System with all speed controlled pumps. MPC-E (CRE) use CRE variable speed controlled pumps. MPC-E (CUE) use CR pumps and have a CUE VFD mounted in the control panel for each pump. MPC-E with CRE shown below.	System with three CR pumps connected to one Grundfos CUE frequency drive in the control panel. The speed-controlled operation alternates between the pumps.	System with three fixed speed CR pumps.
 TM03 0993 0905	 TM03 1265 1505	 TM03 0999 0905
One CRE pump in operation.	One CR pump connected to one Grundfos CUE frequency drive in operation.	One fixed speed CR pump in operation.
 TM00 7995 2296	 TM00 7995 2296	 TM03 9204 3507
Three CRE pumps in operation.	One CR pump connected to one Grundfos CUE frequency drive and two fixed speed CR pumps in operation.	Three fixed speed CR pumps in operation.
 TM00 7996 2296	 TM00 7998 2296	 TM03 9003 3507
• Hydro MPC-E maintains a constant pressure through continuous adjustment of the speed of the pumps. • The system performance is adjusted to the demand through cutting in/out the required number of pumps and through parallel control of the pumps in operation. • Pump changeover is automatic and depends on load, operating hours and fault. • All pumps in operation will run at equal speed.	• Hydro MPC-F maintains a constant pressure through continuous adjustment of the speed of the CR pump connected to the Grundfos CUE frequency drive. The speed-controlled operation alternates between the pumps. • One CR pump connected to the Grundfos CUE frequency drive always starts first. If the pressure cannot be maintained by the pump, one or two fixed speed CR pumps will be cut in. • Pump changeover is automatic and depends on load, operating hours and fault.	• Hydro MPC-S maintains a pressure differential through cutting in/out the required number of pumps. • The operating range of the pumps will lie between H_{set} and H_{stop} (cut-out pressure). • Pump changeover is automatic and depends on load, operating hours and fault.

6. Delivery and handling

6.1 Delivery

Depending on size, the booster system is delivered in an open wooden box or wooden/cardboard box designed for transport by forklift truck or a similar vehicle.

Hydro MPC booster systems with CR 120 or CR 150 pumps are secured by means of transport straps. Do not remove these transport straps until the booster system has been installed.

6.2 Handling

Hydro MPC booster systems with CR 120 or 150 pumps have eyebolts in the base frame. See fig. 4.

The lifting point should always be above the center of gravity of the booster system.

Each lifting strap must be at least three meters long.

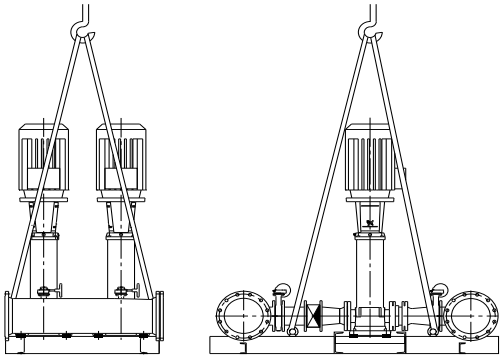


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Fig. 4 Correct lifting of Hydro MPC XL

Warning

When lifting Hydro MPC booster systems with CR 120 or CR 150 pumps, never use the eyebolts of the motors.

Do not lift the booster system by the manifolds, but according to fig. 4.

Use suitable lifting equipment that is in good condition and approved for the weight. The weight is stated on the nameplate of the booster system.

Caution ***Do not use chains for lifting booster systems with CR 120 or CR 150 pumps, as the motors of the pumps can be damaged.***

7. Installation

Before installation, check the following:

- That the booster system is as ordered.
- That no visible parts have been damaged.

7.1 Mechanical installation

7.1.1 Location

The booster system must be installed in a well-ventilated room to ensure sufficient cooling of the pumps and control cabinet.

Caution ***The Hydro MPC is not designed for outdoor installation unless protected, and must not be exposed to direct sunlight.***

The booster system must have a 3-foot clearance in front and on the two sides for inspection and dismantling.

7.1.2 Pipework

Arrows on the pump base show the direction of flow of water through the pump.

The pipework connected to the booster system must be of adequate size. The pipes are connected to the manifolds of the booster system. Either end can be used. Apply sealing compound to the unused end of the manifold, and fit the screw cap.
For manifolds with flanges, fit a blanking flange with gasket.

To achieve optimum operation and minimiz6e noise and vibration, it may be necessary to consider vibration dampening of the booster system.

Noise and vibration are generated by the rotations in the motor and pump and by the flow in pipework and fittings. The effect on the environment is subjective and depends on correct installation and the state of the other parts of the system.

If booster systems are installed in blocks of flats or the first consumer on the line is close to the booster system, we recommend to fit expansion joints on the suction and discharge pipes to prevent vibration being transmitted through the pipework.

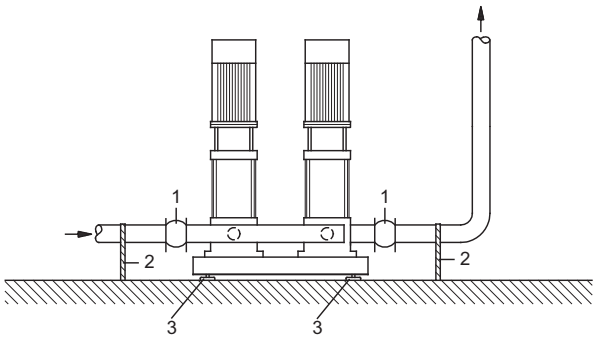

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Fig. 5 Sketch showing the position of expansion joints, pipe supports and machine shoes

Pos.	Description
1	Expansion joint
2	Pipe support, and good location for system isolation valve (not shown)
3	Machine shoe

Note ***Expansion joints, pipe supports and machine shoes shown in the figure above are not supplied with a standard booster system.***

All nuts should be tightened prior to start-up.

Fasten the pipes to parts of the building to ensure that they cannot move or be twisted.

7.1.3 Foundation

The booster system should be positioned on an even and solid surface, for instance a concrete floor or foundation. If the booster system is not fitted with machine shoes, it must be bolted to the floor or foundation.

Note ***As a rule of thumb, the weight of a concrete foundation should be 1.5 x the weight of the booster system.***

7.1.4 Vibration dampers

To prevent the transmission of vibrations to buildings, it may be necessary to isolate the booster system foundation from building parts by means of vibration dampers.

Which is the right damper varies from installation to installation, and a wrong damper may increase the vibration level. Vibration dampers should therefore be sized by the supplier of vibration dampers. If the booster system is installed on a base frame with vibration dampers, expansion joints should always be fitted on the manifolds. This is important to prevent the booster system from "hanging" in the pipework.

7.1.5 Expansion joints

Expansion joints are installed for the following reasons:

- to absorb expansions/contractions in the pipework caused by changing liquid temperature
- to reduce mechanical strains in connection with pressure surges in the pipework
- to isolate mechanical structure-borne noise in the pipework (only rubber bellows expansion joints).

Note

Expansion joints must not be installed to compensate for inaccuracies in the pipework such as center displacement of flanges.

Fit expansion joints at a distance of minimum 1 to 1 1/2 times the nominal flange diameter from the manifold on the suction as well as on the discharge side. This prevents the development of turbulence in the expansion joints, resulting in better suction conditions and a minimum pressure loss on the pressure side.

TM02 4981 1902 - TM02 4979 1902

Fig. 6 Examples of rubber bellows expansion joints without and with limiting rods

Expansion joints with limiting rods can be used to minimize the forces caused by the expansion joints. Recommend expansion joints with limiting rods for flanges larger than 6 inches.

The pipework should be anchored so that it does not stress the expansion joints and the pump. Follow the supplier's instructions and pass them on to advisers or pipe installers.

7.2 Electrical installation

Warning

The electrical installation should be carried out by an authorized person in accordance with local regulations and the relevant wiring diagram.

- Make sure that the booster system is suitable for the electricity supply to which it is connected.
- Make sure that the wire cross-section corresponds to the specifications in the wiring diagram.

The connection of the electrical supply, transmitters and external monitoring equipment must be carried out by an authorized electrician in accordance with the NEC, local regulations and the BoosterpaQ wiring diagram.

Ensure that the Hydro MPC controls and the pumps are suitable for the electricity supply on which they will be used (see Technical Data). Please read the wiring diagram carefully. According to the NEC, if the motors cannot be seen from the control panel, they must be fitted with a disconnect switch.

Any BoosterpaQ that utilizes a variable frequency drive (E, ED, ES, EF, EDF, F) should be connected to an electrical supply with all phase lines electrically symmetrical with respect to ground. A "four wire wye" electrical supply with line impedance between 0.5% - 3% is recommended. If a variable frequency drive is connected to a delta transformer or if line impedance is not within the recommended 0.5% - 3%, the drive may not operate correctly and may not provide optimum performance (excessive faults, erratic behavior, or complete failure). "Open delta" power is not recommended. Ask your power company or electrician to determine what type of electrical supply is present. Generator supplied power must meet public utility power quality standards.

7.3 Start-up

1. Have a qualified person check for proper power supply and plumbing connections. Make sure the main power is off.
2. Check that the air pre-charge in the diaphragm tank is 0.7 times the required discharge pressure set-point (0.9 times for MPC-S systems). System pressure must not be applied to the tank connection during the tank precharge process. If water is supplied to the tank from the system, close the tank valve and bleed off the pressure in the tank before the pressurizing process.

Prime the system as follows

3. Suction pressure system (pumps are flooded at least as high as the highest part of the pumps)
   – close all discharge manifold pump isolation valves and open all inlet manifold pump isolation valves
   – open the vent plug on top of each pump. It is a small hex head screw in a large vent plug. Air and water will escape from the pump through a small hole in the large vent plug. When the air is out and water is flowing steadily, tighten the small hex head screw on the vent plug.

Note ***Expansion joints must not be installed to compensate for inaccuracies in the pipework such as center displacement of flanges.***

4. Suction lift system (the water source is below the pumps or does not flood the pumps to the highest point on the pumps).
   – close all discharge manifold pump isolation valves and open all inlet manifold pump isolation valves
   – for suction lift applications, a foot valve must be placed on the inlet piping at the water source (tank, etc). If there is a fill point above the highest point of the pumps, you may fill the system from this point. If there is no fill point above the highest point of the pumps, remove the large vent plug on each pump. Fill each pump until the water is up to the vent plug, then replace the vent plugs.
5. Ensure all circuit breakers are in the "on" position.
6. Make sure the discharge manifold pump isolation valves are closed. Switch on main power.

Caution ***The pumps may start at this time.***

7. If this is the first time the system has been powered on, the "Start-up wizard" may appear. Once you have completed the wizard, you may skip Step 8. If the wizard does not appear, please proceed to Step 8.
8. Run the "Start-up wizard" again by performing the following: Move top line display to "Settings". If prompted for password, enter "1234", next move down to "Functions, CU352" and press the "OK" button. Now move down to "Run wizard again" and press the "OK" button.
9. Vent the system by opening the vent plug on each pump (as in Step 3, while the pump is running starting in step 18 of the "Start-up wizard"). Venting with the pumps running ensures all air is removed from the suction piping. Do not run the system with the discharge manifold pump isolation valves closed more than five minutes to prevent over-heating of the pump liquid.
10. As pumps stop, check pump rotation. Repeat as necessary. If the area is dark, a flashlight may be required, or remove a coupling guard on each pump for better visibility. Disconnect the main power when removing coupling guards.

Warning

Do not touch the couplings while the pumps are turning as injury may result. Replace all coupling guards after the rotation check. Disconnect main power when removing and replacing coupling guards (or open service disconnect switches if this option was supplied).

If the rotation is incorrect on any 3 phase pumps, switch any 2 of the 3 power main wires supplied to the control panel (L1, L2, L3). If that doesn't correct the rotation, call your Grundfos representative.

Note ***If you are filling an empty piping system, do not allow the pumps to run with the discharge valves wide open as cavitation may occur.***

11. Upon completion of venting pumps and checking for correct rotation you are now ready to bring the BoosterpaQ into normal operation. With the discharge manifold isolation valves still closed, partially open each pump discharge isolation valve to allow water to enter into the discharge piping. Continue the process of filling the discharge piping until discharge piping pressure is approximately at the desired Setpoint pressure of the system.
12. Open pump discharge isolation valves completely. System is now ready for operation.

It may be necessary to clear alarms in the fault log. Follow the stops in paragraph sections 9.6 to clear arms.

Installation and Startup Notes

8. Control panel

The control panel in the front cover of the control cabinet features a display, a number of buttons and two indicator lights.
The control panel enables manual setting and monitoring of the performance of the system.

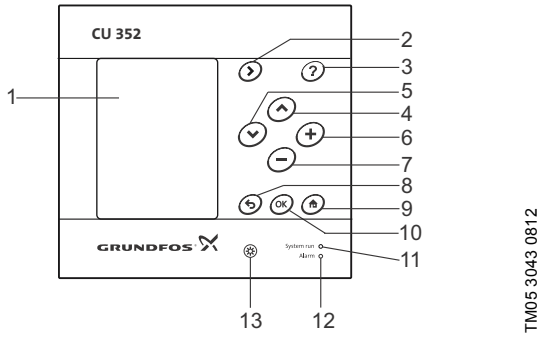


Fig. 7 Control panel

Pos.	Description
1	Display
2	Arrow to the right
3	Help
4	Up
5	Down
6	Plus
7	Minus
8	Back
9	Home
10	OK
11	Indicator light, operation (green)
12	Indicator light, fault (red)
13	Brightness

8.1 Display

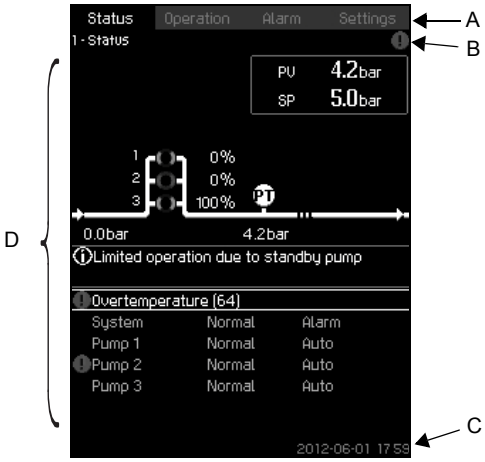


Fig. 8 Display design

8.1.1 Menu line

The menu line (A) is illustrated in fig. 8.
The display has four main menus:

Status	Indication of system status
Operation	Change of operating parameters such as setpoint
Alarm	Alarm log for fault finding
Settings	Change of settings (password option)

8.1.2 Top line

The top line (B) is illustrated in fig. 8. It shows the following:

- the display number and title (left side)
- the selected menu (left side)
- the symbol ⊗ in case of alarm (right side)
- the symbol ⚠ in case of warning (right side)
- the symbol ✎ if the service language has been selected (right side).

8.1.3 Graphical illustration

The graphical illustration (D) may show a status, an indication or other elements, depending on the position in the menu structure.
The illustration may show the entire system or part of it as well as various settings.

8.1.4 Scroll bar

If the list of illustration elements exceeds the display, the symbols ▲ and ▼ will appear in the scroll bar to the right. Move up and down in lists with these symbols.

8.1.5 Bottom line

The bottom line (C) shows the date and time.

8.2 Buttons and indicator lights

The buttons (pos. 2 to 10 in fig. 7) on the CU 352 are active when they are lit.

8.2.1 Arrow to the right (pos. 2)

Press [>] to go to the next menu in the menu structure. If you press [>] when menu "Settings" is highlighted, you will go to menu "Status".

8.2.2 Help (pos. 3)

When this symbol is lit, a help text applying to the display will appear if you press the button.

Close the text with ⮌.

8.2.3 Up and down (pos. 4 and 5)

Move up and down in lists with [∨] and [∧].

You can select a text with [ok] when it is in a box.

If a text is marked and you press [∧], the text above will be marked. If you press [∨], the text below will be marked.

If you press [∨] in the last line in the list, the first line will be marked.

If you press [∧] in the first line in the list, the last line will be marked.

8.2.4 Plus and minus (pos. 6 and 7)

Increase and reduce a value with [+] and [-]. Save with [ok].

8.2.5 Back (pos. 8)

Press ⮌ to go one display back in the menu.

If you have changed a value and press ⮌, the new value will not be saved. See also section *8.2.7 OK (pos. 10)*.

If you press [ok] before pressing ⮌, the new value will be saved. See also section *8.2.7 OK (pos. 10)*.

8.2.6 Home (pos. 9)

Press ⌂ to return to menu "Status".

8.2.7 OK (pos. 10)

Use the button as an enter button.

The button is also used to start the setting of a value. If you have changed a value, you must press [ok] to save the change.

8.2.8 Indicator lights (pos. 11 and 12)

The control panel incorporates a green and red indicator light.

The green indicator light will be on when the system is in operation and flash when the system has been set to stop.

The red indicator light will be on if there is an alarm or a warning. The fault can be identified from the alarm list.

8.2.9 Brightness (pos. 13)

You can change the brightness in the display with this button:

1. Press ☼ .
2. Adjust the brightness with [+] and [-].

8.2.10 Back light

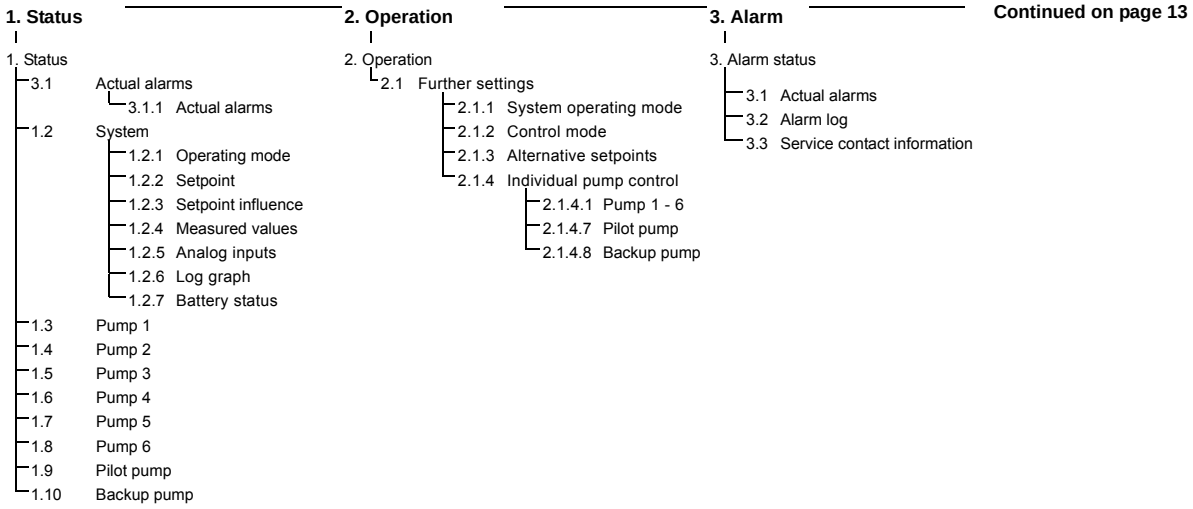
If no button is touched for 15 minutes, the back light of the display will be dimmed, and the first display in menu "Status" will appear.

Press any button to re-activate the back light.

9. Functions

9.1 Tree of functions

The functions depend on system configuration.



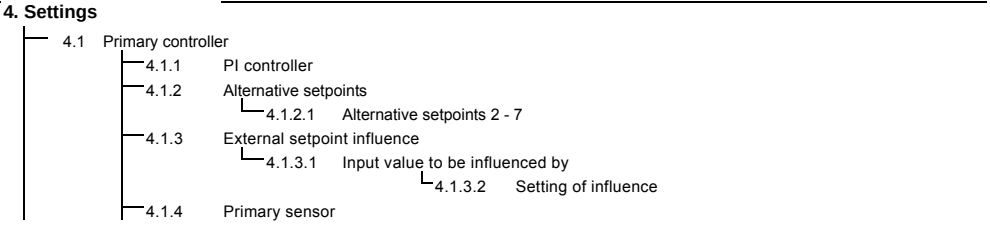
Continued on page 13

Key to the four menus

Status
This menu shows alarms, status of the system and a graph of logged data. **Note:** No settings can be made in this menu.
Operation
In this menu, you can set the basic parameters, such as setpoint, operating mode, control mode and individual pump control.
Alarm
This menu gives an overview of alarms and warnings. You can reset alarms and warnings in this menu.
Settings
In this menu, you can set various functions: • Primary controller PI controller, Alternative setpoints, External setpoint influence, Primary sensor, Clock program, Proportional pressure, S-system configuration, Setpoint ramp • Pump cascade control Min. time between start/stop, Max. number of starts/hour, Number of standby pumps, Forced pump changeover, Pump test run, Pump stop attempt, Pump start and stop speed, Min. performance, Compensation for pump start-up time • Secondary functions Stop function, Soft pressure build-up, Digital inputs, Analog inputs, Digital outputs*, Analog outputs, Emergency run, Min., max. and user-defined duty, Pump curve data, Control source, Fixed inlet pressure, Flow estimation, Reduced operation • Monitoring functions Dry-running protection, Min. pressure, Max. pressure, External fault, Limit 1 exceeded, Limit 2 exceeded, Pumps outside duty range, Pressure relief, Log values, Fault, primary sensor • Functions, CU 352 Display language, Units, Date and time, Password, Ethernet, GENibus number Software status.

* If an IO 351 is installed.

Continued



Continued

- **4. Settings**
  - 4.1.6 Clock program
  - 4.1.7 Proportional pressure
  - 4.1.8 S-system configuration
  - 4.1.9 Setpoint ramp
  - 4.2 Pump cascade control
    - 4.2.1 Min. time between start/stop
      Max. number of starts/hour
    - 4.2.3 Standby pumps
    - 4.2.4 Forced pump changeover
    - 4.2.5 Pump test run
    - 4.2.7 Pump stop attempt
    - 4.2.8 Pump start and stop speed
    - 4.2.9 Min. performance
    - 4.2.10 Compensation for pump start-up time
  - 4.3 Secondary functions
    - 4.3.1 Stop function
      - 4.3.1.1 Stop parameters
    - 4.3.3 Soft pressure build-up
    - 4.3.5 Emergency run
    - 4.3.7 Digital inputs
      - Function, DI1, (CU 352) - DI3, [10, 12, 14]
      - Function, DI1 (IO 351-41) - DI9, [10 - 46]
      - Function, DI1 (IO 351-42) - DI9, [10 - 46]
    - 4.3.8 Analog inputs
      - Setting, AI1 (CU 352), [51] - AI3, [51, 54, 57]
        - Function, AI1 (CU 352) - AI3 [51, 54, 57]
      - Setting, AI1 (IO 351-41), [57] - AI2 [57, 60]
        - Function, AI1 (IO 351-41) - AI2, [57, 60]
      - Setting, AI1 (IO 351-42), [57] - AI2 [57, 60]
        - Function, AI1 (IO 351-42) - A2 [57, 60]
    - 4.3.9 Digital outputs
      - DO1 (CU 352), [71] is signaling - DO2 [71, 74]
      - DO1 (IO 351-41), [77] is signaling - DO7 [77 - 88]
      - DO1 (IO 351-42), [77] is signaling - DO7 [77 - 88]
    - 4.3.10 Analog outputs
      - AO1 (IO 351-41) [18] - AO3 [18, 22, 26]
      - AO1 (IO 351-42) [18] - AO3 [18, 22, 26]
    - 4.3.14 Min., max. and user-defined duty
      - 4.3.14.1 Min. duty
      - 4.3.14.2 Max. duty
      - 4.3.14.3 Set user-defined duty
    - 4.3.19 Pump curve data
      - 4.3.23 Flow estimation
    - 4.3.20 Control source
    - 4.3.22 Fixed inlet pressure
    - 4.3.23 Flow estimation
    - 4.3.24 Reduced operation
  - 4.4 Monitoring functions
    - 4.4.1 Dry-running protection
      - 4.4.1.1 Pressure/level switch
      - 4.4.1.2 Measurement, inlet pressure
      - 4.4.1.3 Measurement, tank level
    - 4.4.2 Min. pressure
    - 4.4.3 Max. pressure
    - 4.4.4 External fault
    - 4.4.5 Limit 1 exceeded
    - 4.4.6 Limit 2 exceeded
    - 4.4.7 Pumps outside duty range
    - 4.4.8 Pressure relief
    - 4.4.9 Log values
    - 4.4.10 Fault, primary sensor
  - 4.5 Functions, CU 352
    - Change language to the service language (English)
    - Run wizard again
    - 4.5.1 Display language
    - 4.5.2 Units
      - 4.5.2.1 Pressure
      - 4.5.2.2 Differential pressure
      - 4.5.2.3 Head
      - 4.5.2.4 Level
      - 4.5.2.5 Flow rate
      - 4.5.2.6 Volume
      - 4.5.2.7 Specific energy
      - 4.5.2.8 Temperature
      - 4.5.2.9 Power
      - 4.5.2.10 Energy
    - 4.5.3 Date and time
    - 4.5.4 Password
    - 4.5.5 Ethernet
    - 4.5.6 GENibus number
    - 4.5.9 Software status

9.2 Overview

9.3 Description of functions

The description of functions is based on the four main menus of the CU 352 control unit:

- Status
- Operation
- Alarm
- Settings

The functions apply to all control variants unless otherwise stated.

9.4 Status (1)

The first status display is shown below. This display is shown when the power is switched on, and it appears if the buttons of the control panel remain untouched for 15 minutes.

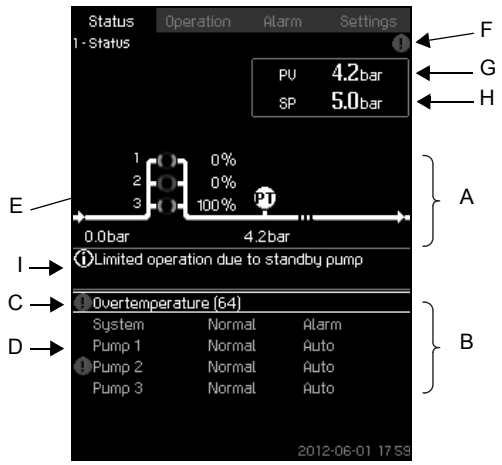


Fig. 9 Status

Description

No settings can be made in this menu.

The actual value (process value, PV) of the control parameter, usually the discharge pressure, is shown in the upper right corner (G) together with the selected setpoint (SP) (H).

The upper half of the display (A) shows a graphic illustration of the pump system. The selected measuring parameters are shown with sensor symbol and actual value.

In MPC-E systems where the differential pressure across the pumps and pump curve data are known, the display shows the estimated flow rate when the flow rate and speed of the pumps are within a range where it is possible to estimate the flow rate.

≈ : Indicates that the flow rate is an estimated value.

Note ***The estimated flow rate may differ from a measured value.***

In the middle of the display, an information field (I) will be shown if any of the following events occurs:

- Limited operation due to standby pump
- Proportional-pressure influence active
- External setpoint influence active
- Alternative setpoint active
- Low flow boost active
- Pressure relief active
- Clock program active
- Remote-controlled via Ethernet
- Remote-controlled via GENI (RS-485)
- Limited due to reduced operation
- Stopped due to low flow

The lower display half (B) shows the following:

- the most recent active alarm, if any, and the fault cause with the fault code in brackets
- system status with actual operating mode and control source
- pump status with actual operating mode.

Note ***If a fault has occurred, the warning symbol ⚠ or alarm symbol ⊗ will be shown in the line (C) together with the cause and fault code, for instance "Overtemperature (64)".***

If the fault is related to one of the pumps, the symbols ⚠ or ⊗ will also be shown in front of the status line (D) of the pump in question. At the same time, the pump status indicator (E) will change color to either yellow or red as described in the table below. The symbol ⚠ or ⊗ will be shown to the right in the top line of the display (F). As long as a fault is present, this symbol will be shown in the top line of all displays.

To open a menu line, select the line with [∨] or [∧] and press [ok].

The display makes it possible to open status displays showing the following:

- actual alarms
- system status
- status of each pump.

Description of pump status

Pump status indicator	Description
Rotating, green	Pump running.
Permanently green	Pump ready (not running).
Rotating, yellow	Warning. Pump running.
Permanently yellow	Warning. Pump ready (not running).
Permanently red	Alarm. Pump stopped.

9.4.1 Actual alarms (3.1)

Fig. 10 Actual alarms

Description

This display shows active unreset alarms and warnings.

For further information, see sections 8.6.2 Actual alarms (3.1) and 8.6.3 Alarm log (3.2).

9.4.2 System (1.2)

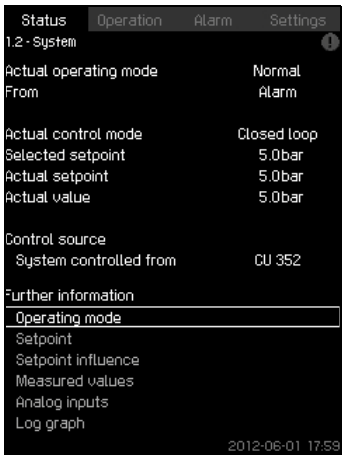


Fig. 11 System

Description

This display shows the operational state of the system.
It is possible to go to subdisplays showing details.

The display makes it possible to open displays about the following:

- Operating mode
- Setpoint
- Setpoint influence
- Measured values
- Analog inputs
- Log graph
- Battery status

9.4.3 Operating mode (1.2.1)

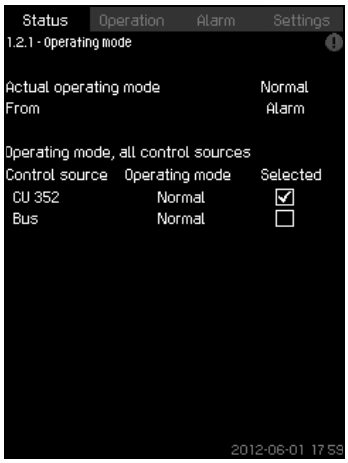


Fig. 12 Operating mode

Description

This display shows the operating mode of the system and from where it is controlled.

Operating modes

The system has six operating modes:

1. Normal
   – The pumps adapt their performance to the requirement.
2. Max.
   – The pumps run at a constant high speed. Normally, all pumps run at maximum speed.
3. User-defined
   – The pumps run at a constant speed set by the user. It is usually a performance between "Max." and "Min".
4. Min.
   – The pumps run at a constant low speed. Normally, one pump is running at a speed of 70%.
5. Stop
   – All pumps have been stopped.
6. Emergency run
   – The pumps run according to the setting made in display Emergency run (4.3.5).

The performance required in these operating modes can be set in menu "Settings":

- Max.
- Min.
- User-defined
- Emergency run

See sections 8.7.35 Min., max. and user-defined duty (4.3.14) and 8.7.25 Emergency run (4.3.5).

The actual operating mode can be controlled from four different sources:

- fault
- external signal
- CU 352
- bus

Control source

The system can be set to remote control via an external bus (option). In this case, you must set a setpoint and an operating mode via the bus.

In menu "Settings", you can select whether the CU 352 or the external bus is to be the control source.

The status of this setting is shown in display "Operating mode".

9.4.4 Setpoint (1.2.2)

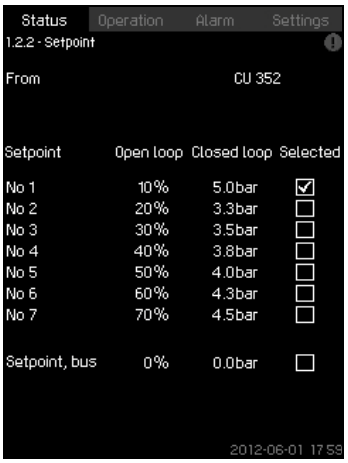


Fig. 13 Setpoint

Description

This display shows the selected setpoint and whether it comes from the CU 352 or an external bus.

The display also shows all seven possible setpoints from the CU 352 (for closed- and open-loop control). At the same time, the selected setpoint is shown.

As it is a status display, no settings can be made.

Setpoints can be changed in menu "Operation" or "Settings". See section 8.7.3 Alternative setpoints (4.1.2).

9.4.5 Setpoint influence (1.2.3)

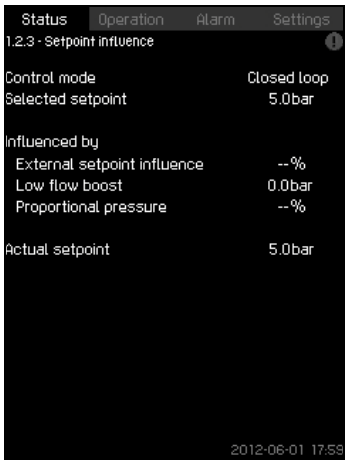


Fig. 14 Setpoint influence

Description

The selected setpoint can be influenced by an external analog input parameter. The parameter is shown as percentage from 0 to 100% or as a pressure. The influence can only potentially reduce the setpoint as the influence is a percentage multiplied by the setpoint.

Actual setpoint (SP) =
selected setpoint x influence (1) x influence (2) x ...

The display shows the parameters influencing the selected setpoint and the percentage or value of influence.

Some of the possible parameters can be set in display External setpoint influence (4.1.3). The parameter "Low flow boost" is set as a start/stop band as a percentage of the setpoint set in display Stop function (4.3.1). The parameter is set as a percentage in display Proportional pressure (4.1.7).

Finally, the resulting actual setpoint (SP) is shown.

9.4.6 Measured values (1.2.4)

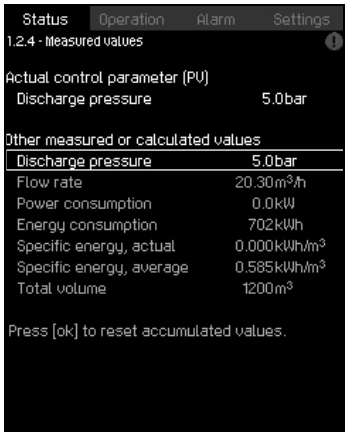


Fig. 15 Measured values

Description

This display gives a general status of all measured and calculated parameters. In MPC-E systems with a flowmeter, the specific energy is shown as an average value and actual value (mean value over the last minute). The average value is based on the accumulated flow shown as total volume. The total volume and specific energy average can be reset in this display.

Note ***The lines "Power consumption" and "Energy consumption" are only shown in MPC-E systems.***

9.4.7 Analog inputs (1.2.5)

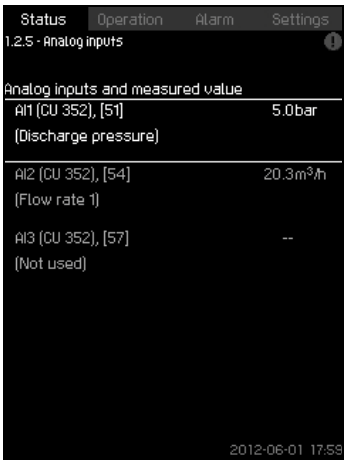


Fig. 16 Analog inputs

Description

This display shows an overview of the analog inputs and the measured values of each input. See sections 8.7.28 Analog inputs (4.3.8), 8.7.29 Analog inputs (4.3.8.1 to 4.3.8.7) and 8.7.30 Analog inputs and measured value (4.3.8.1.1 - 4.3.8.7.1).

9.4.8 Log graph (1.2.6)

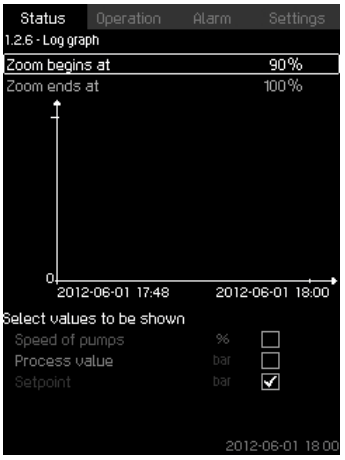


Fig. 17 Log graph

Description

This display can show logged data stored in the controller. Select log values in display Log values (4.4.9). Various values can be shown, and the time scale can be changed.

Setting via control panel

Status > System > Log graph

1. Set as a percentage:
   - Zoom begins at
   - Zoom ends at
2. Select values to be shown

9.4.9 Battery status (1.2.7)

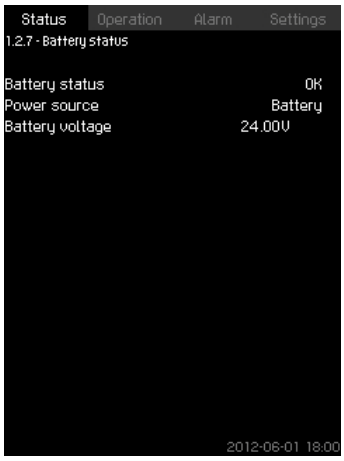


Fig. 18 Battery status

Description

Here you can see the status of the backup battery, if installed.

9.4.10 Pumps 1 - 6, Pilot pump, Backup pump (1.3 - 1.10)

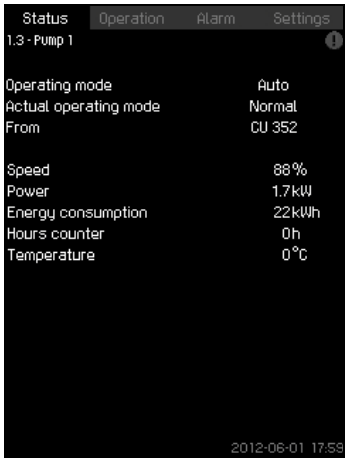


Fig. 19 Pump 1

Description

This display shows the operational state of the individual pumps.

Note ***The displays for backup and pilot pump are only shown if such pumps are installed.***

The pumps can have different operating modes:

- Auto
  - Together with the other pumps in automatic operation, the pump is controlled by the PI controller which ensures that the system delivers the required performance.
- Manual
  - The pump is not controlled by the PI controller. In manual operation, the pump has one of the following operating modes:
- Max.
  - The pump runs at a set maximum speed. (This operating mode can only be selected for variable-speed pumps.)
- Normal
  - The pump runs at a set speed.
- Min.
  - The pump runs at a set minimum speed. (This operating mode can only be selected for variable-speed pumps.)
- Stop
  - The pump has been forced to stop.

Besides information about the operating mode, it is possible to read various parameters in the status display, such as these:

- actual operating mode
- control source
- speed (only 0 or 100% are shown for fixed speed pumps)
- power (only MPC-E)
- energy consumption (only MPC-E)
- operating hours

9.5 Operation (2)

In this menu, you can set the basic parameters, such as setpoint, operating mode, control mode and individual pump control.

9.5.1 Operation (2)

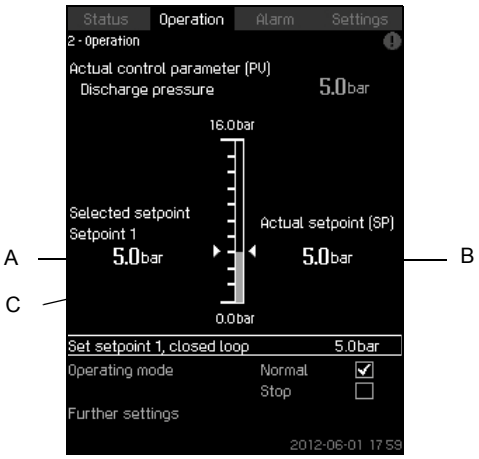


Fig. 20 Operation

Description

The column shows the setting range. In closed-loop control, it corresponds to the range of the primary sensor, here 0-16 bar. In open-loop control, the setting range is 0-100 %.

At the left hand of the column, the selected setpoint 1 (A) is shown, i.e. the value set in the display. At the right hand of the column, the actual setpoint (B) is shown, i.e. the setpoint acting as reference for the PI controller. If no kind of external setpoint influence has been selected, the two values will be identical. The measured value (discharge pressure) is shown as the grey part of the column (C). See sections 8.7.5 External setpoint influence (4.1.3) and 8.7.6 Setting of influence function (4.1.3.2).

Below the display is a menu line for setting of setpoint 1 and selection of operating mode, including the operating modes "Normal" and "Stop". It is possible to select further settings: system operating mode, control mode, setpoints for closed and open loop and individual pump control.

Setting range

Setpoint:

Closed-loop control:	Measuring range of the primary sensor
Open-loop control:	0-100 %

Setting via control panel

Setpoint

- Operation > Set setpoint 1, open loop / Set setpoint 1, closed loop.

Set the value.

Operating mode

- Operation

Select: Normal / Stop.

Further settings

- Operation > Further settings.

Select one of the settings below:

- System operating mode (see section *9.5.2*).
- Control mode (see section *9.5.3*).
- Alternative setpoints (see section *9.5.4*).
- Individual pump control (see section *9.5.6*).

Factory setting

The setpoint is a value suitable for the system in question. The factory setting may have been changed in the start-up menu.

9.5.2 System operating mode (2.1.1)

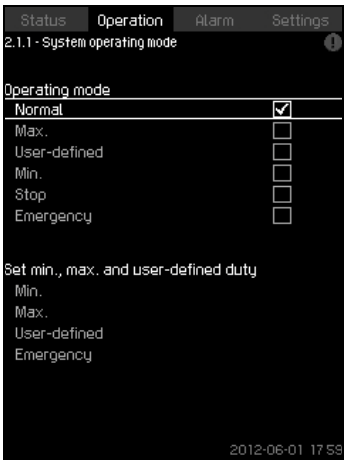


Fig. 21 System operating mode

Description

The system can be set to six different operating modes. "Normal" is the typical setting. See section 8.4.3 Operating mode (1.2.1).

The performance of these operating modes can be set in this menu:

- Max.
- Min.
- User-defined
- Emergency

Setting range

- Normal
- Max.
- Min.
- User-defined
- Stop
- Emergency

Setting via control panel

- Operation > Further settings > System operating mode > Operating mode.

Select the desired line at the bottom of the display to set the performance for min., max., user-defined duty or emergency run. See sections 8.7.35 Min., max. and user-defined duty (4.3.14) and 8.7.25 Emergency run (4.3.5).

Factory setting

Normal.

9.5.3 Control mode (2.1.2)

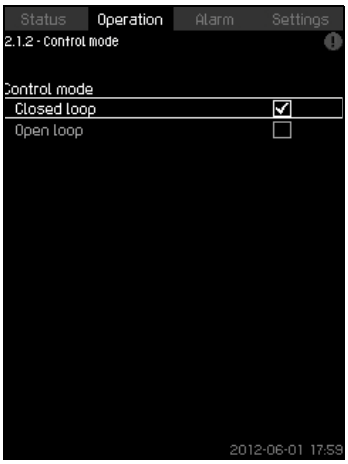


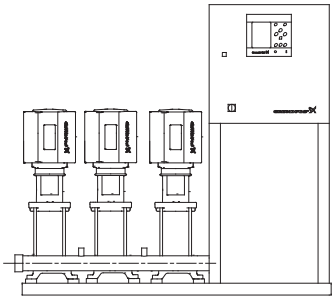
Fig. 22 Control mode

Description

There are two control modes, namely closed and open loop.

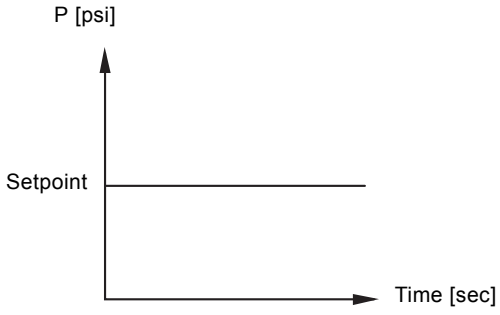
Closed loop

The typical control mode is closed loop where the built-in PI controller ensures that the system reaches and maintains the selected setpoint. The performance is based on the setpoint set for closed loop. See figures 23 and 24.



TM03 2231 3905

Fig. 23 Booster system controlled by built-in PI controller (closed loop)



TM03 2390 4105

Fig. 24 Regulation curve for closed loop

Setting via control panel

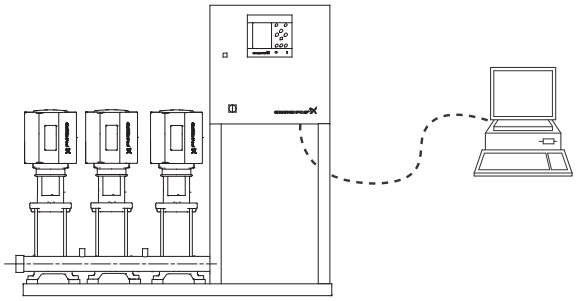
- Operation > Further settings > Control mode > Closed loop.

Set the setpoint. See sections *9.5.4* and *9.5.1*.

Open loop

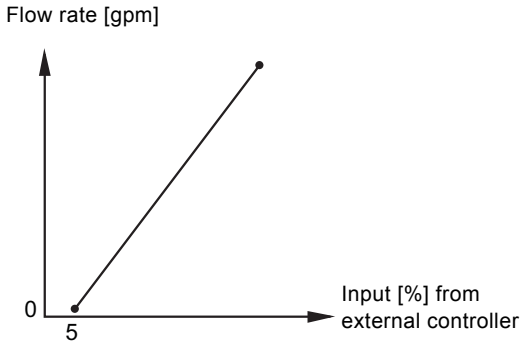
In open-loop control, the pumps run at a fixed speed.
The pump speed is calculated from the performance set by the user (0-100%). The pump performance in percentage is proportional with the flow rate.

Open-loop control is usually used when the system is controlled by an external controller which controls the performance via an external signal. The external controller could for instance be a building management system connected to the MPC system. In such cases the MPC is like an actuator. See figures 25 and 26.



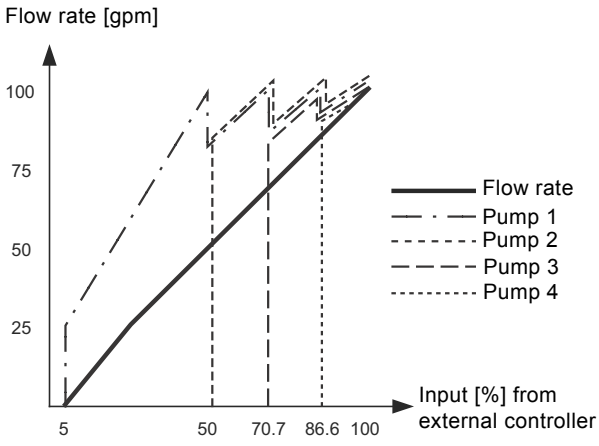
TM03 2232 3905

Fig. 25 Booster system with external controller (open loop)



TM03 2391 3607

Fig. 26 Regulation curve for open loop



TM03 9977 4807

Fig. 27 Regulation curve for MPC-E system in open loop

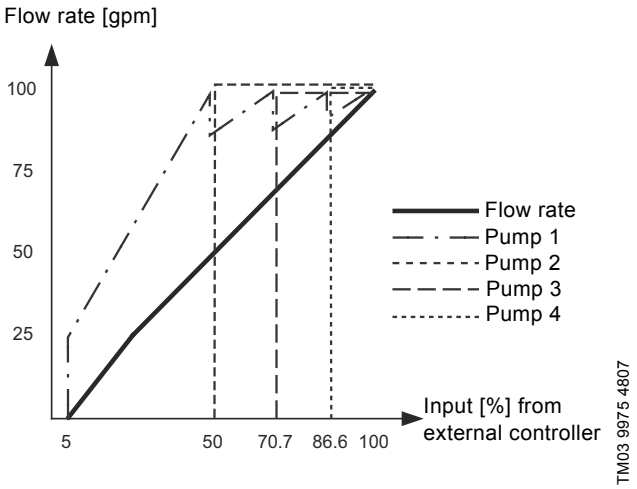


Fig. 28 Regulation curve for MPC-F system in open loop

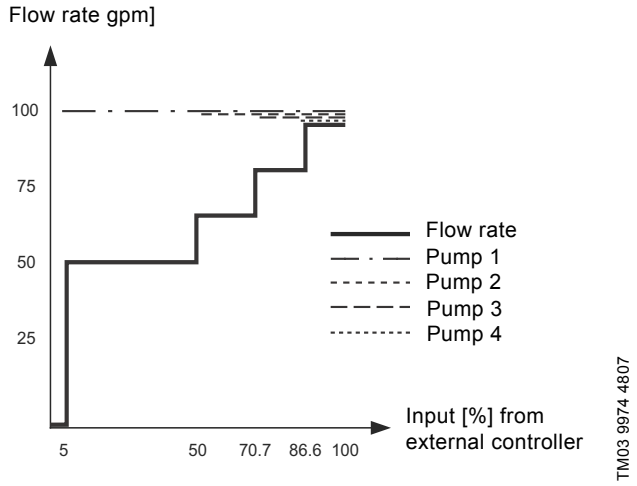


Fig. 29 Regulation curve for MPC-S system in open loop

Correlating open loop input setpoint percentage with number of pumps in operation. Example: MPC system with (4) pumps

- Setpoint 0% to 5% = All pumps stopped

One pump operation from setpoint from 5% to √

(1-pump/4-pumps) = 50%

- Two pump operation from 50% to √ (2-pump/4-pumps) = 70.7%
- Three pump operation from 70.7% to √ (3-pumps/4-pumps) = 86.6%
- Four pump operation from 86.6% to 100%
- For staging pumps off the cut-out is 2% less then cut-in. Example: staging from 4-pump to 3-pump operation will occur at 84.6% reference signal.

Setting range

These settings must be made in connection with open loop:

- Open loop
- Set setpoint 1, open loop
- External setpoint influence
- Normal

Setting via control panel

Proceed as follows to set an external control source to control the system:

- Operation > Further settings > Control mode
- Select: Open loop
- Select: Stop

1. ↩ x 2.
2. Set to 100%: Set setpoint 1, open loop
3. Settings > Primary controller > External setpoint influence > Go to setting of analog input
4. Select analog input and range
5. Select:

- Measured input value
  Display 4.3.8.1.1 appears
- Select: 0-100% signal

6. ↩.
7. Set the minimum and maximum sensor value.
8. ↩ x 2
9. Select:

- Input value to be influenced by
- 0-100% signal

10. ↩.
11. Select: Set the influence function
    (See also section *9.7.6.*)
12. Set the number of points
13. Set: External input value. (Point 1.)
14. Set as a percentage: Reduce setpoint to. (Point 1.)
15. Repeat steps 13 and 14 for all selected points
16. ↩.
17. Set as seconds: Filter time
18. Select: Enabled
19. ↩ x 2
20. Select:

- Operation
- Normal

The booster system can now be controlled by an external controller.

Factory setting

Closed-loop control.

9.5.4 Alternative setpoints (2.1.3)

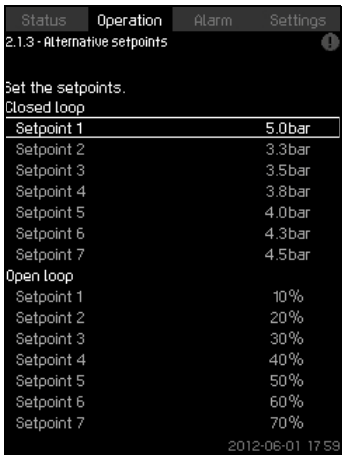


Fig. 30 Alternative setpoints

Description

In addition to the primary setpoint 1 (shown in display 2 in menu "Operation"), six alternative setpoints can be set for closed-loop control. It is furthermore possible to set seven setpoints for open-loop control.

It is possible to activate one of the alternative setpoints by means of external contacts. See sections 8.7.3 Alternative setpoints (4.1.2) and 8.7.4 Alternative setpoints 2 - 7 (4.1.2.1 - 4.1.2.7)

Setting range

The setting range of setpoints for closed-loop control depends on the range of the primary sensor. See section 8.7.7 Primary sensor (4.1.4).

In open loop control, the setting range is 0-100%.

Setting via control panel

- Operation > Further settings > Alternative setpoints.

Set the setpoint.

Factory setting

Setpoint 1 for closed-loop control is a value suitable for the system in question.

The alternative setpoints for closed-loop control are 3 bar.

All setpoints for open-loop control are 70%.

9.5.5 Individual pump control (2.1.4)

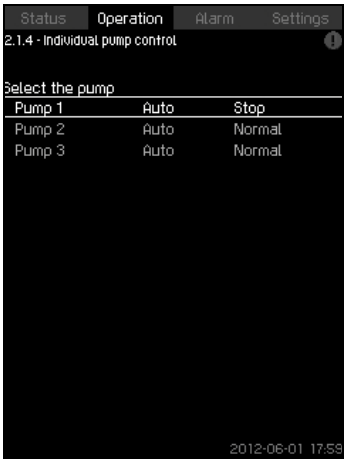


Fig. 31 Individual pump control

Description

It is possible to change the operating mode from automatic operation to one of the manual operating modes.

Auto

The pumps are controlled by the PI controller, ensuring that the system delivers the required performance.

Manual

The pump is not controlled by the PI controller, but set to one of the following manual operating modes:

- Max.
  - The pump runs at a set maximum speed. (This operating mode can only be selected for variable-speed pumps.)
- Normal
  - The pump runs at a set speed.
- Min.
  - The pump runs at a set minimum speed. (This operating mode can only be selected for variable-speed pumps.)
- Stop
  - The pump has been forced to stop.

Pumps in manual operation are not part of the normal pump cascade and speed control. The manual pumps are a "disturbance" of the normal operation of the system.

If one or more pumps are in manual operation, the system may not be able to deliver the set performance.

There are two displays for the function. In the first display, the pump to be set is selected, and in the next display, the operating mode is selected.

Setting range

All pumps can be selected.

Setting via control panel

Operation > Further settings > Individual pump control

9.5.6 Pumps 1 - 6 (2.1.4.1 - 2.1.4.6)

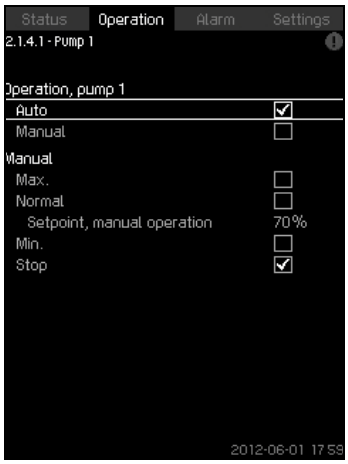


Fig. 32 Pump 1 - 6

Description

This display is shown for the individual pumps and makes it possible to set an operating mode.

Setting range

It is possible to select "Auto" or "Manual" as well as the operating mode of the pump for manual operation - "Max.", "Normal", "Min." or "Stop". For fixed speed pumps only "Normal" or "Stop" can be selected.

Setting via control panel

- Operation > Further settings > Individual pump control

1. Select pump
2. Select resetting: Auto / Manual
3. Manual: Select operating mode.
   Normal: Set the setpoint.

Factory setting

Auto

9.5.7 Operating mode, pilot pump (2.1.4.7)

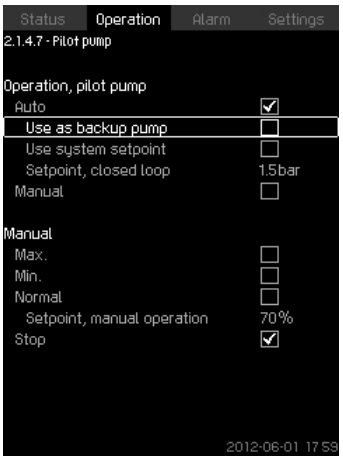


Fig. 33 Operating mode, pilot pump

Description

This display is only shown in systems that have been configured with a pilot pump.

It is possible to set the operating mode and setpoint for the pilot pump.

Setting range

Auto

It is possible to select if the pilot pump is to be used as a backup pump. If the pilot pump is selected as a backup pump, it will start if the main pumps are running at 100% speed and still cannot reach or maintain the setpoint.

The setpoint of the pilot pump can either be set to the same value as that of the main pumps by selecting "Use system setpoint" or to another value.

Manual

Max., Normal, Min., Stop

Setting via control panel

- Operation > Further settings > Individual pump control > Pilot pump

Select resetting: Auto / Manual

Auto

1. Select if the pump is also to be used as backup pump (only possible if the system does not already incorporate a backup pump).
2. Select "Use system setpoint" or enter a setpoint.

Manual

1. Select operating mode.
2. Normal: Set the setpoint.

Factory setting

Auto

Use system setpoint

9.5.8 Operation, backup pump (2.1.4.8)

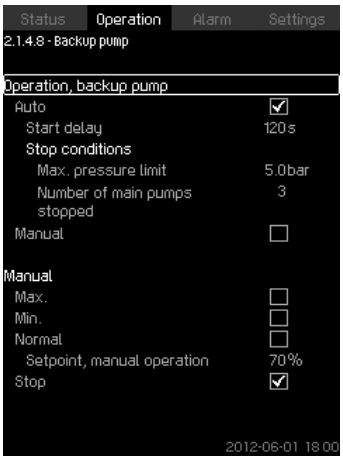


Fig. 34 Operation, backup pump

Description

This display is only shown in systems with a backup pump.

It is possible to set the operating mode, start delay and stop limit for the pump.

The function is only available in pressure-boosting applications.

Setting range

Auto

It is possible to set a start delay. The backup pump will start after the delay set if the main pumps are running at 100% speed and cannot maintain the setpoint.

Two stop parameters can be selected for the backup pump:

- Max. pressure limit
  - The backup pump will be stopped if the pressure exceeds the limit set.
- Number of main pumps stopped
  - The backup pump will be stopped when the set number of main pumps have stopped.

Manual

Max., Min., Normal, Stop.

Setting via control panel

- Operation > Individual pump control

1. Select backup pump
2. Select: Auto / Manual

Auto

1. Set:

- Start delay
- Stop conditions

Manual

1. Select operating mode
2. Set the setpoint if you select "Normal"

Factory setting

Start delay (auto): 2 minutes

Stop limit: 72 psi

9.6 Alarm (3)

This menu gives an overview of alarms and warnings.

It is possible to reset alarms.

9.6.1 Alarm status (3)

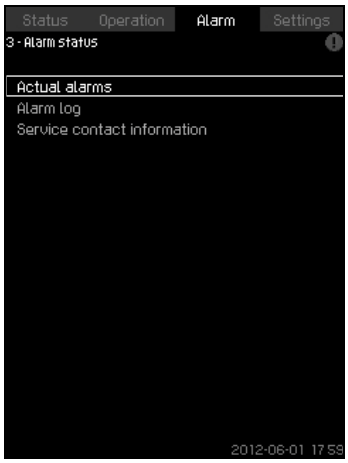


Fig. 35 Alarm status

Description

A fault in the system or one of the components monitored can cause an alarm ⊗ or a warning ⚠. Besides the fault signal via the alarm/warning signal relay and the red indicator light on the CU 352, an alarm can also cause a change of operating mode, for instance from "Normal" to "Stop". A warning only causes a fault indication.

The table shows the possible causes o ith an alarm code, and whether they result in an alarm or a warning. It also shows to what operating mode the system will change in case of alarm, and whether restarting of the system and resetting of the alarm is manual or automatic.

The table also shows that the reaction to some of the fault causes mentioned can be set in menu "Settings". See sections 8.7.24 Soft pressure build-up (4.3.3) and 8.7.44 Monitoring functions (4.4) to 8.7.54 Pressure relief (4.4.8).

Fault	Warning (⚠) Alarm (⊗)	Change of operating mode to	Resetting of alarm Restarting	Set in menu "Settings"	Alarm code
Water shortage	⚠		Man/ auto	X	206
Water shortage	⊗	Sto	Man/	X	214
Pressure high	⊗	Stop	Man/ auto	X	210
Pressure low	⚠		Man/ auto	X	211
	⊗	Stop	Man/ auto		
Pressure relief	⚠		Auto	X	219
Alarm, all pumps	⊗	Stop	Auto		203
External fault	⚠		Man/ auto	X	3
	⊗	Stop	Man/ auto		
Dissimilar sensor signals	⚠		Auto		204
Fault, primary sensor	⊗	Stop	Auto		89
Fault, sensor	⚠		Auto		88
Communication fault	⚠		Auto		10
Phase failure	⚠		Auto		2
Undervoltage, pump	⚠		Auto		7, 40, 42, 73
Overvoltage, pump	⚠		Auto		32
Overload, pump	⚠		Auto		48, 50, 51, 54
Motor temperature too high	⚠		Auto		64, 65, 67, 70
Other fault, pump	⚠		Auto		76, 83
Internal fault, CU 352	⚠		Auto		83, 157
Internal fault, IO 351	⊗	Stop	Auto		72, 83, 157
VFD not ready	⚠		Auto		213
Fault, Ethernet	⚠		Auto		231, 232
Limit 1 exceeded	⚠ ⊗		Man/ auto	X	190
Limit 2 exceeded	⚠ ⊗		Man/ auto	X	191
Pressure build-up fault	⚠ ⊗		Man/ auto	X	215
Pumps outside duty range	⚠		Man/ auto	X	208
Fault, pilot pump	⚠		Auto		216

Alarm (3) continued

MPC alarm indication "Protocol description"	Alarm code	Associated device and device no.	Description/cause	Remedy	Reset type [1]	Alarm/ warning Action type[2]
1. Phase failure, pump	2	Pump 1-6	-	1. Check that all three power supply phases are within a 15V window.	Auto	Warning
2. Undervoltage	7	Pump 1-6	HSD = hardware shutdown. There has been a fault, and the permissible number of restarts for the fault type has been exceeded. a) Fault in power supply. a) Terminal box defective.	1. Restore power supply. 2. Replace terminal box.	Auto	Warning
3. Undervoltage, pump	40	Pump 1-6	a) Power supply voltage is too low at start.	1. Bring voltage back to prescribed level.	Auto	Warning
4. Undervoltage, pump	42	Pump 1-6	a) Faulty power supply at the time of staging on a pump.	1. Restore proper power supply.	Auto	Warning
5. Undervoltage, pump	73	Pump 1-6	a) Low supply voltage. b) Power supply failure while motor is running.	1. Restore proper power supply.	Auto	Warning
6. Overvoltage, pump	32	Pump 1-6	a) Supply voltage is too high at start.	1. Bring voltage back to prescribed level.	Auto	Warning
7. Overload, associated device	48	Pump 1-6	a) Heavy overload has caused software shutdown (SSD).	1. Check and possibly reduce load.	Auto	Warning
8. Overload, associated device	50	Pump 1-6	a) MPF = motor protection function. This built-in motor protection has detected a sustained overload (MPF 60 sec. limit)>	1. Check and possibly reduce load/improve cooling.	Auto	Warning
9. Overload, associated device	51	Pump 1-6	a) Heavy overload (Imax. very high). Pump blocked at start.	1. Unblock the pump.	Auto	Warning
10. Overload, associated device	54	Pump 1-6	a) The built-in motor protection has detected a transitory overload (MPF 3 sec. limit).	1. Check and possibly reduce load/improve cooling	Auto	Warning
11. Over temperature, pump	65	Pump 1-6	a) PTC sensor in the motor has signalled over temperature.	1. Check and possibly reduce load/improve cooling.	Auto	Warning
12. Over temperature, pump	67	Pump 1-6	a) Terminal box has indicated over temperature.	1. Check and possibly reduce load/improve cooling. (Temperature during operation can be read via PC Tool E-products.)	Auto	Warning
13. Other fault, associated device	76	Pump 1-6	a) Internal communication error has occurred in the pump.	Try to reset the fault: 1. Switch off the supply power. 2. Wait until all LEDs are out. 3. Switch on the supply power. If this does not remedy the fault, replace the terminal box.	Auto	Warning

Alarm (3) continued

MPC alarm indication "Protocol description"	Alarm code	Associated device and device no.	Description/cause	Remedy	Reset type [1]	Alarm/ warning Action type[2]
14. Limit 1 exceeded	190	Measured parameter	a) The measured parameter has exceeded the limit set.	1. Remove the cause of the fault.	Auto/ manual	Alarm/warning Stop/ unchanged
15. Limit 2 exceeded	191	Measured parameter	a) The measured parameter has exceeded the limit set.	1. Remove the cause of the fault.	Auto/ manual	Alarm/warning Stop/ unchanged
16. Pressure relief	219	System	a) The monitored pressure could not be reduced sufficiently.	1. Reduce the pressure to below the limit.	Auto	Warning unchanged
17. Pressure build-up fault	215	System	a) The pressure set cannot be reached within the configured time.	1. Check limit and pipes.	Auto/ manual	Alarm/warning Stop/ unchanged
18. Pumps outside duty range	208	System	a) The pump is running outside the defined range.	1. Check the system.	Auto/ manual	Warning unchanged
19. Pilot pump fault	216	Pilot pump	a) Pilot pump fault	1. Check wires. 2. Check the pump.	Auto	Warning
20. Water shortage, level 1 *Water shortage, level 1	206	System	a) The inlet pressure (or the level in the feed tank) is below its programmable warning limit.	1. Check the actual and the corresponding settings. 2. Check the sensor/ switch, wiring and input according to the wiring diagram. 3. Check the sensor/ switch.	Auto	Warning unchanged
21. Water shortage, level 2 *Water shortage, level 2	214		a) The inlet pressure (or the level in the feed tank) is below its programmable warning limit . b) The inlet pressure switch detect water shortage.		Auto/ manual	Alarm Stop Warning unchanged
22. Discharge pressure high. *Pressure above max. pressure	210		a) The system pressure is above the programmable high-pressure alarm limit.		Auto/ manual	Alarm Fast stop (over rule min. seq. time)
23. Discharge pressure low *Pressure below min. pressure	211		a) The system pressure is below the programmable low-pressure alarm limit.		Auto/ manual	
24. All pumps in alarm *All pumps in alarm	203		a) All pumps, set to Auto, are stopped on account of pump alarm.	Troubleshoot according to the alarm message/ code: 1. System 2. Use fault finding documentation for the type of pump installed.	Auto	Alarm Stop
			b) Pumps are not indicating alarm	Check the Genibus wires eg. connection, polarization.		
25. External fault signal *External fault signal	003		a) External fault digital input activated.	1. Check the external signal source. 2. Check the digital input according to the wiring diagram	Auto/ manual	Alarm/Warning Stop/ unchanged
26. Inconsistency between sensors *Inconsistency between sensors	204	Primary sensor and/or redundant sensor	a) Primary feedback sensor value (pressure) is inconsistent with redundant feedback sensor value.	1. Check the wiring and input according to the wiring diagram. 2. Check the sensor output according to the measured value.	Auto	Warning unchanged

Alarm (3) continued

MPC alarm indication "Protocol description"	Alarm code	Associated device and device no.	Description/cause	Remedy	Reset type [1]	Alarm/ warning Action type[2]
27. Primary sensor *Closed loop feedback sensor signal fault	089	Primary sensor	a) A fault in the sensor assigned to the feed back control is detected. b) Error in the settings of the sensor which is assigned to the regulator.	1. Check the wiring and input according to the wiring diagram. 2. Check the sensor output according to the measured value.	Auto	Alarm Stop
28. Sensor fault *General (measurement) sensor signal fault	088	CU 351 IO 351 as IO module	a) The signal (ex. 4-20 mA) from one of the analog sensors is outside the selected signal range.	1. Check the wiring and input according to the wiring diagram. 2. Check the sensor output according to the measured value.		Warning Unchanged
29. CU 351 internal fault *Real time clock out of order	157	CU 351	a) The real-time clock in CU 351 is out of order.	Replace the CU 351	Auto	Warning Unchanged
30. Ethernet fault *Ethernet: No address from DHCP server	231		a) No address from DHCP server	1. Communication error. 2. Please contact the system integrator or network administrator.		
31. Ethernet fault *Ethernet: Auto disabled due to misuse	232		a) Auto-disabled due to misuse			
32. FLASH parameter verification error *FLASH parameter verification error	083		a) Verification error in CU 351 FLASH memory	Replace the CU 351		
33. IO 351 internal fault *Hardware fault type 2	080	IO 351	a) IO 351 pump module hardware fault b) IO 351 I/O module hardware fault	See current alarms and identify the faulty IO 351 module from the alarm message and replace the module.		
34. VFD not ready *VFD not ready	213	Pump 1-6 IO 351	a) The VFD signal relay do not release the VFD for operation	1. Check for VFD alarm 2. Check the wiring and input according to the wiring diagram.		
35. Communication fault *Pump communication fault	010	Pump 1-6 IO 351	a) No GeniBus communication with a device connected to CU 351	See actual alarms and identify the faulty device from the alarm message. 1. Check power supply 2. Check GeniBus cable connection 3. Check, with R100, that the device GeniBus no. is correct.		
36. Device alarms	From device	Pump 1-6	a) The device is in alarm	See actual alarms and identify the faulty device from the alarm message. 1. Fault find according to the service instruction for the device.		

1) Reset type is either fixed as "Auto acknowledge" (Auto) or can be programmed to be Auto or manual acknowledge (Auto/Man)*.
2) Programmable action types:
-Go to operating mode "Stop" (no delay (<0.5 s) between pump disconnections).
-Go to operating mode "Min."
-Go to operating mode "User-defined."
-Go to operating mode "Max."
-Set pumps in source mode "Local." - No action (warning only)

9.6.2 Actual alarms (3.1)

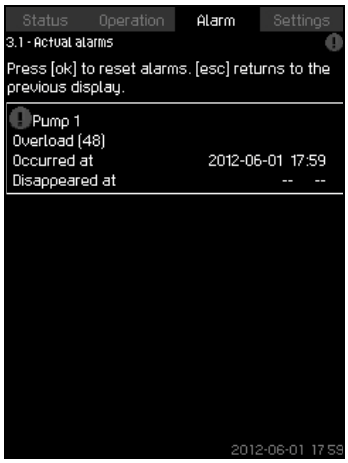


Fig. 36 Actual alarms

Description

This submenu shows the following:

- Warnings ⚠ caused by faults that still exist.
- Warnings ⚠ caused by faults that have disappeared, but the warning requires manual resetting.
- Alarms ⊗ caused by faults that still exist.
- Alarms ⊗ caused by faults that have disappeared, but the alarm requires manual resetting.

All warnings and alarms with automatic resetting are automatically removed from the menu when the fault has disappeared.

Alarms requiring manual resetting can be reset in this display by pressing [ok]. An alarm cannot be reset until the fault has disappeared.

For every warning or alarm, the following will be shown:

- Whether it is a warning ⚠ or an alarm ⊗.
- Where the fault occurred: System, Pump 1, Pump 2, ...
- In case of input-related faults, the input will be shown.
- The cause of the fault and the alarm code in brackets, e.g. "Water shortage (214)".
- When the fault occurred: Date and time.
- When the fault disappeared: Date and time. If the fault still exists, date and time will be shown as --...--.

The most recent warning/alarm is shown at the top of the display.

9.6.3 Alarm log (3.2)

The alarm log can store up to 24 warnings and alarms.

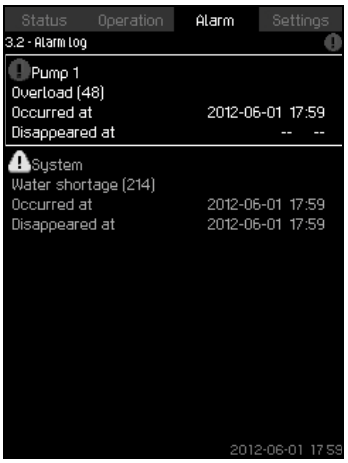


Fig. 37 Alarm log

Description

Here warnings and alarms are shown.

For every warning or alarm, the following will be shown:

- Whether it is a warning ⚠ or an alarm ⊗.
- Where the fault occurred. System, Pump 1, Pump 2, ...
- In case of input-related faults, the input will be shown.
- The cause of the fault and the alarm code in brackets, e.g. "Water shortage (214)".
- When the fault occurred: Date and time.
- When the fault disappeared: Date and time. If the fault still exists, date and time will be shown as --...--.

The most recent warning/alarm is shown at the top of the display.

9.6.4 Service contact information (3.3)

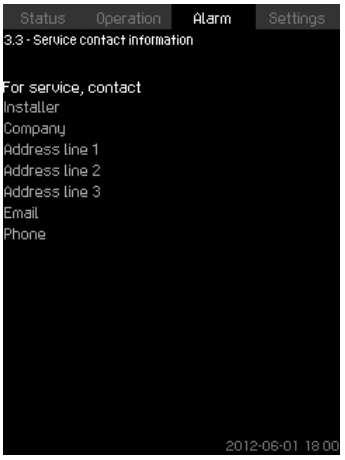


Fig. 38 Service contact information

Description

This display shows the contact information of the installer if entered during commissioning.

9.7 Settings (4)

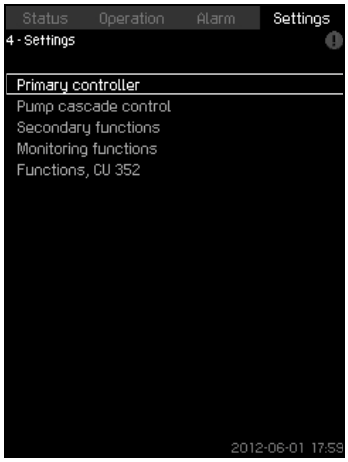


Fig. 39 Settings

In this menu, you can set the following functions:

- Primary controller
  PI controller, Alternative setpoints, External setpoint influence, Primary sensor, Clock program, Proportional pressure, S-system configuration, Setpoint ramp.
- Pump cascade control
  Min. time between start/stop, Max. number of starts/hour, Number of standby pumps, Forced pump changeover, Pump test run, Pump stop attempt, Pump start and stop speed, Min. performance, Compensation for pump start-up time.
- Secondary functions
  Stop function, Soft pressure build-up, Digital inputs, Analog inputs, Digital outputs, Analog outputs, Emergency run, Min., max, and user-defined duty, Pump curve data, Control source, Fixed inlet pressure, Flow estimation, Reduced operation.
- Monitoring functions
  Dry-running protection, Min. pressure, Max. pressure, External fault, Limit 1 exceeded, Limit 2 exceeded, Pumps outside duty range, Pressure relief, Log values, Fault, primary sensor.
- Functions, CU 352
  Display language, Units, Date and time, Password, Ethernet, GENibus number, Software status. The service language, English, can be selected for service purposes. All these functions are usually set correctly when the system is switched on.

9.7.1 Primary controller (4.1)

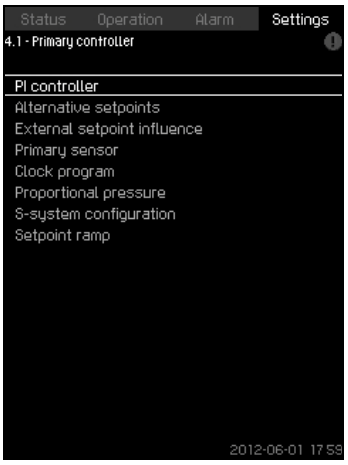


Fig. 40 Primary controller

Description

It is possible to set the functions related to the primary controller. It is only necessary to make settings in this menu if the functionality is to be expanded with for instance alternative setpoints, external setpoint influence, clock program or proportional pressure.

The following menus can be selected:

- PI controller
- Alternative setpoints
- External setpoint influence
- Primary sensor
- Clock program
- Proportional pressure
- S-system configuration

9.7.2 PI controller (4.1.1)

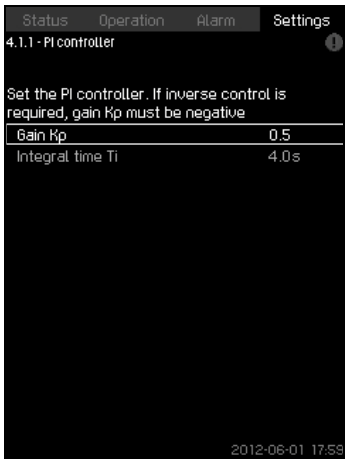


Fig. 41 PI controller

Description

The system includes a standard PI controller which ensures that the pressure is stable and corresponds to the setpoint.

It is possible to adjust the PI controller if a faster or slower reaction to changes of consumption is required.

A faster reaction is obtained if K_p is increased and T_i is reduced.

A slower reaction is obtained if K_p is reduced and T_i is increased.

Setting range

- Gain Kp: -30 to 30.
  Note: For inverse control, set K_p to a negative value.
- Integral time Ti: 0.1 to 3600 seconds.

Setting via control panel

- Settings
- Primary controller
- PI controller

1. Set the gain (K_p) and integral time (T_i).
   Note: Usually it is not necessary to adjust K_p.

Factory setting

- K_p: 0.5
- T_i: 1 second.

9.7.3 Alternative setpoints (4.1.2)

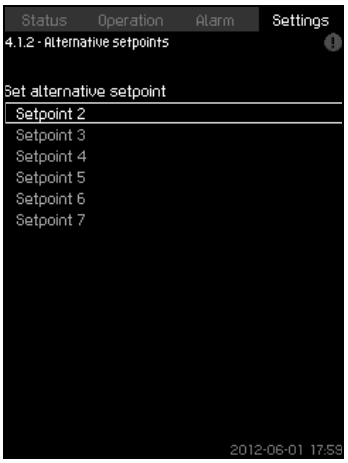


Fig. 42 Alternative setpoints

Description

This function makes it possible to select up to six setpoints (2 to 7) as alternatives to the primary setpoint (1). The primary setpoint (1) is set in the "Operation" menu.
Every alternative setpoint can be addressed manually to a separate digital input (DI). When the contact of the input is closed, the alternative setpoint applies.

If more than one alternative setpoint has been selected, and they are activated at the same time, the CU 352 will select the setpoint with the lowest number.

Setting range

- Six setpoints, No 2 to 7.

Factory setting

No alternative setpoints have been selected.

9.7.4 Alternative setpoints 2 - 7 (4.1.2.1 - 4.1.2.7)

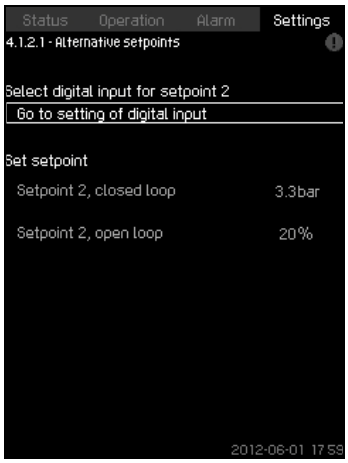


Fig. 43 Alternative setpoints 2 - 7

For each alternative setpoint, select the digital input to activate the setpoint.

It is possible to set a setpoint for closed loop and for open loop.

Setting via control panel

- Settings > Primary controller > Alternative setpoints

1. Select alternative setpoint.
2. Select: alternative setpoint
   Display Digital inputs (4.3.7) appears.
3. Set the input.
4. ⮌.
5. Select the menu line of the setpoint (closed or open loop).
6. Set the setpoint.
   Set both setpoints if the system is to be controlled both in open and closed loop.

Factory setting

No alternative setpoints have been set.

9.7.5 External setpoint influence (4.1.3)

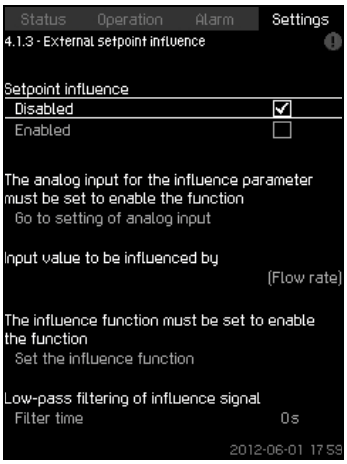


Fig. 44 External setpoint influence

Description

This function makes it possible to adapt the setpoint by letting measuring parameters influence the setpoint. Typically an analog signal from a flow or temperature transmitter, or a similar transmitter.

As an example, the setpoint can be adapted to parameters that can influence the discharge pressure or temperature of the system. The parameters which influence the performance of the system are shown as a percentage from 0 to 100%. They can only reduce the setpoint, as the influence as a percentage is multiplied with the setpoint:

Actual setpoint (SP) =
selected setpoint x influence (1) x influence (2) x ...

The influence values can be set individually.

A low-pass filter ensures smoothing of the measured value which influences the setpoint. This results in stable setpoint changes.

Setting range

- 0 - 100% signal
- Inlet pressure
- Discharge pressure
- External pressure
- Diff. pressure, external
- Diff. pressure, pump
- Flow rate
- Tank level, discharge side
- Tank level, suction side
- Return-pipe temp., external
- Flow-pipe temperature
- Return-pipe temperature
- Differential temperature
- Ambient temperature
- Differential temperature

Setting via control panel

- Settings > Primary controller > External setpoint influence > Input value to be influenced by.
  A list of available parameters appears.

1. Select the parameter which is to influence the setpoint.
2. ⮌.
3. Set the influence function
   (See section *9.7.6.*)
4. Set the number of points
5. Set: External input value. (Point 1.)
6. Set as a percentage: Reduce setpoint to. (Point 1.)
7. Repeat steps 4 to 6 for all desired parameters
8. ⮌.
9. Set as seconds: Filter time
10. Select: Enabled

Factory setting

The function is disabled.

9.7.6 Setting of influence function (4.1.3.2)

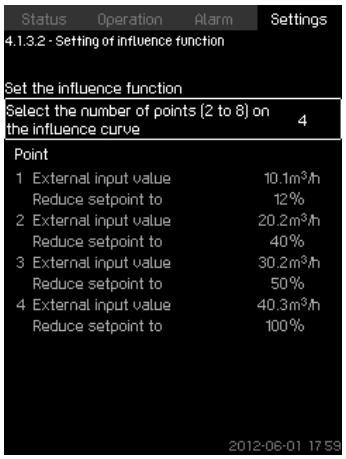


Fig. 45 Setting of influence function

Description

It is possible to select the relation between the measuring parameter which is to influence the setpoint and the desired influence as a percentage.

The relation is set by entering values in a table with maximum eight points by means of the control panel.

Example:

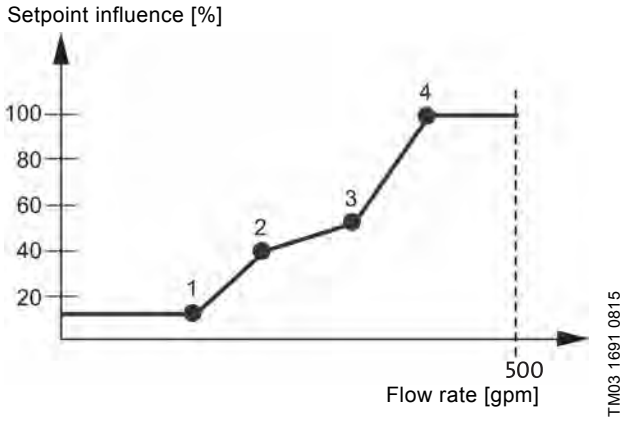


Fig. 46 Relation between setpoint influence and flow rate

The control unit draws straight lines between the points.
A horizontal line is drawn from the minimum value of the relevant sensor (0 gpm in the example) to the first point. This is also the case from the last point to the sensor's maximum value (example 500 gpm).

Setting range

Two to eight points can be selected. Each point contains the relation between the value of the parameter which is to influence the setpoint and the influence of the value.

Setting via control panel

- Settings > Primary controller > External setpoint influence

1. Set the influence function
2. Set the number of points
3. Set: External input value. (Point 1.)
4. Set as a percentage: Reduce setpoint to. (Point 1.)
5. Repeat steps 2 to 4 for all desired parameters

Factory setting

The function is disabled.

9.7.7 Primary sensor (4.1.4)

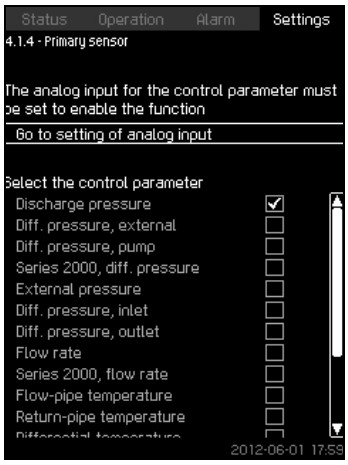


Fig. 47 Primary sensor

Description

You can select the control parameter of the system and set the sensor to measure the value.

Setting range

- Discharge pressure
- Diff. pressure, external
- Diff. pressure, pump
- Series 2000, diff. pressure
- External pressure
- Diff. pressure, inlet
- Diff. pressure, outlet
- Flow rate
- Series 2000, flow rate
- Flow-pipe temperature
- Return-pipe temperature
- Differential temperature
- Ambient temperature
- Return-pipe temp., external
- 0 - 100% signal
- Not used

Setting via control panel

- Settings > Primary controller > Primary sensor > Go to setting of analog input.
  Display Analog inputs (4.3.8) appears.

1. Select analog input (AI) for the primary sensor and set the parameters.
2. ↩.
3. Select control parameter for the primary sensor.

Factory setting

The primary parameter is discharge pressure. The sensor is connected to AI1 (CU 352). Other primary parameters can be selected in the start-up wizard.

9.7.8 Clock program (4.1.6)

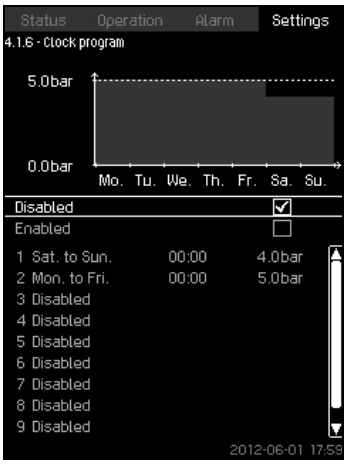


Fig. 48 Clock program

Description

With this function, it is possible to set setpoints and day and time for their activation. It is also possible to set day and time for stop of the system.

If the clock program is disabled, the setpoint of the program will remain active.

Note

Minimum two events are required when activating the clock program; one to start the clock program and one to change the clock program.

Setting range

- Activation and setting of event.

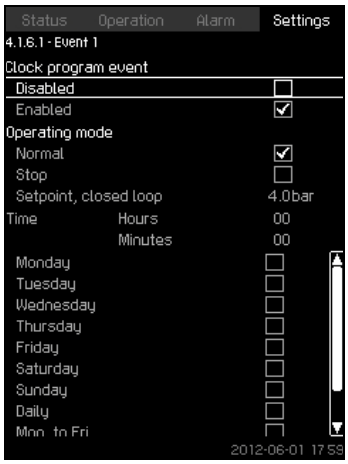


Fig. 49 Event 1

Setting via control panel

- Settings > Primary controller > Clock program

1. Enable the function
2. Select and enable one of the ten events
3. Select: "Normal" or "Stop"
   (Skip step 4 if you select "Stop".)
4. Set: Setpoint, closed loop
5. Set: Time, Hours, Minutes
6. Select the day of week on which the settings are to be activated
7. Select: Enabled
8. Repeat steps 2 to 7 if several events are to be enabled.
   Note: Up to ten events can be set.
9. ⮌.
10. Select: Enabled

Factory setting

The function is disabled.

9.7.9 Proportional pressure (4.1.7)

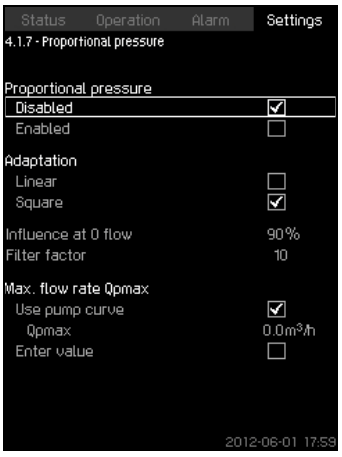
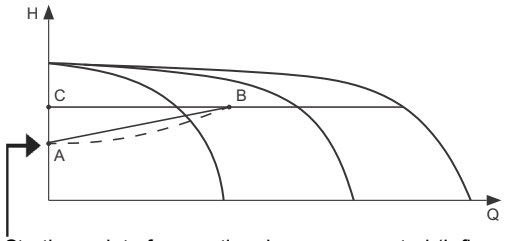


Fig. 50 Proportional pressure

Description

The function can only be enabled in pressure-controlled systems and automatically adapts the setpoint to the actual flow rate to compensate for flow-dependent dynamic losses. As many systems are designed with extra flow capacity, the estimated maximum flow rate (Qpmax) can be entered manually. In systems with CR pumps, the pump curves can be used to calculate the maxium flow rate at the selected setpoint. A filter factor can be set to prevent fluctuation.

The adaptation can be linear or square. See fig. 50.



Starting point of proportional pressure control (Influence at 0 flow = x% of H_{set})

TM05 3005 0812

Fig. 51 Proportional pressure

Pos.	Description
A	Pressure at 0 flow. Starting point of proportional-pressure control (influence at 0 flow = x % of setpoint)
B	Qpmax
C	Setpoint

The function has these purposes:

- to compensate for pressure losses
- to reduce the energy consumption
- to increase the comfort for the user

Setting range

- Selection of control mode
- Influence at 0 flow
- Estimated flow rate
- Filter factor

Setting via control panel

- Settings > Primary controller > Proportional pressure

1. Select: Enabled
2. Select:
- Adaptation
- Linear / Square
3. Set: Influence at 0 flow
4. Set: Filter factor
5. Select: Use pump curve / Enter value
6. Set "Qpmax" if you select "Enter value"

Factory setting

The function is disabled.

9.7.10 S-sytem configuration (4.1.8)

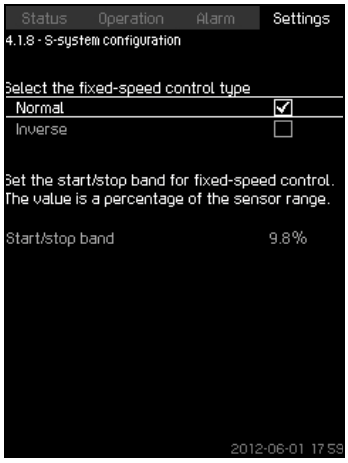


Fig. 52 S-system configuration

Description

The function makes it possible to invert the control of fixed speed pumps (MPC-S). That is to set whether pumps are to be started or stopped depending on the actual value.

A start/stop band must be set in order to use this function. See fig. 53.

Normal

A pump is stopped when the value becomes higher than H_{set} + start/stop band. And a pump is started when the value becomes lower than H_{set}. See fig. 53.

Inverse

A pump is started when the value becomes higher than H_{set} + start/stop band. And a pump is stopped when the value becomes lower than H_{set}. See fig. 53.

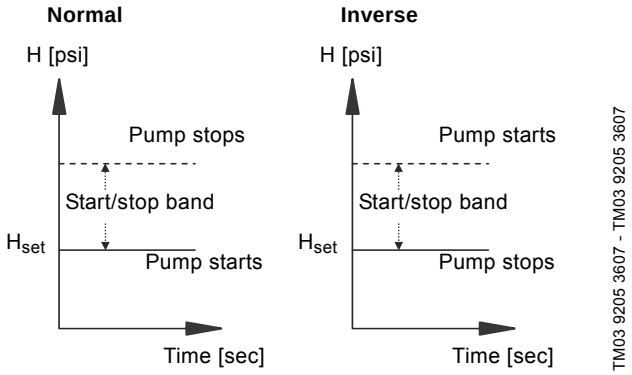


Fig. 53 Normal and inverse control

Setting range

- Selection of configuration (normal or inverse)
- Start/stop band

Setting via control panel

- Settings > Primary controller > S-system configuration

1. Select: Normal / Inverse
2. Set: Start/stop band

Factory setting

Normal

9.7.11 Setpoint ramp (4.1.9)

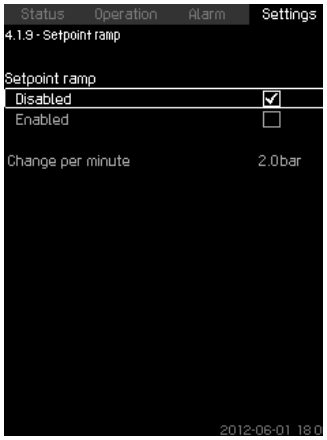


Fig. 54 Setpoint ramp

Description

When this function is enabled, setpoint changes will be affected by the setpoint ramp, and the setpoint will change gradually over a period of time.

"Proportional pressure" or "Setpoint influence" will not be affected by this function.

Setting range

The function can be enabled and change per minute can be set.

Setting via control panel

- Settings > Primary controller > Setpoint ramp

1. Select: Enabled
2. Set: Change per minute

Factory setting

The function is disabled.

9.7.12 Pump cascade control (4.2)

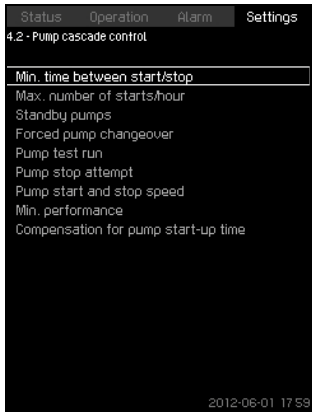


Fig. 55 Pump cascade control

It is possible to set the functions connected to pump cascade control.

The following menus can be selected:

- Min. time between start/stop
- Max. number of starts/hour
- Standby pumps
- Forced pump changeover
- Pump test run
- Pilot pump
- Pump stop attempt
- Pump start and stop speed
- Min. performance
- Compensation for pump start-up time

9.7.13 Min. time between start/stop (4.2.1)

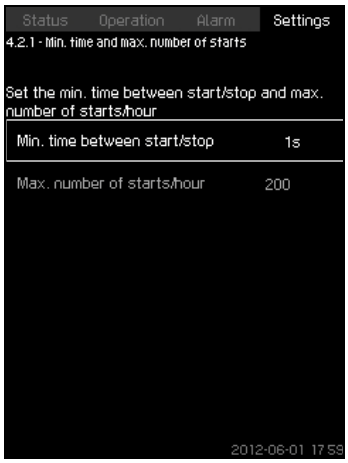


Fig. 56 Min. time between start/stop

Description

This function ensures a delay between the starting/stopping of one pump and the starting/stopping of another pump.

The purpose is to prevent hunting when pumps start and stop continuously.

Setting range

From 1 to 3600 seconds.

Setting via control panel

Settings > Pump cascade control > Min. time between start/stop.

Factory setting

The setting is done in the start-up wizard and depends on the application.

9.7.14 Max. number of starts/hour (4.2.1)

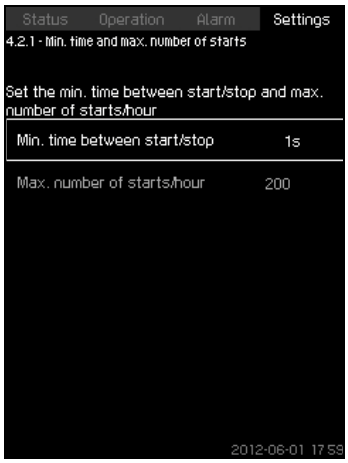


Fig. 57 Max. number of starts/hour

Description

This function limits the number of pump starts and stops per hour for the complete system. It reduces noise emission and improves the comfort of systems with fixed speed pumps.

Each time a pump starts or stops, the CU 352 calculates when the next pump is allowed to start/stop in order not to exceed the permissible number of starts per hour.

The function always allows pumps to be started to meet the requirement, but pump stops will be delayed, if needed, in order not to exceed the permissible number of starts per hour.

The time between pump starts must be between the minimum time between start/stop, see section *9.7.13*, and 3600/n, n being the set number of starts per hour.

Setting range

1 to 1000 starts per hour.

Setting via control panel

- Settings > Pump cascade control > Max. number of starts/hour

1. Set:

- Min. time between start/stop
- Max. number of starts/hour

Factory setting

MPC-E:	200 starts per hour
Other variants:	100 starts per hour

Note ***This function has no influence on Stop function (4.3.1).***

9.7.15 Standby pumps (4.2.3)

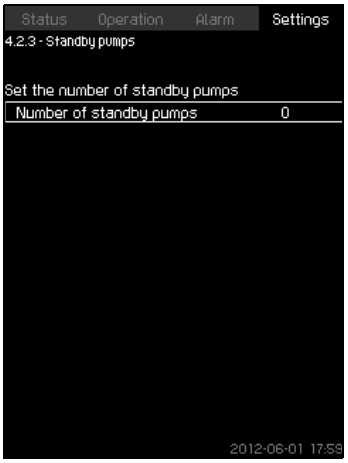


Fig. 58 Standby pumps

Description

This function makes it possible to limit the maximum performance of the system, by selecting one or more pumps as standby pumps.

If a three-pump system has one standby pump, maximum two pumps are allowed to be in operation at a time.

If one of the two pumps in operation has a fault and has stopped, the standby pump will be started. The performance of the system is thus not reduced.

The status as standby pump alternates between all pumps.

Setting range

The number of possible standby pumps in a system is equal to the total number of pumps in the system minus 1.

Setting via control panel

- Settings > Pump cascade control > Standby pumps
- Set: Set the number of standby pumps

Factory setting

The number of standby pumps is set to 0, i.e. function is disabled.

9.7.16 Forced pump changeover (4.2.4)

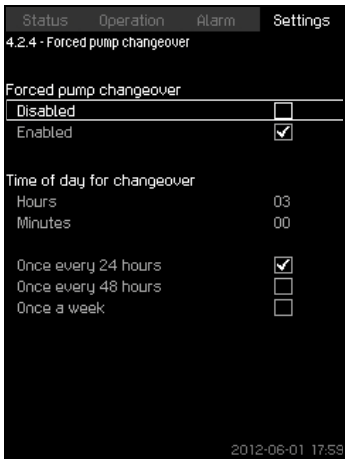


Fig. 59 Forced pump changeover

Description

This function ensures that the pumps run for the same number of operating hours.

In certain applications, the requirement remains constant for long periods and does not require all pumps to run. In such situations, pump changeover does not take place naturally, and forced pump changeover may thus be required.

Once every 24 hours, the CU 352 checks if any pump running has a larger number of operating hours than pumps that are stopped. If this is the case, the pump will be stopped and replaced by a pump with a lower number of operating hours.

Setting range

The function can be enabled/disabled. The hour of the day at which the changeover is to take place can be set.

Setting via control panel

- Settings > Pump cascade control > Forced pump changeover

1. Select: Enabled
2. Set: Time of day for changeover
3. Select interval for pump changeover.

Factory setting

The function is enabled. The time is set to 03:00.

9.7.17 Pump test run (4.2.5)

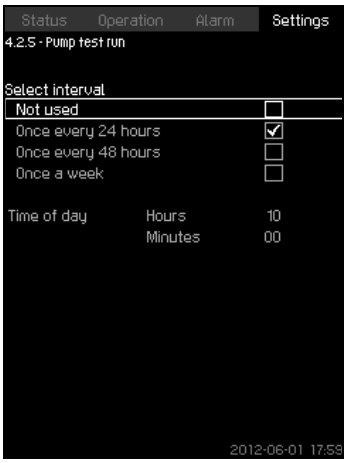


Fig. 60 Pump test run

Description

This function is primarily used in situations where the forced pump changeover is disabled, and/or if the system is set to operating mode "Stop", for instance in a period when the system is not needed. In such situations, it is important to test the pumps regularly.

Advantages of this function:

- Pumps do not seize up during a long standstill due to deposits from the pumped liquid.
- The pumped liquid does not decay in the pump.
- Trapped air is removed from the pump.

The pumps start automatically one by one and run for five seconds.

Note

Pumps in operating mode "Manual" are not included in the test run. If there is an alarm, the test run will not be carried out.

If the backup pump is included in the test run, the system pressure will be high when the pump is started.

Setting range

- Time of day
- Day of week
- Include pilot pump
- Include backup pump

Setting via control panel

- Settings > Pump cascade control > Pump test run

1. Select interval
2. Set:

- Time of day
- Minutes

3. Select the day of week if you select "Once a week"
4. If system is configured with a pilot or a backup pump, select "include pilot pump" or "Include backup pump"

Factory setting

The function is disabled.

9.7.18 Pump stop attempt (4.2.7)

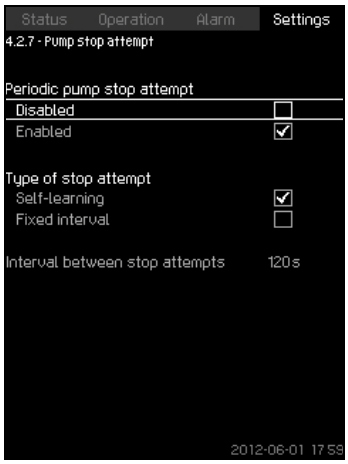


Fig. 61 Pump stop attempt

Description

The function makes it possible to set automatic stop attempts of a pump when several pumps are running. It ensures that the optimum number of pumps is always running, in terms of energy consumption. See 8.7.19 Pump start and stop speed (4.2.8). At the same time, the purpose is to avoid disturbances in connection with automatic stop of pumps.

Stop attempts can either take place with a fixed interval set under "Interval between stop attempts" or by self-learning. If self-learning is selected, the interval between stop attempts will be increased if repeated attempts to stop the pump fail.

Setting via control panel

- Settings > Pump cascade control > Pump stop attempt

1. Select: Self-learning / Fixed interval
2. Set "Interval between stop attempts" if you select "Fixed interval".
3. Select: Enabled

Factory setting

The function is enabled, and "Self-learning" is selected.

9.7.19 Pump start and stop speed (4.2.8)

Description

The function controls the starting and stopping of pumps.
There are two options:

1. Use calculated speed
   This function ensures that the optimum number of pumps is always running at a desired duty point, in terms of energy consumption. The CU 352 calculates the required number of pumps and their speed. This requires that the differential pressure of the pump is measured by a differential-pressure sensor or separate pressure sensors on the inlet and discharge side.
   If calculated speed has been selected, the CU 352 will ignore the percentages set.
2. Use fixed speed
   The pumps are started and stopped at speeds set by the user.

1. Use calculated speed

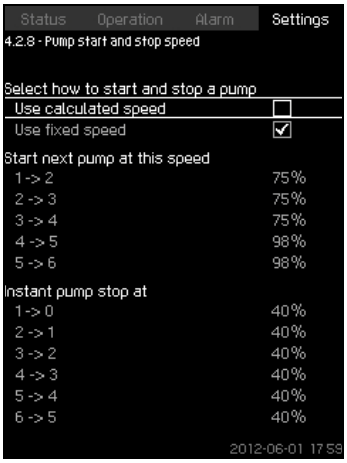


Fig. 62 Use calculated speed

Setting via control panel

- Settings > Pump cascade control > Pump start and stop speed > Use calculated speed

2. Use fixed speed

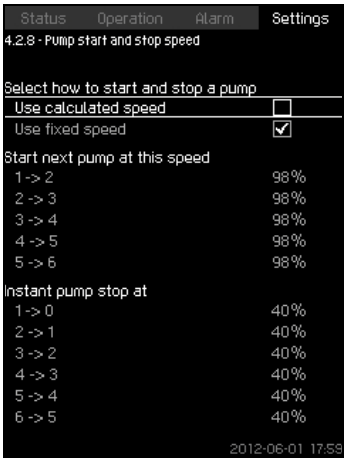


Fig. 63 Use fixed speed

Setting via control panel

- Settings > Pump cascade control > Pump start and stop speed
- Select: Use fixed speed
- Set: Start next pump at this speed > 1 -> 2

1. Set the speed as percentage
2. Set the other pumps in the same way
3. Select: Instant pump stop at > 1 -> 0
4. Set the speed as percentage
5. Set the other pumps in the same way

Factory setting

The function is set to calculated speed.

9.7.20 Min. performance (4.2.9)

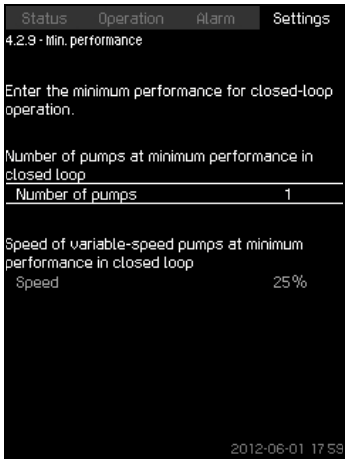


Fig. 64 Min. performance

Description

This function ensures circulation in a system. Note that the stop function, if enabled, can influence this function. See section 8.7.23 Stop function (4.3.1). Examples:

- If 0 pumps have been selected, the stop function can stop the pump if there is no or a very small consumption.
- If pumps have been selected, the stop function will not be active.

Setting via control panel

- Settings > Pump cascade control > Min. performance

1. Set:

- Number of pumps
- Speed

Factory setting

The number of pumps is set to 0. The speed in closed loop is set to 25%.

9.7.21 Compensation for pump start-up time (4.2.10)

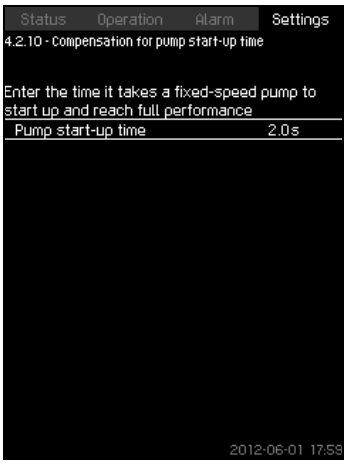


Fig. 65 Compensation for pump start-up time

Description

The function is used for MPC-F systems only.

The purpose is to avoid disturbances when a fixed speed pump with fixed speed is started. The function compensates for the time it takes a fixed speed pump to reach its full performance after start. The start-up time of the fixed speed pump must be known.

Setting via control panel

- Settings > Pump cascade control > Compensation for pump start-up time
- Set: Pump start-up time

Factory setting

The start-up time is set to 0 seconds.

9.7.22 Secondary functions (4.3)

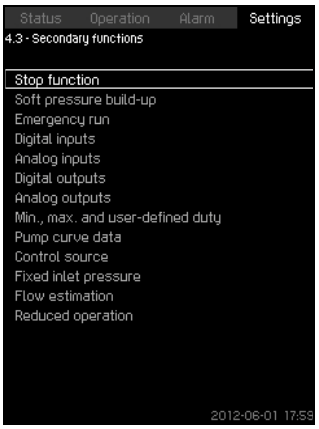


Fig. 66 Secondary functions

Description

Functions that are secondary in relation to the normal operation of the system can be set in this display. Secondary functions are functions that offer additional functionality.

The display makes it possible to open these specific displays:

- *Stop function (4.3.1)*
- *Soft pressure build-up (4.3.3)*
- *Digital inputs (4.3.7)*
- *Analog inputs (4.3.8)*
- *Digital outputs (4.3.9)*
- *Analog outputs (4.3.10)*
- *Emergency run (4.3.5)*
- *Min., max. and user-defined duty (4.3.14)*
- *Pump curve data (4.3.19)*
- *Flow estimation (4.3.23)*
- *Control source (4.3.20)*
- *Fixed inlet pressure (4.3.22)*
- *Flow estimation (4.3.23)*
- *Reduced operation (4.3.24)*

9.7.23 Stop function (4.3.1)

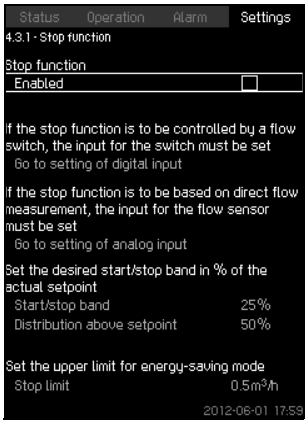


Fig. 67 Stop function

Description

This function is typically used in constant pressure applications and makes it possible to stop the last pump if there is no or a very small consumption.

Purpose of the function:

- to save energy
- to prevent heating of shaft seal faces due to increased mechanical friction as a result of reduced cooling by the pumped liquid
- to prevent heating of the pumped liquid.

The description of the stop function applies to all booster systems with variable-speed pumps. MPC-S systems will have on/off control of all pumps as described in section *5. Overview of control variants*.

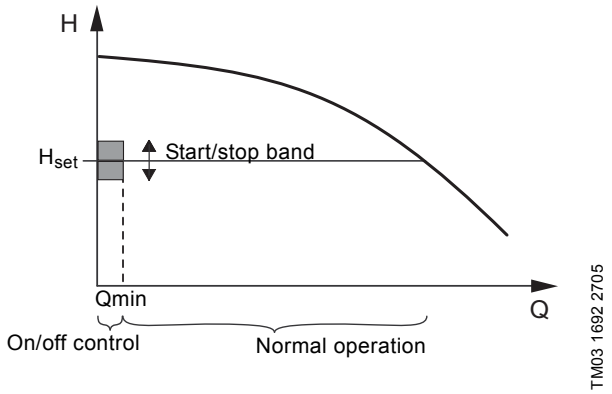


Fig. 68 Start/stop band

When the stop function is enabled, the operation is continuously monitored to detect a low flow rate. When the CU 352 detects no or a low flow rate (Q < Qmin), it changes from constant-pressure operation to on/off control of the last pump in operation.

Before stopping, the pump increases the pressure to a value corresponding to H_{set} plus (distribution above setpoint / 100) x start/stop band. The pump is restarted when the pressure is H_{set} minus (100-distribution above setpoint) / 100 x start/stop band. See fig. 69. The start/stop band can be distributed around the setpoint.

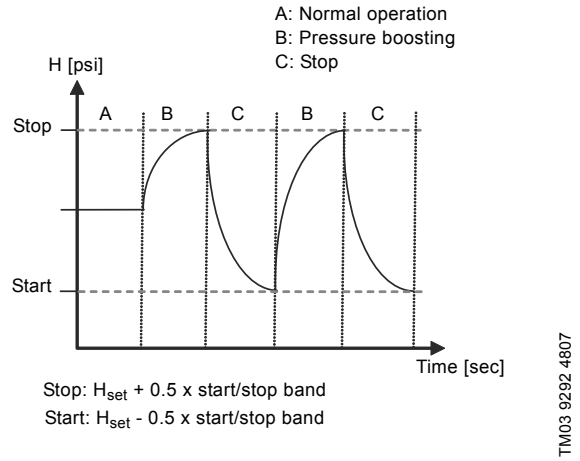


Fig. 69 On/off operation

The flow rate is estimated by the CU 352 when the pump is in the stop period. As long as the flow rate is lower than Qmin, the pump will run on/off. If the flow rate is increased to above Qmin, the pump returns to normal operation, H_{set}. H_{set} is equal to the actual setpoint. See section *9.4.4 Setpoint (1.2.2)*.

Detection of low flow rate

Low flow rate can be detected in two ways:

- direct flow measurement with a flowmeter or flow switch
- estimation of flow rate by measurement of pressure and speed.

If the booster system is not connected to a flowmeter or flow switch, the stop function will use the estimating function.

If the detection of low flow rate is based on flow estimation, a diaphragm tank of a certain size and with a certain precharge pressure is required.

Diaphragm tank size

Pump type	Recommended diaphragm tank size [gallons]		
	-E	-F	-S
CR(E) 3	4.4	4.4	20
CR(E) 5	4.4	4.4	34
CR(E) 10	10.3	10.3	62
CR(E) 15	34	34	211
CR(E) 20	34	34	211
CR(E) 32	44	44	317
CR(E) 45	86	86	528
CR(E) 64	132	132	1056
CR(E) 90	132	132	1056
CR(E) 120	132	132	1056
CR(E) 150	132	132	1056

Precharge pressure

Hydro MPC-E and -F: 0.7 x setpoint
Hydro MPC-S: 0.9 x setpoint

During each flow estimation (every 2 minutes), the estimating function will disturb the discharge pressure by ± 10% of the setpoint. If this disturbance is not acceptable, the stop function must be based on direct flow measurement with a flowmeter or flow switch.

The minimum flow rate can be set, i.e. the flow rate at which the booster system changes to on/off control of the last pump in operation.

If both a flowmeter and a flow switch are connected, the changeover to on/off control will be determined by the unit first indicating low flow rate.

Setting range

Start/stop band:	5-30 %
Min. flow rate:	2-50 % of the rated flow rate (Qnom) of one of the pumps. (Can only be set if direct flow measurement by means of flowmeter has been selected.)
Distribution above setpoint:	0-100 %.

Setting via control panel

System without flow switch or flowmeter

- Settings > Secondary functions > Stop function
- Select: Enabled

1. Set: Start/stop band
2. Select: Go to setting of flow stop parameters.
   The display below appears.

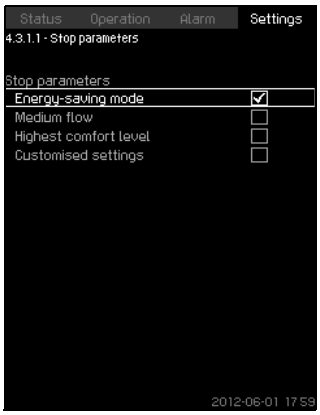


Fig. 70 Stop parameters

3. Select one of the stop parameters. If you select "Customized settings", you must set the parameters shown in fig. 71.
   See the examples below.

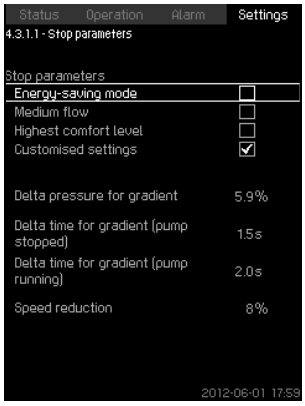


Fig. 71 Customized settings

Note ***Rule of thumb: Speed reduction = 2 x delta pressure for gradient.***

Example 1: Increasing the stop limit, Qmin (high flow limit)

- Increase the delta pressure for gradient
- Reduce the delta time for gradient (pump stopped)
- Reduce the delta time for gradient (pump running)
- Increase speed reduction

Example of increased stop limit

Parameter	Value
Delta pressure for gradient	6%
Delta time for gradient (pump stopped)	1.5 sec.
Delta time for gradient (pump running)	2.0 sec.
Speed reduction	10%

Example 2: Reducing the stop limit, Qmin (low flow limit)

- Reduce the delta pressure for gradient
- Increase the delta time for gradient (pump stopped)
- Increase the delta time for gradient (pump running)
- Reduce speed reduction

Example of reduced flow limit

Parameter	Value
Delta pressure for gradient	3%
Delta time for gradient (pump stopped)	15.0 sec.
Delta time for gradient (pump running)	25.0 sec.
Speed reduction	6%

Note ***The stop limit depends on the tank size.***

System with flow switch

Make the following additional settings:

1. Select: Go to setting of digital input.
   Display Digital inputs (4.3.7) appears
2. Select the digital input where the flow switch is connected
3. Select: Flow switch
4. ↩.

Note ***An open contact indicates low flow.***

System with flowmeter

Make the following additional settings:

1. Select: Go to setting of analog input
   Display Analog inputs (4.3.8) appears
2. Select the analog input where the flowmeter is connected.
3. Select: Flow rate
4. ↩ x 2.
5. Set: Stop limit

Factory setting

The function is enabled in pressure-boosting applications with the settings in the table.

Start/stop band:	10%
Min. flow rate:	30 % of the rated flow rate of one pump
Distribution above setpoint:	50%

The function is disabled in all other applications.

9.7.24 Soft pressure build-up (4.3.3)

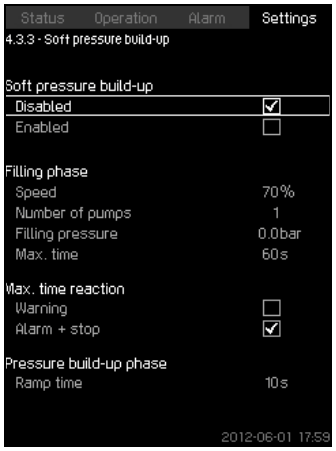


Fig. 72 Soft pressure build-up

Description

This function is typically used in pressure-boosting applications and ensures a smooth start-up of systems with for instance empty pipes.

Start-up takes place in two phases. See fig. 73.

1. Filling phase
   The pipework is slowly filled with water. When the pressure sensor of the system detects that the pipework has been filled, phase two begins.
2. Pressure build-up phase
   The system pressure is increased until the setpoint is reached. The pressure build-up takes place over a ramp time. If the setpoint is not reached within a given time, a warning or an alarm can be given, and the pumps can be stopped at the same time.

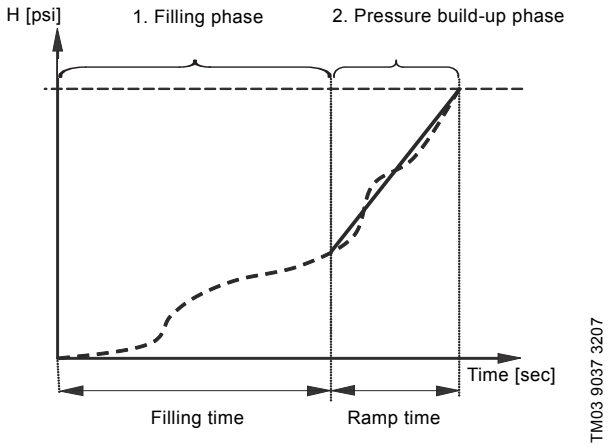


Fig. 73 Filling and pressure build-up phases

Setting range

- Pump speed
- number of pumps
- filling pressure
- maximum filling time
- warning or alarm + stop
- ramp time for the pressure build-up phase.

Setting via control panel

- Settings > Secondary functions > Stop function > Soft pressure build-up

1. Select and set:
- Speed
- Number of pumps
- Filling pressure
- Max. time.

2. Select: Warning / Alarm + stop
3. Set: Ramp time
4. Select: Enabled

Factory setting

The function is disabled.

9.7.25 Emergency run (4.3.5)

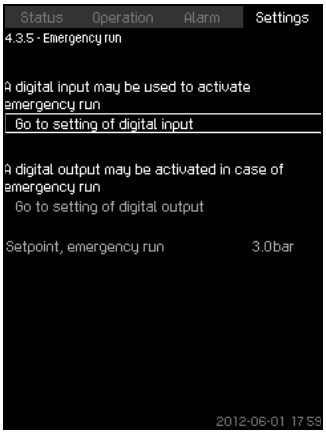


Fig. 74 Emergency run

Description

This function is used in booster applications. When this function has been enabled, the pumps will keep running regardless of warnings or alarms. The pumps will run according to a setpoint set specifically for this function.

Caution ***In case of sensor fault, both main and standby pumps will run at 100% speed!***

Setting range

- Setting of digital input (8.7.26 Digital inputs (4.3.7))
- Setting of digital output (8.7.31 Digital outputs (4.3.9))
- Setting of setpoint for emergency run

Setting via control panel

- Settings > Secondary functions > Stop function > Emergency run > Go to setting of digital input

1. Select digital input
2. Select: Emergency run
3. ↩ x 2
4. Select: Go to setting of digital output.
5. Select digital output.
6. Select: Emergency run
7. ↩ x 2
8. Set: Setpoint, emergency run

Note ***When this function has been set as described above, it can also be enabled via display System operating mode (2.1.1).***

9.7.26 Digital inputs (4.3.7)

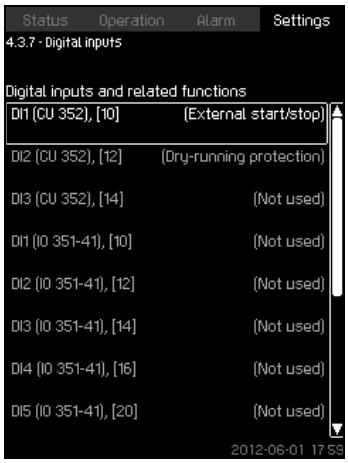


Fig. 75 Digital inputs

Description

It is possible to set the digital inputs of the CU 352. Each input, except DI1, can be activated and related to a certain function.

As standard, the system has three digital inputs. If the system incorporates an IO 351B module (option), the number of digital inputs is 12.

All digital inputs are shown so that their physical position in the system can be identified.

Example

DI1 (IO 351-41), [10]:

DI1:	Digital input No 1
(IO 351-41):	IO 351, GENIbus number 41
[10]:	Terminal No 10

For further information on the connection of various digital inputs, see the wiring diagram supplied with the control cabinet.

Setting range

Note ***DI1 (CU 352) cannot be changed.***

Setting via control panel

- Settings > Secondary functions > Stop function > Digital inputs

9.7.27 Functions of digital inputs (4.3.7.1)

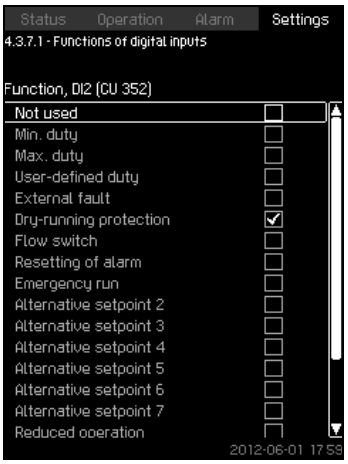


Fig. 76 Functions of digital inputs

Description

A function can be related to the digital inputs.

Setting range

It is possible to select one function in each display:

Function	Contact activated
Not used	
Min. duty	= Operating mode "Min."
Max. duty	= Operating mode "Max."
User-defined duty	= Operating mode "User-defined"
External fault	= External fault
Dry-running protection	= Water shortage
Flow switch	= Flow
Resetting of alarm	= Alarms are reset
Emergency run	= Operating mode "Emergency run"
Fault, pilot pump	= Fault
Alternative setpoint 2 - 7	= The setpoint is selected
Reduced operation	= Activation of "Reduced operation"
Stop pump 1 - 6	= Forces the pump to stop
Stop pilot pump	
Stop backup pump	

Note ***Only pumps defined in the system can be selected in the display.***

See the relevant sections for further information about the functions.

Generally, a closed contact activates the function selected.

Setting via control panel

- Settings > Secondary functions > Stop function > Digital inputs.

Factory setting

Digital input	Function
DI1 (CU 352) [10]	External start/stop. Open contact = stop. **Note:** Input No 1 cannot be changed.
DI2 (CU 352) [12]	Monitoring of water shortage (dry-running protection). Open contact = water shortage (if the system is supplied with this option).

Note ***Monitoring of water shortage requires a pressure or level switch connected to the system.***

9.7.28 Analog inputs (4.3.8)

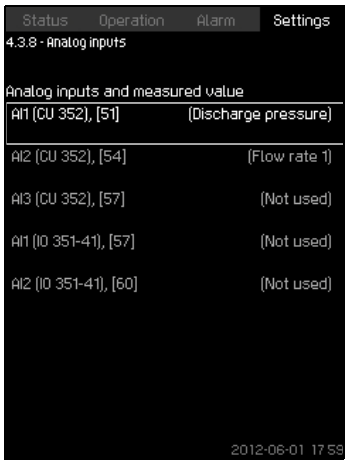


Fig. 77 Analog inputs

Description

Each analog input can be activated and related to a certain function.

As standard, the system has three analog inputs. If the system incorporates an IO 351B module (option), the number of analog inputs is 5.

All analog inputs are shown so that their physical position in the system can be identified. A redundant primary sensor can be fitted as backup for the primary sensor in order to increase reliability and prevent stop of operation.

Note ***If two sensors are to be redundant, each must have a separate analog input.***

Example

AI1 (CU 352) [51]:

AI1:	Analog input No 1
(CU 352):	CU 352
[51]:	Terminal No 51

Setting via control panel

- Settings > Secondary functions > Stop function > Analog inputs

9.7.29 Analog inputs (4.3.8.1 to 4.3.8.7)

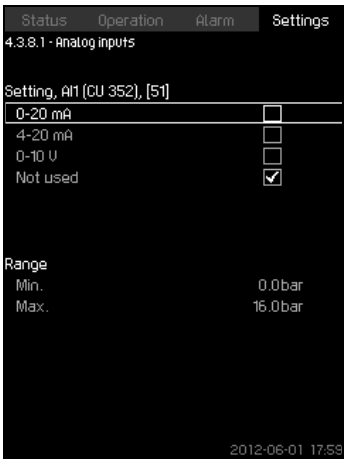


Fig. 78 Analog inputs

Description

Analog inputs can be set. Each display is divided into three parts:

- Setting of input signal, for instance 4-20 mA
- Measured input value, for instance discharge pressure
- Measuring range of the sensor/signal transmitter, for instance 0-16 bar

Setting range

It is possible to set the following parameters in each display:

- Not used
- Range of input signal, 0-20 mA, 4-20 mA, 0-10 V
- Measured input value
- Sensor range

Setting via control panel

- Settings > Secondary functions > Stop function > Analog inputs.

Note ***If an analog input is deactivated, the display will only show the top part, i.e. the setting of the analog input.***
If the input is activated, the middle part, "Measured input value," will be shown.
This makes it possible to relate a function to the analog input in another display. When the analog input has been related to a function, the CU 352 will return to the display for setting of analog inputs.

Factory setting

Analog input	Function
AI1 (CU 352) [51]	Discharge pressure

9.7.30 Analog inputs and measured value (4.3.8.1.1 - 4.3.8.7.1)

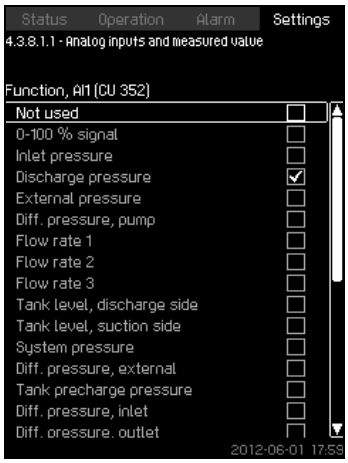


Fig. 79 Analog inputs and measured value

Description

A function can be related to the individual analog inputs.

Setting range

It is possible to select one function per analog input.

- Not used
- 0 - 100% signal
- Inlet pressure
- Discharge pressure
- External pressure
- Diff. pressure, pump
- Flow rate 1 - 3
- Tank level, discharge side
- Tank level, suction side
- System pressure
- Diff. pressure, external
- Tank precharge pressure
- Diff. pressure, inlet
- Diff. pressure, outlet
- Return-pipe temp., external
- Flow-pipe temperature
- Return-pipe temperature
- Differential temperature
- Ambient temperature
- Power, pump 1 - 6
- Power, VFD

Setting via control panel

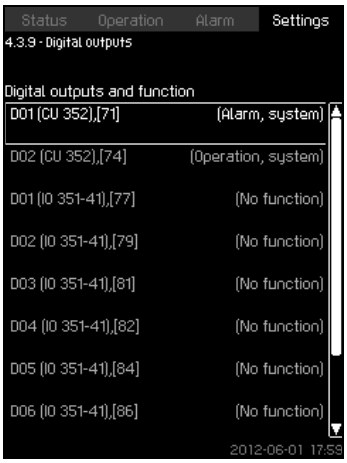
Note

If more flow rates are used, the flow rate measured and shown will be the sum of defined flow rates.

- Settings > Secondary functions > Stop function > Analog inputs

1. Select analog input
2. Select: Measured input value
   Display 4.3.8.1.1 appears.
3. Select input.
4. ↩.
5. Set the minimum and maximum sensor value.

9.7.31 Digital outputs (4.3.9)



TM03 2333 4607

Fig. 80 Digital outputs

Description

Each digital output can be activated and related to a certain function.

As standard, the system has two digital outputs.

If the system incorporates an IO 351B module (option), the number of digital outputs is 9.

All digital outputs are shown so that their physical position in the system can be identified.

Example

DO1 (IO 351-41) [71]:

DO1	Digital output No 1
(IO 351-41)	IO 351B, GENIbus number 41
[71]	Terminal No 71

For further information on the connection of various digital outputs, see the wiring diagram supplied with the CU 352.

9.7.32 Function of digital outputs (4.3.9.1 - 4.3.9.16)

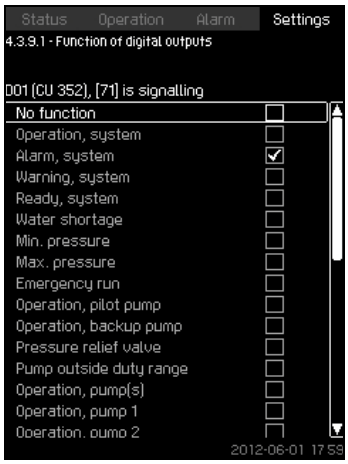


Fig. 81 Function of digital outputs

Description

A function can be related to the individual outputs.

Setting range

It is possible to select one function in each display:

- No function
- Operation, system
- Alarm, system
- Warning, system
- Ready, system
- Water shortage
- Min. pressure
- Max. pressure
- Emergency run
- Operation, pilot pump
- Operation, backup pump
- Pressure relief valve
- Pump outside duty range
- Operation, pump(s)
- Operation, pump 1 - 6
- Alarm, pump 1
- Alarm, limit 1 exceeded
- Warning, limit 1 exceeded
- Alarm, limit 2 exceeded
- Warning, limit 2 exceeded
- Reduced operation

Setting via control panel

- Settings > Secondary functions > Stop function > Digital outputs

Factory setting

Digital output	Function
DO1 (CU 352) [71]	Alarm, system
DO2 (CU 352) [74]	Operation, system

9.7.33 Analog outputs (4.3.10)

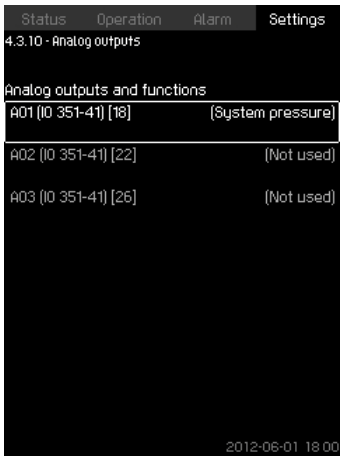


Fig. 82 Analog outputs

Note ***This display will only appear if an IO 351B module is installed.***

Description

The CU 352 does not have analog outputs as standard, but the system can be fitted with an IO 351B module with three analog outputs.

Setting via control panel

- Settings > Secondary functions > Stop function > Analog outputs

9.7.34 Output signal (4.3.10.1 - 4.3.10.3)

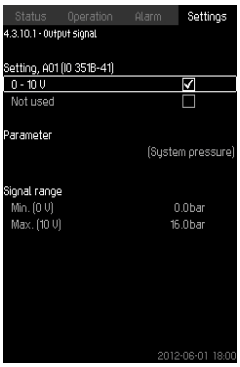


Fig. 83 Output signal

Description

You can select the parameters below.

Setting range

- 0 - 100% signal
- Inlet pressure
- Discharge pressure
- External pressure
- Diff. pressure, pump
- Tank level, discharge side
- Tank level, suction side
- System pressure
- Diff. pressure, external
- Tank precharge pressure
- Diff. pressure, inlet
- Diff. pressure, outlet
- Return-pipe temp., external
- Flow-pipe temperature
- Return-pipe temperature
- Differential temperature
- Ambient temperature
- Differential pressure 2 - 3
- System power
- Power, pump 1 - 6
- Power, pilot pump
- Power, backup pump
- Power, VFD
- Speed, pump 1 - 6
- Current, pump 1 - 6
- Current, pilot pump
- Current, backup pump

Setting via control panel

- Settings > Secondary functions > Stop function > Analog outputs

1. Select analog output and range
2. Select: Parameter
   Display 4.3.10.2 appears
3. Select output
4. ⮌.
5. Set: Signal range

9.7.35 Min., max. and user-defined duty (4.3.14)

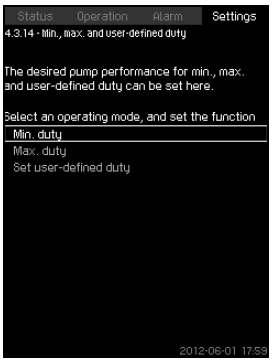


Fig. 84 Min., max. and user-defined duty

Description

This function makes it possible to let the pumps run in open loop at a set performance.

Setting range

The CU 352 makes it possible to change between three operating modes:

1. Min. duty (4.3.14.1)
2. Max. duty (4.3.14.2)
3. User-defined duty (4.3.14.3)

Note

For each of these operating modes, the number of operating pumps and the pump performance (speed) can be set.

9.7.36 Min. duty (4.3.14.1)

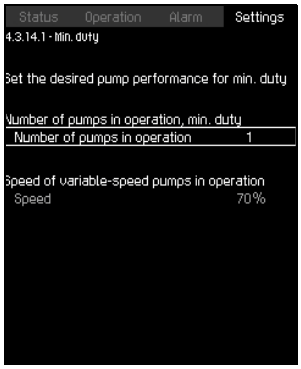


Fig. 85 Min. duty

Description

In all systems, apart from MPC-S systems, minimum duty is only possible for variable-speed pumps. In MPC-S systems, only the number of pumps running at 100 % speed can be set.

Setting range

- Number of pumps in operation.
- Speed as percentage (25 to 100 %) for variable-speed pumps.

Setting via control panel

- Settings > Secondary functions > Stop function > Min., max. and user-defined duty > Min. duty

Select and set:

- Number of pumps in operation, min. duty
- Speed

Factory setting

Number of pumps in operation during min. duty:	1
Speed as percentage for variable-speed pumps:	70

9.7.37 Max. duty (4.3.14.2)

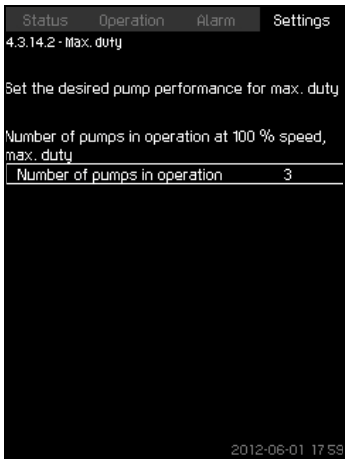


Fig. 86 Max. duty

Description

The function makes it possible for a set number of pumps to run at maximum performance when the function is enabled.

Setting range

You can set the number of pumps to run in the operating mode "Max." All pumps run at 100% speed.

Setting via control panel

- Settings > Secondary functions > Stop function > Min., max. and user-defined duty > Max. duty

Select and set: Number of pumps in operation at 100% speed, max. duty.

Factory setting

Number of pumps in operation during max. duty:	All pumps (except standby pumps)

9.7.38 User-defined duty (4.3.14.3)

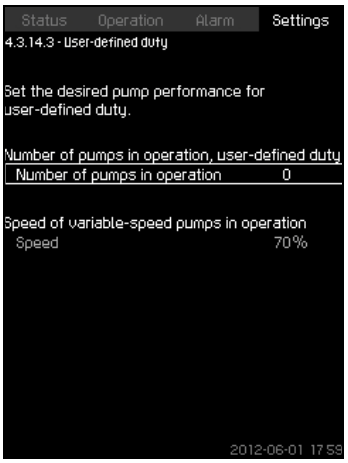


Fig. 87 User-defined duty

Description

You can set a user-defined performance, typically a performance between min. and max. duty.

The function makes it possible to set a pump performance by selecting the number of pumps to run and the speed of variable-speed pumps.

This function primarily selects the variable-speed pumps. If the number of selected pumps exceeds the number of variable-speed pumps, fixed speed pumps are started too.

Setting range

- Number of pumps in operation.
- Speed as percentage for variable-speed pumps.
  Note: In systems with only variable-speed pumps, the speed can be set between 25 and 100%; in systems with both variable-speed pumps and fixed speed pumps the speed can be set between 70 and 100%.

Setting via control panel

- Settings > Secondary functions > Stop function > Min., max. and user-defined duty > User-defined duty

Select and set:

- Number of pumps in operation, user-defined duty
- Speed

Factory setting

The function is disabled as the following has been set:

Number of pumps in operation during user-defined duty:	0

9.7.39 Pump curve data (4.3.19)

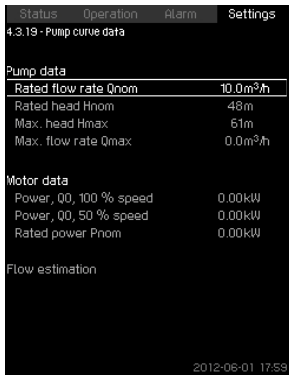


Fig. 88 Pump curve data

Description

The CU 352 has a number of functions using pump data information:

- Rated flow rate Qnom [gpm]
- Rated head Hnom [ft]
- Max. head Hmax [ft]
- Max. flow rate Qmax [gpm]
- Power, Q0, 100% speed [kW]
- Power Q0, 50% speed [kW]
- Rated power Pnom [kW]

Note

Grundfos can supply hydraulic data for CR and CRE pumps where GSC files can be downloaded to the CU 352.

All other pump types require manual entering of hydraulic pump data.

Note

The electrical data, "Power, Q0, 100% speed" and "Power, Q0, 50% speed" must be entered manually for all pump types, including CR and CRE.

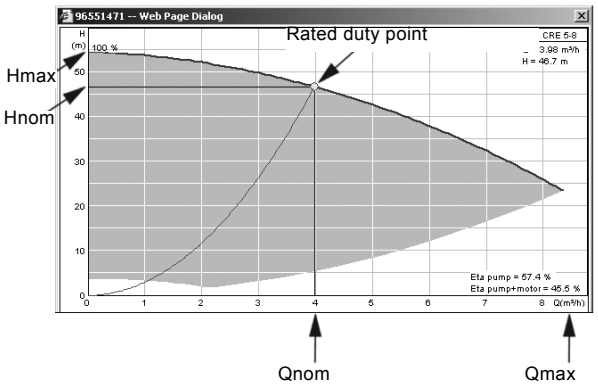
For Grundfos E-pumps, the data of input power (P1) must be entered.

The data are read by means of the pump performance curves which can be found in WebCAPS on Grundfos' homepage, www.grundfos.com. See the examples in fig. 89 to 92.

If WebCAPS is not accessible, try to bring a pump into the three duty points:

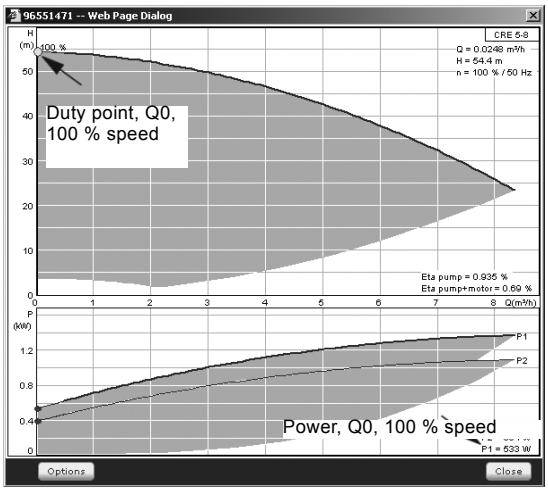
- Power, Q0, 100% speed
- Power, Q0, 50% speed
- Rated power Pnom

Read the power values in displays 1.3 to 1.8, depending on the pump. See section *9.4.10 Pumps 1 - 6, Pilot pump, Backup pump (1.3 - 1.10)*.



TM03 9993 4807

Fig. 89 Reading of Qnom, Hnom, Hmax & Qmax (WebCAPS)



TM03 9994 4807

Fig. 90 Reading of power, Q0, 100 % speed (WebCAPS)

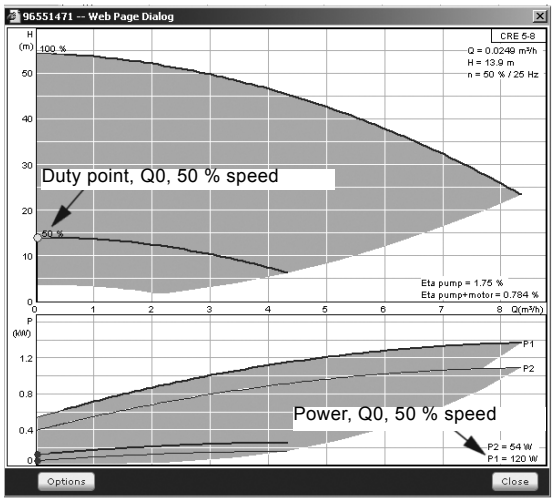


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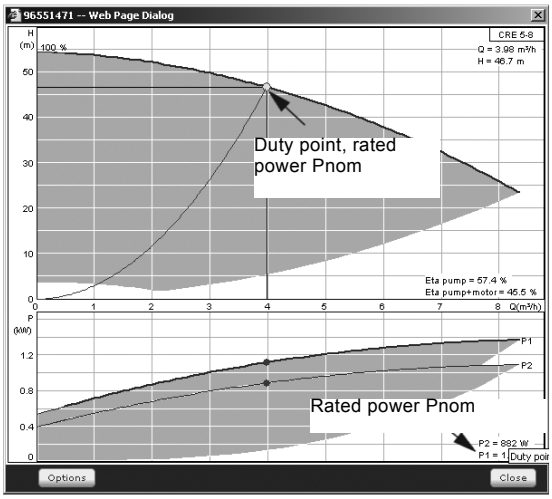
Fig. 91 Reading of power, Q0, 50 % speed (WebCAPS)



TM03 9996 4807

Fig. 92 Reading of rated power Pnom (WebCAPS)

Note

Qnom and Hnom are the rated duty point of the pumps and usually the duty point with the highest efficiency.

Setting via control panel

- Settings > Secondary functions > Stop function Settings > Secondary functions > Stop function > Pump curve data

4. Select and set:

- Rated flow rate Qnom
- Rated head Hnom
- Max. head Hmax
- Max. flow rate Qmax
- Power, Q0, 100% speed
- Power Q0, 50% speed
- Rated power Pnom

9.7.40 Control source (4.3.20)

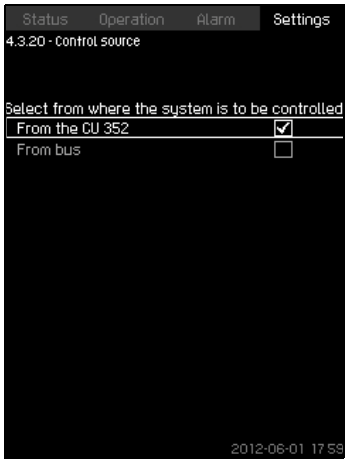


Fig. 93 Control source

Description

The system can be remote-controlled via an external bus connection (option). See section *9.8.2 GENIbus*.
For further information, see section *9.8 Data communication*.

The control source, CU 352 or the external bus connection, can be selected.

Setting via control panel

- Settings > Secondary functions > Stop function > Control source

Factory setting

The control source is the CU 352.

9.7.41 Fixed inlet pressure (4.3.22)

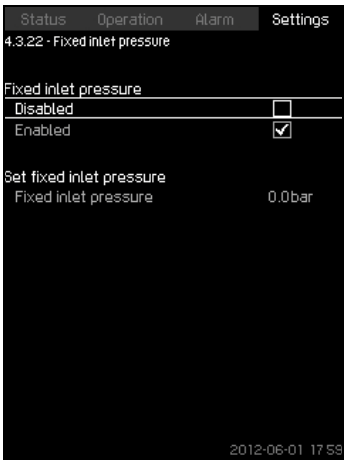


Fig. 94 Fixed inlet pressure

Description

This function is only used when no inlet-pressure sensor is fitted in the system and the inlet pressure is fixed and known.

If the booster system has a fixed inlet pressure, it can be entered in this display so that the CU 352 can optimize the performance and control of the system.

Setting range

A fixed inlet pressure can be set, and the function can be enabled/disabled.

Setting via control panel

- Settings > Secondary functions > Stop function > Fixed inlet pressure
- Select: Enabled / Disabled
- Set: Fixed inlet pressure

Factory setting

The function is disabled.

9.7.42 Flow estimation (4.3.23)

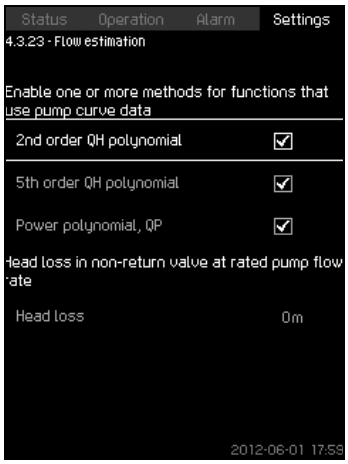


Fig. 95 Flow estimation

Description

As described in section 8.7.39 Pump curve data (4.3.19), the CU 352 can optimize operation according to performance curves and motor data. In this display, you can select the curve types which the CU 352 will use for the optimization if they are available.

At large flow rates, there may be a considerable head loss between the pump discharge flange and the pressure sensor. The loss is caused by non-return valves and pipe bends.
To improve the flow estimation of the system, it is necessary to compensate for the difference between the measured and the actual differential pressure across the pump. This is done by entering the head loss in non-return valves and pipe bends at the rated flow rate of one pump.

Setting range

- 2nd order QH polynomial
- 5th order QH polynomial
- Power polynomial, QP
- Head loss

Note

It is possible to select several curve types, as the CU 352 makes a priority based on the data available.

Setting via control panel

- Settings > Secondary functions > Stop function > Flow estimation

Factory setting

All polynomials are selected.

9.7.43 Reduced operation (4.3.24)

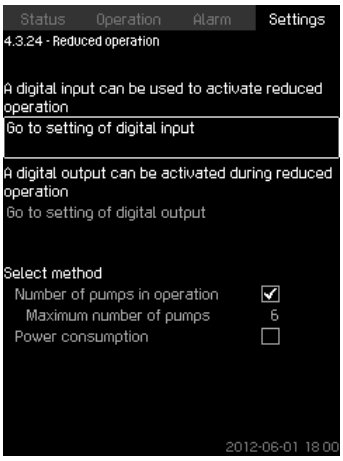


Fig. 96 Reduced operation

Description

This function makes it possible to limit the number of pumps in operation, or for MPC-E systems, to limit power consumption. The limit is activated by a digital input.

Setting range

- Setting of digital input (*9.7.26 Digital inputs (4.3.7)*)
- Setting of digital output (*9.7.31 Digital outputs (4.3.9)*)
- Maximum number of pumps in operation
- Maximum power consumption

Setting via control panel

- Settings > Secondary functions > Stop function > Reduced operation > Go to setting of digital input

1. Select digital input.
2. Select: Reduced operation
3. ↩ x 2.
4. Select: Go to setting of digital output
5. Select digital output.
6. Select: Reduced operation
7. ↩ x 2.
8. Set: Number of pumps in operation / Power consumption

Factory setting

No digital input is selected (disabled).

9.7.44 Monitoring functions (4.4)

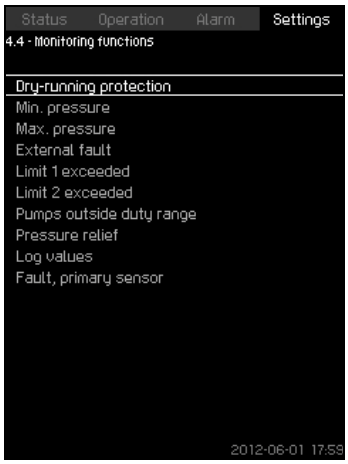


Fig. 97 Monitoring functions

Description

The system has a series of functions that constantly monitor the operation of the system.

The primary purpose of the monitoring functions is to ensure that faults do not damage pumps or the system.

Setting range

- Dry-running protection (4.4.1)
- Min. pressure (4.4.2)
- Max. pressure (4.4.3)
- External fault (4.4.4)
- Limit 1 exceeded (4.4.5 - 4.4.6)
- Pumps outside duty range (4.4.7)
- Presure relief (4.4.8)
- Log values (4.4.9)
- Fault, primary sensor (4.4.10)

Setting via control panel

- Settings > Monitoring functions

9.7.45 Dry-running protection (4.4.1)

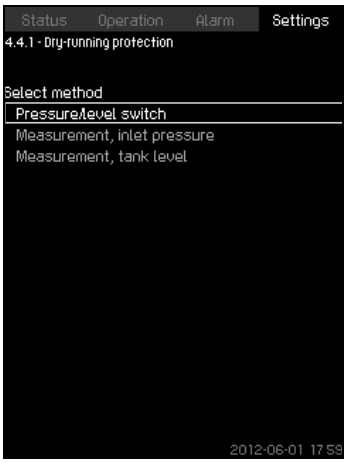


Fig. 98 Dry-running protection

Description

Dry-running protection is one of the most important monitoring functions, as bearings and shaft seal may be damaged if the pumps run dry. Grundfos thus always recommends dry-running protection.

The function is based on monitoring of the inlet pressure or the level in a possible tank or pit on the suction side.

Level switches, pressure switches or analog sensors signalling water shortage at a set level can be used.

There are three different methods for detection of water shortage:

- Pressure switch on suction manifold or float switch/electrode relay in the supply tank. See section 8.7.46 Pressure/level switch (4.4.1.1).
- Measurement of inlet pressure in the suction manifold by means of an analog pressure transmitter. See section 8.7.47 Measurement, inlet pressure (4.4.1.2).
- Measurement of level in the supply tank by means of an analog level transmitter. See section 8.7.48 Measurement, tank level (4.4.1.3).

Setting via control panel

- Settings > Monitoring functions > Dry-running protection > Select method.

9.7.46 Pressure/level switch (4.4.1.1)

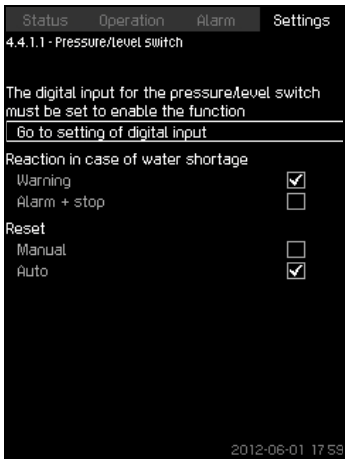


Fig. 99 Pressure/level switch

Description

This function is primarily used in booster applications.
Dry-running protection can take place by means of a pressure switch on the suction manifold or a level switch in a tank on the suction side.

When the contact is open, the CU 352 will register water shortage after a time delay of approximately five seconds. It is possible to set whether the indication is to be just a warning or an alarm stopping the pumps.

Restarting and resetting of alarms can be set to be automatic or manual.

Setting range

- Selection of digital input for the function
- Reaction in case of water shortage: Alarm + stop
- Restarting: Manual / Auto

Setting via control panel

- Settings > Monitoring functions > Dry-running protection > Pressure/level switch > Go to setting of digital input
  Display *Digital inputs (4.3.7)* appears.

1. Set the input to dry-running protection.
2. ⮌.
3. Select:

- Warning / Alarm + stop
- Manual / Auto

Factory setting

The setting is done in the start-up wizard and depends on the application.

9.7.47 Measurement, inlet pressure (4.4.1.2)

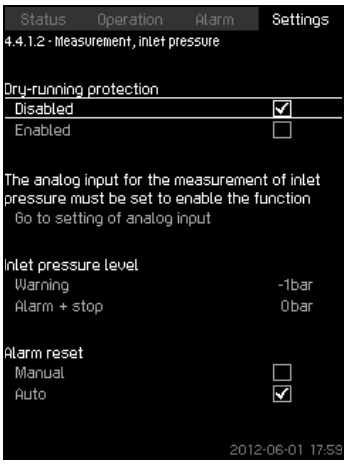


Fig. 100 Measurement, inlet pressure

Description

Dry-running protection can take place by means of a pressure transmitter measuring the inlet pressure.

It is possible to set two levels:

- Warning
- Alarm + stop

Restarting and resetting of alarms can be set to be automatic or manual.

Setting range

- Selection of analog input for the function
- Inlet pressure level for warning
- Inlet pressure level for alarm + stop
- Restarting: Auto / Manual

Setting via control panel

- Settings > Monitoring functions > Dry-running protection > Measurement, inlet pressure > Go to setting of analog input
  Display *Analog inputs (4.3.8)* appears.

1. Select: Inlet pressure
2. ⮌.
3. Select: Enabled
4. Select and set the level:

- Warning
- Alarm + stop

5. Select resetting: Auto / Manual

Note

If one of the levels is not required, the level value must be the minimum value of the inlet-pressure transmitter. This disables the function.

Factory setting

The setting is done in the start-up wizard and depends on the application.

9.7.48 Measurement, tank level (4.4.1.3)

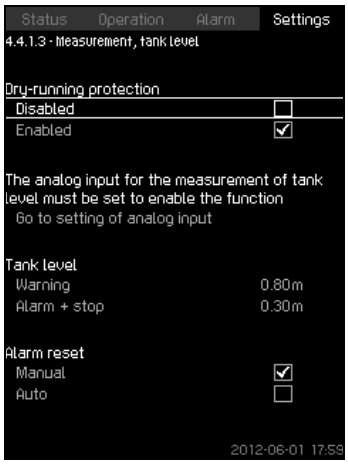


Fig. 101 Mesurement, tank level

Description

Dry-running protection can take place by means of a level transmitter measuring the level in a tank on the suction side.

It is possible to set two levels:

- Warning
- Alarm + stop

Restarting and resetting of alarms can be set to be automatic or manual.

Setting range

- Selection of analog input for the function
- Tank level for warning
- Tank level for alarm + stop
- Restarting: Manual or automatic

Setting via control panel

- Settings > Monitoring functions > Dry-running protection > Measurement, tank level > Go to setting of analog input. Display *Analog inputs (4.3.8)* appears

1. Set the input to "Tank level, suction side"
2. ⮌.
3. Select: Enabled
4. Select and set the level:

- Warning
- Alarm + stop

5. Select resetting: Auto / Manual

Factory setting

The function is disabled.

9.7.49 Min. pressure (4.4.2)

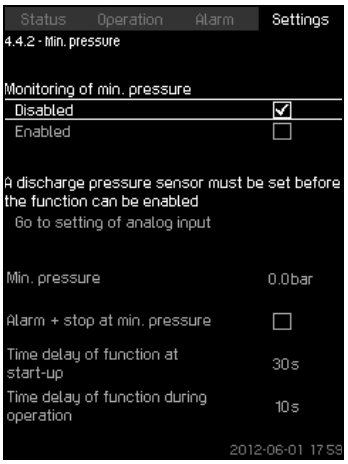


Fig. 102 Min. pressure

Description

The discharge pressure will be monitored if the application is pressure boosting. In all other applications, the system pressure will be monitored. The CU 352 will react if the pressure becomes lower than a set minimum level for an adjustable time.

The minimum pressure can be monitored if a fault indication is required in situations where the discharge pressure becomes lower than the set minimum pressure.

It is possible to set whether the indication is to be just a warning or an alarm stopping the pumps. This may be desirable if the system is used for an irrigation system where a very low discharge pressure may be due to pipe fracture and thus an extraordinarily high consumption and a very low counter-pressure. In such situations, it is desirable that the system stops and indicates alarm. This situation will require manual resetting of alarms.

It is possible to set a start-up delay ensuring that the system can build up pressure before the function is enabled. It is also possible to set a time delay, i.e. for how long time the discharge pressure may be lower than the set minimum pressure before the alarm is activated.

Setting range

- Minimum pressure level within the range of the primary sensor
- Activation of stop when the pressure falls below the minimum pressure
- Time delay of function at start-up
- Time delay of function during operation

Setting via control panel

- Settings > Monitoring functions > Min. pressure > Enabled

1. Select and set: Min. pressure
2. Select: Alarm + stop at min. pressure
3. Set:

- Time delay of function at start-up
- Time delay of function during operation

Factory setting

The function is disabled.

9.7.50 Max. pressure (4.4.3)

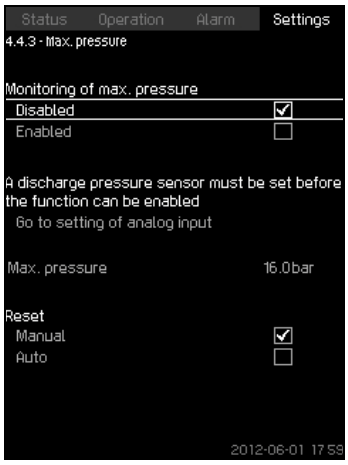


Fig. 103 Max. pressure

Description

The discharge pressure will be monitored if the application is pressure boosting. In all other applications, the system pressure will be monitored. The CU 352 will react if the pressure becomes higher than a set maximum level.

In certain installations, a too high discharge pressure may cause damage. It may therefore be necessary to stop all pumps for a short period if the pressure is too high.

It is possible to set whether the system is to restart automatically after the pressure has dropped below the maximum level, or if the system must be reset manually. Restarting will be delayed by an adjustable time. See section *9.7.13 Min. time between start/stop (4.2.1)*.

Setting range

- Maximum pressure level within the range of the primary sensor
- Manual or automatic restarting

Setting via control panel

- Settings > Monitoring functions > Max. pressure > Enabled

4. Set: Max. pressure
5. Select resetting: Auto / Manual

Factory setting

The function is disabled

9.7.51 External fault (4.4.4)

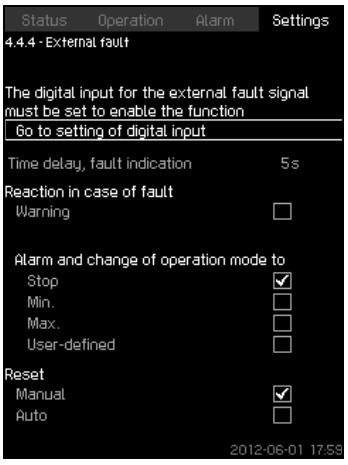


Fig. 104 External fault

Description

The function is used when the CU 352 is to be able to receive a fault signal from an external contact. In case of external fault, the CU 352 indicates warning or alarm. In case of alarm, the system changes to another manual operating mode, for instance "Stop."

Setting range

- Selection of digital input for the function
- Setting of time delay from closing of the contact until the CU 352 reacts
- Reaction in case of external fault: Warning or alarm and change of operating mode
- Restarting after alarm: Manual or automatic

Setting via control panel

- Settings > Monitoring functions > External fault > Go to setting of digital input
  Display *Digital inputs (4.3.7)* appears

6. Set the input to "External fault"
7. ↩.
8. Set: Time delay, fault indication
9. If only a warning is required in case of external fault, select "Warning"
   If the system is to give alarm and change operating mode in case of external fault, select operating mode "Manual" or "Auto"

Factory setting

The function is disabled. If the function is enabled, the following values have been set from factory:

- Time delay: 5 seconds
- Operating mode in case of alarm: Stop
- Restarting: Manual

9.7.52 Limit 1 exceeded (4.4.5 - 4.4.6)

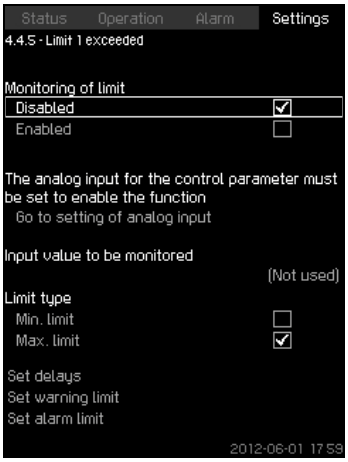


Fig. 105 Limit 1 exceeded

Description

With this function, the CU 352 can monitor set limits of analog values. It will react if the values exceed the limits. Each limit can be set as a maximum or minimum value. For each of the monitored values, a warning limit and an alarm limit must be defined.

The function makes it possible to monitor two different locations in a pump system at the same time. For instance the pressure at a consumer and the pump discharge pressure. This ensures that the discharge pressure does not reach a critical value.

If the value exceeds the warning limit, a warning is given. If the value exceeds the alarm limit, the pumps will be stopped.

A delay can be set between the detection of an exceeded limit and the activation of a warning or an alarm. A delay can also be set for resetting a warning or an alarm.

A warning can be reset automatically or manually.

It is possible to set whether the system is to restart automatically after an alarm, or if the alarm must be reset manually. Restarting can be delayed by an adjustable time. It is also possible to set a start-up delay ensuring that the system reaches a steady state before the function becomes active.

Setting range

- Selection of analog input for the function
- input value to be monitored
- limit type (min./max.)
- warning limit
- alarm limit.

Setting via control panel

Note

Analog inputs must be correctly set before the function is enabled. See section 9.7.28 Analog inputs (4.3.8).

- Settings > Monitoring functions > Limit 1 exceeded / Limit 2 exceeded > Go to setting of analog input

1. Select analog input
2. Select: Input value to be monitored
   Display 4.3.8.1.1 appears
3. Select input
4. ↩.
5. Set the minimum and maximum sensor value
6. ↩ x 2.
7. Select: Input value to be monitored
8. Select input
9. ↩.
10. Select:
- Min. limit / Max. limit
- Set delays

11. ↩.
12. Select:
- Set warning limit
- Enabled

13. Set limit
14. Select resetting: Auto / Manual
15. ↩.
16. Select:
- Set alarm limit
- Enabled

17. Set limit
18. Select resetting: Auto / Manual
19. ↩.
20. Select: Enabled

Factory setting

The function is disabled.

9.7.53 Pumps outside duty range (4.4.7)

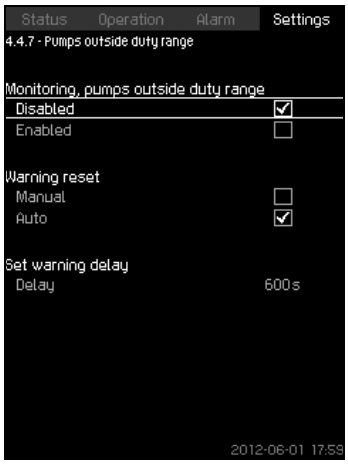


Fig. 106 Pumps outside duty range

Description

The function gives a warning if the duty point of the pumps moves outside the defined range. For instance, if the inlet pressure becomes lower than a minimum permissible value, thus causing a risk of cavitation for some pump types.

The warning is given with a set time delay. It is possible to set whether the warning is to be reset automatically or manually when the duty point comes within the defined duty range. You can also set a relay output to be activated when the warning is given, and to be deactivated when the warning is reset.

This function requires that the discharge pressure and the inlet pressure (either measured or configured) or the differential pressure of the pumps is monitored, and that CU 352 contains valid pump data from either a GSC file or from manual input. See section *9.7.39 Pump curve data (4.3.19)*.

Setting range

- Setting of manual or automatic resetting
- Setting of warning delay

Setting via control panel

- Settings > Monitoring functions > Pumps outside duty range > Manual / Auto > Set warning delay

Factory setting

The function is disabled.

9.7.54 Pressure relief (4.4.8)

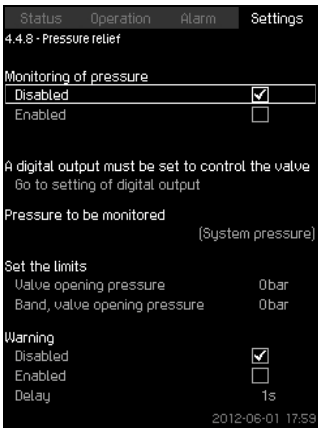


Fig. 107 Pressure relief

Description

The purpose of the function is to reduce the pressure in the pipework by opening a solenoid valve if it exceeds a set limit. If the pressure is not reduced within a given time, the solenoid valve will be closed, and a warning can be given.

1: Solenoid valve opens.
2: Solenoid valve closes.
3: Solenoid valve opens.
4: Warning is activated.
5: Solenoid valve closes, and warning is reset.

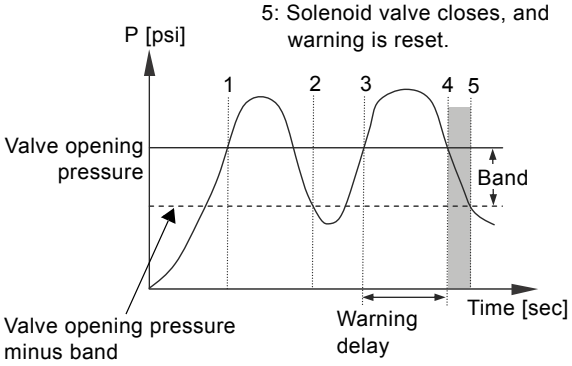


Fig. 108 Pressure relief

Setting range

- Setting of digital output
- Setting of pressure to be monitored
- Setting of valve opening pressure
- Setting of band for valve opening pressure
- Setting of warning or alarm

Setting via control panel

- Settings > Monitoring functions > Pressure relief > Go to setting of digital output

1. Select digital output
2. Select: Pressure relief
3. ↩ x 2
4. Select:

- Pressure to be monitored
- Discharge pressure, System pressure / External pressure

5. ↩.
6. Select and set:

- Valve opening pressure
- Band, valve opening pressure

7. Select: Warning > Disabled / Enabled
8. Set: Delay(Only to be set if warning has been enabled.)
9. Select: Enabled

Factory setting

The function is disabled.

9.7.55 Log values (4.4.9)

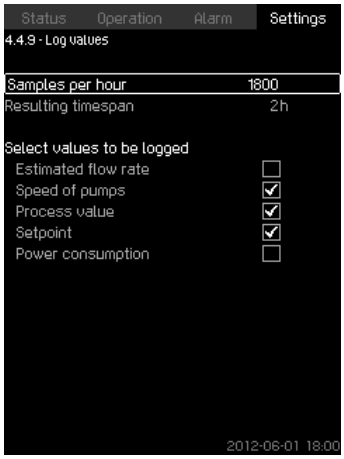


Fig. 109 Log values

Description

Select the values to be logged and the number of samples per hour. The resulting timespan will be shown. When the timespan has elapsed, old logged values will be deleted and overwritten by the new ones.

Log values

- Estimated flow rate
  (only if no flowmeter is installed)
- Speed of pumps
- Process value
- Setpoint
- Power consumption
  (MPC-E systems)
- Inlet pressure
  (if an inlet-pressure sensor is installed)

Setting range

Samples per hour: 1-3600

Setting via control panel

- Settings > Monitoring functions > Log values

1. Set: Samples per hour
2. Select the values to be logged

9.7.56 Fault, primary sensor (4.4.10)

Fig. 110 Fault, primary sensor

Description

You can set how the system is to react if the primary sensor fails.

Setting range

- Stop (without delay)
- Stop (with delay)
- Min.
- Max.
- User-defined
- Operating mode "Local"
- Emergency run
- Reset: Manual / Auto

Setting via control panel

- Settings > Monitoring functions > Fault, primary sensor

1. Select reaction in case of a fault in the primary sensor.
2. Select resetting: Auto / Manual

9.7.57 Functions, CU 352 (4.5)

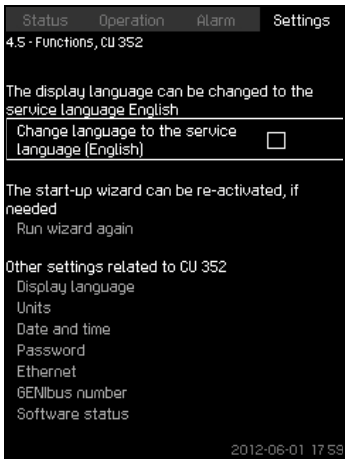


Fig. 111 Functions, CU 352

Description

Make the basic settings of the CU 352 in this submenu.

CU 352 comes with most of these settings, or they are made at start-up and normally not to be changed.

The service language, English, can be selected for service purposes. If no buttons are touched for 15 minutes, the display will return to the language selected at start-up or to the language set in Display language (4.5.1).

Note

If the service language is selected, the symbol will be shown to the right of the top line of all displays.

Setting range

- Activation of service language, English
- Re-activation of start-up wizard.
  (After start-up, the wizard is inactive.)
- Selection of display language
- Selection of display units
- Setting date and time
- Selection of password for menu "Operation" and "Settings"
- Setting of Ethernet communication.
- Setting of GENIbus number.
- Reading of software status.

9.7.58 Display language (4.5.1)

Fig. 112 Display language

Description

Here you select the language for the CU 352 display.

Setting range

- English
- German
- Danish
- Spanish
- Finnish
- French
- Greek
- Italian
- Dutch
- Polish
- Portuguese
- Russian
- Swedish
- Chinese
- Korean
- Japanese
- Czech
- Turkish
- Hungarian
- Bulgarian

Setting via control panel

- Settings > Functions, CU 352

Factory setting

The display language is English. It can be changed at start-up.

9.7.59 Units (4.5.2)

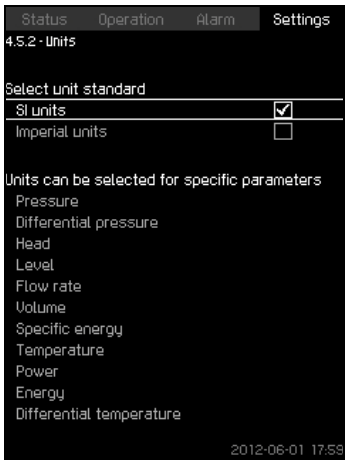


Fig. 113 Units

Description

Here you can select units for the various parameters.

Select between SI and imperial units. You can also select other units for the individual parameters.

Setting range

Parameter	Basic setting		Possible units
	SI	US	
Pressure	bar	psi	kPa, MPa, mbar, bar, m, psi
Differential pressure	m	psi	kPa, MPa, mbar, bar, m, psi
Head	m	ft	m, cm, ft, in
Level	m	ft	m, cm, ft, in
Flow rate	m^3/h	gpm	m^3/s, m^3/h, l/s, gpm, yd^3/s, yd^3/min, yd^3/h
Volume	m^3	gal	l, m^3, gal, yd^3
Specific energy	kWh/m^3	Wh/gal	kWh/m^3, Wh/gal, Wh/kgal, BTU/gal, HPh/gal
Temperature	°C	°F	K, °C, °F
Differential temperature	K	K	K
Power	kW	HP	W, kW, MW, HP
Energy	kWh	kWh	kWh, MWh, BTU, HPh

Note

If units are changed from SI to imperial or vice versa, all individually set parameters will be changed to the basic setting in question.

Setting via control panel

- Settings > Functions > CU 352 > Units

Set unit standard, measuring parameter and specific unit. See the example in fig. 114.

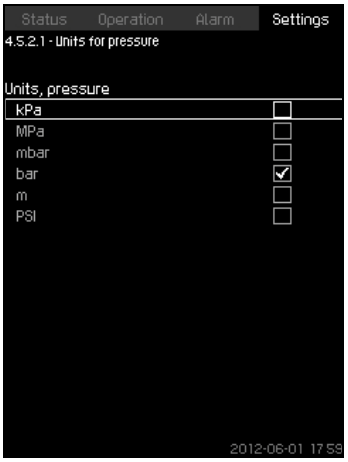


Fig. 114 Example of selection of units

Factory setting

The setting is done in the start-up wizard and depends on the application.

9.7.60 Date and time (4.5.3)

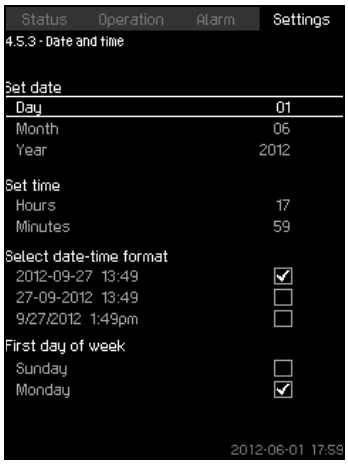


Fig. 115 Date and time

Description

You can set date and time as well as how they are to be shown in the display.

The clock has a built-in rechargeable voltage supply which can supply the clock for up to 20 days if the voltage supply to the system is interrupted.

If the clock is without voltage for more than 20 days, it must be set again.

Setting range

The date can be set as day, month and year. The time can be set as a 24-hour clock showing hours and minutes.

There are three formats.

Examples of format
2005-09-27 13:49
27-09-2005 13:49
9/27/2005 1:49pm

It is also possible to select if Sunday or Monday is to be the first day of week.

Setting via control panel

- Settings > Functions, CU 352 > Date and time

1. Select and set:
2. Day, Month, Year, Hours, Minutes
3. Select format
4. Select "Sunday" or "Monday" under "First day of week"

Factory setting

Local time.

Note

If the system has been without voltage for more than 20 days since it left the factory, the clock may have returned to the original setting: 01-01-2005 0:00.

Date and time may have been changed during the setting of the system.

There is no automatic changeover to/from daylight-saving time.

9.7.61 Password (4.5.4)

Fig. 116 Password

Description

You can limit the access to menu "Operation" and "Settings" by means of a password. If the access is limited, it is not possible to view or set any parameters in the menus.

The password must consist of four digits and may be used for both menus.

Note

If you have forgotten the password(s), contact Grundfos.

Setting via control panel

- Settings > Functions, CU 352 > Password

1. Select the password to be enabled
2. Select: Enter password
   The first digit of the password is flashing
3. Select digit
   The second digit of the password is flashing
4. Repeat these steps if it is necessary to enable the other password

Factory setting

The "Operation" menu password is deactivated and the "Settings" menu password is activated. The password factory setting is "1234".

9.7.62 Ethernet (4.5.5)

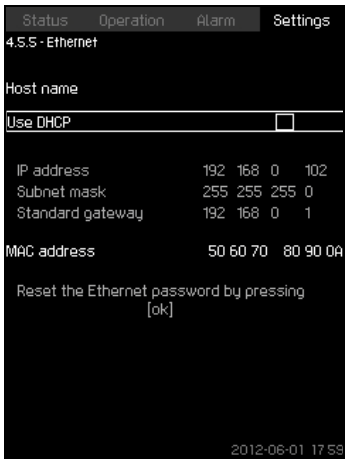


Fig. 117 Ethernet

Description

The CU 352 is equipped with an Ethernet connection for communication with a computer, either direct or via Internet. See also section *9.8.1 Ethernet*.

9.7.63 GENibus number (4.5.6)

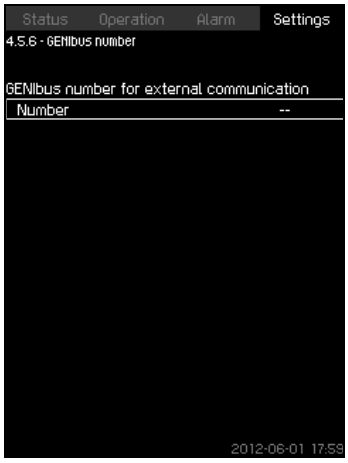


Fig. 118 GENibus number

Description

CU 352 can communicate with external units via an RS-485 interface (option). For further information, see fig. 120 and section *9.8.2 GENIbus*.

Communication is carried out according to the Grundfos bus protocol, GENIbus, and enables connection to a building management system or another external control system.

Operating parameters, such as setpoint and operating mode, can be set via the bus signal. Furthermore, status about important parameters, such as actual value and input power, and fault indications can be read from the CU 352.

Contact Grundfos for further information.

Setting range

The number can be set between 1 and 64.

Setting via control panel

- Settings > Functions, CU 352 > GENibus number

Factory setting

No number has been set.

9.7.64 Software status (4.5.9)

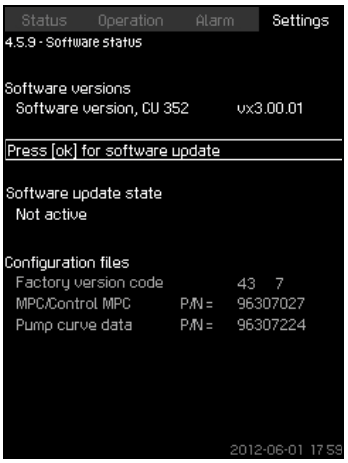


Fig. 119 Software status

Description

This display shows the status of the software installed in the CU 352. Furthermore, the version code and the product numbers of configuration files (GSC) read into the unit are shown. It is also possible to upgrade the software version. Contact Grundfos for further information.

9.8 Data communication

CU 352 is equipped with a hardware enabling communication with external units, such as a computer, via an external GENIbus or Ethernet connection.

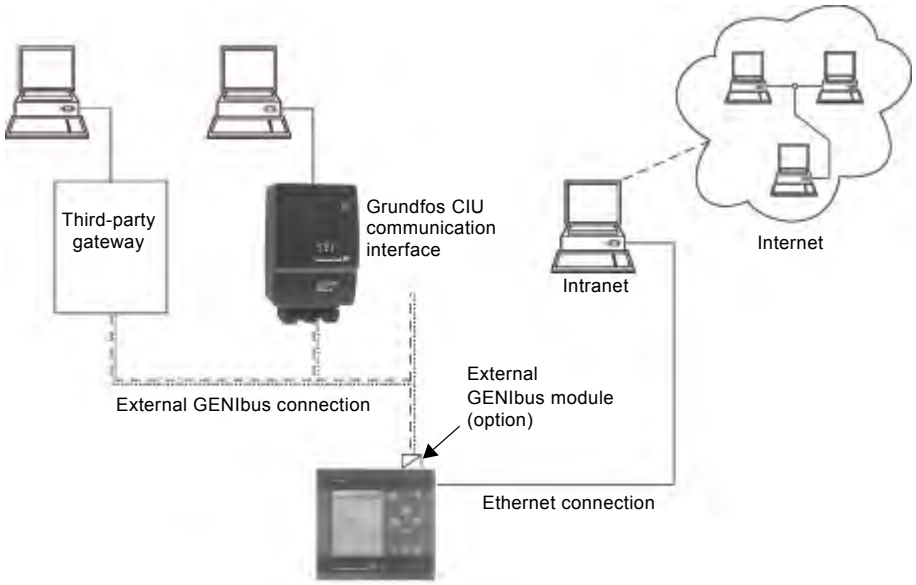


Fig. 120 Data communication via external GENIbus and Ethernet connection

9.8.1 Ethernet

Ethernet is the most widely used standard for local networks (LAN). The standardization of this technology has created some of the easiest and cheapest ways of creating communication between electric units, for instance between computers or between computers and control units.

The web server of the CU 352 makes it possible to connect a computer to the CU 352 via an Ethernet connection. The user interface can thus be exported from the CU 352 to a computer so that the CU 352 and consequently the system can be monitored and controlled externally.

Note ***Grundfos recommends that you protect the connection to the CU 352 according to your safety requirements in consultation with the system administrator.***

In order to use the web server, you must know the IP address of the CU 352. All network units must have a unique IP address to communicate with each other. The IP address of the CU 352 from factory is 192.168.0.102.

Alternatively to the factory-set IP address, it is possible to use a dynamic assignment of IP address. This is possible by activating a DHCP (Dynamic Host Configuration Protocol) in the CU 352 or via the web server. See the example in fig. 121.

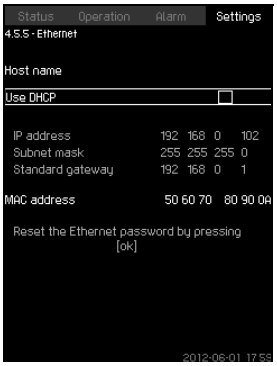


Fig. 121 Example of setting of Ethernet

Dynamic assignment of an IP address for the CU 352 requires a DHCP server in the network. The DHCP server assigns a number of IP addresses to the electric units and makes sure that two units do not receive the same IP address.

A standard Internet browser is used for connection to the web server of the CU 352.

If you want to use the factory-set IP address, no changes are required in the display. Open the Internet browser and enter the IP address of the CU 352.

If you want to use dynamic assignment, you must enable the function by selecting "Use DHCP" and clicking [ok]. A check mark shows that the function has been enabled.

Open the Internet browser and enter the host name of the CU 352 instead of the IP address. The Internet browser will now try to connect to the CU 352. The host name can be read in the display, but can only be changed by either a GSC file (configuration file) or via a web server. See *Change of network setting* on page 68.

Note ***A host name is required to use DHCP.***

This is the first display shown when connecting to the CU 352.

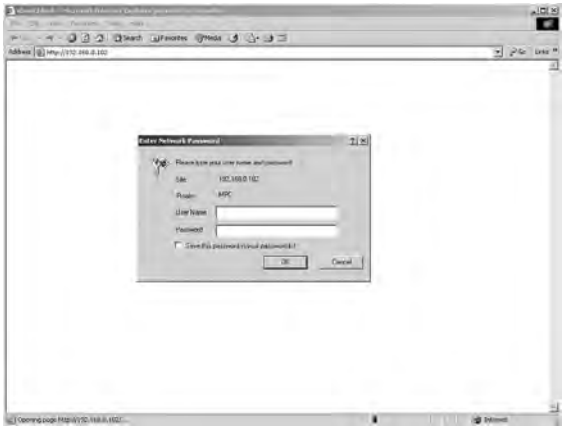


Fig. 122 Connection to CU 352

Factory setting

User name: admin
Password: admin

When you have entererd user name and password, a Java Runtime Environment application starts up in the CU 352, provided that it has been installed on the computer. If this is not the case, but the computer is connected to Internet, then use the link on the screen to download and install the Java Runtime Environment application.

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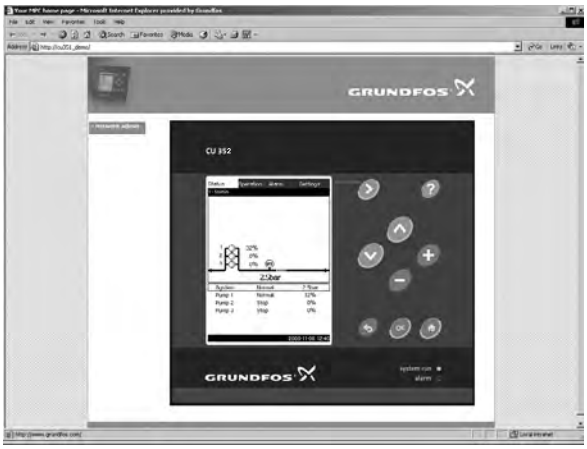
Fig. 123 Display with link to the JavaScript® application

The Java Runtime Environment application will then export the CU 352 user interface (including display and operating panel) to the computer screen. It is now possible to monitor and control the CU 352 from the computer.



TM05 3236 1012

Fig. 124 Network setting

Change of network setting

When connection to the web server of the CU 352 has been established, it is possible to change the network setting.

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Fig. 125 Change of network setting

1. Click [>Network admin].
2. Enter the changes.
3. Click [Submit] enable the changes.

Change of password

TM03 2051 3505

Fig. 126 Change of password

1. Click [Change password].
2. Enter the new password.
3. Click [Submit] save the new password.

9.8.2 GENIbus

By installing a GENIbus module in the CU 352 it is possible to connect the system to an external network. The connection can take place via a GENIbus-based network or a network based on another fieldbus protocol via a gateway. See examples in fig. 120. For further information, contact Grundfos.

The gateway may be a Grundfos CIU communication interface or a third-party gateway. For further information on the CIU, see WebCAPS, or contact Grundfos.

10. External variable frequency drive

External variable frequency drives used in Hydro MPC booster system variants -F, -EF and -EDF come with the manufacturer's factory settings. See tables below.

At start-up, the factory settings must be changed to the Grundfos settings in the tables below.

In order not to affect the functions of the CU 352 at optimum operation, only the parameters shown should be adjusted. Other parameters should be as set from factory.

10.1 *VLT FC 202

Press [EXTEND MENU] to access all parameters.

		Grundfos setting
Parameter	**Function**	**Value**
001	Language	English
002	Motor speed unit	Hz
003	Regional settings	North America
020	Display line 1.1.	Power [HP]
021	Display line 1.2	Motor voltage
022	Display line 1.3	Motor current
023	Display line 2 Large	Frequency
024	Display line 3 Large	Speed [rpm]
100	Configuration mode	Open loop
103	Torque characteristics	Variable torque
121	Motor power [HP]	Nameplate
122	Motor voltage	Nameplate
123	Motor frequency	Nameplate
124	Motor current	Nameplate
125	Motor nominal speed	Nameplate
190	Motor thermal protection	ETR trip 1
302	Minimum reference	20.000 Hz
303	Maximum reference	60.000 Hz
304	Reference function	External preset
310	Preset reference	100.00%
313	Reference site	Remote
341	Ramp 1 ramp up time	1.50 s
342	Ramp 1 ramp down time	3.00 s
412	Motor speed low limit [HZ]	0.0 Hz
414	Motor speed high limit [HZ]	62.0 Hz
419	Max. Output frequence	65.0 Hz
510	Terminal 18 digital input	Star
513	Terminal 29 digital input	Preset reference on
540.0	Function relay	Drive ready
542.0	Off delay, relay	2.00 s
610	Terminal 53 low voltage	0.00 V
611	Terminal 53 high voltage	10.00 V
614	Terminal 53 low ref. / feedb.	20.000 Hz
615	Terminal 53 high ref. / feedb.	60.000 Hz
1400	Switching pattern	60 AVM
1401	Switching frequency	5.0 kHz

Factory setting of VLT FC 200

To recall the factory settings of all parameters, follow one of the procedures below:

1. Select parameter 14-22
2. Press [OK]
3. Select "initialization" (for NLCP select "2")
4. Press [OK]
5. Disconnect the power supply
6. Reconnect the power supply
7. All parameters are now factory-set, except RFI 1, protocol, address, baud rate, minimum response delay, maximum response delay, maximum inter-char delay, operating data, historic log and fault log.

or

1. Disconnect the power supply
2. Press and hold [STATUS] + [MAIN MENU] + [OK] and reconnect the power supply
3. All parameters are now factory-set, except operating hours, the number of power-ups and overtemps and overvolts.

10.2 Configuration of E-pump(s), if any

Before the Hydro MPC system is ready for test, the E-pumps have to be set.

- Turn on the power supply to the E-pumps by means of the automatic circuit breaker.
- Set with R100 the GENibus number to the same number as that of the pump.
- (Number = 1 for pump No 1, etc.)

Note **The pumps are numbered from left to right, while facing the suction.**

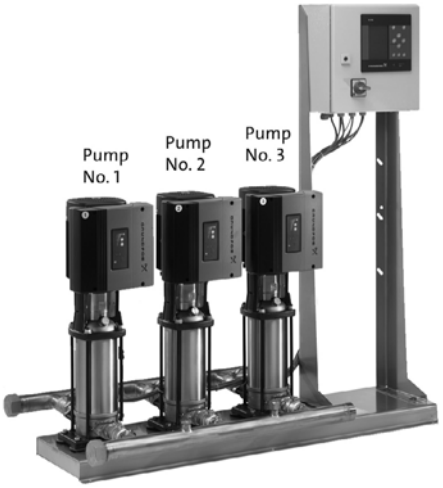

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Fig. 127 Pumps numbered from left to right.

Configuration of the CUE(s), if any

The manufacturer's factory settings of the CUE used in Control MPC must be changed to the Control MPC settings before it is ready to test.

To configure the CUE:

1. Switch off the power supply to the CUE(s) by means of the automatic circuit breaker.
2. Connect the PC Tool to the GENibus terminals of the CUE which you want to configure.
3. Turn on the power supply to the CUE.
4. Start the PC Tool E-products.
5. When communication has been established, the PC Tool "Network list" will display the icon for the CUE.
6. Select the CUE in "Network list."
7. Select the PC Tool function "Custom configuration."
8. Go to section "GENibus," and set the "Unit number" to the same number as that of the CUE. (Number = 1 for CUE No. 1, etc.)

Note: Steps 7 and 8 are not necessary for the CUE in Hydro MPC-F.

9. Go to section "General," select the "Pump Family" and enter motor data. See fig. 117.

Note **Collect the motor data from the motor nameplate.**

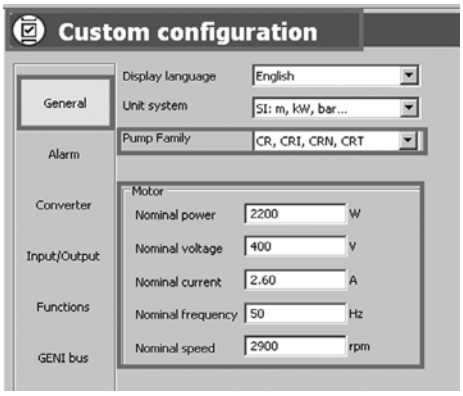

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Fig. 128 "Custom configuration" (General)

10. Select the PC Tool function "Standard configuration."
11. Go to section "Searcy by" and select "Number."
12. Type the GCS file number "97685157" in the "Configuration No." field and click "Search Now."
13. Select the file from the "Configuration files" field and click "Send."
14. Switch on the power supply to the next CUE with the main switch, and repeat steps 6 to 13 for each CUE.

Note **The bus termination dip switch on the last CUE drive should be switched to the "ON" position.**

11. Fault finding

Warning

Before starting fault finding, switch off the power supply for at least five minutes. Make sure that the power supply cannot be accidentally switched on.

Fault	Possible cause	Remedy
Pumps do not run when started.	The actual pressure is higher than or equal to the setpoint.	Wait until the pressure has dropped, or lower the pressure on the discharge side of the Hydro MPC and check that the pumps start.
	Power supply disconnected.	Connect the power supply.
	Main switch cut out.	Cut in the main switch.
	Main switch is defective.	Replace the main switch.
	Motor protection is activated.	Contact Grundfos.
	Motor is defective.	Repair or replace the motor.
	Pressure transmitter fault - Pressure transmitter is defective.	Replace the pressure transmitter. Transmitters with 0-20 mA or 4-20 mA output signals are monitored by the Hydro MPC.
	- Cable is broken or short-circuited.	Repair or replace the cable.
The pumps start, but stop immediately. The operating pressure is not reached.	Dry running or no inlet pressure.	Reestablish the supply of water to the Hydro MPC. When the inlet pressure has been reestablished, the pumps will restart after 15 seconds.
The Hydro MPC is stopped and cannot restart.	Pressure transmitter fault - Pressure transmitter is defective.	Replace the pressure transmitter. Transmitters with 0-20 mA or 4-20 mA output signals are monitored by the Hydro MPC.
	- Cable is broken or short-circuited.	Repair or replace the cable.
	CU 352 fault - Power supply disconnected.	Connect the power supply.
	- The CU 352 is defective.	Contact Grundfos.
Unstable water delivery from Hydro MPC (applies to unstable water supply).	Inlet pressure is too low.	Check the suction pipe and possible suction strainer.
	Suction pipe or pumps partly blocked by impurities.	Clean the suction pipe, strainer or pumps.
	Pumps suck air.	Check the suction pipe for leakages.
	Pressure transmitter is defective.	Replace the pressure transmitter.
Pumps are running, but deliver no water.	The valves are closed.	Open the valves.
	Suction pipe or pumps blocked by impurities.	Clean the suction pipe or pumps.
	Non-return valve blocked in closed position.	Clean the non-return valve. The non-return valve must move freely.
	Suction pipe leaky.	Check the suction pipe for leakages.
	Air in suction pipe or pumps.	Vent and prime the pumps. Check the suction pipe for leakages.
The Hydro MPC is unable to reach the setpoint.	Too high consumption.	Reduce consumption (if possible). Install a bigger Hydro MPC booster system.
	Too many standby pumps selected.	Reduce the number of standby pumps.
	Pipe fracture or leakage in the system.	Check the system, and repair damages, if necessary.
Leakage from the shaft seal.	Shaft seal is defective.	Replace the shaft seal.
	Height adjustment of pump shaft inaccurate.	Readjust the shaft height.
Noise.	The pumps are cavitating.	Clean the suction pipe/pumps and possibly the suction strainer.
	The pumps do not rotate freely (friction resistance) due to inaccurate height adjustment of the pump shaft.	Readjust the shaft height.
Very frequent starts and stops.	Wrong diaphragm tank precharge pressure.	Set correct precharge pressure.

12. Maintenance

Warning

Before starting work on the product, switch off the power supply.

Lock the main switch with a padlock to ensure that the power supply cannot be accidentally switched on.

12.1 CU 352

The CU 352 is maintenance-free. Keep the unit clean and dry, and protect it against direct sunlight. Ambient temperature, see section *15. Technical data*.

12.2 Pumps

Pump bearings and shaft seal are maintenance-free.

12.3 Motor bearings

Motors without lubricating nipples are maintenance-free.

Motors with lubricating nipples should be lubricated with a high-temperature lithium-based grease. See the instructions on the fan cover of Grundfos motors.

In the case of seasonal operation (motor is idle for more than six months of the year), we recommend to grease the motor when the pump is taken out of operation.

13. Frost protection

Pumps which are not being used during periods of frost should be drained to avoid damage.

Drain the pump by loosening the air vent screw in the pump head and by removing the drain plug from the base.

Warning

Make sure that the escaping hot or cold liquid does not cause injury to persons or damage to the equipment.

Do not tighten the air vent screw and fit the drain plug until the pump is to be used again.

14. Shutdown

Switch off the main switch to take the system out of operation.

Warning

The conductors in front of the main disconnect switch are still energized.

Lock the main disconnect switch with a padlock to ensure that the power supply cannot be accidentally switched on.

Take individual pumps out of operation by switching off the corresponding motor-protective circuit breaker, automatic circuit breaker or fuse.

15. Technical data

15.1 Pressure

Inlet pressure

Hydro MPC booster systems can operate with a positive inlet pressure (precharged pressure system) or with a negative inlet pressure (i.e vacuum at the inlet manifold).

We recommend to calculate the inlet pressure in these cases:

- Water is drawn through long pipes
- Water is drawn from depths
- Inlet conditions are poor

Note ***In this manual, the term "inlet pressure" is defined as the pressure/vacuum which can be measured immediately before the booster system.***

To avoid cavitation, make sure that there is a minimum inlet pressure on the suction side of the booster system. The minimum inlet pressure in bar can be calculated as follows:

$H = P_b - NPSH - H_f - H_v - H_s$

P_b = Barometric pressure in feet (33.9 feet at sea level). In closed systems, p_b indicates system pressure in feet.

H_f = Friction loss in suction piping in feet. (At the highest flow the pump will be delivering.)

H_v = Vapor pressure in feet.

NPSH = **N**et **P**ositive **S**uction **H**ead in feet. NPSH can be read from the NPSH curve at the maximum capacity at which the pump will run. (See installation and operating instructions for CR, CRI, CRN.)

H_s = Safety margin = minimum 2 feet.

If "H" is calculated as positive, the pump can operate at a suction of maximum "H" feet. If "H" is calculated as negative, an inlet pressure (psia) of minimum "H" feet is required.

Maximum inlet pressure

See the CR, CRI, CRN installation and operating instructions.

Operating pressure

As standard, the maximum operating pressure is 230 psi [16 bar].

On request, Grundfos offers Hydro MPC booster systems with a maximum operating pressure higher than 230 psi [16 bar].

15.2 Temperature

Liquid temperature: 32 °F to +158 °F

Ambient temperature: 32 °F to +104 °F

15.3 Relative humidity

Max. relative humidity: 95%

15.4 Sound pressure

For sound pressure level, see the installation and operating instructions for the CR pumps.

The sound pressure level for a number of pumps can be calculated as follows:

$L_{max.} = L_{pump} + (n - 1) \times 3$

$L_{max.}$ = Maximum sound pressure level

L_{pump} = Sound pressure level of one pump

n = Number of pumps

16. Electrical data

Supply voltage

See nameplate of the system.

Backup fuse

See the wiring diagram supplied with the system.

Digital inputs

Open-circuit voltage:	24 VDC
Closed-circuit current:	5 mA, DC
Frequency range:	0-4 Hz

Note ***All digital inputs are supplied with PELV voltage (Protective Extra-Low Voltage).***

Analog inputs

Input current and voltage:	0-20 mA 4-20 mA 0-10 V
Tolerance:	± 3.3 % of full scale
Repetitive accuracy:	± 1 % of full scale
Input resistance, current:	< 250 Ω
Input resistance, voltage, CU 352:	50 kΩ ± 10 %
Input resistance, voltage, IO 351:	> 50 kΩ ± 10 %
Supply to sensor:	24 V, maximum 50 mA, short-circuit protected

Note ***All analog inputs are supplied with PELV voltage (Protective Extra-Low Voltage).***

Digital outputs (relay outputs)

Maximum contact load:	240 VAC, 2 A
Minimum contact load:	5 VDC, 10 mA

All digital outputs are potential-free relay contacts.

Note ***Some outputs have a common C terminal. For further information, see the wiring diagram supplied with the system.***

Inputs for PTC sensor/thermal switch

For PTC sensors to DIN 44082. Thermal switches can also be connected.

Open-circuit voltage:	12 VDC ± 15 %
Closed-circuit current:	2.6 mA, DC

Note ***Inputs for PTC sensors are electrically separated from the other inputs and outputs of the system.***

17. Further product documentation

Further information about the system can be found in the following documents.

All documents are available in WebCAPS on Grundfos' homepage, www.grundfos.com.

Title	Frequency	Publication number
Product Guide		
Grundfos Hydro MPC	60 Hz	L-BPQ-PG-01
Grundfos Hydro MPC	60 Hz	L-CR-PG-001
Grundfos CUE Frequency drive *	60 Hz	L-CUE-PG-01
Installation and operating instructions		
CR, CRI, CRN	60 Hz	L-CP-TL-003
Grundfos E-pumps **	60 Hz	L-ML-PG-001
Service documentation		
Service instructions	50/60 Hz	96646712
Service kit catalogue	50/60 Hz	96488862
Other documentation		
***	-	-

* Only relevant for Hydro MPC booster systems with external frequency drive, -E (CUE), -F.

** Only relevant for Hydro MPC-E with CRE booster systems.

*** A wiring diagram is supplied with the booster system.

18. Disposal

This product or parts of it must be disposed of in an environmentally sound way:

1. Use the public or private waste collection service.
2. If this is not possible, contact the nearest Grundfos company or service workshop.

Subject to alterations.

EtherNet/IP for Grundfos boosters

CIM/CIU 500 Ethernet

Functional profile and user manual

Original functional profile and user manual

This functional profile describes Grundfos EtherNet/IP for boosters.

CONTENTS

Read this document before installing the product. Installation and operation must comply with local regulations and accepted codes of good practice.

1. General information

1.1 Hazard statements

The symbols and hazard statements below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious personal injury.

WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious personal injury.

CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate personal injury.

The hazard statements are structured in the following way:

SIGNAL WORD

Description of hazard

Consequence of ignoring the warning.

- Action to avoid the hazard.

1.2 Notes

The symbols and notes below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

Observe these instructions for explosion-proof products.

A blue or grey circle with a white graphical symbol indicates that an action must be taken.

A red or grey circle with a diagonal bar, possibly with a black graphical symbol, indicates that an action must not be taken or must be stopped.

If these instructions are not observed, it may result in malfunction or damage to the equipment.

Tips and advice that make the work easier.

2. Introduction

2.1 About this functional profile

This functional profile describes CIM/CIU 500 Ethernet for EtherNet/IP for the Grundfos booster systems mentioned below:

- Grundfos Hydro/Control MPC (CU 352)
- Grundfos Demand Driven Distribution (CU 354)
- Grundfos Hydro Multi-E model G
- Grundfos Hydro Multi-E model H and later
- Grundfos TPED model H and later, twin-head pump
- Grundfos MAGNA3 D, twin-head pump.

All Multi-E systems that are based on the MGE motor model G and earlier models are referred to as Multi-E model G.

All Multi-E systems that are based on the MGE motor model H and later models are referred to as Multi-E model H.

The data parameters for Hydro MPC and Control MPC are identical, so in the following, only Hydro MPC is mentioned. If not specifically mentioned, Hydro MPC, Hydro Multi-E model G, Hydro Multi-E model H, TPED model H and MAGNA3 D are referred to as "booster system".

2.2 EDS file

For this product, an associated Electronic Data Sheet file (Grundfos_EIP_Booster_Adapter_EDS.eds) can be downloaded from the Grundfos Product Center.

2.3 Assumptions

This functional profile assumes that the reader is familiar with commissioning and programming of EtherNet/IP devices.

2.4 Definitions and abbreviations

ARP	Address Resolution Protocol. Translates IP addresses into MAC addresses.
Auto-MDIX	Ensures that both crossover cable types and non-crossover cable types can be used.
CAT5	Ethernet cable type with four twisted pairs of wires.
CAT5e	Enhanced CAT5 cable with better performance.
CAT6	Ethernet cable compatible with CAT5 and CAT5e, with very high performance.
CIM	Communication Interface Module.
CIU	Communication Interface Unit.
Control MPC	Grundfos pump controller and booster system.
CRC	Cyclic Redundancy Check. A data error detection method.
DHCP	Dynamic Host Configuration Protocol. Used to configure network devices so that they can communicate on an IP network.
DNS	Domain Name System. Used to resolve host names to IP addresses.
Enumeration	List of values.
GENIbus	Proprietary Grundfos fieldbus standard.
GENIpro	Proprietary Grundfos fieldbus protocol.
Grundfos GO Remote	A Grundfos application designed to control Grundfos products via infrared or radio communication. Available for iOS and Android devices.
H	Head. Often used as abbreviation for water head (pressure in metres).
HTTP	Hyper Text Transfer Protocol. The protocol commonly used to navigate the world wide web.
Hydro MPC	Multipump controller. Grundfos booster system.
Hydro Multi-E	Grundfos booster system.
IANA	Internet Assigned Numbers Authority.
LED	Light-Emitting Diode.
Local mode	The booster system uses the setpoint and operating mode set on CU 352 (MPC) or with Grundfos GO Remote (Hydro Multi-E).
MAC	Media Access Control. Unique network address for a piece of hardware.
Ping	Packet InterNet Groper. A software utility that tests connectivity between two TCP/IP hosts.
Q	Often used as abbreviation for water flow rate.
Remote mode	The booster system uses the setpoint and operating mode set from the bus.
SELV	Separated or Safety Extra-Low Voltage.
SELV-E	Separated or Safety Extra-Low Voltage with earth connection.
SMTP	Simple Mail Transfer Protocol.
SNTP	Simple Network Time Protocol. Used for clock synchronisation between computer systems.
TCP/IP	Transmission Control Protocol/Internet Protocol. Protocol for Internet communication, and also used as middle-layer protocol for most Ethernet-based fieldbuses.
Transmission speed	Bits transferred per second, bit/s.
URL	Uniform Resource Locator. The address used to connect to a server.
UTC	Coordinated Universal Time. The primary time standard by which the world regulates clocks and time.

3. System description

The system diagrams give an overview for the different technologies of how to connect the CIM module or CIU unit to the Grundfos booster system that you connect to an EtherNet/IP network.

The booster system controls and monitors a number of pumps, all connected with RS-485 cables (Sub-GENIbus) or with built-in radio communication.

Note that Hydro MPC exists in two variants; one with the old CU 351 controller or one with the present CU 352 controller. They have different CIM/CIU connections as described below.

CIM solution

CIM 500 is an add-on communication module that you install into the back of CU 352 Hydro MPC or CU 354 DDD, using a 10-pin connection. In this setup, the booster system supplies power to the module. See fig. 1.

CIU solution

CIU 500 is a unit with a power supply and a CIM module. You can mount it either on a DIN rail or on a wall.

You use CIU 500 with products:

- Hydro MPC with old CU 351 controller
- Multi-E model G. See Fig. 2.

Further, you must fit CU 351 MPC with an add-on module for the external GENIbus connection to connect to the CIU unit.

3.1 EtherNet/IP, CIM 500

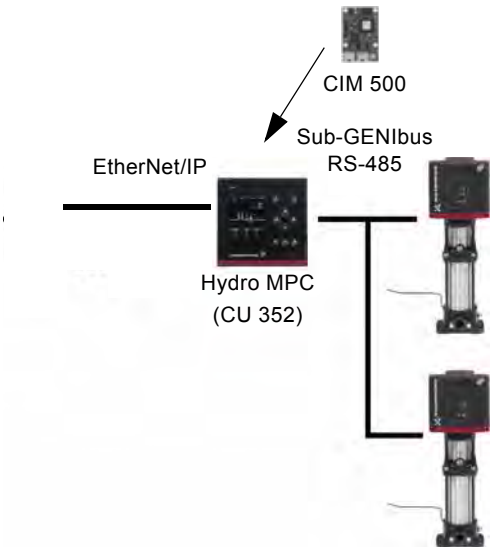

Fig. 1 Example of a CIM 500 EtherNet/IP solution. The module is installed inside the CU 352 controller, similarly to the setup for CU 354 DDD

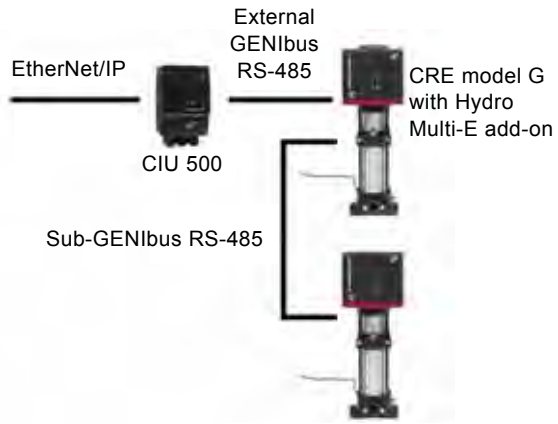

Fig. 2 Example of a CIU 500 EtherNet/IP solution for Hydro Multi-E, model G

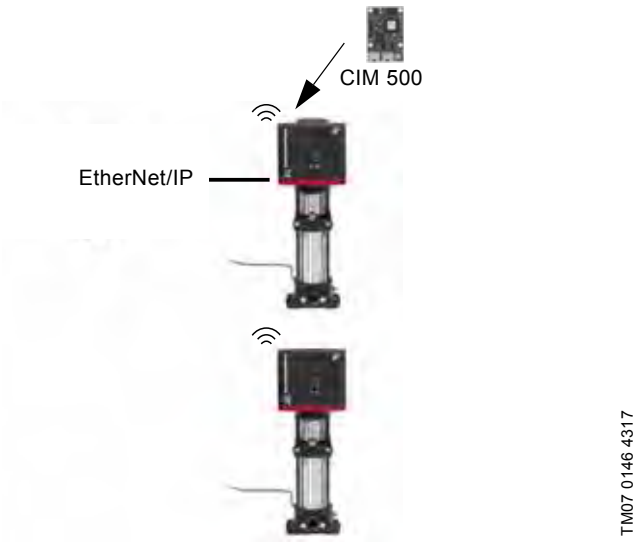

Fig. 3 Example of a CIM 500 EtherNet/IP solution for Hydro Multi-E model H and later. CIM 500 is mounted in the master pump. The other pumps in the Multi-E booster connects to the master pump via built-in radio communication (Grundfos Glowpan)

The example for Multi-E model H and later is identical for TPED model H and later and MAGNA3 D. In all cases, mount the CIM module in the master pump placed to the left.

For the purpose of redundancy, you can mount a second CIM module in pump 2 for TPED and Multi-E (not MAGNA3 D). In that case, all writings from the EtherNet/IP master must be sent to both CIM modules.

4. Specifications

4.1 CIM module

General data	Description	Comments
Ambient humidity	30-95 %	Relative, non-condensing.
Operating temperature	-20 to +45 °C	
Storage temperature	-25 to +70 °C	
GENIbus visual diagnostics	LED2	The LED will be in one of these states: Off, permanently green, flashing red, permanently red. See section *5.5 Status LEDs*.
Power supply (CIU)	24-240 V	Integrated in the unit.
GENIbus connection type (CIU)	RS-485, 3-wire + screen	Conductors: A, B and Y.
CIU box enclosure class	IP54	
CIU box dimensions (H × W × D)	182 × 108 × 82 mm	

4.2 CIM 500 Ethernet

CIM 500 Ethernet specifications	Description	Comments
Application layer	DHCP, HTTP, Ping, FTP, fieldbus protocols	
Transport layer	TCP	
Internet layer	Internet protocol V4 (IPv4)	
Link layer	ARP, Media Access Control (Ethernet)	
Ethernet cable	CAT5, CAT5e or CAT6	Supports auto cable-crossover detecting (Auto-MDIX).
Maximum cable length	100 metres at 10/100 Mbit/s	Corresponds to 328 feet.
Transmission speed	10 Mbit/s, 100 Mbit/s	Auto-detected.
Industrial Ethernet fieldbus protocols	PROFINET IO, Modbus TCP, BACnet IP, EtherNet/IP, GRM IP, Grundfos iSolutions Cloud	Selected with rotary switch. See section *5.2 Selection of Industrial Ethernet protocol*.

4.3 EtherNet/IP

EtherNet/IP specifications	Description
Minimum requested packet interval	15 ms
I/O data	505 bytes output 509 bytes input Maximum 255 bytes I/O data per assembly.
Number of IO connections	10 Default; configurable depending on available socket resources.
Number of encapsulation sessions	10 Default; configurable depending on available socket resources.
Number of explicit messaging connections	2 explicit messaging connections per encapsulation session 20 explicit messaging connections in total, configurable.
User-specific objects	Object 100. Depending on the connected product. • Grundfos pump • Grundfos booster • Grundfos dosing.
Maximum number of connections	2 explicit messaging connections × 10 encapsulation sessions Additional 10 I/O connections Total: 30 connections.
Standard objects	• Identity object (class 0x01) • Message Router object (class 0x02) • Assembly object (class 0x04). Assembly: up to 32 • Connection Manager object (class 0x06) • Device Level Ring (DLR) object (0x47) • Quality of Service (QoS) object (0x48) • TCP/IP Interface object (0xF5) • Ethernet Link object (0xF6)
DHCP	Supported
Functional scope	• Adapter • Support of 2 Ethernet Link objects for implementing ring and daisy chain topologies • Device Level Ring (DLR) protocol (announce-based ring node) • Quality of Service (QoS) • IPv4 Address Conflict Detection (ACD)
Watchdog	Communication watchdog with fixed 5 seconds time-out. It can be enabled via the CIM 500 web page.
Certificate	Plugfest December 2018, Conformance July 2019.

5. EtherNet/IP, CIM 500 setup

WARNING

Electric shock

Death or serious personal injury

- Connect CIM 500 only to SELV or SELV-E circuits.

5.1 Connecting the Ethernet cable

Use RJ45 plugs and an Ethernet cable. Connect the cable shield to protective earth at both ends.

CIM 500 is designed for flexible network installation; the built-in two-port switch makes it possible to daisy chain from product to product without the need of additional Ethernet switches. The last product in the chain is only connected to one of the Ethernet ports. Each Ethernet port has its own MAC address.

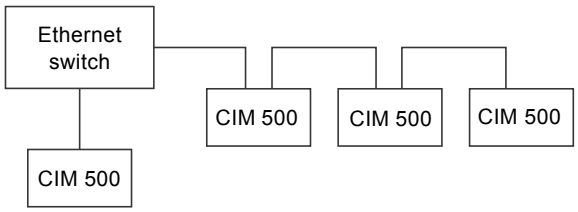

Fig. 4 Example of an Industrial Ethernet network with CIM 500

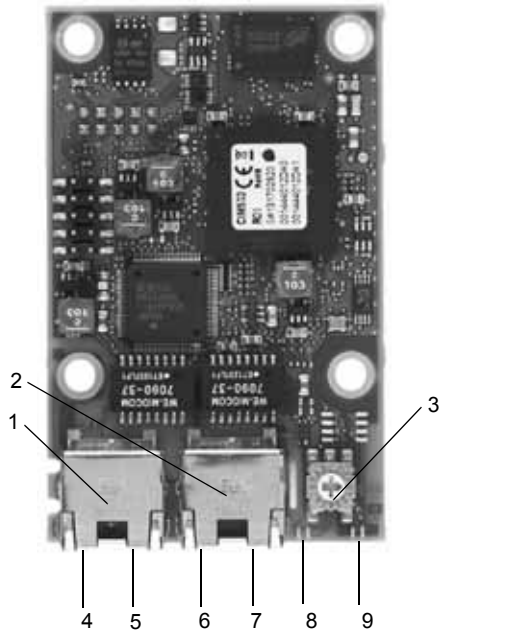

Fig. 5 CIM 500 Ethernet module

Pos.	Description	Designation
1	Industrial Ethernet RJ45 connector 1	ETH1
2	Industrial Ethernet RJ45 connector 2	ETH2
3	Rotary switch for protocol selection	SW1
4	Data activity LED for connector 1	DATA1
5	Link LED for connector 1	LINK1
6	Data activity LED for connector 2	DATA2
7	Link LED for connector 2	LINK2
8	Green and red status LED for Ethernet communication	LED1
9	Green and red status LED for internal communication between module and pump	LED2

5.2 Selection of Industrial Ethernet protocol

The module has a rotary switch for selection of the Industrial Ethernet protocol. See fig. 6.

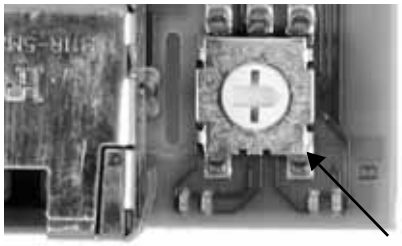

Fig. 6 Selecting the Industrial Ethernet protocol

Pos.	Description
0	PROFINET IO, default
1	Modbus TCP
2	BACnet IP
3	EtherNet/IP
4	GRM IP for Grundfos Remote Management, requires a contract with Grundfos.
5	Grundfos iSOLUTIONS Cloud (GiC)
6...E	Reserved. LED1 is permanently red to indicate an invalid configuration.
F	Resetting to factory settings. 1. Set the rotary switch to this position. 2. LED1 starts to flash red and green for 20 seconds to indicate that factory resetting is about to take place. 3. After 20 seconds, LED1 stops to flash and factory resetting is initiated. 4. When both LED1 and LED2 switch off, the resetting is completed. The rotary switch can be moved to another position.

If the rotary switch position is changed when the module is powered on, the module will restart and use the protocol associated with the new position.

5.3 Setting the IP addresses

The CIM 500 Ethernet module is by default set to a fixed IP address. It is possible to change the IP address settings from the built-in webserver.

Default IP settings used by the webserver	IP address: Subnet mask: Gateway:	192.168.1.100 255.255.255.0 192.168.1.1
IP settings for EtherNet/IP	Make the settings via the webserver	

5.4 Establishing a connection to the webserver

You can configure CIM 500 using the built-in webserver. To establish a connection from a PC to CIM 500, the following steps are required:

- Connect the PC and CIM 500 using an Ethernet cable.
- Configure the PC Ethernet port to the same subnetwork as CIM 500, for example 192.168.1.101, and the subnet mask to 255.255.255.0. See section *Webserver configuration*.
- Open a standard Internet browser, and type 192.168.1.100 in the URL field.
- Log in to the webserver using the following:

Username	admin (default)
Password	Grundfos (default)

The first time you log in, you will be asked to change the password.

The username and password may have been changed from their default values.

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Fig. 7 CIM 500 connected to a PC

You can use both ETH1 and ETH2 to establish a connection to the webserver.

You can access the webserver while the selected Industrial Ethernet protocol is active.

5.5 Status LEDs

The CIM 500 Ethernet module has two Status LEDs, LED1 and LED2. See fig. 5.

- Red and green status LED, LED1, for Ethernet communication
- Red and green status LED, LED2, for internal communication between CIM 500 and the Grundfos product.

LED1

Status	Description
Off	Ethernet Link is not active.
Permanently green	Ethernet Link is active, connection is established.
Flashing green	Ethernet Link is active, no connection is established.
Permanently red	Ethernet Link is active, IP address conflict is detected.
Flashing red	Ethernet Link is active, any connection is timed out.

LED2

Status	Description
Off	CIM 500 is switched off.
Flashing red	No internal communication between CIM 500 and the Grundfos product.
Permanently red	CIM 500 does not support the Grundfos product connected.
Permanently green	Internal communication between CIM 500 and the Grundfos product is OK.
Permanently red and green	Memory fault.

During startup, there is a delay of up to 5 seconds before LED1 and LED2 status is updated.

5.6 DATA and LINK LEDs

The CIM 500 Ethernet module has two connectivity LEDs related to each RJ45 connector. See fig. 5.

DATA1 and DATA2

These yellow LEDs indicate data traffic activity.

Status	Description
Yellow off	No data communication on the RJ45 connector.
Yellow flashing	Data communication is ongoing on the RJ45 connector.
Permanently yellow	Heavy network traffic on the RJ45 connector.

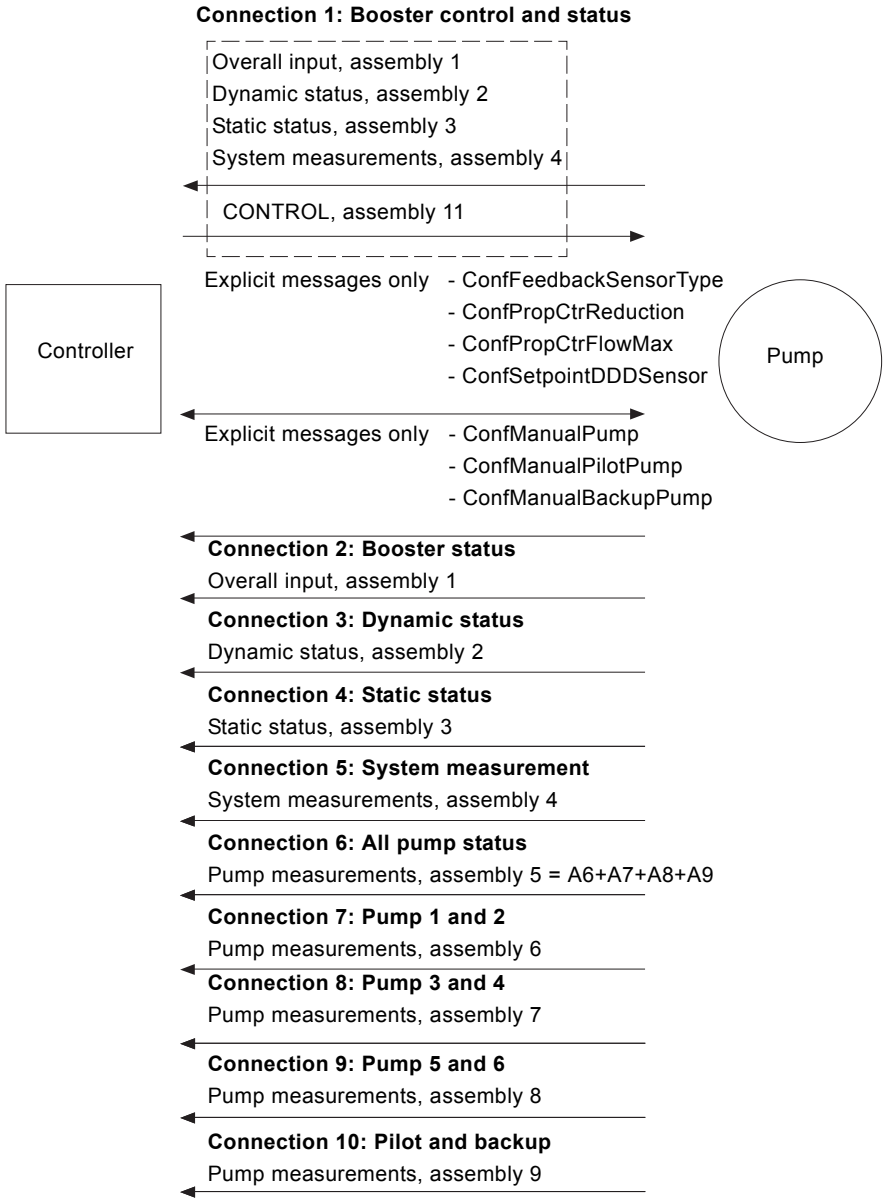
LINK1 and LINK2

These green LEDs show whether the Ethernet cable is properly connected.

Status	Description
Green off	No Ethernet Link on the RJ45 connector.
Green on	Ethernet Link on the RJ45 connector is OK.

6. Detailed description of data parameters

6.1 Connection and assembly overview



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6.2 Booster input/output assembly details

Connection No	Connection type	Connection name	Input assembly instance	Input assembly size	Output assembly instance	Output assembly size
1	Exclusive owner	Booster control and status	1	156	11	24
2	Input only	Booster status	1	156	197	0
3	Input only	Booster dynamic status	2	28	197	0
4	Input only	Booster static status	3	8	197	0
5	Input only	Booster measurements	4	120	197	0
6	Input only	Pumps status and measurements	5	192	197	0
7	Input only	Pump 1 and 2 parameters	6	48	197	0
8	Input only	Pump 3 and 4 parameters	7	48	197	0
9	Input only	Pump 5 and 6 parameters	8	48	197	0
10	Input only	Pilot and backup pump parameters	9	48	197	0

TM07 7371 3820

Fig. 8 Rockwell PLC dialogue box for manual entering of information

6.3 Control parameters, output assembly 1

The control parameters are output parameters for controlling the booster. If pump 2 in a Multi-E or TPED pump also has a CIM module mounted, for redundancy, any writings to the control module must be done for both pump heads.

To control the setpoint and operating mode of the Hydro MPC and DDD from bus, you must select the control source "From bus" on the CU 352: "Settings" > "Secondary functions" > "Control source". The control mode however can be changed from bus without making this selection.

Parameter	Name	Data type	Scaling	Range	Description	MPC, CU 352	DDD, CU 354	Multi-E model G	Multi-E/TPED model H	MAGNA3 D
1	SetRemoteLocal	SINT8, 0xC2	Bool (state)	0, 1	Setting of Remote/Local state	●	●		●	●
2	SetOnOff				Setting of On/Off state	●	●	●	●	●
3	SetCopyToLocal				Setting of Copy to local state				●	●
4	SetRelayOutput1				Setting of Relay output 1				●	
5	SetRelayOutput2				Setting of Relay output 2				●	
6	SetRelayOutput3				Setting of Relay output 3				●	
7	SetRelayOutput4				Setting of Relay output 4				●	
8	TrigResetAlarm		Bool (event)	↑ 1 (edge)	Command: Triggers alarms reset	●	●	●	●	●
9	TrigResetAccCnt			↑ 1 (edge)	Command: Triggers counter reset	●	●		●	
10	SetReserved1		Bool (state)	0, 1	Reserved for future use					
20	SetControlMode	SINT16, 0xC3	Enum	0-255	Select Control mode					
					0: Constant Speed	●			●	●
					1: Constant Frequency	●			●	●
					3: Constant Head	●	●		●	●
					4: Constant Pressure	●	●	●	●	●
					5: Constant Differential Pressure				●	
					6: Proportional Pressure	●	●		●	●
					7: Constant Flow				●	●
					8: Constant Temperature				●	●
					9: Constant Temp. Difference				●	●
					10: Constant Level				●	
					128: Auto-Adaption		●		●	●
					129: Flow Adaption				●	●
					130: Closed Loop Sensor Control				●	
21	SetOperatingMode	SINT16, 0xC3	Enum	0-255	Select Operating mode					
					0: AutoControl	●	●	●	●	●
					4: Minimum	●			●	●
					6: Maximum	●		●	●	●
30	SetSetpoint	SINT16, 0xC3	0.01 %	0 - 327.67 %	Setting of Setpoint	●	●	●	●	●
31	SetReserved2	SINT16, 0xC3	-	-	Reserved for future use					
32	SetReserved3	SINT16, 0xC3	-	-	Reserved for future use					
40	SetRTCValue	SINT32, 0xC4	Unix time	$0-(2^{31}-1)$	Setting of Real Time Clock in seconds elapsed since 01-01-1970.				●	●

6.3.1 Explanation to event trigger

Rising edge

Control bits with a rising-edge event trigger behave like a command that is executed when a bit transition from "0" to "1" occurs. Each of them has a corresponding acknowledge bit in the StatusModule which is set when the command is executed and cleared when the control bit is written back to "0".

State

Control bits with a state event trigger behave like a "state" that is forced upon the booster system. In CIU 500, the "actual state" of the booster system as read from StatusModule is continuously compared with the "requested" state in ControlModule, and CIU 500 writes the appropriate GENIbus command to the booster system to make the two states correspond to each other. Due to state restrictions or priorities, this might not always be possible, see the explanation to the bit in question.

Value change

Control parameters behave like a command that is executed when the value changes. CIM 500 attempts to make the system operate according to the requested value. The change will be reflected in a parameter value in a corresponding input module.

6.3.2 Explanation to control bits

SetRemoteLocal

Control bit for setting the booster system in remote mode, controlled from bus, or local mode, controlled from the operating panel or Grundfos GO Remote:

0:	The booster system is set to local mode and operates according to its local operating mode and setpoint. With this setting, the other control parameters will have no influence.
1:	The booster system is set to remote mode and operates according to the operating mode and setpoint written from the bus. The other control bits will also be active.

However, certain commands from other control sources, for example Stop or Max. from a local source or external Stop from a digital input, have a higher priority and overrule the control from the bus.

SetOnOff

Control bit used to start and stop the booster system:

0:	For stopping the booster system remotely.
1:	For starting the booster system remotely.

SetCopyToLocal

If this bit is set, the remote settings for the control mode, operating mode and setpoint are copied to the local settings during a remote to local transition. This bit is not supported by MPC, Multi-E model G and earlier models.

0:	Copy to local settings inactive.
1:	Copy to local settings active. Switching the booster from remote to local will thus not influence the behaviour of the booster.

- For Multi-E model H with a CIM module in the master pump only, set CopyToLocal (parameter 3) to value "1" in the master pump.
- For Multi-E model H with a CIM module in two pumps, always set CopyToLocal (parameter 3) to value "1" in both pumps. Any writings to a control parameter must be written to each pump.
- A TPED model H is essentially a Multi-E model H with two pumps. Mount a CIM module in each pump head. Always set CopyToLocal (parameter 3 to value "1" in both pump heads. Any writings to a control parameter must be written to each pump head.

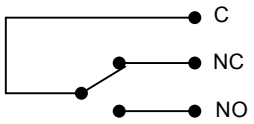
SetRelayOutput 1-4

These parameters can control the electromechanical relays in the booster if they are configured via a Grundfos PC Tool to be bus-controlled.

Only available for Multi-E and TPED pumps.

Bit	Name	Event trigger	Description
0	OutputRelay1Control	State	0: Relay inactive. 1: Relay active.
1	OutputRelay2Control	State	
2	OutputRelay3Control	State	
3	OutputRelay4Control	State	

Relay 3 and 4 are only available for Multi-E model H and later and TPED model H and later.



TM04 9679 4910

Fig. 9 Relay output shown in inactive state

TrigResetAlarm

Control bit that resets alarms and warnings during transitions from "0" to "1" (positive edge triggered).

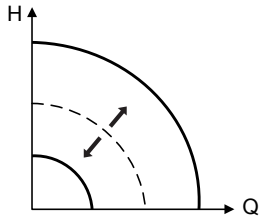
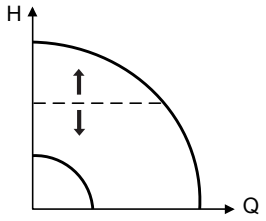
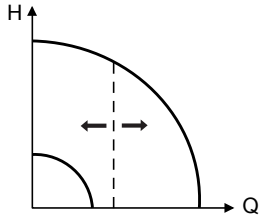
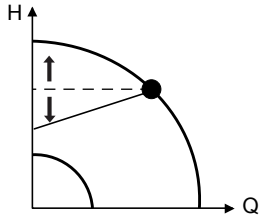
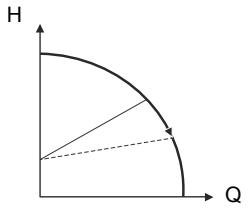
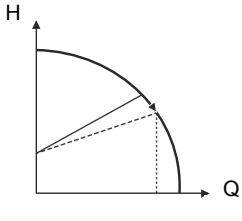
TrigResetAccCnt

Control bit used to reset operating hours and energy counter.

6.3.3 Explanation to control mode

Control enumeration for selection of the remote control mode via SetControlMode (parameter 20).

For Hydro MPC and DDD the control mode can be changed from bus without selecting "Controlled from bus" in the Settings menu.

Control modes	Description	Illustration
> ConstSpeed (0) > ConstFreq (1)	The setpoint of the booster system is a percentage of the maximum performance. No sensor is required, and in these modes the booster system is operating in open-loop control.	 TM04 2289 2208
> ConstHead (3) > ConstPressure (4) > ConstDiffPressure (5)	The setpoint of the booster system is interpreted as the setpoint for the pressure. In these modes, the booster system operates in closed-loop control and adapts its speed so that the pressure is constant, regardless of the flow. A pressure sensor is required.	 TM04 2290 2208
> ConstFlow (7) > ConstTemp (8) > ConstTemDiff (9) > ConstLev (10)	The setpoint of the booster system is interpreted as the setpoint for the flow, temperature or level. ConstFlow is indicated in the figure. In these modes, the booster system operates in closed-loop control, and a relevant sensor is required: • a temperature sensor for temperature control • a level sensor for level control • a flow sensor for flow control.	 TM04 2288 2208
> PropPress (6)	The setpoint of the booster system is interpreted as a proportional-pressure setpoint as shown in the figure. This is a closed-loop control mode, and a pressure sensor is required.	 TM04 2291 2208
> AUTO$_{ADAPT}$ (128)	In this control mode, the setpoint curve is a proportional-pressure curve where the setpoint has been set from factory. The AUTO$_{ADAPT}$ algorithm in the pump will over time optimise the setpoint value according to the pipe characteristics of the system. The setpoint curve will always be adjusted in a downward direction. A pressure sensor is required for all system types, except MAGNA3 D.	 TM05 3241 1012
> FLOW$_{ADAPT}$ (129)	This control mode works similar to AUTO$_{ADAPT}$, except that the flow-limiting function, FLOW$_{LIMIT}$, is always active and limits the flow to the value of SetMaxFlowLimit (parameter 50). A pressure sensor is required for all system types, except MAGNA3 D.	 TM05 3242 1012
> ClosedLoopSensor (130)	This is a general purpose closed-loop control mode that you can use in cases where the system is used for a type of control not covered by one of the other control modes.	

H: Pressure (head)

Q: Flow

Important:

When using CIM 500 or CIU 500 with Hydro MPC, the following limitations in the setup of the primary sensor apply:

- Only sensor 1 (AI1) can be used as primary sensor.
- The primary sensor must have a minimum value of 0 for the SetSetpoint and SystemFeedback scaling to be correct.

6.3.4 Explanation to operating mode

Control enumeration for selection of the remote operating mode.

0:	AutoControl This is the normal mode. The booster system is controlled according to the selected control mode and setpoint. See section *6.3.3 Explanation to control mode*.
4:	Minimum The booster system operates at a fixed minimum performance. Not supported by Hydro Multi-E model G and DDD.
6:	Maximum The booster system operates at a fixed maximum performance. Not supported by DDD.

6.3.5 Setpoint in closed-loop control

Hydro MPC, DDD and Multi-E model G

The setpoint is written to SetSetpoint (parameter 30) as a percentage value scaled in 0.01 % of the sensor maximum value, FeedbackSensorMax (parameter 110). The sensor minimum value is always 0. The selected setpoint is reflected in UserSetpoint (parameter 300) with the same scaling.

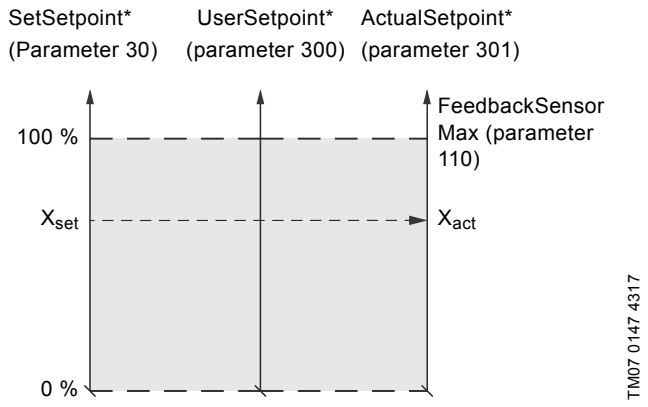
The actual setpoint, whether it has been set via Grundfos GO Remote, the pump display, the pump buttons or the fieldbus, can be read from ActualSetpoint (parameter 301). It is a percentage value scaled in 0.01 % of FeedbackSensorMax (parameter 110).

Generally, the actual setpoint value represents head, pressure, flow, temperature and so on, depending on what the feedback sensor has been set to measure. The unit of measure can be read from FeedbackSensorUnit (parameter 108).

Unless a setpoint influencing function, like proportional influence, is active, ActualSetpoint equals UserSetpoint.

It is possible to calculate back and forth between the setpoint in percentage and its scaled value:

X_{act}[unit] =
X_{set}[%] × FeedbackSensorMax × FeedbackSensorUnit



* Percentage of sensor maximum.

Fig. 10 Setpoint in closed-loop control for Hydro MPC, DDD and Multi-E model G

TPED, MAGNA3 D, Multi-E model H

The setpoint is written to SetSetpoint (Parameter 30) as a percentage value scaled in 0.01 % of the setpoint range [r_{min}; r_{max}]. The selected setpoint is reflected in UserSetpoint (parameter 300) with the same scaling.

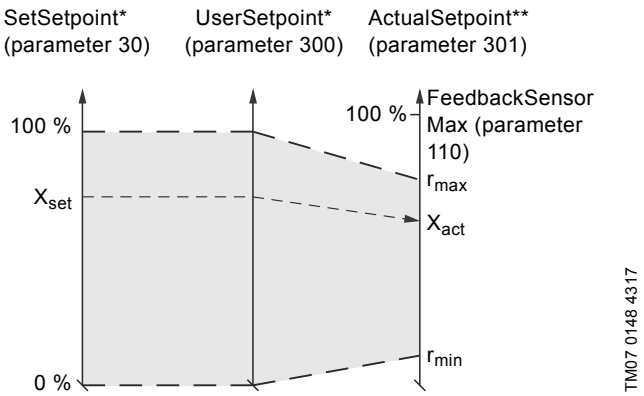
The actual setpoint, whether it has been set via Grundfos GO Remote, the pump display, the pump buttons or the fieldbus, can be read from ActualSetpoint (parameter 301). It is a percentage value scaled in 0.01 % of FeedbackSensorMax (parameter 110).

Generally, the actual setpoint value represents head, pressure, flow, temperature and so on, depending on what the feedback sensor has been set to measure. The unit of measure can be read from FeedbackSensorUnit (parameter 108).

It is possible to calculate back and forth between ActualSetpoint in percentage and its scaled value:

X_{act}[unit] =
X_{act}[%] × FeedbackSensorMax × FeedbackSensorUnit

The setpoint range limits r_{min} and r_{max} cannot be read from the fieldbus, but can be found in the pump data sheet or can be seen in the Grundfos GO Remote "Setpoint" menu.



* Percentage of setpoint range.

** Percentage of sensor maximum.

Fig. 11 Setpoint in closed-loop control for TPED, MAGNA3 D and Multi-E model H

6.4 Illustration of closed-loop control

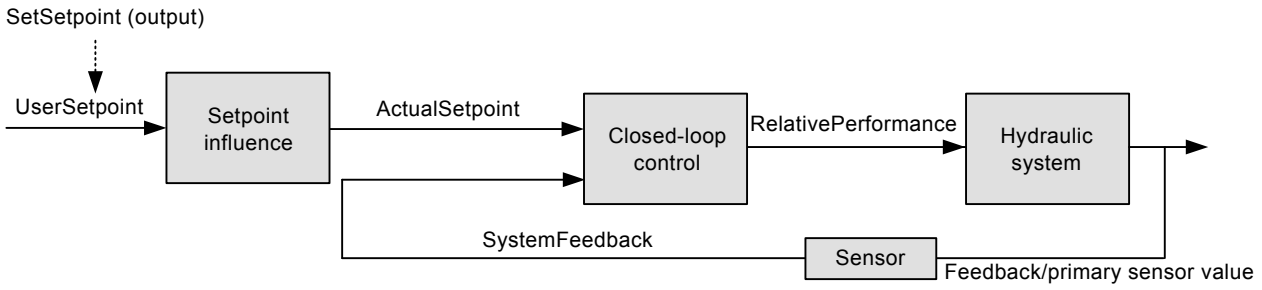


Fig. 12 Illustration of closed-loop control

The system feedback scaled according to SystemFeedbackUnit can be calculated from this formula:

Feedback (scaled) = SystemFeedback × (FeedbackSensorMax - FeedbackSensorMin) / 100 % + FeedbackSensorMin

See also section *6.3 Control parameters, output assembly 1*.

SystemFeedback

In closed-loop control, this is the value of the controlled process variable (feedback/primary sensor). SystemFeedback (parameter 302) can always be compared directly with the ActualSetpoint (parameter 301) variable. If no setpoint influence is active, it can also be compared with SetSetpoint parameter.

In open-loop control, SetSetpoint is mapped to SystemFeedback. The value of the feedback sensor can always be read in the corresponding measurement parameter.

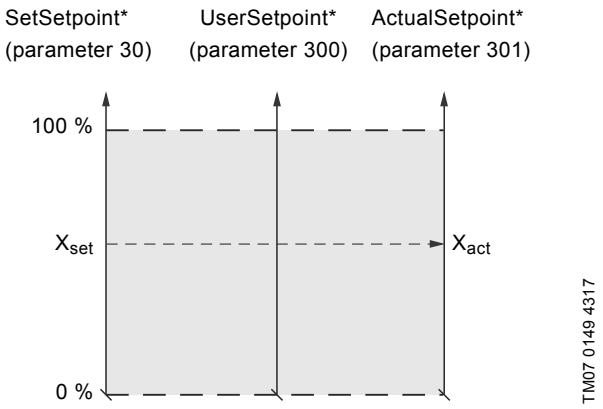
See section *6.9 Booster system measured parameters, input assembly 4*.

6.4.1 Setpoint in open-loop control

Hydro MPC, DDD and Multi-E model G

The setpoint is written to SetSetpoint (parameter 30) as a percentage value scaled in 0.01 % of the maximum performance. The selected setpoint is reflected in UserSetpoint (parameter 300) with the same scaling.

The actual setpoint, whether it has been set via Grundfos GO Remote, the pump or controller display or buttons, or the fieldbus, can be read from ActualSetpoint (parameter 301), and it reflects whatever limitations, for example power or frequency limits, that might be active in the system. It equals the value that the booster system actually uses.



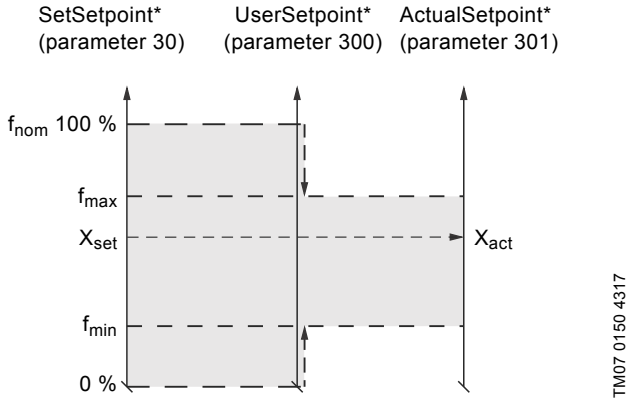
* Percentage of system performance.

Fig. 13 Setpoint in open-loop control for Hydro MPC, DDD and Multi-E model G

TPED, MAGNA3 D and Multi-E model H

The setpoint is written to SetSetpoint (parameter 30) as a percentage value scaled in 0.01 % of the nominal pump frequency f_{nom}. The selected setpoint is reflected in UserSetpoint (parameter 300) with the same scaling. From the fieldbus, it gets whatever value written to SetSetpoint, but from the display and Grundfos GO Remote, it is truncated to the internal pump frequency limits [f_{min}; f_{max}].

The actual setpoint, whether it has been set via Grundfos GO Remote, the pump display, the pump buttons or the fieldbus, can be read from ActualSetpoint (parameter 301), and it always reflects the frequency limitations. It equals the value that the pump actually uses. Values of f_{min}, f_{max} and f_{nom} can be read via Grundfos GO Remote.



* Percentage of f_{nom}

Fig. 14 Setpoint in open-loop control for TPED, MAGNA3 D and Multi-E model H

6.4.2 Set RTC value

Use this output to set the internal real-time clock of the pump. The format of the clock value is Unix Time format. It is not possible to read the actual value of the real-time clock.

Only Multi-E and TPED having a graphical display and MAGNA3 D support a built-in real-time clock. The real-time clock is used for time stamping of alarms, warnings and internal data logging. It has a built-in battery backup. If the power supply to the system is switched off, the real-time clock will keep running and a new setting is not required.

6.5 Configuration parameters, Input/Output explicit messaging

Configuration parameters are parameters that can be used to program selected settings in the booster.

Parameter	Name	Data type	Scaling	Range	Description	MPC, CU 352	DDD, CU 354	Multi-E model G	Multi-E/TPED model H	MAGNA3 D
50	ConfFeedbackSensorType	SINT8, 0xC2	Enum	0-127	Select feedback sensor: 3: Flow 6: Press.	•				
51	ConfPropCtrReduction	SINT16, 0xC3	0.01 %	0 - 327.67 %	Configure reduction percentage in Proportional Pressure mode	•	•		•	
52	ConfPropCtrFlowMax		0.1 m^3/h	0 - 3276.7 m^3/h	Configure maximum flow in Proportional Pressure mode	•	•		•	
60	ConfManualPump1	SINT8, 0xC2	Bool (state)	0, 1	Pump1: 0: Forced to Stop 1: Auto	•	•			
61	ConfManualPump2				Pump2: 0: Forced to Stop 1: Auto	•	•			
62	ConfManualPump3				Pump3: 0: Forced to Stop 1: Auto	•	•			
63	ConfManualPump4				Pump4: 0: Forced to Stop 1: Auto	•	•			
64	ConfManualPump5				Pump5: 0: Forced to Stop 1: Auto	•	•			
65	ConfManualPump6				Pump6: 0: Forced to Stop 1: Auto	•	•			
66	ConfManualPilotPump				Pilot pump: 0: Forced to Stop 1: Auto	•				
67	ConfManualBackupPump				Backup pump: 0: Forced to Stop 1: Auto	•				
70	ConfReserved1	SINT16, 0xC3	-	-	Reserved for future use					
71	ConfReserved2		-	-	Reserved for future use					
72	ConfReserved3		-	-	Reserved for future use					
73	ConfReserved4		-	-	Reserved for future use					
80	ConfSetpointDDDSensor1		0.001 bar	0 - 32.767 bar	Configure the DDD remote sensor 1 setpoint		•			
81	ConfSetpointDDDSensor2				Configure the DDD remote sensor 2 setpoint		•			
82	ConfSetpointDDDSensor3				Configure the DDD remote sensor 3 setpoint		•			
83	ConfSetpointDDDSensor4				Configure the DDD remote sensor 4 setpoint		•			
84	ConfSetpointDDDSensor5				Configure the DDD remote sensor 5 setpoint		•			
85	ConfSetpointDDDSensor6				Configure the DDD remote sensor 6 setpoint		•			
86	ConfSetpointDDDSensor7				Configure the DDD remote sensor 7 setpoint		•			
87	ConfSetpointDDDSensor8				Configure the DDD remote sensor 8 setpoint		•			
88	ConfSetpointDDDSensor9				Configure the DDD remote sensor 9 setpoint		•			
89	ConfSetpointDDDSensor10	SINT16, 0xC3	0.001 bar	0 - 32.767 bar	Configure the DDD remote sensor 10 setpoint		•			

ConfFeedbackSensorType (parameter 50)

This parameter is only available for CU 352.

With this parameter it is possible to dynamically change the feedback sensor type between a flow sensor and a pressure sensor. For the setting to work, CU 352 must in advance be configured to use a pressure sensor on one of its analogue inputs and a flow sensor on another one.

6.6 Dynamic status parameters, input assembly 2

Dynamic status parameters are parameters that describe the actual modes and states of the booster. They are thus variables that can often change during operation of the booster.

This assembly is included in assembly 1.

Parameter	Name	Data type	Scaling	Range	Description	MPC, CU 352	DDD, CU 354	Multi-E model G	Multi-E/TPED model H	MAGNA3 D
100	BoosterStatus	WORD, 0xD2	Array of Bools		Miscellaneous states/modes					
	0. RemoteLocal		Bool (state)	0, 1	Present status of Remote/ Local state	●	●	●	●	●
	1. OnOff				Present status of On/Off state	●	●	●	●	●
	2. CopyToLocal				Present status of Copy to local state				●	●
	3. AtMinSpeed				Speed/Performance at Minimum	●		●	●	●
	4. AtMaxSpeed				Speed/Performance at Maximum	●		●	●	●
	5. AtMaxPower				Power at Maximum				●	●
	6. Rotation				Rotation, at least one pump is running	●	●	●	●	●
	7. SetPointInfluence				Setpoint influence is active	●	●		●	●
	8. ResetAlarmAck				Set when "TrigResetAlarm" is activated	●	●	●	●	●
	9. ResetAccCntAck				Set when "TrigResetAccCnt" is activated	●	●		●	●
101	Digital Outputs	BYTE, 0xD1	Array of Bools		Digital outputs					
	0. DO1		Bool (state)	0, 1	Status of Digital Output 1	●	●	●	●	●
	1. DO2				Status of Digital Output 2	●	●		●	●
	2. DO3				Status of Digital Output 3				●	
	3. DO4				Status of Digital Output 4				●	
102	Digital Inputs	BYTE, 0xD1	Array of Bools		Digital inputs					
	0. DI1		Bool (state)	0, 1	Status of Digital Input 1	●	●	●	●	●
	1. DI2				Status of Digital Input 2	●	●		●	●
	2. DI3				Status of Digital Input 3	●	●		●	●
	3. DI4				Status of Digital Input 4	●	●		●	
	4. DI5				Status of Digital Input 5	●	●			
	5. DI6				Status of Digital Input 6	●	●			
	6. DI7				Status of Digital Input 7	●	●			
	7. DI8				Status of Digital Input 8	●	●			
103	ControlMode	SINT16, 0xC3	Enum	0-255	Present status of Control mode	●	●	●	●	●
104	OperatingMode				Present status of Operating mode	●	●	●	●	●
105	AlarmCode				Alarm code	●	●	●	●	●
106	WarningCode				Warning code	●	●		●	●
107	StatusReserved1				Reserved for future use					
108	FeedbackSensorUnit	SINT16, 0xC3	Enum	0-255	Feedback sensor unit 0: bar 1: mbar 2:m 3: kPa 4: psi 5: ft 6: m^3/h 7: m^3/s 8:/s 9: gpm 10: °C 11: °F 12: % 13: kelvin 14: l/h	●	●		●	●
109	FeedbackSensorMin		1	0-32767	Feedback sensor min (counting in units)	●	●		●	●
110	FeedbackSensorMax				Feedback sensor max (counting in units)	●	●		●	●
111	FeedbackSensorType	SINT8, 0xC2	Enum	0-127	Feedback sensor type: 3: Flow 6: Pressure	●				

Parameter	Name	Data type	Scaling	Range	Description	MPC, CU 352	DDD, CU 354	Multi-E model G	Multi-E/TPED model H	MAGNA3 D
112	PumpsPresent	BYTE, 0xD1	Array of Bools	Bits	One bit for each pump. "1" indicates pump present	•	•	•	•	•
113	PumpsRunning				One bit for each pump. "1" indicates pump running	•	•	•	•	•
114	PumpsFault				One bit for each pump. "1" indicates pump alarm	•	•	•	•	•
115	PumpsCommFaults				One bit for each pump. "1" indicates communication error	•	•	•	•	•
116	PumpsAutoMode				One bit for each pump. "1" indicates Auto mode	•	•			
117	SystemActiveFunctions	WORD, 0xD2	Array of Bools		A bit value of "1" indicates that the function is active	•	•			
	0. EmergencyRun		Bool (state)	0, 1	Emergency Run function is active					
	1. StandbyPump				A standby pump is activated					
	2. PumpTest				Pump Test Run is active					
	3. AltSetpoint				Booster is using the alternate setpoint					
	4. ClockProgram				Booster under Clock Program control					
	5. RemoteVNC				Virtual Network Computing (VNC) is active					
	6. RemoteBus				The remote bus (External GENIbus) is active					
	7. ServicePort				The Service port (GENI-TTL) is active					
	8. PressRelief				The Pressure Relief function is active					
	9. SoftPress				The Soft Pressure Buildup function is active					
	10. LowFlowBoost				The Low Flow Boost function is active					
	11. LowFlowStop				The Low Flow Stop function is active					
	12. PropPress				Proportional Pressure is active					

6.6.1 Explanation to dynamic status parameters

RemoteLocal

Status bit indicating whether the booster system is controlled from the bus or from some other control source.

0:	The booster system is controlled from a local source, (display or Grundfos GO Remote), or from an external digital input (Access mode is Local).
1:	The booster system is controlled from the bus (Access mode is Remote).

To allow the booster system to be controlled from EtherNet/IP, the SetRemoteLocal (parameter 1) control bit must be set to "1". However, certain commands from other control sources, for example Stop or Max. from a local source or external Stop from a digital input, have a higher priority and set the RemoteLocal bit to "0", indicating that the actual control source is not EtherNet/IP.

OnOff

Status bit indicating whether the booster system is started or stopped.

0:	The booster system is stopped (off).
1:	The booster system is started (on).

The booster system can be started and stopped from the bus by using the SetOnOff (parameter 2) control bit.

"Started" does not necessarily indicate that the booster system is pumping as it might be in a "low-flow stop" condition.

CopyToLocal

Status bit indicating that the booster will copy remote settings to local settings when it is switched from Access mode Remote to Access mode Local. The involved settings are the Control Mode, operating mode and setpoint.

0:	Copying remote settings to local settings is not active.
1:	Copying remote settings to local settings is active.

AtMinSpeed

Status bit indicating that the booster system is running at minimum performance.

0:	The booster system is not running at minimum performance.
1:	The booster system is running at minimum performance.

AtMaxSpeed

Status bit indicating that the booster system is running at maximum performance.

0:	The booster system is not running at maximum performance.
1:	The booster system is running at maximum performance.

AtMaxPower

Status bit indicating that the booster system is running at its maximum power.

0:	The booster system is not running at maximum power.
1:	The booster system is running at maximum power.

Rotation

Status bit indicating that the booster system is pumping.

0:	No rotation (not pumping).
1:	Rotation (pumping).

SetPointInfluence

Status bit indicating if the setpoint is influenced, for example by analog input. If influenced, ActualSetpoint (parameter 301) differs from UserSetpoint (parameter 300).

0:	No setpoint influence.
1:	The setpoint is influenced.

ResetAlarmAct

Acknowledge bit belonging to the TrigResetAlarm control bit. It is set when the control bit is set and the command is executed. It is cleared when the control bit is cleared.

ResetAccCntAck

Acknowledge bit belonging to the TrigResetAccCnt (parameter 9) control bit. It is set when the control bit is set and the command is executed. It is cleared when the control bit is cleared.

ControlMode

Status enumeration showing the actual booster system control mode.

See section *6.3.3 Explanation to control mode* for detailed explanation to the various control modes.

OperatingMode

Status enumeration showing the actual booster system operating mode.

See section *6.3.4 Explanation to operating mode* for detailed explanation to the various operating modes.

6.7 Alarms and warnings

Parameter	Name	Description
105	AlarmCode	Code for booster system alarm.
106	WarningCode	Code for booster system warning.

In the AlarmCode parameter, the cause of a booster system alarm can be read. A booster system alarm always leads to a reaction in the booster system operation, usually all pumps are stopped, but some Hydro MPC alarms have programmable alarm action types.

In the WarningCode parameter, the cause of a booster system warning can be read. A warning has no influence on the booster system operation.

The complete list of possible alarm and warning codes is shown below.

Code	Alarm/warning description	Reset type[1)]	Action type[2)]
3	External fault signal	A/M	Prog.
10	Communication fault, pump	A	None
80	Hardware fault, IO 351 pump module	A	None
80	Hardware fault, IO 351 I/O module	A	None
83	Verification error, EEPROM parameter area	A	None
88	Sensor fault, general measuring sensor	A	None
89	Signal fault, closed-loop feedback sensor	A/M	Prog.
91	Temperature sensor 1 signal fault	A/M	Prog.
157	Real Time Clock error	A	None
161	Sensor supply fault, 5 V	A	None
162	Sensor supply fault, 24 V	A	None
165	Signal fault, analog input A1	A/M	Prog.
166	Signal fault, analog input A2	A/M	Prog.
167	Signal fault, analog input A3	A/M	Prog.
175	Signal fault, temperature 2 sensor (t_mo2)	A/M	Prog.
190	Limit exceeded, supervised item 1	A/M	Prog.
191	Limit exceeded, supervised item 2	A/M	Prog.
203	Alarm on all pumps	A/M	Prog.
204	Inconsistency between sensors	A	None
208	Operation outside performance range	A/M	Prog.
210	High pressure	A/M	Prog.
211	Low pressure	A/M	Prog.
213	VFD not ready	A	None
214	Water shortage	A/M	Prog.
215	Soft pressure buildup timeout	A/M	Prog.
216	Pilot pump alarm	A	None
219	Pressure relief not adequate	A	None
228	Night flow limit exceeded	A/M	None
231	Ethernet: No IP address from DHCP server	A	None
232	Ethernet: Auto-disabled due to misuse	A	None
248	Fault, battery/UPS	A	None
253	SMS data from DDD sensor not received within time	A	None
254	Inconsistent data model	A	None
From device	Pump alarms. See section *8. Product simulation*.	-	None

1) For Hydro MPC, DDD and Multi-E model H and later, it can be automatic (A) or selectable Automatic/Manual (A/M).

2) For Hydro MPC, DDD and Multi-E model H and later, it can be none or programmable (Prog.).
Programmable event actions are Stop, Stop with delay, Min., UserDef, Max., Pumps in local, and Emergency run.
The Hydro Multi-E model G is always stopped in case of an alarm.

6.8 Static status parameters, input assembly 3

Static status parameters are parameters that describe characteristics of the booster. They are constants unable to change.
This assembly is included in assembly 1.

Table legend

●: Always available.

Parameter	Name	Data type	Scaling	Range/ Resolution	Description	MPC, CU 352	DDD, CU 354	Multi-E model G	Multi-E/TPED model H	MAGNA3 D
200	UnitFamily	SINT8, 0xC2	Enum	0-127	Unit family	21	21	17	39	38
201	UnitType				Unit type	1	3	1, 2	1	1
202	UnitVersion				Unit version	●	●	●	●	●
203	CIMSoftwareVersion		1		CIM 500 software version	●	●	●	●	●
204	CIMSoftwareRevision				CIM 500 software revision	●	●	●	●	●
205	CIMSoftwareFix				CIM 500 software fix	●	●	●	●	●
206	StatusReserved1				Reserved					
207	StatusReserved2				Reserved					

6.8.1 Device identification

The UnitFamily and the UnitType parameters identify what E-pump product EtherNet/IP is connected to.

UnitFamily [enumeration]	UnitType [enumeration]
17: Hydro Multi-E model G	1: With 3-phase pumps 2: With 1-phase pumps
21: Hydro MPC, CU 354 DDD	1: Hydro MPC, CU 352 3: Demand Driven Distribution, CU 354
39: Hydro Multi-E model H and later	1: With 3-phase pumps 2: With 1-phase pumps

6.9 Booster system measured parameters, input assembly 4

Measured parameters are physical values measured by internal and external sensors and values calculated by the booster itself based on measured values and its state/mode behaviour.

This assembly is included in assembly 1.

Table legend:

●: Always available.

S: Sensor required.

*: Without flow sensor, flow estimation can be used.

**: MPC-E only.

Parameter	Name	Data type	Scaling	Range	Description	MPC, CU 352	DDD, CU 354	Multi-E model G	Multi-E/TPED model H	MAGNA3 D
300	UserSetpoint	SINT16, 0xC3	0.01 %	0 - 327.67 %	User setpoint (0-100 % of setpoint range)	●	●		●	●
301	ActualSetpoint				Actual setpoint in % of sensor max value	●	●	●	●	●
302	SystemFeedback				Closed-loop feedback	●	●	●	●	●
303	Head		0.001 bar	0 - 32.767 bar	Head value	S	S	S	S	●
304	OutletPressure				Outlet pressure	S	S		S	
305	DiffOutletPressure				Differential outlet pressure				S	
306	InletPressure			-1.000 to 32.767 bar	Inlet pressure	S	S		S	
307	DiffInletPressure			0 - 32.767 bar	Differential inlet pressure				S	
308	DiffPressure				Differential pressure				S	●
309	RemotePressure1				Remotely measured pressure 1	S	S		S	S
310	RemotePressure2				Remotely measured pressure 2				S	
311	RemoteDiffPressure				Remotely measured differential pressure				S	
312	Flow		0.1 m^3/h	0 - 3276.7 m^3/h	Flow	S*	S*	S	S	●
313	RemoteFlow				Remotely measured flow				S	
314	FlowMeas1				Flow measurement 1	S	S			
315	FlowMeas2				Flow measurement 2	S	S			
316	FlowMeas3				Flow measurement 3	S	S			
317	RemoteTemperature1		0.01 °C	-273.15 to 327.67 °C	Remotely measured temperature 1	S		S	S	
318	RemoteTemperature2				Remotely measured temperature 2				S	S
319	DiffTemperature				Differential temperature	S			S	
320	AmbientTemperature				Ambient temperature	S			S	
321	FluidTemperature				Fluid temperature				S	●
322	HeatDiffTemperature				Heat monitoring differential temperature				S	S
323	InletTemperature				Inlet temperature	S			S	S
324	OutletTemperature				Outlet temperature	S			S	
325	StorageTankLevel		0.01 m	-10.00 to 327.67 m	Storage tank level	S	S	S	S	
326	FeedTankLevel				Feed tank level	S	S		S	
327	AuxSensorInput		0.01 %	0 - 327.67 %	Auxiliary sensor input			S	S	
328	RelativePerformance				Relative performance	●	●	●	●	●
329	Current		0.1 A	0 - 3276.7 A	Sum of all motor currents			●		

Parameter	Name	Data type	Scaling	Range	Description	MPC, CU 352	DDD, CU 354	Multi-E model G	Multi-E/TPED model H	MAGNA3 D
330	SpecificEnergy	SINT16, 0xC3	0.1 Wh/m^3	0 - 3276.7 Wh/m3	Specific energy	S*, **	S*		S	●
331	SpecificEnergyAverage				Average value of the specific energy	S*, **	S*			
332	AnalogInfluence		0.01 %	0 - 327.67 %	Setpoint influencing analog input	●	●		●	●
333	NoOfPowerOns		1	0 - 32767	Number of booster power on times	●	●			
334	LatestNightFlowAverage		0.1 m^3/h	0 - 3276.7 m^3/h	Average flow latest night		●			
335	LatestNightPressAverage		0.001 bar	0 - 32.767 bar	Average pressure latest night		●			
336	SysMeasReserved1		-	-	Reserved for future use					
337	SysMeasReserved2		-	-	Reserved for future use					
338	SysMeasReserved3		-	-	Reserved for future use					
339	SysMeasReserved4		-	-	Reserved for future use					
350	Volume1	SINT32, 0xC4	1 m^3	0-(2^{31}-1) m^3	Pumped volume (direction 1)	S	S		S	S
351	Power		1 W	0-(2^{31}-1) W	Pump power	●**	●	●	●	●
352	Energy		1 Wh	0-(2^{31}-1) Wh	Consumed energy	●**	●	●	●	●
353	OperatingTime		1 h	0-(2^{31}-1) h	Operating time	●	●	●	●	●
354	TotalPoweredTime				Total powered time			●		
355	HeatPower		1 W	0-(2^{31}-1) W	Heat metering power				S	S
356	HeatEnergy1		1 Wh	0-(2^{31}-1) Wh	Heat metering energy (direction 1)				S	S
357	HeatEnergy2				Heat metering energy (direction 2)				S	S
358	Volume2		1 m^3	0-(2^{31}-1) m^3	Pumped volume (direction 2)				S	S
359	RealTimeClock		Unix time	0-(2^{31}-1) s	Present value of Real Time Clock				●	●

6.10 Pump 1 and pump 2 measured parameters, input assembly 6

Measured parameters are physical values measured by internal and external sensors, and values calculated by the pump based on measured values and its state/mode behaviour. The assembly contains measured parameters from pump 1 and pump 2.

This assembly is included in assembly 5.

Table legend:

●: Always available.

●**: MPC-E only.

Parameter	Name	Data type	Scaling	Range	Description	MPC, CU 352	DDD, CU 354	Multi-E model G	Multi-E/TPED model H	MAGNA3 D
400	Pump1Status	BYTE, 0xD1	Array of Bools		Pump 1 miscellaneous status					
	0. AccessMode		Bool (state)	0, 1	Actual access mode of Pump 1: 0: Local 1: Remote	●	●		●	●
	1. OnOff				Actual running status of Pump 1: 0: Stopped 1: Running	●	●	●	●	●
	2. Alarm				Actual alarm status of Pump 1: 0: No alarm 1: Alarm	●	●	●	●	●
401	Pump1CtrSource	SINT8, 0xC2	Enum	0-127	Pump 1 control source					
					0: Unknown					
					1: Setpoint buttons on pump					
					2: GENIbus (from controller)	●	●		●	●
					3: GENIlink (IR)/GENIair (radio)					
					4: External control					
					5: Start/Stop button					
402	Pump1AlarmCode	SINT16, 0xC3		0-255	Pump1 Alarm Code	●	●		●	●
403	Pump1Speed	SINT16, 0xC3	0.01 %	0 - 327.67 %	Pump 1 speed	●	●		●	●
404	Pump1LineCurrent	SINT16, 0xC3	0.1 A	0 - 3276.7 A	Pump 1 line current	●**	●		●	●
405	Pump1MotorTemp	SINT16, 0xC3	0.01 °C	-273.15 to 327.67 °C	Pump 1 motor temperature	●**	●		●	●
406	PumpMeasReserved1	SINT16, 0xC3	-	-	Reserved for future use					
407	Pump1Power	SINT32, 0xC4	1 W	0-(2^{31}-1) W	Pump 1 power consumption	●**	●		●	●
408	Pump1Energy	SINT32, 0xC4	1 Wh	0-(2^{31}-1) Wh	Pump 1 energy consumption	●**	●		●	●
409	Pump1OprTime	SINT32, 0xC4	1 h	0-(2^{31}-1) h	Pump 1 operating time	●	●	●	●	●
410	Pump2Status	BYTE, 0xD1	Array of Bools		Pump 1 miscellaneous status					
	0. AccessMode		Bool (state)	0, 1	Actual access mode of Pump 1: 0: Local 1: Remote	●	●		●	●
	1. OnOff				Actual running status of Pump 1: 0: Stopped 1: Running	●	●	●	●	●
	2. Alarm				Actual alarm status of Pump 1: 0: No alarm 1: Alarm	●	●	●	●	●

Parameter	Name	Data type	Scaling	Range	Description	MPC, CU 352	DDD, CU 354	Multi-E model G	Multi-E/TPED model H	MAGNA3 D
411	Pump2CtrSource	SINT8, 0xC2	Enum	0-127	Pump 1 control source					
					0: Unknown					
					1: Setpoint buttons on pump					
					2: GENIbus (from controller)	●	●		●	●
					3: GENIlink (IR)/GENIair (radio)					
					4: External control					
					5: Start/Stop button					
412	Pump2AlarmCode	SINT16, 0xC3		0-255	Pump 2 alarm code	●	●		●	●
413	Pump2Speed		0.01 %	0 - 327.67 %	Pump 2 speed	●	●		●	●
414	Pump2LineCurrent		0.1 A	0 - 3276.7 A	Pump 2 line current	●**	●		●	●
415	Pump2MotorTemp		0.01 °C	-273.15 to 327.67 °C	Pump 2 motor temperature	●**	●		●	●
416	PumpMeasReserved1		-	-	Reserved for future use					
417	Pump2Power	SINT32, 0xC4	1 W	0-(2^{31}-1) W	Pump 2 power consumption	●**	●		●	●
418	Pump2Energy	SINT32, 0xC4	1 Wh	0-(2^{31}-1) Wh	Pump 2 energy consumption	●**	●		●	●
419	Pump2OprTime		1 h	0-(2^{31}-1) h	Pump 2 operating time	●	●	●	●	●

6.11 Pump 3 and pump 4 measured parameters, input assembly 7

Measured parameters are physical values measured by internal and external sensors, and values calculated by the pump based on measured values and its state/mode behaviour. The assembly contains measured parameters from pump 3 and pump 4.

Notice that since TPED and MAGNA3 D twin pumps only represent two pumps, they are not present in this table.

This assembly is included in assembly 5.

Table legend:

●: Always available.

●**: MPC-E only.

Parameter	Name	Data type	Scaling	Range	Description	MPC, CU 352	DDD, CU 354	Multi-E model G	Multi-E model H
420	Pump3Status	BYTE, 0xD1	Array of Bools		Pump 3 miscellaneous status				
	0. AccessMode		Bool (state)	0, 1	Actual access mode of Pump 3: 0: Local 1: Remote	●	●		●
	1. OnOff				Actual running status of Pump 3: 0: Stopped 1: Running	●	●	●	●
	2. Alarm				Actual alarm status of Pump 3: 0: No alarm 1: Alarm	●	●	●	●
421	Pump3CtrSource	SINT8, 0xC2	Enum	0-127	Pump 3 Control Source				
					0: Unknown	●	●		●
					1: Setpoint buttons on pump				
					2: GENIbus (from controller)				
					3: GENIlink (IR)/GENIair (radio)				
					4: External control				
					5: Start/Stop button				
422	Pump3AlarmCode	SINT16, 0xC3		0-255	Pump 3 alarm code	●	●		●
423	Pump3Speed		0.01 %	0 - 327.67 %	Pump 3 speed	●	●		●
424	Pump3LineCurrent		0.1 A	0 - 3276.7 A	Pump 3 line current	●**	●		●
425	Pump3MotorTemp		0.01 °C	-273.15 to 327.67 °C	Pump 3 motor temperature	●**	●		●
426	PumpMeasReserved1		-	-	Reserved for future use				
427	Pump3Power	SINT32, 0xC4	1 W	$0-(2^{31}-1)$ W	Pump 3 power consumption	●**	●		●
428	Pump3Energy		1 Wh	$0-(2^{31}-1)$ Wh	Pump 3 energy consumption	●**	●		●
429	Pump3OprTime		1 h	$0-(2^{31}-1)$ h	Pump 3 operating time	●	●	●	●
430	Pump4Status	BYTE, 0xD1	Array of Bools		Pump 4 miscellaneous status				
	0. AccessMode		Bool (state)	0, 1	Actual access mode of Pump 4: 0: Local 1: Remote	●	●		●
	1. OnOff				Actual running status of Pump 4: 0: Stopped 1: Running	●	●	●	●
	2. Alarm				Actual alarm status of Pump 4: 0: No alarm 1: Alarm	●	●	●	●

Parameter	Name	Data type	Scaling	Range	Description	MPC, CU 352	DDD, CU 354	Multi-E model G	Multi-E model H
431	Pump4CtrSource	SINT8, 0xC2	Enum	0-127	Pump 4 control source				
					0: Unknown				
					1: Setpoint buttons on pump				
					2: GENIbus (from controller)	●	●		●
					3: GENIlink (IR)/GENIair (radio)				
					4: External control				
					5: Start/Stop button				
432	Pump4AlarmCode	SINT16, 0xC3		0-255	Pump 4 alarm code	●	●		●
433	Pump4Speed		0.01 %	0 - 327.67 %	Pump 4 speed	●	●		●
434	Pump4LineCurrent		0.1 A	0 - 3276.7 A	Pump 4 line current	●**	●		●
435	Pump4MotorTemp		0.01 °C	-273.15 to 327.67 °C	Pump 4 motor temperature	●**	●		●
436	PumpMeasReserved1		-	-	Reserved for future use				
437	Pump4Power	SINT32, 0xC4	1 W	0-(2^{31}-1) W	Pump 4 power consumption	●**	●		●
438	Pump4Energy		1 Wh	0-(2^{31}-1) Wh	Pump 4 energy consumption	●**	●		●
439	Pump4OprTime		1 h	0-(2^{31}-1) h	Pump 4 operating time	●	●	●	●

6.12 Pump 5 and pump 6 measured parameters, input assembly 8

Measured parameters are physical values measured by internal and external sensors, and values calculated by the pump based on measured values and its state/mode behaviour. The assembly contains measured parameters from pump 5 and pump 6.

Notice that since TPED and MAGNA3 D twin pumps only represent two pumps and Multi-E only represents four pumps they are not present in this table.

This assembly is included in assembly 5.

Table legend:

●: Always available.

●**: MPC-E only.

Parameter	Name	Data type	Scaling	Range	Description	MPC, CU 352	DDD, CU 354
440	Pump5Status	BYTE, 0xD1	Array of Bools		Pump 5 miscellaneous status		
	0. AccessMode		Bool (state)	0, 1	Actual access mode of Pump 5: 0: Local 1: Remote	●	●
	1. OnOff				Actual running status of Pump 5: 0: Stopped 1: Running	●	●
	2. Alarm				Actual alarm status of Pump 5: 0: No alarm 1: Alarm	●	●
441	Pump5CtrSource	SINT8, 0xC2	Enum	0-127	Pump 5 control source		
					0: Unknown	●	●
					1: Setpoint buttons on pump		
					2: GENIbus (from controller)		
					3: GENIlink (IR)/GENIair (radio)		
					4: External control		
					5: Start/Stop button		
442	Pump5AlarmCode	SINT16, 0xC3	Enum	0-255	Pump 5 alarm code	●	●
443	Pump5Speed		0.01 %	0 - 327.67 %	Pump 5 speed	●	●
444	Pump5LineCurrent		0.1 A	0 - 3276.7 A	Pump 5 line current	●**	●
445	Pump5MotorTemp	SINT16, 0xC3	0.01 °C	-273.15 to 327.67 °C	Pump 5 motor temperature	●**	●
446	PumpMeasReserved1		-	-	Reserved for future use		
447	Pump5Power	SINT32, 0xC4	1 W	0-(2^{31}-1) W	Pump 5 power consumption	●**	●
448	Pump5Energy		1 Wh	0-(2^{31}-1) Wh	Pump 5 energy consumption	●**	●
449	Pump5OprTime		1 h	0-(2^{31}-1) h	Pump 5 operating time	●	●
450	Pump6Status	BYTE, 0xD1	Array of Bools		Pump 6 miscellaneous status		
	0. AccessMode		Bool (state)	0, 1	Actual access mode of Pump 6: 0: Local 1: Remote	●	●
	1. OnOff				Actual running status of Pump 6: 0: Stopped 1: Running	●	●
	2. Alarm				Actual alarm status of Pump 6: 0: No alarm 1: Alarm	●	●
451	Pump6CtrSource	SINT8, 0xC2	Enum	0-127	Pump 6 control source		
					0: Unknown	●	●
					1: Setpoint buttons on pump		
					2: GENIbus (from controller)		
					3: GENIlink (IR)/GENIair (radio)		
					4: External control		
					5: Start/Stop button		

Parameter	Name	Data type	Scaling	Range	Description	MPC, CU 352	DDD, CU 354
452	Pump6AlarmCode	SINT16, 0xC3	Enum	0-255	Pump 6 alarm code	●	●
453	Pump6Speed		0.01 %	0 - 327.67 %	Pump 6 speed	●	●
454	Pump6LineCurrent		0.1 A	0 - 3276.7 A	Pump 6 line current	●**	●
455	Pump6MotorTemp		0.01 °C	-273.15 to 327.67 °C	Pump 6 motor temperature	●**	●
456	PumpMeasReserved1		-	-	Reserved for future use		
457	Pump6Power	SINT32, 0xC4	1 W	$0-(2^{31}-1)$ W	Pump 6 power consumption	●**	●
458	Pump6Energy		1 Wh	$0-(2^{31}-1)$ Wh	Pump 6 energy consumption	●**	●
459	Pump6OprTime		1 h	$0-(2^{31}-1)$ h	Pump 6 operating time	●	●

6.13 Pilot pump and backup pump measured parameters, input assembly 9

Measured parameters are physical values measured by internal and external sensors, and values calculated by the pump based on measured values and its state/mode behaviour. The assembly contains measured parameters from the pilot pump and the backup pump.

Notice that since TPED and MAGNA3 D twin pumps only represent two pumps, Multi-E only represents four pumps and DDD only represent 6 pumps they are not present in this table.

This assembly is included in assembly 5.

Table legend:

●: Always available.

●**: MPC-E only.

Parameter	Name	Data type	Scaling	Range	Description	MPC, CU 352
460	PilotPumpStatus	BYTE, 0xD1	Array of Bools		Pilot pump miscellaneous status	
	0. AccessMode		Bool (state)	0, 1	Actual access mode of Pilot pump: 0: Local 1: Remote	●
	1. OnOff				Actual running status of Pilot pump: 0: Stopped 1: Running	●
	2. Alarm				Actual alarm status of Pilot pump: 0: No alarm 1: Alarm	●
461	PilotPumpCtrSource	SINT8, 0xC2	Enum	0-127	Pilot pump control source	
					0: Unknown	●
					1: Setpoint buttons on pump	
					2: GENIbus (from controller)	
					3: GENIlink (IR)/GENIair (radio)	
					4: External control	
					5: Start/Stop button	
462	PilotPumpAlarmCode	SINT16, 0xC3	Enum	0-255	Pilot pump alarm code	●
463	PilotPumpSpeed		0.01 %	0 - 327.67 %	Pilot pump speed	●
464	PilotPumpLineCurrent		0.1 A	0 - 3276.7 A	Pilot pump line current	●**
465	PilotPumpMotorTemp		0.01 °C	-273.15 to 327.67 °C	Pilot pump motor temperature	●**
466	PumpMeasReserved1		-	-	Reserved for future use	
467	PilotPumpPower	SINT32, 0xC4	1 W	$0-(2^{31}-1)$ W	Pilot pump power consumption	●**
468	PilotPumpEnergy		1 Wh	$0-(2^{31}-1)$ Wh	Pilot pump energy consumption	●**
469	PilotPumpOprTime		1 h	$0-(2^{31}-1)$ h	Pilot pump operating time	●
470	BackupPumpStatus	BYTE, 0xD1	Array of Bools		Backup pump miscellaneous status	
	0. AccessMode		Bool (state)	0, 1	Actual access mode of backup pump: 0: Local 1: Remote	●
	1. OnOff				Actual running status of backup pump: 0: Stopped 1: Running	●
	2. Alarm				Actual alarm status of backup pump: 0: No alarm 1: Alarm	●
471	BackupPumpCtrSource	SINT8, 0xC2	Enum	0-127	Backup pump control source	
					0: Unknown	
					1: Setpoint buttons on pump	
					2: GENIbus (from controller)	●
					3: GENIlink (IR)/GENIair (radio)	
					4: External control	
					5: Start/Stop button	

Parameter	Name	Data type	Scaling	Range	Description	MPC, CU 352
472	BackupPumpAlarmCode	SINT16, 0xC3	Enum	0-255	Backup pump alarm code	●
473	BackupPumpSpeed		0.01 %	0 - 327.67 %	Backup pump speed	●
474	BackupPumpLineCurrent		0.1 A	0 - 3276.7 A	Backup pump line current	●**
475	BackupPumpMotorTemp		0.01 °C	-273.15 to 327.67 °C	Backup pump motor temperature	●**
476	PumpMeasReserved1		-	-	Reserved for future use	
477	BackupPumpPower	SINT32, 0xC4	1 W	$0-(2^{31}-1)$ W	Backup pump power consumption	●**
478	BackupPumpEnergy		1 Wh	$0-(2^{31}-1)$ Wh	Backup pump energy consumption	●**
479	BackupPumpOprTime		1 h	$0-(2^{31}-1)$ h	Backup pump operating time	●

7. Pump alarms

Code	Alarm/warning description
1	Leakage current
2	Missing phase
3	External fault signal
4	Too many restarts
4	Too many restarts per 24 hours
7	Too many hardware shutdowns
10	Communication fault, pump
14	Electronic DC-link protection activated (ERP)
16	Other
29	Turbine operation, impellers forced backwards
30	Change bearings (specific service information)
31	Change varistor(s) (specific service information)
32	Overvoltage
40	Undervoltage
41	Undervoltage transient
42	Cut-in fault (dV/dt)
45	Voltage asymmetry
48	Overload
49	Overcurrent (i_line, i_dc, i_mo)
50	Motor protection function, general shutdown (MPF)
51	Blocked motor or pump
54	Motor protection function, 3 sec. limit
55	Motor current protection activated (MCP)
56	Underload
57	Dry running
64	Overtemperature
65	Motor temperature 1 (t_m or t_mo or t_mo1)
66	Temperature, control electronics
67	Temperature too high, internal frequency converter module (t_m)
70	Thermal relay 2 in motor, for example thermistor
72	Hardware fault, type 1
73	Hardware shutdown (HSD)
76	Internal communication fault
77	Communication fault, twin-head pump
80	Hardware fault, type 2
83	Verification error, FE parameter area (EEPROM)
84	Memory access error
85	Verification error, BE parameter area (EEPROM)
88	Sensor fault
89	Signal fault, (feedback) sensor 1
91	Signal fault, temperature 1 sensor
91	Temperature sensor 1 signal fault
93	Signal fault, sensor 2
96	Setpoint signal outside range
105	Electronic rectifier protection activated (ERP)
106	Electronic inverter protection activated (EIP)
148	Motor bearing temperature high (Pt100) in drive end (DE)
149	Motor bearing temperature high (Pt100) in non-drive end (NDE)
155	Inrush fault
156	Communication fault, internal frequency converter module
157	Real Time Clock error
161	Sensor supply fault, 5 V
162	Sensor supply fault, 24 V

Code	Alarm/warning description
163	Motor drive protection function measurement fault
164	Signal fault, LiqTec sensor
165	Signal fault, analog input A1
166	Signal fault, analog input A2
167	Signal fault, analog input A3
175	Signal fault, temperature 2 sensor (t_mo2)
176	Signal fault, temperature 3 sensor (t_mo3)
190	Limit exceeded, sensor 1
191	Limit exceeded, sensor 2
240	Lubricate bearings (specific service information)
241	Motor phase failure
242	Automatic motor model recognition failed

7.1 Sensor dependent measurements

All the parameters. SetSetpoint, SystemFeedback, ActualSetpoint and UserSetpoint have a scaling relative to the feedback sensor. By using the scaling information of the feedback sensor (FeedbackSensorUnit, FeedbackSensorMin, FeedbackSensorMax) these parameters can be expressed in absolute units.

Many of the booster system measurement parameters require a particular sensor to be present. As a limited number of sensors are available, only a few of the measurement parameters can be available simultaneously.

The table below shows the relationship between the EtherNet/IP measurement parameters and the sensor value selected for the individual booster systems.

Hydro MPC and DDD				
Parameter	**Register name**	**FeedBack SensorUnit**	**Measuring sensor selected via controller display**	**Primary sensor selected via controller display**
303	Head	0.01 m	Differential pressure, pump	Differential pressure, pump Differential pressure, Series 2000
312	Flow	0.1 m^3/h	Flow rate	Flow rate Flow rate, Series 2000
306	InletPressure	0.001 bar	Differential pressure, inlet	Differential pressure, inlet
309	RemotePressure1	0.001 bar	Differential pressure, external External pressure	Differential pressure, external External pressure
317	RemoteTemperature1	0.01 K	Return-pipe temperature, external	Return-pipe temperature, external
320	AmbientTemperature	0.01 K	Ambient temperature	Ambient temperature
323	InletTemperature	0.01 K	Return-pipe temperature	Return-pipe temperature
324	OutletTemperature	0.01 K	Flow-pipe temperature	Flow-pipe temperature
319	DiffTemperature	0.01 K	Differential temperature	Differential temperature
304	OutletPressure	0.001 bar	Outlet pressure Differential pressure, outlet	Outlet pressure Differential pressure, outlet
	-	-	0-100 % signal	0-100 % signal

The table below shows the relationship between the measurement parameters for the Hydro Multi-E model G and the measurement unit selected with Grundfos GO Remote for the feedback sensor. Only one of the measurement parameter groups in the table below will be available at a time.

Hydro Multi-E model G	
Sensor unit configuration with Grundfos GO Remote	**EtherNet/IP parameter generated from feedback sensor measurement**
bar	Head (303) OutletPressure (304)
mbar	
m	
kPa	
psi	
ft	
m^3/h	Flow (312)
m^3/s	
l/s	
gpm	
°C	RemoteTemperature1 (317)
°F	
%	-

Hydro Multi-E/TPED model H

Measured parameters (Selected from display or Grundfos GO Remote)			
Value	**Analog input AI1, AI2, AI3**	**Temperature Pt100 input T1, T2**	**Mapped to EtherNet/IP parameter**
Head	●		Head (303)
Pump outlet pressure	●		OutletPressure (304)
Pump outlet differential pressure	●		DiffOutletPressure (305)
Pump inlet pressure	●		InletPressure (306)
Pump inlet differential pressure	●		DiffInletPressure (307)
Remote pressure 1	●		RemotePressure1 (309)
Remote pressure 2	●		RemotePressure2 (310)
Remote differential pressure	●		RemoteDiffPressure (311)
Pump flow	●		Flow (312)
Remote flow	●		RemoteFlow (313)
Temperature 1	●	●	RemoteTemperature1 (317)
Temperature 2	●	●	RemoteTemperature2 (318)
Differential temperature	●		DiffTemperature (319)
Ambient temperature	●	●	AmbientTemperature (320)
Fluid temperature	●		FluidTemperature (321)
Heat monitor differential temperature	●		HeatDiffTemperature (322)
Inlet temperature	●		InletTemperature(323)
Outlet temperature	●		OutletTemperature(324)
Feed tank level	●		FeedTankLevel (326)
Storage tank level	●		StorageTankLevel (325)
Other parameter	●		AuxSensorInput (327)

MAGNA3 D

Measured parameters (Selected from display or Grundfos GO Remote)			
Value	**Analog input AI1, AI2, AI3**	**Temperature Pt100 input T1, T2**	**Mapped to EtherNet/IP parameter**
Remote pressure 1	●		RemotePressure1 (309)
Temperature 2	●		RemoteTemperature2 (318)

7.2 Special parameter, input explicit messaging

Special parameters are parameters that might be used by the PLC but bear no relation to the operation of the booster.

Parameter	Name	Data type	Scaling	Range/ Resolution	Description	MPC, CU 352	DDD, CU 354	Multi-E model G	Multi-E/TPED model H	MAGNA3 D
500	RPILimits	UINT32, 0xC8	1 µs	15000 - 200000 µs	Requested Packet Interval	●	●	●	●	●
500	TCPIPCapability	DWORD32, 0xD3	-	-	For Logix EDS AOP integration	●	●	●	●	●

8. Product simulation

The CIM module can be put in product simulation mode in which case it generates life-like simulated values of all the EtherNet/IP input data parameters.

It will thus be possible to connect an EtherNet/IP master to CIU 500 without this device being connected to a real pump in a real-life system. In an office environment, it can then be verified that communication works and data is being received and handled correctly by the master application program, for example PLC program, before the equipment is installed under real-life conditions.

Product simulation mode is entered via the webserver. See section *Webserver configuration*.

The below functional profiles can be selected from the webserver.

Simulated product
Pump profile
Booster system profile
Digital Dosing DDA profile

Only input parameters are simulated. The data read has dummy values and no real product functionality is simulated.

9. Fault finding the product

9.1 EtherNet/IP

You can detect faults in a module by observing the status of the two status LEDs. See the table below.

CIM 500 fitted in a Grundfos booster system or CIM 500 fitted in a CIU 500

Ensure that SW1 is in position "3".

Fault (LED status)	Possible cause	Remedy
1. LED1 and LED2 remain off when the power supply is connected.	a) The module is fitted incorrectly in the Grundfos product.	Check that the module is fitted and connected correctly.
	b) The module is defective.	Replace the module.
	c) CIU 500 is defective.	Replace CIU 500.
2. LED1 remains off.	a) SW1 is not set correctly.	Set the switch to "3".
3. LED2 is flashing red.	a) No internal communication between the module and the Grundfos product.	Check that the module is fitted correctly.
	b) No internal communication between CIU 500 and the Grundfos product.	• Check the cable connection between the Grundfos product and CIU 500. • Check that the individual conductors have been connected correctly, for example not reversed. • Check the power supply to the Grundfos product.
4. LED2 is permanently red.	a) The module does not support the connected Grundfos product.	Contact the nearest Grundfos company.
5. LED1 is permanently red.	a) IP address conflict.	Check the IP address configuration.
	b) SW1 is in illegal position.	Check that SW1 is set to "3".
6. LED1 is flashing red.	a) Connection time-out.	Verify the connection and communication between PLC and CIM 500.
7. LED1 is permanently red and green at the same time.	a) Error in firmware download.	Use the webserver to download the firmware again. See section *Update* in the appendix.
8. LED2 is permanently red and green at the same time.	a) Memory fault.	Replace the module.

10. Disposing of the product

This product or parts of it must be disposed of in an environmentally sound way:

1. Use the public or private waste collection service.
2. If this is not possible, contact the nearest Grundfos company or service workshop.

11. Grundfos alarm and warning codes

This is a complete list of alarm and warning codes for Grundfos products. For the codes supported by this product, see the alarms and warnings section.

Code	Description	Code	Description	Code	Description
1	Leakage current	36	Outlet valve leakage	71	Motor temperature 2 (Pt100, t_mo2)
2	Missing phase	37	Inlet valve leakage	72	Hardware fault, type 1
3	External fault signal	38	Vent valve defective	73	Hardware shutdown (HSD)
4	Too many restarts	39	Valve stuck or defective	74	Internal supply voltage too high
5	Regenerative braking	40	Undervoltage	75	Internal supply voltage too low
6	Mains fault	41	Undervoltage transient	76	Internal communication fault
7	Too many hardware shutdowns	42	Cut-in fault (dV/dt)	77	Communication fault, twin-head pump
8	PWM switching frequency reduced	43	-	78	Fault, speed plug
9	Phase sequence reversal	44	-	79	Functional fault, add-on module
10	Communication fault, pump	45	Voltage asymmetry	80	Hardware fault, type 2
11	Water-in-oil fault (motor oil)	46	-	81	Verification error, data area (RAM)
12	Time for service (general service information)	47	-	82	Verification error, code area (ROM, FLASH)
13	Moisture alarm, analog	48	Overload	83	Verification error, FE parameter area (EEPROM)
14	Electronic DC-link protection activated (ERP)	49	Overcurrent (i_line, i_dc, i_mo)	84	Memory access error
15	Communication fault, main system (SCADA)	50	Motor-protection function, general shutdown (MPF)	85	Verification error, BE parameter area (EEPROM)
16	Other	51	Blocked motor or pump	86	Fault (add-on) I/O module
17	Performance requirement cannot be met	52	Motor slip high	87	-
18	Commanded alarm standby (trip)	53	Stalled motor	88	Sensor fault
19	Diaphragm break (dosing pump)	54	Motor-protection function, 3 sec. limit	89	Signal fault, (feedback) sensor 1
20	Insulation resistance low	55	Motor current protection activated (MCP)	90	Signal fault, speed sensor
21	Too many starts per hour	56	Underload	91	Signal fault, temperature sensor 1
22	Moisture switch alarm, digital	57	Dry running	92	Calibration fault, (feedback) sensor
23	Smart trim gap alarm	58	Low flow	93	Signal fault, sensor 2
24	Vibration	59	No flow	94	Limit exceeded, sensor 1
25	Setup conflict	60	Low input power	95	Limit exceeded, sensor 2
26	Load continues even if the motor has been switched off	61	-	96	Setpoint signal outside range
27	External motor protector activated (for example MP 204)	62	-	97	Signal fault, setpoint input
28	Battery low	63	-	98	Signal fault, input for setpoint influence
29	Turbine operation (impellers forced backwards)	64	-	99	Signal fault, input for analog setpoint
30	Change bearings (specific service information)	65	Motor temperature 1 (t_m or t_mo or t_mo1)	100	RTC time synchronisation with cellular network occurred
31	Change varistor(s) (specific service information)	66	Temperature, control electronics (t_e)	101	-
32	Overvoltage	67	Temperature too high, internal frequency converter module (t_m)	102	Dosing pump not ready
33	Soon time for service (general service information)	68	External temperature or water temperature (t_w)	103	Emergency stop
34	No priming water	69	Thermal relay 1 in motor, for example Klixon	104	Software shutdown
35	Gas in pump head, de-aerating problem	70	Thermal relay 2 in motor, for example thermistor	105	Electronic rectifier protection activated (ERP)

Code	Description	Code	Description	Code	Description
106	Electronic inverter protection activated (EIP)	141	-	176	Signal fault, temperature sensor 3 (t_mo3)
107	-	142	-	177	Signal fault, Smart trim gap sensor
108	-	143	-	178	Signal fault, vibration sensor
109	-	144	Motor temperature 3 (Pt100, t_mo3)	179	Signal fault, bearing temperature sensor (Pt100), general or top bearing
110	Skew load, electrical asymmetry	145	Bearing temperature high (Pt100), in general or top bearing	180	Signal fault, bearing temperature sensor (Pt100), middle bearing
111	Current asymmetry	146	Bearing temperature high (Pt100), middle bearing	181	Signal fault, PTC sensor (short-circuited)
112	Cosφ too high	147	Bearing temperature high (Pt100), bottom bearing	182	Signal fault, bearing temperature sensor (Pt100), bottom bearing
113	Cosφ too low	148	Motor bearing temperature high (Pt100) in drive end (DE)	183	Signal fault, extra temperature sensor
114	Motor heater function activated (frost protection)	149	Motor bearing temperature high (Pt100) in non-drive end (NDE)	184	Signal fault, general-purpose sensor
115	Too many grinder reversals or grinder reversal attempt failed	150	Fault (add-on) pump module	185	Unknown sensor type
116	Grinder motor overtemperature	151	Fault, display (HMI)	186	Signal fault, power meter sensor
117	Intrusion (door opened)	152	Communication fault, add-on module	187	Signal fault, energy meter
118	Signal fault, hydrogen sulfide H2S sensor	153	Fault, analog output	188	Signal fault, user-defined sensor
119	Signal fault, analog input AI4	154	Communication fault, display	189	Signal fault, level sensor
120	Auxiliary winding fault (single phase motors)	155	Inrush fault	190	Limit exceeded, sensor 1 (for example alarm level in WW application)
121	Auxiliary winding current too high (single-phase motors)	156	Communication fault, internal frequency converter module	191	Limit exceeded, sensor 2 (for example high level in WW application)
122	Auxiliary winding current too low (single-phase motors)	157	Real-time clock out of order	192	Limit exceeded, sensor 3 (for example overflow level in WW application)
123	Start capacitor, low (single-phase motors)	158	Hardware circuit measurement fault	193	Limit exceeded, sensor 4 (for example low level in WW/tank filling application)
124	Run capacitor, low (single-phase motors)	159	CIM fault (Communication Interface Module)	194	Limit exceeded, sensor 5
125	Signal fault, outdoor temperature sensor	160	Cellular modem, SIM card fault	195	Limit exceeded, sensor 6
126	Signal fault, air temperature sensor	161	Sensor supply fault, 5 V	196	Operation with reduced efficiency
127	Signal fault, shunt relative pressure sensor	162	Sensor supply fault, 24 V	197	Operation with reduced pressure
128	Strainer clogged	163	Measurement fault, motor protection	198	Operation with increased power consumption
129	-	164	Signal fault, LiqTec sensor	199	Process out of range (monitoring, estimation, calculation, control)
130	-	165	Signal fault, analog input 1	200	Application alarm
131	-	166	Signal fault, analog input 2	201	External sensor input high
132	-	167	Signal fault, analog input 3	202	External sensor input low
133	-	168	Signal fault, pressure sensor	203	Alarm on all pumps
134	-	169	Signal fault, flow sensor	204	Inconsistency between sensors
135	-	170	Signal fault, water-in-oil (WIO) sensor	205	Level float switch sequence inconsistency
136	-	171	Signal fault, moisture sensor	206	Water shortage, level 1
137	-	172	Signal fault, atmospheric pressure sensor	207	Water leakage
138	-	173	Signal fault, rotor position sensor (Hall sensor)	208	Cavitation
139	-	174	Signal fault, rotor origo sensor	209	Non-return valve fault
140	-	175	Signal fault, temperature sensor 2 (t_mo2)	210	High pressure

Code	Description	Code	Description	Code	Description
211	Low pressure	226	Communication fault, I/O module	241	Motor phase failure
212	Diaphragm tank precharge pressure out of range	227	Combi event	242	Automatic motor model recognition failed
213	VFD not ready	228	Night flow max. limit exceeded	243	Motor relay has been forced (manually operated or commanded)
214	Water shortage, level 2	229	Water on floor	244	Fault, On/Off/Auto switch
215	Soft pressure buildup time-out	230	Network alarm	245	Pump continuous runtime too long
216	Pilot pump alarm	231	Ethernet: No IP address from DHCP server	246	User-defined relay has been forced (manually operated or commanded)
217	Alarm, general-purpose sensor high	232	Ethernet: Auto-disabled due to misuse	247	Power-on notice, (device or system has been switched off)
218	Alarm, general-purpose sensor low	233	Ethernet: IP address conflict	248	Fault, battery/UPS
219	Pressure relief not adequate	234	Backup pump alarm	249	User-defined event 1
220	Fault, motor contactor feedback	235	Gas detected	250	User-defined event 2
221	Fault, mixer contactor feedback	236	Pump 1 fault	251	User-defined event 3
222	Time for service, mixer	237	Pump 2 fault	252	User-defined event 4
223	Time for service, mixer	238	Pump 3 fault	253	SMS data from DDD sensor not received within time limit
224	Pump fault, due to auxiliary component or general fault	239	Pump 4 fault	254	Inconsistent data model
225	Communication fault, pump module	240	Lubricate bearings (specific service information)		

1. Webserver configuration

The built-in webserver offers easy monitoring of the CIM 500 module, and makes it possible to configure the selected Industrial Ethernet protocol. Using the webserver, you can also update the firmware of the CIM 500 module and store or restore settings, among other functions.

To connect a PC to CIM 500, proceed as follows:

1. Connect the PC and the module using an Ethernet cable.
2. Configure the Ethernet port of the PC to the same subnetwork as CIM 500, for example 192.168.1.101. See section *1.1 How to configure an IP address on your PC using Windows 7* or *1.2 How to configure an IP address on your PC using Windows 10*.
3. Open a standard Internet browser and type 192.168.1.100 in the URL field.

1.1 How to configure an IP address on your PC using Windows 7

1. Open "Control Panel".
2. Select "Network and Sharing Center".
3. Click [Change adapter settings].
4. Right-click and select "Properties" for the Ethernet adapter. Typically "Local Area Connection".
5. Select properties for "Internet Protocol Version 4 (TCP/IPv4)".
6. Select the "Alternate Configuration" tab and enter the user-configured IP address and the subnet mask you would like to assign to your PC. See fig. 1.

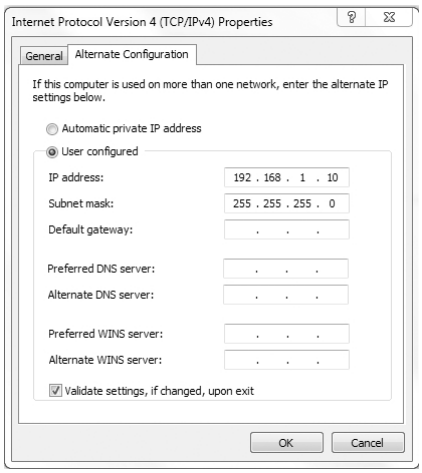


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Fig. 1 Example from Windows 7

1.2 How to configure an IP address on your PC using Windows 10

1. Search for "Ethernet" in Windows.
2. Select "Change Ethernet setting".
3. Select "Change adapter options".
4. Right-click "Ethernet" and select "Properties".
5. Select properties for "Internet Protocol Version 4 (TCP/IPv4)".
6. Select the "Alternate Configuration" tab and enter the user-configured IP address and subnet mask you would like to assign to your PC.

1.3 Login

For administration of username and password, see also *User Management*.

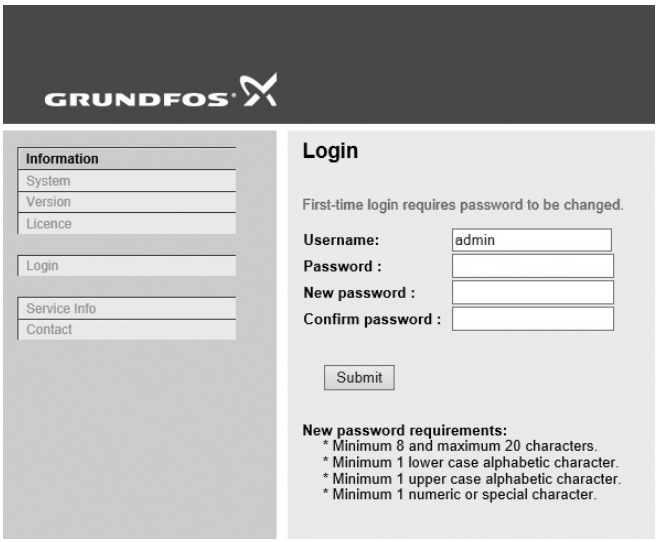

Fig. 2 Login

Object	Description
Username	Enter username. Default: admin.
Password	Enter password. Default: Grundfos. After the first login, you are forced to change the password. The password must contain: • at least 8 and maximum 20 characters • at least one lower case letter • at least one upper case letter • at least one numeric or special character. When logging in, you have four attempts before a back-off algorithm starts an exponentially increasing time delay between each attempt. Power cycling CIM 500 resets the back-off algorithm.

1.4 EtherNet/IP configuration

This web page is used to configure all the parameters relevant to the EtherNet/IP protocol standard.

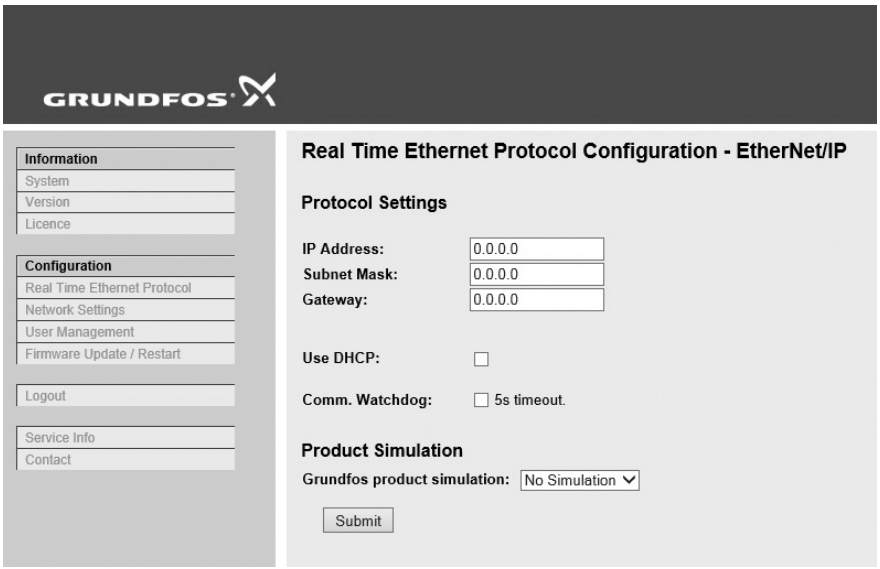

Fig. 3 Real Time Ethernet Protocol Configuration - EtherNet/IP

Object	Description
IP Address	Configuration of the static IP address if a DHCP server is not used. EtherNet/IP is not allowed to share the IP address with a CIM 500 webserver.
Subnet Mask	Configuration of the subnet mask if a DHCP server is not used.
Gateway	Configuration of the gateway address if a DHCP server is not used.
Use DHCP	The CIM 500 module can be configured to automatically obtain its EtherNet/IP network settings from a DHCP server, if available on the network. Default: No use of DHCP.
Communication Watchdog	For enabling of a 5 seconds communication watchdog timer. Only active for pump or booster products. Unchecked: Watchdog is disabled (default). Checked: Watchdog is enabled, time-out is 5 seconds. Watchdog action: The pump or the booster is set to local mode.
Grundfos product simulation	The module can be put in product simulation mode to generate realistic simulated values of all the EtherNet/IP input data. It will thus be possible to connect an EtherNet/IP master to a module fitted in a CIU or an E-box without installing this device in a real industrial process system. In an office environment, it can then be verified that communication works, and data is received and handled correctly by the EtherNet/IP master application program (for example PLC program) before installing the device. To enable product simulation, select a product type from the dropdown list. To terminate product simulation, select "No Simulation".

You need a contract with Grundfos and an external router with Internet connection to gain access to the GRM server.

1.5 Network settings

This web page is used to configure the network settings of the webserver and of the GENIpro TCP protocol. The network settings here are also used for BACnet IP. Additional configuration of BACnet IP is done in the Real Time Ethernet Protocol menu. See *EtherNet/IP configuration*.

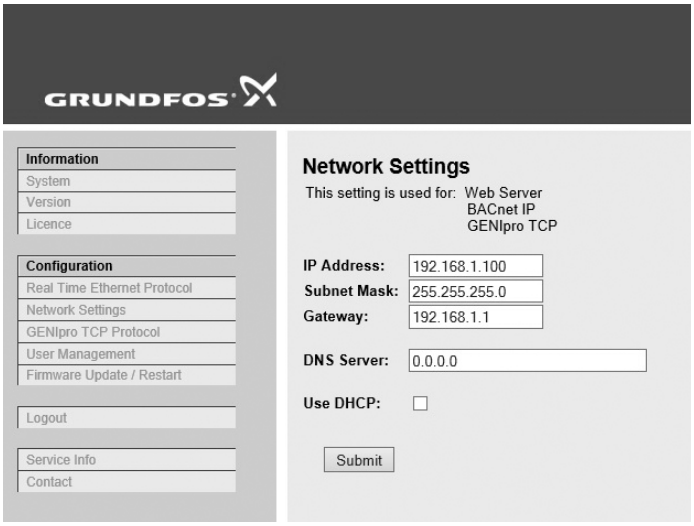

Fig. 4 Network settings

Object	Description
IP Address	Configuration of the static IP address if a DHCP server is not used. Default: 192.168.1.100.
Subnet Mask	Configuration of the subnet mask if a DHCP server is not used. Default: 255.255.255.0.
Gateway	Configuration of the gateway address if a DHCP server is not used. Default: 192.168.1.1.
DNS Server	The module can be configured to use a specific domain name server, if available on the network. Default: 0.0.0.0.
Use DHCP	The module can be configured to automatically obtain the IP address from a DHCP server, if available on the network. Default: Do not use DHCP.

1.6 User Management

A login is required for any change of the CIM 500 settings, and this web page is used to configure the username and password. See *Login*.

It is only possible to configure one user.

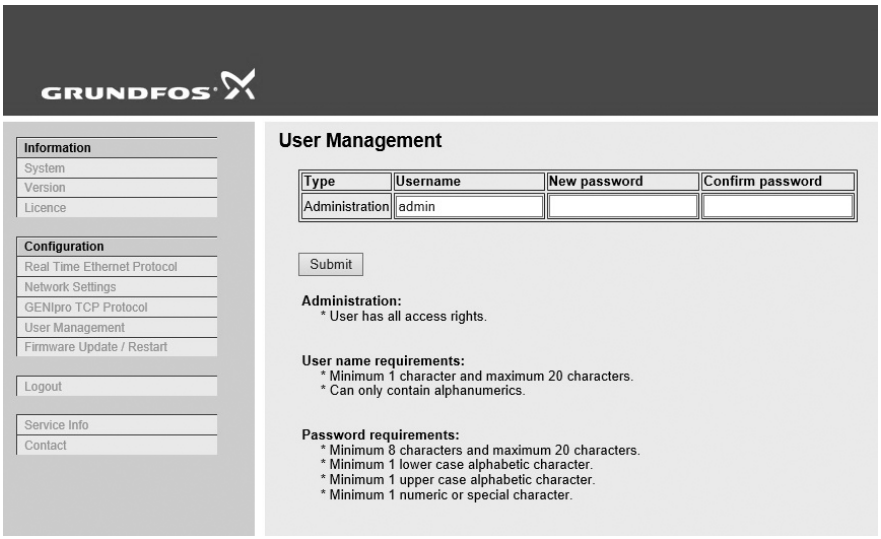

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Fig. 5 User management

1.7 Update

You can update the firmware by means of the built-in webserver. The binary file is supplied by Grundfos.

To make installation and configuration easier, you can upload the configuration to a PC for backup or distribution to multiple modules.

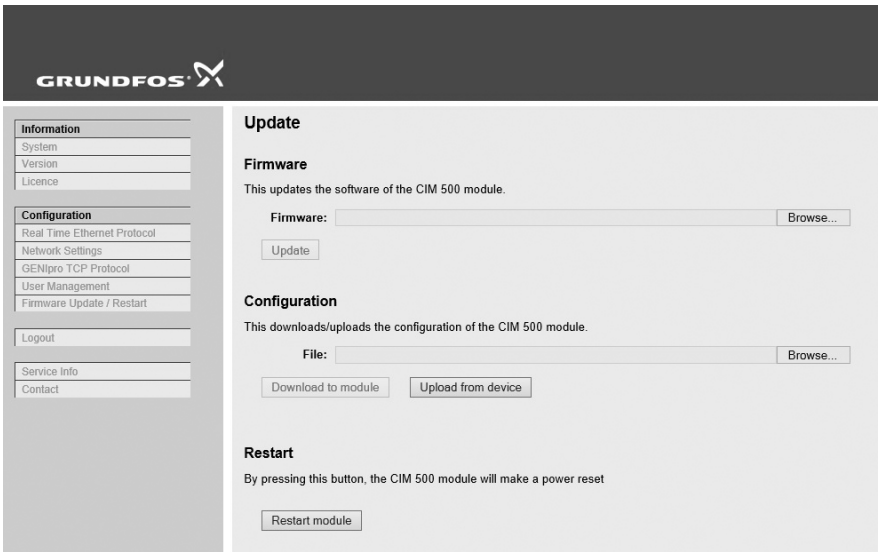

Fig. 6 Update

Object	Description
Firmware	Path to binary firmware image that can be used for updating the module.
Update	Click [Update] to start the update. The procedure takes approximately one minute.
File	Path to the configuration file.
Download to module	Click here to transfer the configuration file to the module.
Upload from device	Click here to upload the configuration of the module to a file on your PC.
Restart module	By pressing this button, the CIM 500 module performs a power-up reset.

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Addresses Revised 09.09.2020

99747759 09.2020
ECM: 1294919

SECTION 4

INSTRUMENTS

D80 Series

Dry or Liquid Filled • Stainless Steel Case

UTILITY GAUGES

D82LFB shown

- **1 1/2", 2", 2 1/2", 4" Dial Sizes**
- **±1.6% Accuracy (1% Optional)**
- **Stainless Steel Case**
- **Glycerine Fill Standard**

The Trerice **D80 Series** Industrial Gauge is designed for rugged performance requirements at an economical cost. This liquid filled gauge is furnished with a stainless steel case and crimped ring. Wetted parts are either bronze tube with Lead-Free (PBF) brass socket or stainless steel.

- **Optional features and case style variations available: Please consult the Options & Accessories Section for details.**
- **For correct use and application of all pressure gauges, please refer to: Pressure Gauge Standard ASME B40.100.**

Specifications

Models		Wetted Parts
D82B **D82LFB**	(dry) (liquid filled)	Bronze tube, brass socket Lead-Free (PBF) Meets NSF/ANSI Standards 372 and 61
D83SS **D83LFSS**	(dry) (liquid filled)	316 Stainless steel tube & socket

Dial Sizes	1 1/2", 2", 2 1/2", 4"
Fill	Glycerine, other fills available See Optional Features Section
Movement	**D82**: Brass **D83**: 316 Stainless steel
Connection	Lower male or center back male, (Lower back male 4" Dial only)
Case	304 stainless steel, stem-mounted flangeless
Ring	Crimped 304 stainless steel
Window	Acrylic
Pointer	Plain, black finished
Dial Face	Aluminum, white background with black graduations and markings
Accuracy	±1.6% Full Scale (1% available as an option)
Maximum Temperature	**150°F (65°C)**
Approximate Shipping Weight	1 1/2" Dial Size: 0.4 lbs [0.18 kg] 2" Dial Size: 0.4 lbs [0.18 kg] 2 1/2" Dial Size: 0.5 lbs [0.23 kg] 4" Dial Size: 1.0 lbs [0.45 kg]

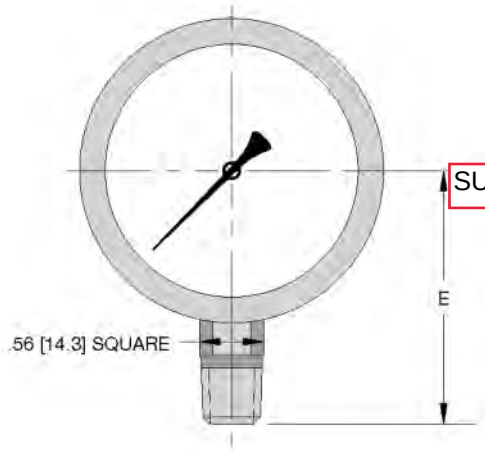
HOW TO ORDER

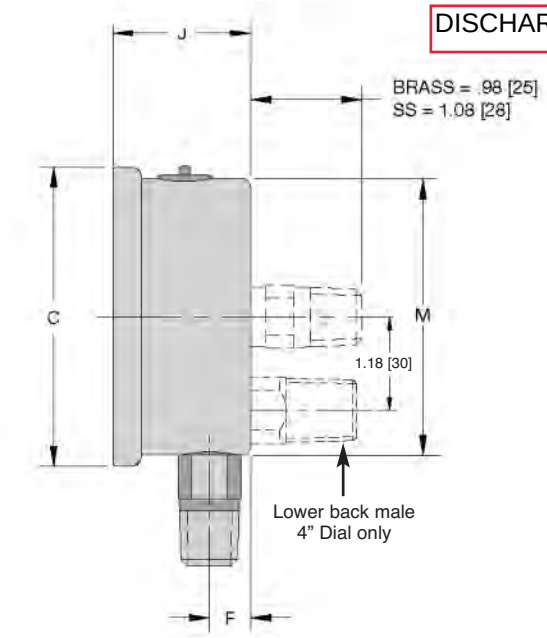
Sample Order Number: **D82LFB 25 02 L A 110**

Model	Dial Size	Connection Size	Connection Location	Units of Measure	Range Code
D82LFB	**15** 1 1/2	**01** 1/8 NPT*	**L** Lower	**A** psi	See Standard Ranges
D83LFSS	**20** 2"	**02** 1/4 NPT**	**B** Back	**D** psi/kPa	
D82B	**25** 2 1/2"	**04** 1/2 NPT***			
D83SS	**40** 4"				

* 1/8 NPT connection size not available with 4" dial size.
** 1/4 NPT connection size not available with 1 1/2" dial size.
*** 1/2 NPT connection size only available with 4" dial size.

All dimensions are nominal. Dimensions in [ ] are in millimeters.





Standard Ranges

psi Ranges (A)		D82		D83	
Range Code	Specific Range (psi)	Figure Intervals	Minor Divisions	Figure Intervals	Minor Divisions
010	30" Hg to 0	5	0.5	5	0.5
020	30" Hg to 15 psi	10/5	1/0.5	10/5	1/0.5
030	30" Hg to 30 psi	10/5	1/1	10/5	1/1
040	30" Hg to 60 psi	10/10	2/1	10/10	2/1
050	30" Hg to 100 psi	30/20	2/2	30/20	2/2
060	30" Hg to 150 psi	30/30	5/2	30/30	5/2
070	30" Hg to 300 psi	30/50	5/5	30/50	5/5
080	0 to 15 psi	3	0.2	3	0.2
090	0 to 30 psi	5	0.5	5	0.5
100	0 to 60 psi	10	1	10	1
110	0 to 100 psi	10	1	10	1
120	0 to 160 psi	20	2	20	2
130	0 to 200 psi	20	2	20	2
140	0 to 300 psi	50	5	50	5
150	0 to 400 psi	50	5	50	5
160	0 to 600 psi	100	10	100	10
180	0 to 1000 psi	100	20	100	20
190	0 to 1500 psi	300	20	300	20
200	0 to 2000 psi	200	20	200	20
210	0 to 3000 psi	500	50	500	50
220	0 to 5000 psi	1000	100	1000	100

Ranges over 5000 PSI are not available on D82LFB.

230	0 to 10000 psi	N/A	N/A	2000	200
240	0 to 15000 psi	N/A	N/A	3000	200

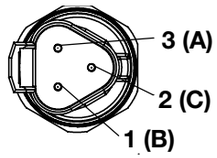
*For dual scale ranges specify the appropriate **Units of Measure: D** (psi/kPa) followed by the corresponding **A** (psi) **Range Code***

Dial Size	C	E	F	J	M
1½" D82	1.85 [47]	1.50 [38]	0.32 [8]	1.06 [27]	1.61 [41]
1½" D83	1.85 [47]	1.50 [38]	0.32 [8]	1.06 [27]	1.61 [41]
2" D82	2.28 [58]	1.89 [48]	0.39 [10]	1.14 [29]	2.05 [52]
2" D83	2.28 [58]	2.05 [52]	0.35 [9]	1.18 [30]	2.05 [52]
2½" D82	2.68 [68]	2.24 [57]	0.39 [10]	1.18 [30]	2.44 [62]
2½" D83	2.68 [68]	2.32 [59]	0.51 [13]	1.38 [35]	2.44 [62]
4" D82	4.29 [109]	3.07 [78]	0.47 [12]	1.42 [36]	3.90 [99]
4" D83	4.29 [109]	3.94 [100]	0.75 [19]	1.93 [49]	3.94 [100]

G2, G3. GV ELECTRICAL TERMINATIONS AND WIRING

DEUTSCH DT SERIES DT04-3P

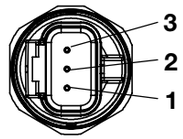
Pin No.	Voltage Output	4-20mA Output*	Mating Cable Color
1 (B)	Common	V –	Black
2 (C)	Output	V –	White
3 (A)	V +	V +	Red



* Use either V- termination on G2 with 4-20mA output

DEUTSCH DTM SERIES DTM04-3P

Pin No.	Voltage Output	4-20mA Output*	Mating Cable Color
1	V +	V +	Red
2	Common	V –	Black
3	Output	V –	White

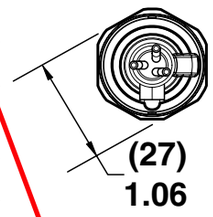


* Use either V- termination on G2 with 4-20mA output

SHIELDED CABLE, PVC JACKET 24AWG LEADS

Wire Color	Voltage Output	4-20mA Output*
Red	V +	V +
Black	Common	V –
White	Output	V –
Bare**	Shield Drain Wire	Shield Drain Wire

IP67 Ingress rating



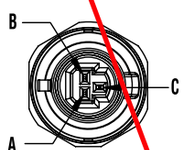
* Use either V- termination on G2 with 4-20mA output

3-PIN DELPHI (PACKARD) METRI-PACK 150 SERIES

Mates to Optional Metri-Pack connector 12065287

Pin No.	Voltage Output	4-20mA Output*	Mating Cable Color
A	Common	V –	Black
B	V +	V +	Red
C	Output	V –	White

IP67 Ingress rating



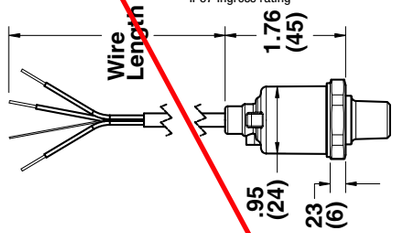
* Use either V- termination on G2 with 4-20mA output

G2, G3. GV ELECTRICAL TERMINATIONS AND WIRING

FLYING LEADS 18AWG

Wire Color	Voltage Output	4-20mA Output*
Red	V +	V +
BlackCommon	V –	V –
WhiteOutput		

IP67 Ingress rating

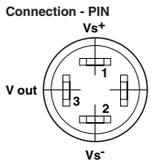


DIN 43650 FORM C (EN 175301-803-C) ELECTRICAL TERMINATION (DC), (N1), (N2), (N3), (N9)

Mates to Hirschmann P/N: GSSNR 300, Ashcroft P/N 300A126-01

Pin No.	Voltage Output	4-20mA Output*	Mating Cable Color
1	V +	V +	Red
2	Common	V –	Black
3	Output		White

IP65 Ingress rating



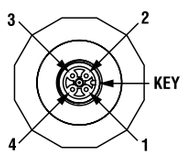
T2 ELECTRICAL TERMINATIONS AND WIRING

M12 ELECTRICAL TERMINATION FOR T2 (EW), (EO), (E2), (E1)

Mates to optional Hirschmann connector Part 933 172-100 or equal

Pin No.	Voltage Output	4-20mA Output*	Mating Cable Color
1	V +	V +	Red
2	Output	None	White
3	Case Gnd.	Case Gnd.	Green
4	Common	Common	Black

IP65 Ingress rating



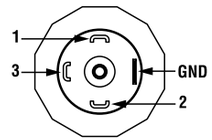
T2 ELECTRICAL TERMINATIONS AND WIRING

DIN 43650 FORM A (EN 175301-803-A) ELECTRICAL TERMINATION (DN), (DO), (D2), (D1)

Mates to optional Hirschmann connector GDM 3009 or equal

Pin No.	Voltage Output	4-20mA Output*	Mating Cable Color
1	V +	V +	Red
2	Common	Common	Black
3	Output	None	White
GND	Case Gnd.	Case Gnd.	Green

IP65 Ingress rating

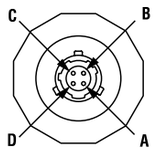


4-PIN BENDIX STYLE ELECTRICAL TERMINATION (B4), (H1), (L1), (P2)

Mates to optional Amphenol Bendix connector PTO6A-8-4-SR or equal

Pin No.	Voltage Output	4-20mA Output*	Mating Cable Color
A	V +	V +	Red
B	Output	None	White
C	Case Gnd.	Case Gnd.	Green
D	Common	Common	Black

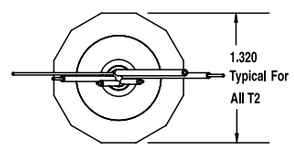
IP65 Ingress rating



SHIELDED CABLE, PVC JACKET, 24 AWG LEADS, TERMINATION (F2), (P1)

Wire Color	Voltage Output	4-20mA Output
Red	V +	V +
White	Output	None
Black	Common	Common
Green	Case Gnd.	Case Gnd.
Bare**	Drain Wire	Drain Wire

IP65 Ingress rating



* Use either V- termination on G2 and GV with 4-20mA output

** Where shielded wiring is being used; Connect the drain wire to the guard terminal on the read out device or measuring instrument if available. In all other cases connect to the ground of the power supply negative terminal.

ASHCROFT®

G2, G3, GV & T2 PRESSURE TRANSMITTER INSTRUCTION SHEET

⚠ WARNING! READ BEFORE INSTALLATION ⚠

1. GENERAL:

A failure resulting in injury or damage may be caused by excessive overpressure, excessive vibration or pressure pulsation, excessive instrument temperature, corrosion of the pressure containing parts, or other misuse. Consult Ashcroft Inc., Stratford, Connecticut, USA before installing if there are any questions or concerns.

2. OVERPRESSURE:

Pressure spikes in excess of the rated overpressure capability of the transducer may cause irreversible electrical and/or mechanical damage to the pressure measuring and containing elements.

Fluid hammer and surges can destroy any pressure transducer and must always be avoided. A pressure snubber should be installed to eliminate the damaging hammer effects. Fluid hammer occurs when a liquid flow is suddenly stopped, as with quick closing solenoid valves. Surges occur when flow is suddenly begun, as when a pump is turned on at full power or a valve is quickly opened.

Liquid surges are particularly damaging to pressure transducers if the pipe is originally empty. To avoid damaging surges, fluid lines should remain full (if possible), pumps should be brought up to power slowly, and valves opened slowly. To avoid damage from both fluid hammer and surges, a surge chamber should be installed.

Symptoms of fluid hammer and surge's damaging effects:

- Pressure transducer exhibits an output at zero pressure (large zero offset).
- Pressure transducer output remains constant regardless of pressure
- In severe cases, there will be no output.

FREEZING:

Prohibit freezing of media in pressure port. Unit should be drained (mount in vertical position with electrical termination upward) to prevent possible overpressure damage from frozen media.

3. STATIC ELECTRICAL CHARGES:

Any electrical device may be susceptible to damage when exposed to static electrical charges. To avoid damage to the transducer observe the following:

- Ground the body of the transducer BEFORE making any electrical connections.
- When disconnecting, remove the ground LAST!

Note: The shield and drain wire in the cable (if supplied) is not connected to the transducer body, and is not a suitable ground.

DESCRIPTION

The Ashcroft Model G2, GV and T2 pressure transducers are high performance instruments intended for use in industrial applications where the process media is compatible with the 17-4PH stainless steel sensor material and the 304 SS process connection.
The G3 utilizes 316L SS for both the sensor and process connection for use with a process media that requires all 316 SS wetted parts.

MECHANICAL INSTALLATION

Environmental

The G2, G3, GV and T2 transducers can be stored and used within the temperature limits of –40°C to 125°C (-40°F to 257°F). Ingress protection ratings of the units are dependent on the electrical termination specified. Refer to the wiring diagrams on the reverse for the IP rating of the unit which is being installed.

Mounting

The G2, G3, GV and T2 transducers require no special mounting hardware and can be mounted in any orientation with negligible position error. Although the units can withstand considerable vibration without damage or significant output effects, it is always good practice to mount the transducer where there is minimum vibration. For units with NPT type pressure fittings apply sealing tape or an equivalent sealant to the threads before installing. When instal-ling or removing the unit apply a wrench to the hex wrench flats, located above the pressure fitting.
DO NOT tighten by using a pipe wrench on the housing. A 27mm (1 1/16") wrench can be used on the wrench flats of the hex. For G2, G3, GV models with detachable electrical connectors a 6 point deep socket can also be used to install the unit.

Electro-Magnetic Interference

The circuitry of the G2, G3, GV and T2 transducers is designed to minimize the effect of electromagnetic and radio frequency interference. To minimize susceptibility to noise, avoid running the termination wiring in a conduit which contains high current AC power cables. Where possible avoid running the termination wiring near inductive equipment.

Field Adjustments

The G2, G3, GV and T2 transducers are precisely calibrated and temperature compensated at the factory to ensure long and stable performance. There are no field accessible adjustments on the G2 or T2 transducers.

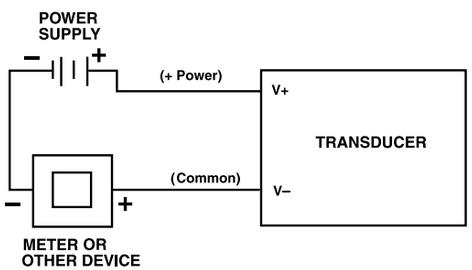
ELECTRICAL INSTALLATION

Please refer to the reverse of this page for power supply requirements and for appropriate wiring protocol based on the particular output signal and electrical terminal.

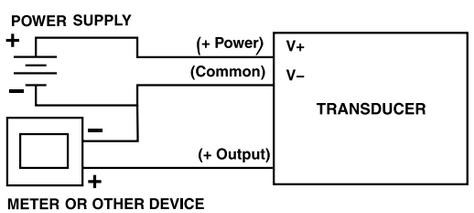
G2, G3, GV & T2 ELECTRICAL INSTALLATION

Wiring Diagrams (see following pages for further detail)

4-20mA Output



3-Wire Voltage Output



G2, G3, GV & T2 ELECTRICAL INSTALLATION (cont.)

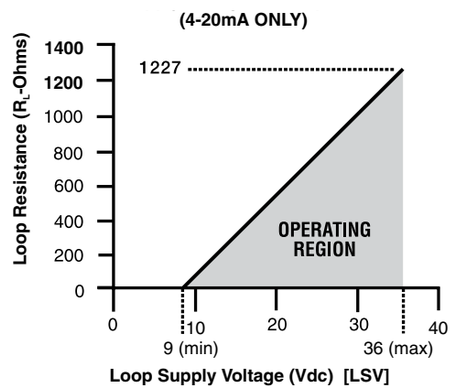
Power Supply Requirements:

Output Signal	Min Supply	Max Supply
Ratiometric* (0.5V to 4.5V)	4.5Vdc	5.5Vdc
0-5Vdc	9Vdc	36Vdc
1-5Vdc	9Vdc	36Vdc
1-6Vdc	9Vdc	36Vdc
0-10V	14Vdc	36Vdc
0.5-4.5Vdc	9Vdc	36Vdc
4-20mA**	9Vdc	36Vdc

*0.5Vdc-4.5Vdc output is ratiometric to the nominal 5Vdc supply

**For transmitters with 4-20mA output signal, the minimum voltage at the terminals is 9Vdc. However, the minimum supply voltage should be calculated using the adjacent graph and formula.

Power Supply Voltage vs Loop Resistance



To determine minimum loop supply voltage:

$LSV(min)=9(V)+[.022(A)*R_L]$

Where:
LSV= Loop Supply Voltage (Vdc)
$R_L = R_S + R_W$ (ohms)
R_L = Loop Resistance (ohms)
R_S = Sense Resistance (ohms) [Measuring Instrument]
R_W = Wiring Resistance (ohms)

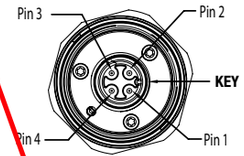
G2, G3 ELECTRICAL TERMINATIONS AND WIRING

M12 ELECTRICAL TERMINATION FOR G2, G3 (EW), (EO), (E2), (E1)

Mates to optional Hirschmann connector Part 933 172-100 or equal

Pin No.	Voltage Output	4-20mA Output*	Mating Cable Color
1	V +	V +	Red
2	Case Grd.	Case Grd.	Green
3	Common	V –	Black
4	Output	V –	White

IP67 Ingress rating



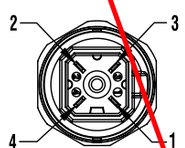
HIRSCHMANN G SERIES

Mates to Optional Hirschmann G4W1F connector, or equal

Pin No.	Voltage Output	4-20mA Output*	Mating Cable Color
1	V +	V +	Red
2	Common	V –	Black
3	Output	V –	White
4	Case Gnd.	Case Gnd.	Green

IP67 Ingress rating

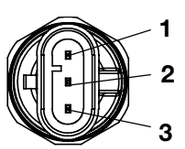
* Use either V- termination on G2 with 4-20mA output



AMP SUPERSEAL

Pin No.	Voltage Output	4-20mA Output*	Mating Cable Color
1	Common	V –	Black
2	Output	V –	White
3	V +	V +	Red

* Use either V- termination on G2 with 4-20mA output



SECTION 5

VALVES

Description:

LEAD FREE NSF/ANSI 61

The Sylax®3 butterfly valve is a resilient-seated valve designed for many general industrial service applications including commercial, irrigation and municipal usage. The butterfly valve is composed of body, shaft, disc, seat, bushing, shaft bearings, manual operator, etc. The manual operator drives the shaft and disc to open/close the valve and control the flow.
Available in lugged or wafer style ductile iron body, Stainless Steel disc and EPDM liner as standard materials. The standard valve ratings are listed below:

Standards / Ratings:

Nominal Diameters	2” (50mm) THRU 12” (300mm)
Max Working Temperature	230º F (110º C)
Max Pressure	250 psi (17 bar) Bidirectional
Flanges Rating	ANSI 150 (B16.1)
Top Mounting	ISO 5211

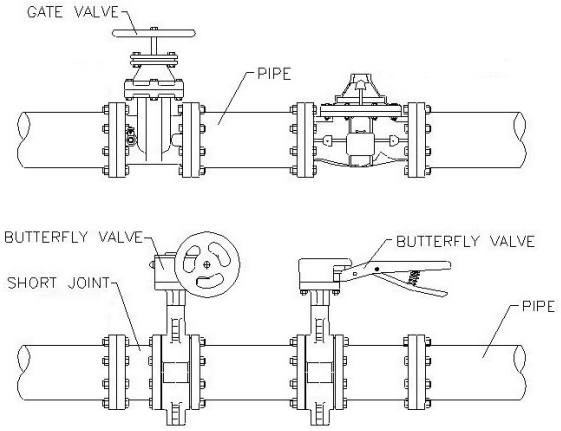
- Drinking Water System Componets – Health Effects according to NSF/ANSI 61
- Low Lead Certified according to NSF/ANSI 372

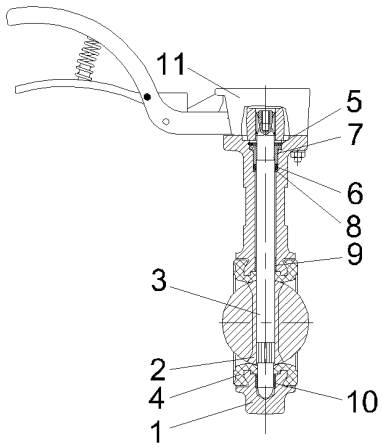
OPTIONAL OPERATED METHODS:

- Lever operated: depress the lever and turn it clockwise or counter-clockwise up to 90º then release the lever. (There are 10 locking positions between and including 0º and 90º)
- Gear operated: turn the hand wheel to drive the disc to the closed position and control the flow. To close the valve turn the hand wheel clockwise.
- Actuator operated, electric, pneumatic or chain-wheel.

FEATURES:

- Small in size and light in weight. Easy installation and maintenance, versatile installation.
- Simple and compact construction. Quick 90º on-off operation.
- Minimized operating torque, energy saving.
- Bubble-tight shut off.
- Flow curve modified linear, excellent regulation performance.
- Extended service, high cycle life.
- The pipeline installed with gate valve, plug valve, rubber pipe valve or diaphragm valve etc. can be replaced by a butterfly valve and a short joint (spool piece), details as per the sketch.





1	BODY
2	DISC
3	SHAFT
4	LINER
5	CIRCLIP
6	O'RING
7	BUSHING
8	SAFETYBUSHING
9	UPPER BUSHING
10	LOWER BUSHING
11	LEVER ASSEMBLY

SHIPMENT / STORAGE / INSTALATION:

- Sylax®3 butterfly valves disc should be opened no more then 4 to 5 degrees during storage or transportation. This is to protect the disc edge from damage.
- Sylax®3 butterfly valves should be stored in a clean, dry place away from UV light.
- Prior to installation verify:
  - That the Sylax®3 butterfly valve selected is correct for the application.
  - That all sealing surfaces are clean, and free from debris.
  - That all scale, debris, foreign materials are removed from piping system.
  - That valve operator (lever, gear or actuator) is properly secured to valve.
  - That Sylax®3 butterfly valve disc outside diameter is not greater than piping/flange inside diameter. If it is valve will not open properly and you may "jam" disc inside piping/flange damaging valve disc.
- The Sylax®3 butterfly valve can be installed in any orientation in pipeline.
- Flow through the Sylax®3 butterfly valve can be bi-directional.
- Position of Sylax®3 butterfly valve in piping system should allow for ease of operation, maintenance and removal.
- Mounting wafer style Sylax®3 butterfly valves to the pipeline flanges can be done with either bolts or studs that extend through both flanges
- Mounting lug style Sylax®3 butterfly valves to the pipeline flanges should be done with bolts only. Studs are not recommended.
- During installation verify:
  - The piping alignment to Sylax®3 butterfly valve is correct.
  - The Sylax®3 butterfly valve disc is open partially inside the valve body. Disc should not be in full closed position when tightening flanges. This allows rubber seal to self position for proper seal to disc interaction.
  - A flange gasket is not used between the Sylax®3 butterfly valve and the pipe flange. The Sylax®3 butterfly valve seat / liner flange face has a molded in o'ring which provides all the valve to flange sealing necessary.
  - ***When an actuator is mounted on the Sylax®3 butterfly valve, the actuator should not be mounted below horizontal in order to avoid water damage to the actuator that may occur if there is condensation or a water leak that travels along the piping and into the actuator.***
  - The Sylax®3 butterfly disc is interference free from piping components. While flange bolting is finger tight, open disc slowly to check for interference. If no interference return disc to partial open and finish tightening flange bolts in a crisscross pattern. **If interference occurs check for piping misalignment.** After realigning piping flanges recheck for interference.
- After installation Sylax®3 butterfly valve disc should be in open position for initial system pressure testing.
- Recommended routine inspection checks should include:
  - Verification by visual inspection that valve seat and flange sealing surfaces are in good condition.
  - Verification that the valve operator is in working condition.
  - After inspection/maintenance verify that valve is opening and closing smoothly.
  - After inspection/maintenance verify that valve is leak tight in closed position.

- Wafer and lug style butterfly valves provide the same working performance. However ONLY the lug style, can be used for "***bi-directional dead end***" service.

NOTE: for size and quantities of bolts see table

REMOVING VALVE FROM SYSTEM:

- WARNING !
  Loosening the bolts on a pressurized valve/system can cause the valve to shift and release uncontrolled pipeline fluid. This will cause personal injury and/or pipeline damage.
- Relieve the pressure from the system and make sure to drain the pipeline before loosening valve bolting.
- Close the Sylax®3 butterfly valve disc before removing from between the pipe flanges.
  If the Sylax®3 butterfly valve has an electric actuator make sure to turn off and lock out the power before removing or servicing.
- If the actuator is powered, disconnect and lock out any electric, pneumatic or hydraulics to prevent injury and/or accidental operation.
- Support the Sylax®3 butterfly valve, remove the bolts completely then remove the Sylax®3 butterfly valve from the pipeline.
  Do not lift by the stem – this will damage the Sylax®3 butterfly valve and void the warranty.

TROUBLE SHOOTING:

PROBLEM	REASON	POSSIBLE SOLUTION
Valve does not fully close	Debris wedged between disc and seal or stop is not adjusted correctly	Open valve to flush out debris or adjust the close stop
Leakage at sealing surface	Seat damaged, disc damaged or dirt between disc and seat	Replace seat or disc, clean the sealing surface
Leakage at the shaft	The seat shaft hole damaged, or O-ring damaged	Replace seat or O-ring
Leakage at flange end	The bolt did not contact tightly, or not uniform, or seat damaged	Tighten bolts or replace the seat.

Warning: Working pressure, temperature, media must match valve capability or valve/piping damage can occur.

- Working pressure must not exceed valve maximum pressure rating.
- Temperature must not exceed maximum temperature rating.
- Media must be compatible with body, seat, seals and disc material.

Flomatic Valves is not responsible for the loss caused by the usage beyond the valve capabilities.

STANDARD FLANGE SIZE & QUANTITIES OF BOLTS FOR INSTALLATION:
(FOR REFERENCE ONLY)

SIZE		Flange 125# / 150#			
in	mm	QTY	Bolt Ø	Bolt Length	Torque (ft/lbs)
2	50	4	5/8	2-1/4	25-75
2-1/2	65	4	⅝	2-1/2	25-75
3	80	4	⅝	2-1/2	25-75
4	100	8	⅝	3	30-90
5	125	8	¾	3	30-90
6	150	8	¾	3-1/4	30-90
8	200	8	¾	3-1/2	40-120
10	250	12	⅞	3-3/4	45-150
12	300	12	⅞	3-3/4	65-200

Limited One Year Warranty: Flomatic valves are guaranteed against defects of material or workmanship when used for the services recommended. If, in any recommended service a defect develops due to material or workmanship, and the device is returned, freight prepaid, to Flomatic Corporation within 12 months from date of purchase, it will be repaired or replaced free of charge. Flomatic Corporations' liability shall be limited to our agreement to repair or replacement of valve only.©2019

Operation:

Flomatic 888 wafer check valves are normally installed downstream of a pump. Upon pump shut down the spring loaded valve is designed to close before reversal of flow. This will prevent flow reversal slam, which helps to eliminate water hammer and system surges associated with valve closure. On start-up, the water forces the poppet open and allows water to pass thru the valve. On shut-down the spring closes the poppet to prevent the flow reversal. The only moving parts are the poppet and spring, with the bushing guiding the poppet stem for even seating.

Installation:

Installation must be performed by qualified, licensed personnel only.
Remove all packing materials from the valve, including the tabs that stop seat from getting damaged during shipping.
The Flomatic 888 wafer check valve can be installed vertically (flow up) or horizontally. Consult factory for vertical flow down. The valve must be installed with the flow arrow on the tag pointing to the flow of water. Three diameters of straight pipe upstream of the valve are recommended to prevent turbulent flow thru the valve, which will cause vibration and wear. Valves must be mounted between ANSI B16.5 flat face flanges with 1/16 min thickness ring gaskets. Centering the valve properly is important to prevent damage to the valve and/or leakage. Never lift the valve by the bronze or stainless steel trim. Hand tighten, then torque the bolts using the cross-over flange bolt tightening method. This will load the bolts evenly and help eliminate concentrated stresses.

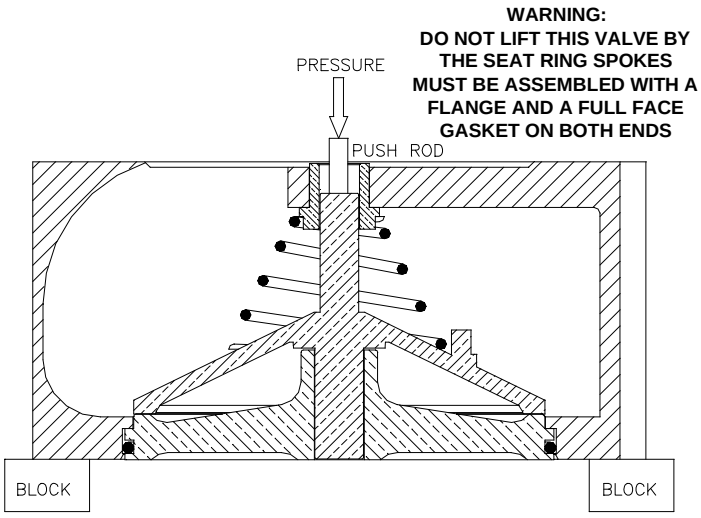
125# Flange			250# Flange		
Valve Size	Bolt Diameter	Bolt Torque	Valve Size	Bolt Diameter	Bolt Torque
2	5/8	25-75	2	5/8	25-75
2.5	5/8	25-75	2.5	3/4	25-75
3	5/8	25-75	3	3/4	35-75
4	3/4	30-90	4	3/4	50-150
5	3/4	30-90	5	3/4	70-150
6	3/4	30-90	6	3/4	70-150
8	3/4	40-120	8	7/8	90-200
10	7/8	45-150	10	1	110-300

Maintenance:

The Flomatic 888 wafer check valve should be serviced yearly by a qualified and licensed person only. The valve should be isolated, and the pressure in the line needs to be relieved on both sides of the valve. The outlet flange should be loosened first, then the inlet flange can be loosened to relieve line pressure. After the valve is removed, inspect the internal parts and valve body for wear or damage. Any worn or damage parts should be replaced.

Disassembly / Reassembly:

The Flomatic 888 wafer check valve can be disassembled by placing the valve arrow up on at least two 2 x 4 boards, making sure that the seat ring is not covered, so it can drop from the valve body freely. Make sure that the internals will drop on a surface that will not damage them. Hold a metal rod on the top of the stem. It should cover the stem only, not the bushing. Hit the rod with a hammer and the seat, poppet, spring and bushing will drop out of the valve. See illustration on the next page.



To reassemble the valve, place on a flat surface with the arrow facing down and the inlet side exposed. Place the bushing in the center hole of the spokes. Place the spring on the top of the bushing and the poppet stem thru the spring and bushing. Make sure to lubricate the seat ring o'ring (this is very important to prevent damage to the o'ring which will cause a leak, and not let the seat enter the valve). We recommend using Super Lube – which is NSF approved. Make sure to place the seat ring in valve, lining up the poppet stem thru the bushing and using both hands press on the seat ring to pop it back in. On the larger size valves a 2 x 4 can be places across the seat ring and hit with a hammer to pop it back in.

Trouble Shooting Guide	
Problem:	**Possible Solutions:**
Valve chatters or vibrates	Make sure the velocity is at least 4 feet per second. Noise that sounds like rocks in the line can be cavitation from high velocities, or low downstream pressure. Make sure there is at least 3 diameters of straight pipe upstream.
Valve leaks	If the seat ring is lifted above the flange face – the mating flange and gasket are not seated correctly. Re-align the valve and gaskets and tighten the bolts according to the torque chart. Also make sure that the correct size gaskets are being used.
Water does not flow thru valve	Check to make sure the arrow is in the direction of flow. Verify that the downstream isolation valve is open and there is no blockage preventing flow.
Valve Slams	Remove the valve from line and check the spring. Replace worn or damaged spring. If necessary consult the factory about purchasing a heavier spring for your conditions.

Information needed to order repair parts:
Valve Model Number
Valve Size
Valve working Pressure

Limited One Year Warranty: Flomatic valves are guaranteed against defects of material or workmanship when used for the services recommended. If, in any recommended service a defect develops due to material or workmanship, and the device is returned, freight prepaid, to Flomatic Corporation within 12 months from date of purchase, it will be repaired or replaced free of charge. Flomatic Corporations' liability shall be limited to our agreement to repair or replacement of valve only.

SECTION 6

FACTORY TEST REPORTS