

# Operation and maintenance manual

Engine

**TAD1640GE-B**

**TAD1641GE-B**

**TAD1642GE-B**

**TAD1650GE**

**TAD1651GE**

**TWD1643GE**

**TWD1644GE**

**TWD1645GE**

**TWD1653GE**

**VOLVO**

*Supplied by*

**KOHLER®**

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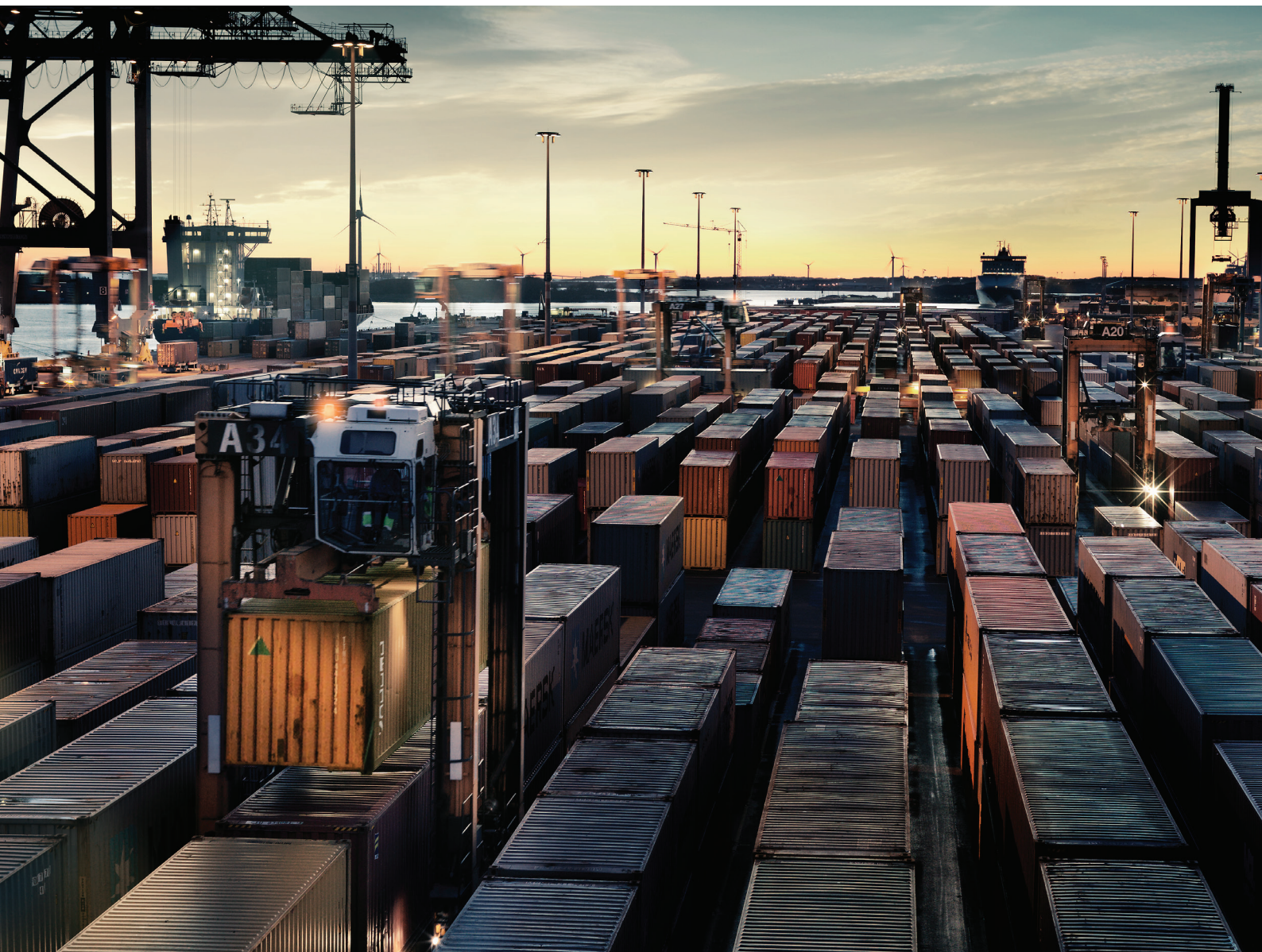
01/08/2023



V O L V O P E N T A

# OPERATOR'S MANUAL

## 16L





## **WARNING!**

Operating, servicing and maintaining a marine vessel can expose you to chemicals including engine exhaust, carbon monoxide, phthalates, and lead which are known to the State of California to cause cancer and birth defects or other reproductive harm.

Breathing diesel engine exhaust exposes you to chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. To minimize exposure, avoid breathing exhaust when operating, servicing and maintaining the engine.

- Always start and operate the engine in a well-ventilated area.
- If in an enclosed area, vent the exhaust to the outside.
- Wear gloves or wash your hands frequently when servicing the vessel.
- Do not modify or tamper with the exhaust system.
- Do not idle the engine except as necessary.

For more information

[www.P65warnings.ca.gov/marine](http://www.P65warnings.ca.gov/marine)

[www.p65warnings.ca.gov/products/diesel](http://www.p65warnings.ca.gov/products/diesel)



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# Foreword

## Welcome!

Volvo Penta engines are designed to fulfill Volvo's core values; quality, safety and environmental care. After more than 100 years as an engine manufacturer, the Volvo Penta brand has also become a symbol of reliability, technical innovation, top-of-the-range performance and long service life. Volvo Penta engines are used all over the world, in different operating conditions.

Make sure to thoroughly read through the Operator's Manual regarding operating and maintenance. It contains the information you need to be able to operate and maintain the engine safely and correctly. Pay careful attention to the safety instructions included in the manual.

As the owner of a Volvo Penta engine, you become part of a worldwide network of dealers and service workshop that assist you with technical advice, service requirements and replacement parts. Contact your nearest authorized Volvo Penta dealer for assistance.

It is possible to buy additional literature about your Volvo Penta engine, e. g. the Service & Maintenance manual. More information on how to do this can be found at [www.volvopenta.com](http://www.volvopenta.com).

**Information about your closest Volvo Penta dealer and other useful news and information can be found at [www.volvopenta.com](http://www.volvopenta.com) and by following Volvo Penta on Facebook.**

**V O L V O  
P E N T A**

[www.volvopenta.com](http://www.volvopenta.com)



[www.facebook.com/volvopenta](http://www.facebook.com/volvopenta)

# Safety Information

This chapter describes how safety precautions are presented in the manual and on the product. Read the chapter through very carefully before you start the engine or do any maintenance or service. It has to do with your safety; an incorrect operation can lead to personal injury and damage to products or property. It also gives you an introduction to the basic safety rules for using and looking after the engine.

If anything remains unclear or if you are unsure of something, contact your Volvo Penta dealer for assistance.

## **IMPORTANT:**

Always follow local safety instructions and regulations.

### **Safety texts have the following order of priority:**

#### **DANGER!**

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

#### **IMPORTANT:**

Indicates a situation, which, if not avoided, could result in property damage.

**NOTICE!** Used to draw attention to important information that facilitates work or operations.



This symbol is may be used on the product to call your attention to the fact that this is safety information. Always read such information very carefully.

Make sure that warning and information symbols on the engine are clearly visible and legible. Replace symbols that have been damaged or have been painted over.



In some cases, this symbol is used on our products and refers to important information in the Operator's Manual.

Most chemicals such as engine and transmission oils, glycol, petrol and diesel oil and chemicals used in workshops such as degreasing agents, paint and solvents are harmful to health.

Carefully read the instructions on the product packaging! Always follow the safety regulations, such as the use of protective masks, goggles, gloves, etc. Make sure that other personnel are not exposed to substances that are hazardous to health. Ensure good ventilation.

Manage used and leftover chemicals in the prescribed manner.

## Daily Checks

### **▲ WARNING!**

Do not start the engine if there is reason to suspect fuel leaks or if there is explosive material nearby.

Make it a habit to give the engine and engine compartment a visual check before the engine is started and after operations, once the engine has stopped. This helps you to quickly discover fuel, coolant or oil leakages or any other abnormality that has occurred, or is about to occur.

## Personal safety equipment

### **▲ CAUTION!**

Always use appropriate safety equipment. Personal protective equipment does not eliminate the risk of injury but it will reduce the degree of injury if an accident does happen.

Some examples are ear protection, eye and face protection, protective footwear, personal protective equipment, head protection, protective clothing, gloves and respirators.

### **▲ WARNING!**

Ensure that all machine guards and safety devices are in place and are functional.

### **▲ CAUTION!**

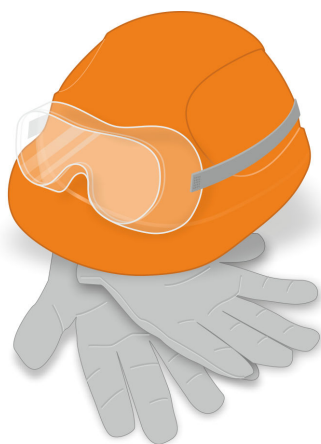
Never use tools or products that show signs of damage.

## Protect your eyes

### **▲ CAUTION!**

Wear safety glasses.

Always wear safety glasses if there is a risk of splintering, sparks and spray from the electrolyte (so-called battery acid), or other chemicals. Your eyes are very delicate and damage can result in loss of sight!



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## Protect your skin

### ⚠ CAUTION!

Risk of skin damage.

Avoid getting oil on your skin! Prolonged or repeated exposure to oil can dry out the skin. Thereafter, irritation, dryness and eczema and other skin problems may occur.

Use protective gloves and avoid oil-soaked clothes and rags. Wash regularly, especially before eating. Wear suitable protective creams to prevent skin from drying out and to facilitate cleaning.

## Fire safety

### ⚠ WARNING!

Fire and Explosion Risk!

Accidental spark could ignite fuel vapors.

All fuels – as well as many lubricants and chemicals – are flammable. Do not allow open flames or sparks near them. **Smoking forbidden!** Hydrogen from the batteries is also very flammable and explosive in certain mixture with air.

Ensure that the workplace is well ventilated and take the necessary precautions before welding or grinding begins. Always ensure that there is a fire extinguisher close at hand in the work area.

## Spare parts — safety

### ⚠ WARNING!

Always use spare parts with the same quality as genuine Volvo Penta parts to minimize the risk of an explosion or fire.

Components in fuel systems and electrical systems on Volvo Penta engines are designed and manufactured to minimize the risk of explosions and fire, in accordance with applicable legal requirements.

## Used oils, filters and chemicals etc.

### ⚠ WARNING!

Risk of fire.

Store fuel soaked rags and other flammable material so that there is no danger of them catching fire.

Oil-soaked rags can spontaneously ignite under certain circumstances.

### IMPORTANT:

Used fuel and oil filters are environmentally hazardous waste and must be taken to an approved waste management facility for correct handling, as must any used lubricating oil, contaminated fuel, paint residue, solvents, degreasers and wash residue.

## Prevent start of the engine

### **⚠ WARNING!**

Immobilize the engine by turning off the power supply with the main switch(es) and lock it (them) in the off position before starting work. Place a warning notice at the main switch.

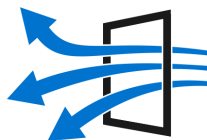
If the engine is equipped with BMS (Battery Management System), always disconnect both battery cables from the battery terminals.

## Ventilation when running the engine

### **⚠ WARNING!**

Only start the engine in a well-ventilated area. If operating the engine in a closed area ensure that there is exhaust ventilation leading out of the work area to remove exhaust gases and crankcase ventilation emissions.

The engine must not be operated in areas where there are explosive materials or stored gas.



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## Rotating parts and hot surfaces

### **⚠ DANGER!**

Working with or approaching a running engine is a safety risk. Watch out for rotating components and hot surfaces.

If the engine is in operation and operates another device, you must not, under any circumstances, staying close to the engine.



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Work on running engines is strictly prohibited. There are however adjustments that require the engine to be run. Approaching a running engine is a safety risk. Loose clothing and long hair can get caught in the rotating parts; careless movements or a dropped tool can lead to serious personal injury.

Be careful to avoid hot surfaces (exhaust pipes, turbochargers, charge air manifolds, start elements etc.) and hot fluids in pipes and hoses on engines that are running or have just stopped. Re-install all protective covers that were removed during maintenance work before starting the engine.

## Information on the engine

### **IMPORTANT:**

Make sure that all warning and information decals on the product are always visible. Replace decals which have been damaged or painted over.



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## Prohibition on use of start spray

### **⚠ WARNING!**

Never use start spray or similar agents to start an engine. This may cause an explosion in the inlet manifold. Risk of personal injury.

## Before start of engine

### **⚠ WARNING!**

Never start the engine if there is reason to suspect fuel and/or gas leaks, or if there is explosive material nearby.

### **IMPORTANT:**

Only start the engine with the air filter and protective caps fitted. Foreign objects in the inlet line could cause machine damage. Also make sure that no tools or other parts have been left next to the engine.

### **⚠ WARNING!**

Never start the engine with the valve cover removed. There is a risk of personal injury. For engines with turbochargers, the rotating compressor turbine can in addition cause serious personal injuries.

## Before any work on the electrical system

### **⚠ WARNING!**

Always stop the engine first. Then disconnect the current at the main switches and any external power supply before working on the electrical system – to minimize the risk of electrical hazards.

### **IMPORTANT:**

Never disconnect the current using the main switches when the engine is running or by disconnecting the battery cables. The alternator and electronics could be damaged.

## Avoid damage to the engine control module and other electronics

### **IMPORTANT:**

Switch off the main switch before connecting or disconnecting a connector.

## Before welding work

### **IMPORTANT:**

Before any work with electric weld can begin, the connection to all control units must be disconnected. After finished welding, re-connect the connection to all control units before connecting any battery cable.

## Before any work on the cooling system

### **⚠ WARNING!**

Stop the engine and let it cool before starting work on the cooling system. Hot fluids and hot surfaces can cause burns.

## Hot coolant under pressure

### **⚠ CAUTION!**

Hot coolant can cause burns. Avoid opening the filler cap for the coolant when the engine is still hot. Steam or hot coolant can spray out and system pressure is lost.

Open the filler cap slowly and release the pressure in the cooling system if the filler cap or valve must be opened – or if a plug or a coolant hose must be removed from a hot engine.

## Hot oil under pressure

### **⚠ CAUTION!**

Hot oil can cause burns. Avoid getting hot oil on the skin. Ensure that the lubrication system is not pressurized before starting any work. Never start or operate the engine without the oil filler cap is on. There is a risk that hot oil can spray out.

## Refueling

### **⚠ WARNING!**

There is always a risk of fire and explosion during refueling. Smoking is forbidden and the engine must be stopped.

## Proper fuel quality

### **IMPORTANT:**

Always use the fuel recommended by Volvo Penta. See *Technical Data* in Operator's Manual. Other fuel can damage the engine.

Wrong fuel quality can also lead to higher service costs.

### **⚠ WARNING!**

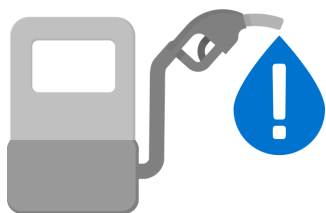
Risk of personal injury.

Wrong fuel quality in a diesel engine can cause the fuel control mechanism to bind which can cause the engine to overspeed!

## Legal requirements to use proper fuel

### **IMPORTANT:**

To meet regulatory requirements for certified emission levels must always recommended fuel according to *Technical Data* in the Operator's Manual be used.



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## At any leak detection on the fuel system

### **⚠ WARNING!**

Wear safety goggles!

Be extremely careful when searching for leaks in the fuel system high-pressure circuits. There is very high pressure in the jet from pipes and injectors. The fuel may penetrate the tissue and cause serious risk of blood infection (septicemia).

## Handling of fuel pipes

### **IMPORTANT:**

High pressure pipes for fuel must not be bent or straightened under any circumstances. Cracks may occur. Damaged pipes must be replaced.

## Safe handling of batteries

### **⚠ WARNING!**

Risk of fire and explosion. Never allow an open flame or electric sparks near the batteries.

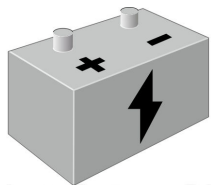
A spark caused by an incorrectly connected battery can be enough for the battery to explode with serious injuries.

Do not touch the connections during start attempts. Sparking hazard! Do not lean over batteries.

## Correct polarity of the batteries

### **IMPORTANT:**

Make sure that the positive (+) and negative (-) battery cables are correctly connected to the corresponding battery terminals. Wrong connection may cause severe damage to electrical equipment.



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## Risks of electrolyte in batteries

### **⚠ WARNING!**

Always wear protective goggles when charging or handling batteries.

Battery electrolyte is highly corrosive.

Rinse immediately with copious amounts of water if the electrolyte gets in your eyes. Search directly after the rinsing help by medical staff.

If it comes electrolyte to unprotected skin, wash immediately with soap and water.

## Layout of the battery compartment

### **IMPORTANT:**

Make sure the battery compartment is designed according to current safety standards.





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## Cleaning the engine and components

### **IMPORTANT:**

Never use a high pressure washer for cleaning of engine or engine components.

## Cleanliness for sensitive components

### **IMPORTANT:**

Observe meticulous cleanliness when handling system components.

Even minimal amounts of dirt could cause a breakdown.

## Adjustment of the clutch

### **CAUTION!**

Clutch adjustments must be carried out with the engine stopped.

# Introduction

**Check that you have received the correct operator's manual before continuing reading. If not, please contact your Volvo Penta dealer.**

For engine designations, refer to *Engine*. The designation is stated on the engine plate, refer to , *page 94*.

The illustrations in this book may cover several product types, which means that there may be slight differences between the illustrations and the purchased product. This does, however, not affect the validity of the information and/or instructions in the manual. Volvo Penta reserves the right to make alterations to specifications, design features, and illustrations without prior notice.

To retain the dependability and exhaust emission control originally built into all Volvo Penta engines, it is essential that the engines and receive periodic maintenance according to the maintenance instructions.

At service, software that affects the functionality described in this manual can be updated.

## About this manual

This Operator's Manual contains the information required for the correct, safe operation and maintenance of your Volvo Penta engine. Read the Operator's manual carefully and learn to handle the engine and other equipment in a safe manner before you start the engine.

## Warranty

Your new Volvo Penta engine is covered by a limited warranty, subject to the conditions compiled in the Warranty Information. AB Volvo Penta's liability is limited to the specification in the Warranty Information and Emission Control System Warranty Statement.

Read the information carefully, as soon as possible after delivery. It includes important information about service and maintenance; the owner is responsible for being familiar with checking and implementing these. Otherwise AB Volvo Penta may deny its warranty obligations in part or in full.

**Contact your Volvo Penta dealer if you have not received information on how to access the Warranty Information or recived the Service Book.**

## Extended Coverage

With the Extended coverage options, customized for each engine's particular needs and working conditions, you can take total control of upcoming operational costs.

For more information regarding our different Services, visit [volvopenta.com](http://volvopenta.com) or contact your Volvo Penta representative.

## Running in the engine

### **The engine must be run in during its first 10 operating hours, as follows:**

Run the engine in normal operations. However, full load may not be applied other than for short periods.

Higher oil consumption is normal during the first 100– 200 hours of operation. For this reason, check the oil level more frequently than the normal recommendation.

When a disengageable clutch is installed, it should be checked more carefully during the first days. Adjustments may be necessary to compensate bedding-in of the friction plates.

## Fuel, oils and coolant

Only use the fuels and oils recommended in the Operator's Manual, other viscosity and quality may cause malfunctions, increased fuel consumption and possibly shorten the life of the engine.

Always change the oil, oil filters and fuel filters at the specified maintenance intervals.

Make sure to always use suitable and correctly mixed coolant.

If an unsuitable coolant has been used, or if the instructions for coolant mixture have not been followed, future warranty claims related to engine and accessories may be denied.

## Maintenance and replacement parts

Volvo Penta engines are designed for maximum reliability and long life and built to withstand a demanding environment. The engines are also designed to have a minimal environmental impact. These qualities will be maintained through regular servicing and the use of spare parts with the same quality as genuine Volvo Penta parts. If reliable and purpose-built parts are not used, your safety, health, and the machine's function may be compromised. Volvo Penta has a world-wide network of authorized dealers.

The authorized dealers are Volvo Penta product specialists, and have the accessories, genuine parts, test equipment and special tools needed for high quality service and repair work. Always observe the maintenance intervals in the manual, the complete Service Protocol can be found at [volvopenta.com](http://volvopenta.com). Remember to note the engine / transmission identification number when you **order service and spare parts**.

## **Excessive strain on a product and components**

Volvo Penta products and components are not dimensioned for external loads. Never stand or step onto an engine, transmission or its components. Loads can bring about damage and the malfunction of a product or property.

## **Environmental care**

Environmental care is a core value at Volvo Penta. Energy efficiency and low emissions are among the most important product related aspects and priority focus areas for Volvo Penta business. Several of the global challenges the world faces are directly or indirectly related to power industries and transports. We recognize that Volvo Penta is part of the environmental problems, but we are also convinced that we are a part of the solution.

Volvo Penta currently has a broad engine program in which great advances have been made in reducing exhaust emissions in the same time as the fuel consumption has been improved. Through regular maintenance, the Volvo Penta engines retain its low fuel consumption and low emissions. We hope that you will be keen to preserve these qualities.

Always follow the directions in the Operator's Manual regarding fuel grades, operation and maintenance to avoid unnecessary environmental impact. Contact your Volvo Penta dealer if you notice any changes such as increased fuel consumption or exhaust smoke.

Remember always to hand in environmental hazardous waste such as drained oil, coolant, old batteries, etc. for treatment at a recycling facility. Our united efforts can make a valuable contribution to the environment.



## Certified engines

**If you own an emission-certified engine used in an area where exhaust emissions are regulated by law, this places special demands on the care and maintenance you provide your engine.**

**NOTICE!** Neglects or failure to follow the points listed here may invalidate the engine emission certificate. This means AB Volvo Penta can no longer guarantee engine conformity with the certified model. Volvo Penta is not responsible for damages or costs arising as a result of this.

- Certification means that an engine type has been checked and approved by the relevant authority. The engine manufacturer guarantees that all engines of the same type are equivalent to the certified engine.
- It is the responsibility of the operator/user to ensure that no intentional misuse of the engine takes place.
- Volvo Penta maintenance and service intervals must be complied with.
- Any case of malfunction must be rectified without delay.
- Only use genuine Volvo Penta parts or spare parts with the same quality as genuine Volvo Penta parts.
- Volvo Penta recommends that service to injection pumps, pump settings and injectors always are carried out by a qualified workshop.
- The engine must not be converted or modified in any way, except with accessories and service kits that Volvo Penta has approved for the engine.
- No installation changes to the exhaust pipe and engine air inlet ducts may be made.
- No warranty seals (where present on the product) may be broken by unauthorized persons.
- The general instructions in the Operator's Manual concerning operation, service and maintenance apply.

## Blue light mode

**NOTICE!** The functionality for Blue light mode only exists on engines ordered with this function.

The function has been developed for applications intended for use in a qualified emergency situation proclaimed by a national or regional government (authority), its emergency services (or its armed forces). All other use of the function constitutes a violation of the law. Examples of applications can be fire pumps, emergency vehicles or generators.

### Activate

The function for Blue light mode is activated automatically and prohibits lowering of performance due to defects in the engine or the aftertreatment system. Triggers for derate due to engine protection are removed. The engine sends warning messages but is not going into derate or shut-down.

## Volvo Penta Dealer Network

The Volvo Penta global network of authorized dealers is at your service. We strongly recommend that you take your product to an authorized Volvo Penta dealer for service and repair. They are specialists in Volvo Penta products and have the accessories, genuine Volvo Penta parts, the special tools and the latest service information for high quality service and repair work.

### Dealer Locator Services

Locate the nearest Volvo Penta dealer through our dealer locator on [www.volvopenta.com](http://www.volvopenta.com) or download the dealer locator app to your smartphone.

## Volvo Penta Action Service

Our global dealer network, your first line of contact, is backed up by Volvo Penta Action Service, a phone based breakdown and support service providing assistance 24 hours a day, every day of the year.

### How it works

A dedicated operator will support you all the way through your case and keep you updated on status and progress.

Whenever on-site assistance or technical support is needed, the operator will put you in contact with the closest Volvo Penta dealer that can support your product.

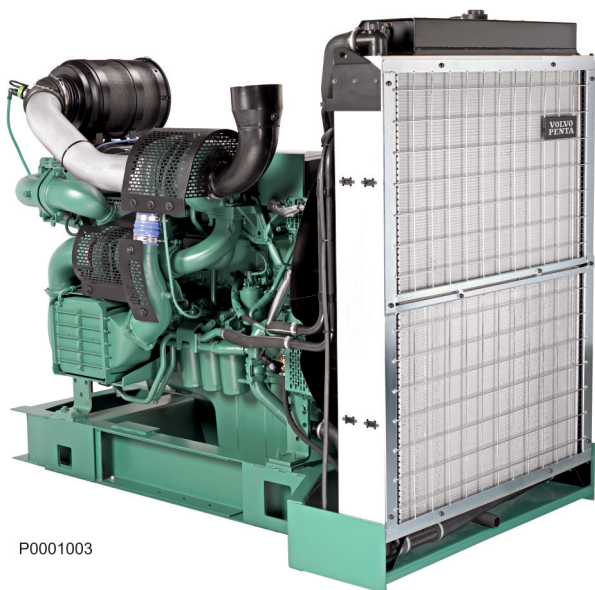
### Phone numbers

Find your Volvo Penta Action Service phone number and more information on [www.volvopenta.com](http://www.volvopenta.com).



# Presentation

## TWD1643GE



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## Engines

This Operator's Manual contains industrial engines TAD1640VE-C, TAD1641VE-C, TAD1642VE-C, TAD1643VE, TAD1643VE-B, TAD1650VE, TAD1651VE, TAD1650VE-B, TAD1641GE-B, TAD1642GE-B, TAD1650GE, TAD1651GE, TWD1643GE, TWD1644GE, TWD1645GE, TWD1652GE, TWD1653GE

These are in-line, directly injected, 6-cylinder industrial diesel engines. The engines are all equipped with electronically controlled fuel management, turbocharger, charge air cooler, thermostatically controlled cooling systems and electronic speed control.

TAD1650VE, TAD1650VE-B, TAD1651VE, TWD1652GE, TWD1653GE, TAD1650GE and TAD1651GE are equipped with EGR (Exhaust Gas Recirculation).

## TAD1643VE-B



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## EMS (Engine Management System)

EMS is an electronic system with CAN communication (Controller Area Network) for diesel engine control. The system has been developed by Volvo Penta and includes fuel regulation and diagnostic functions. The system consists of a control unit, injectors, a number of sensors that supply the control unit with information, and connectors for diagnostics and functional checks. The engine can be connected to a communication interface comprising a CAN link and a serial link.

### Input/Output signals

The information from the sensors provides precise data about prevailing operating conditions and allows the processor in the control module to, among other things, calculate correct injection amount, injection timing and check the engine's condition.

### Fuel regulation

The engine fuel requirement is analyzed up to 100 times per second. The engine injection volume and injection timing are controlled electronically via the fuel valves in the injectors. The control unit receives signals from sensors and monitors in order to determine when the fuel valve must open and close. This means the engine always receives the correct fuel volume under all operating conditions, which means lower fuel consumption and the lowest possible exhaust emission.

### Diagnostic function

The purpose of the diagnostic function is to detect and locate any malfunctions in the EMS system, as well as to protect components from damage.

If a malfunction is detected, this is announced by warning lamps, a flashing diagnostic lamp or a text message on the instrument panel, depending on the equipment fitted. If a fault code is displayed it is used for guidance in any fault tracing. Fault codes can also be read by Volvo's VODIA tool at authorized Volvo Penta workshops.

If there is a serious malfunction, the engine will be shut down completely or the control unit may reduce power output (depending on the application). Fault codes are registered as an aid to fault tracing.

# Instruments and Controls

## Display Control Unit

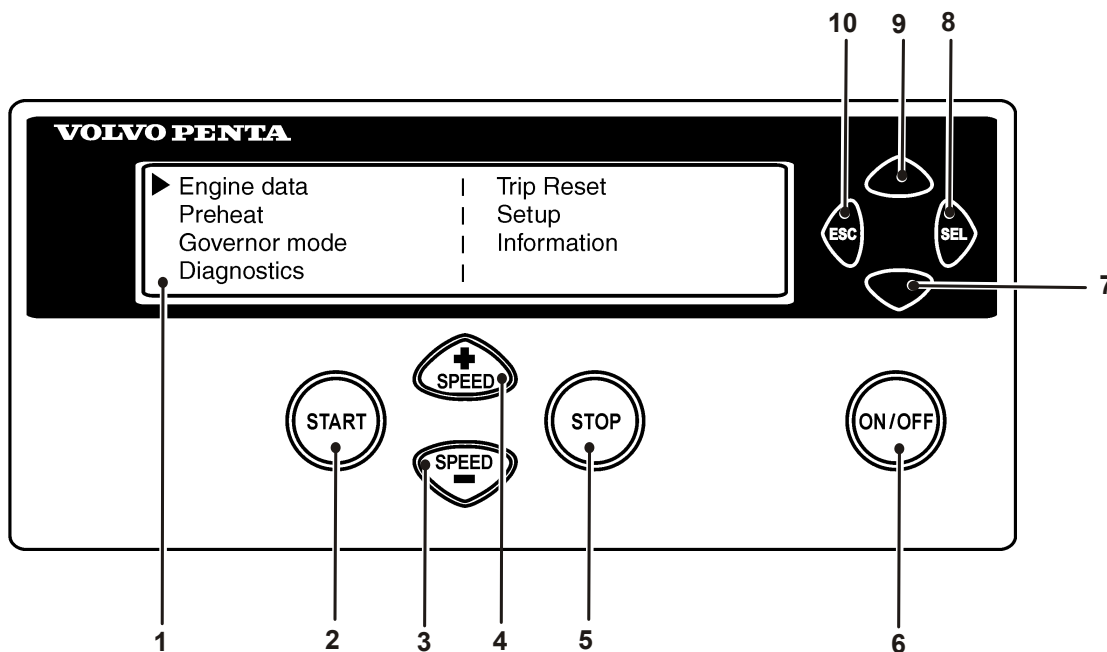
The DCU control panel is available as an optional accessory for the EMS (Engine Management System) electronic control system.

The DCU is a digital instrument panel which communicates with the engine control unit. The DCU has several functions, such as engine control, monitoring, diagnostics, and parameter setting.

The menus in the DCU system can be used to check, and in some cases to set, a number of different functions in the EMS system.

**NOTICE!** Settings and what engine data that appears in the display may vary depending on installation and engine model.

**NOTICE!** The menus and illustrations shown here are the English version. The language can be changed, however; refer to the *Setup* menu.



P0002062

### Start

When the DCU panel is started, the “Engine Data” menu is displayed; press “ESC” to come to the main menu.

- |                                 |   |
|---------------------------------|---|
| 1 LED display                   | 6 ON/OFF. Starts and stops the system     |
| 2 START. Starts the engine      | 7 Scroll downwards in menus               |
| 3 SPEED - . Reduces engine rpm  | 8 SEL. Selects in menus                   |
| 4 SPEED +. Increases engine rpm | 9 Scroll upwards in menus                 |
| 5 STOP. Stops the engine        | 10 ESC. Return to previous menu selection |

## Menus

There are several sub-menus under each main menu. There is not space for all the menu choices on the display. To scroll through the menus, use the **7** and **9** buttons on the display. Press the **SEL** button **8** to make a selection. Refer to the illustration on the previous page.

**NOTICE!** The **Setup** menu can be used to select the language that you want to use on the display.

## Main menu

- **Engine data**, current engine data
- **Preheat**, manual activation of pre-heating. Must be activated with temperatures below 0°C (32°F)
- **Governor mode**, activation of droop
- **Diagnostics**, shows fault codes as text
- **Trip reset**, resets trip data
- **Setup**, parameter setting
- **Information**, shows the currently applicable hard/software, data sets and engine identification for the engine and DCU data

▶ <b>Engine data</b>		Trip Reset
Preheat		Setup
Governor mode		Information
Diagnostics		

P0002063

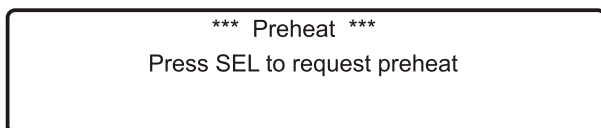
## Engine data

shows relevant engine data.

- Engine speed, can be controlled with the **SPEED+** and **SPEED-** buttons (rpm)
- Charge pressure (kPa)
- Coolant temperature (°C)
- Charge air temperature (°C)
- Oil pressure (kPa)
- Oil temperature (°C)
- Engine hours (h)
- Battery voltage (V)
- Fuel consumption (l/h)
- Instantaneous fuel consumption (trip fuel) (l)

▶ <b>Eng speed</b>	rpm		Boost prs	kpa
Cool temp	c		Boost tmp	C
Oil pres	kpa		Oil temp	C
Eng hours	h		Batt Volt	V

P0002064



P0002065

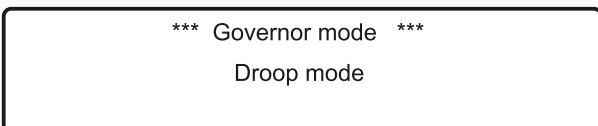
## Preheat

manual activation of pre-heating. When it is activated, the EMS system senses at start-up if pre-heating is needed. For automatic pre-heating, refer to the *Setup / Preheat on ignition* menu.

**NOTICE!** Must be activated with temperatures below 0°C (32°F).

The pre-heating time is adjusted to suit the engine temperature, and can last for up to 50 seconds both before and after starting. Refer also to *Starting procedure EMS 2*.

- Press **SEL**, the text **Preheat requested** will be shown
- The display automatically returns to the **Engine Data** menu.

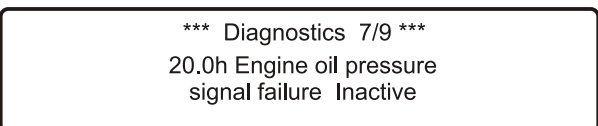


P0002066

## Governor mode

activates/shuts off droop. To set the droop level, refer to the *Setup / Governor gradient or Governor droop* menu.

- Select **Isochronous mode** or **Droop mode** with the SEL button.

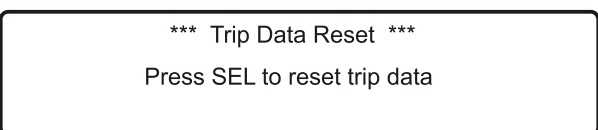


P0002067

## Diagnostics

shows the error list containing the 10 latest active and inactive faults. The fault codes are shown as text on the display.

- Scroll through the fault list with the arrow keys.



P0002068

## Trip Data reset

resets trip data, such as fuel consumption.

- Press the **SEL** button to reset trip data



Setup	
▶ Set Application :	(Versatile)
Units :	(metric)
Language :	(English)

P0002069

## Setup

parameter setting in the engine's control systems. Different menus appear under **Customer parameter**, depending on whether **Versatile** or **Gen set** has been selected from **Set application**. See below.

The parameters that can be set/selected (choice is made with the SEL button) are:

- **Set application**, setting **Versatile** or **Gen set**. Depending on the selection made here, different menus will appear under **Customer parameter**.
- **Unit**, setting of units (metric or US imperial).
- **Language**, setting the language used on the display. Choose between English, French, German and Spanish.
- **Stop energized to**, setting of external stop input. Activated by **Stop** or **Run**.  
**Stop**: The stop input must be connected to voltage to stop the engine.  
**Run**: The stop input must be connected to voltage to run the engine.
- **Customer parameter**, setting alarm limits. Refer to *Customer parameter / Versatile and Customer parameter / Gen set*.
- **Throttle input setting**, setting of engine-speed control and voltage limits. Refer to *Throttle input setting*.
- *Display setting*, setting the display. refer to *Display setting*.

## Customer parameter / Versatile

- **Idle engine speed** - setting idle speed.
- **Preheat on ignition** - activation of automatic pre-heating. The engine control system senses if pre-heating is needed and activates it directly at switch-on.
- **Governor gradient (Nm/rpm)** - setting of droop level, when activated. For activation, refer to *Governor droop* in the main menu.
- **Oil temp warning limit (°C)** - setting alarm limit for oil temperature.
- **Coolant temp warning limit (°C)** - setting alarm limit for coolant temperature.

Set up (Versatile)	
▶ Idle engine speed :	rpm
Preheat on ignition :	
Governor gradient :	Nm/pm

P0002070

Set up (Gen set)	
▶ Primary engine speed	:
Preheat on ignition	:
Governor droop	:

P0002071

### Customer parameter / Gen set

- **Primary engine speed** - selection of engine rpm, 1500 or 1800 rpm.  
For certain markets due to certification the dual speed (or selection of engine rpm) may not be available.
- **Preheat on ignition** - activation of automatic pre-heating. The engine control system senses if pre-heating is needed and activates it directly at switch-on.
- **Governor droop (%)** - setting of droop level, when activated. For activation, refer to “Governor droop” in the main menu.
- **Overspeed limit (%)** - setting of limit for overspeed alarm, % of set engine rpm.
- **Overspeed shutdown** - activation of engine shut-down with overspeed alarm. Refer to “Overspeed limit” to activate the alarm limit for the excess rpm alarm.
- **Oil temp warning limit (°C)** - setting alarm limit for oil temperature.
- **Coolant temp limit (°C)** - setting alarm limit for coolant temperature.

Setup(Throttle)	
Setup throttle mode	: *** OFF ***

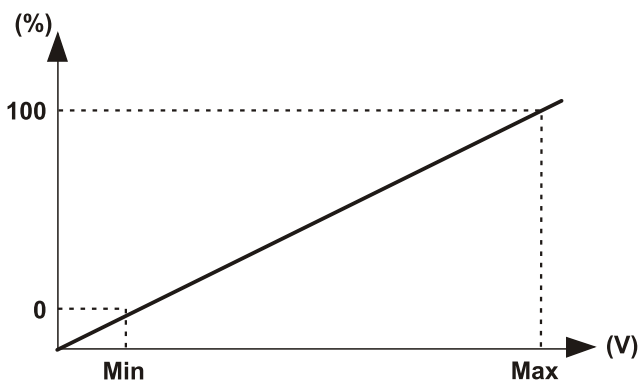
Setup(Throttle)	
▶ Set throttle mode	:
Set idle voltage	:
Set mx voltage	:

P0002955

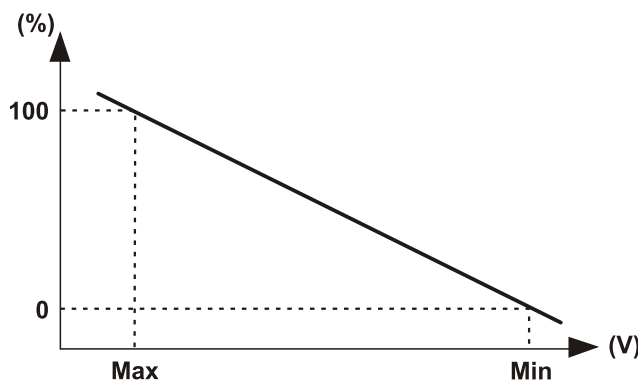
### Throttle input setting

rpm control setting (throttle operation).

- **Set throttle mode** - OFF - engine rpm is controlled via the DCU panel.  
ext throttle input - engine speed is controlled with a potentiometer (accelerator).  
ext voltage input - engine rpm is controlled by an external unit.
- **Set idle voltage (V)** - idle voltage level setting.
- **Set max voltage (V)** - full throttle voltage level setting.



P0002074



Setup(Display)		
▶ Set contrast	:	60%
Set backlighttime	:	5 sec
Set backlight brightness	:	10

P0002075

*** Information ***		
▶ Engine hardware Id	:	
Engine software Id	:	
Engine Dataset1 Id	:	

P0002076

## Display setting

settings for the display. Adjustment is made with the **7** and **9** buttons; see DCU panel illustration.

- **Set contrast (%)** - contrast setting.
- **Set backlight time (sec)** - time setting (in seconds) for display backlighting on, lighting is then shut off if the panel is not used.
- **Set backlight brightness** - display backlighting brightness setting.

## Information

shows the data for the engine and DCU.

- **Engine hardware Id** - engine control unit part number.
- **Engine software Id** - engine control unit software part number.
- **Engine dataset1 Id** - engine data set 1 part number.
- **Engine dataset2 Id** - engine data set 2 part number.
- **Vehicle Id** - chassis number.
- **DCU hardware Id** - DCU part number.
- **DCU software Id** - DCU software part number.
- **DCU dataset1 Id** - DCU data set 1 part number.
- **DCU dataset2 Id** - DCU data set 2 part number.

The Volvo Penta DCU II instrument panel communicates with the engines control unit and has a number of functions as control, monitoring and diagnostics.

**NOTICE!** Settings and the type of engine data presented on the display may vary depending on the installation and engine model.

Depending on the installation the DCU II can also be used as presentation display only.

**NOTICE!** The menus and illustrations shown here are the English version. Refer to the section *Settings* to change the display language.



P0018811



Turn On/Off the ignition

START

Start the engine



Reduce engine rpm



Increase engine rpm

STOP

Stop the engine



Scroll upwards in menus

OK

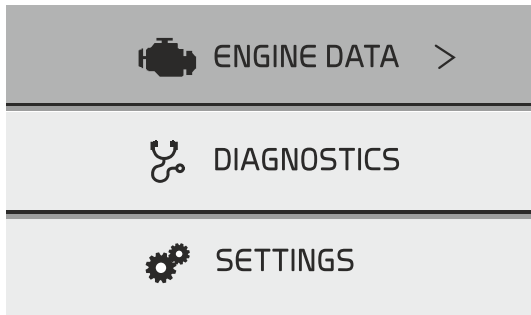
Select and confirm in menus



Scroll downwards in menus



Return to previous menu selection





P0018295

## Display

The DCU II basic view shows three main menus.



- **ENGINE DATA** (ENGINE DATA), shows current engine data.
- **DIAGNOSTICS** (DIAGNOSTICS), shows active fault codes.
- **SETTINGS** (SETTINGS), shows display and engine settings.

Press  to proceed in the submenus and scroll using the panel arrow buttons.

Press  to return to previous menu.


## Status bar

The status bar with symbols for active malfunctions is shown in the top right of the display.

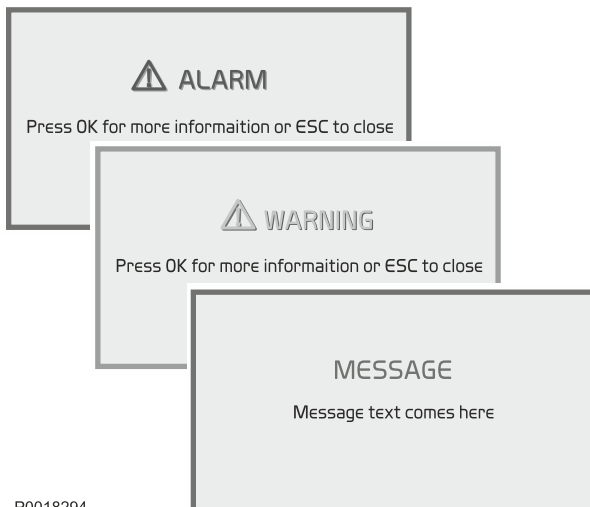
	Emission related malfunction
	EMS system malfunction

## Alarms and messages

Messages to the operator are of three types, color coded according to degree of severity.

When a message is shown on the display, press  to reach the diagnostic menu to get more information regarding registered faults and instructions for remedial actions.

- **ALARM** (ALARM), red text, the system has detected a serious fault — Volvo Penta recommends to immediately contact a qualified workshop .
- **WARNING** (WARNING), yellow text, the system has detected a fault — Volvo Penta recommends to contact a qualified workshop as soon as possible.
- **MEDDELANDE** (MESSAGE), blue text, non-critical engine message for the operator.



P0018294

**ENGINE DATA**

Engine Hours	1536h
Fuel Rate	112 l/h
Oil Pressure	425 kpa
Oil Temperature	65 C ✓

---

Engine Speed **1500** rpm

P0018291

**DIAGNOSTICS**

- Coolant level low >
- Oil temp sensor fsilure
- DTC 3
- DTC 4
- DTC 5

Coolant level low 50000h

Check coolant system for leakage.  
Fill coolant needed.

critical-Service immediatly SPN III FMI I

P0018293

## Menus

### ENGINE DATA (ENGINE DATA)

Engine data shown may vary depending on the engine installation.

- **Engine Hours** (Engine Hour) (tim)
- **Engine Speed** (Engine Speed) (rpm)
- **Coolant Temperature** (Coolant Temperature) (°C)
- **Oil Pressure** (Oil Pressure) (kPa)
- **Fuel Rate** (Fuel Rate) (l/h)  
Current fuel consumption.
- **Boost Temperature** (Boost Temperature) (°C)
- **Boost Pressure** (Boost Pressure) (kPa)
- **Oil Temperature** (Oil Temperature) (°C)

### DIAGNOSTICS (DIAGNOSTICS)

If the system detects a malfunction, the operator is informed via a pop-up message on the display. The fault codes are listed in the diagnostics menu; active fault codes are at the top of the list and are denoted be a green dot. For more information regarding cause and remedies, use the arrow button to scroll to the fault concerned and press **OK**. This will also provided information about number of engine hours when the fault became active and the SPN and FMI codes.



P0018292

## SETTINGS (SETTINGS)

### Display (Display)

- **Set backlight time** (Set backlight time). On/OFF, sets backlight to run in standby mode. *On* is the default setting.
- **Set backlight brightness** (Set backlight brightness). Adjust display backlight brightness using the panel arrow buttons.
- **Set Instrument Brightness** (Set Instrument Brightness). Sets backlighting in the display instrument.
- **Change background color** (Change background color). Select background color, gray or white.

### Language (Language)

Sets the display language; chooses between English, French, German, Spanish and Chinese.

### Save/Restore (Save/Restore)

- **Save current configuration** (Save current configuration). Save the current display settings.
- **Restore last configuration** (Restore last configuration). Restore the last displayed settings saved.
- **Restore default configuration** (Restore default configuration). Restores *all* display setting menus to factory settings.

**NOTICE!** The settings in the following menus do not normally need to be changed; should a change be necessary it must be carried out by an authorized Volvo Penta technician. Refer to the installation manual for further engine information.

### Authorized Volvo Penta dealer or OEM only

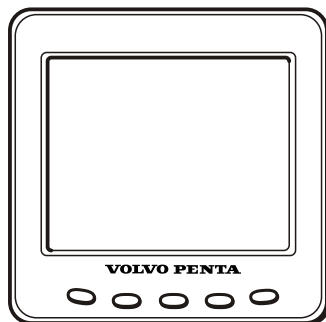
- I/O Status (I/O Status)
- CAN Termination (CAN Termination)
- Stop Logic DCU (Stop Logic DCU)
- Potentiometer supply (Potentiometer supply)
- Speed Control (Speed Control)
- Control display unit (Control display unit)
- Genset/VE (Genset/VE)
- Buzzer (Buzzer)
- Information (Information)

## DU (Display Unit)

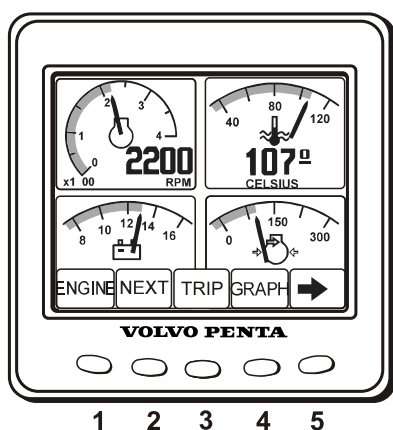
The DU is a computerized instrument panel which shows engine working values on an LCD screen. In the display it is possible to show multiple windows with different information, i. g. engine rpm, coolant temperature, fuel consumption and fault messages.

At start up, the display performs a self-test. If a constant signal is heard, the system has discovered a malfunction. The display will work but may act in an unexpected way.

The DU is connected between the engine control unit and the CIU or DCU.



P0002061



P0002382

### Display modes

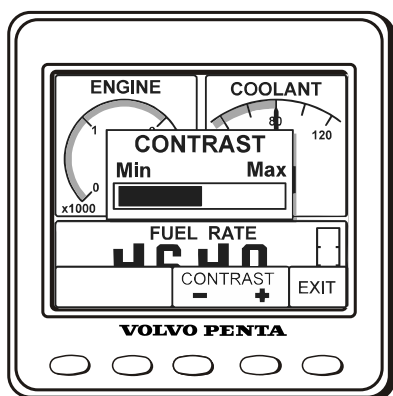
Press any of button 1–4 to view the function menu for the buttons, appearing in the lower part of the display. To leave the menu, wait a few seconds or press button 5 (EXIT).

- 1 Engine
- 2 Multi
- 3 Trip
- 4 Graph
- 5 Exit

### Contrast

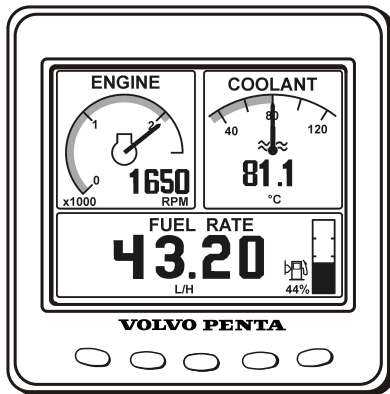
In the display modes Engine, Trip and Graph, it is possible to adjust the contrast.

Press button 5 outside the menu and then + (button 4) or – (button 3) to adjust the contrast.



P0002403

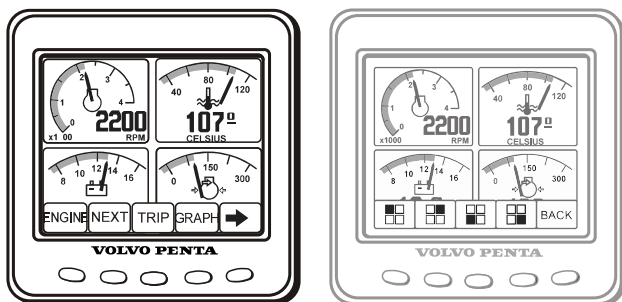




P0002413

### Engine

Rpm and coolant temperature is shown in the upper part of the display. In the lower part it will show trip computer and a fuel level indicator, if these function are installed.



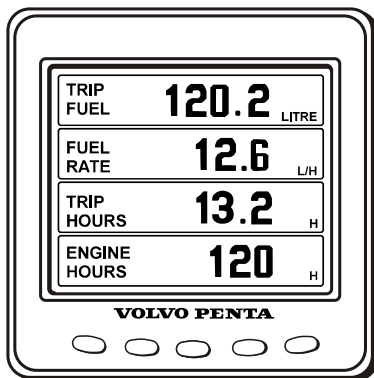
P0014208

### Multi

In the multi mode, button 2, the information can be shown in four windows, analogue or digital. The display toggles between the two when button 2 is pressed repeatedly.

By pressing button 5, the right arrow, you choose what information to be shown in the different windows.

Press repeatedly on the button that correspond to the window, until desired information is shown.



P0002418

### Trip

To display the trip computer press button 3, Trip

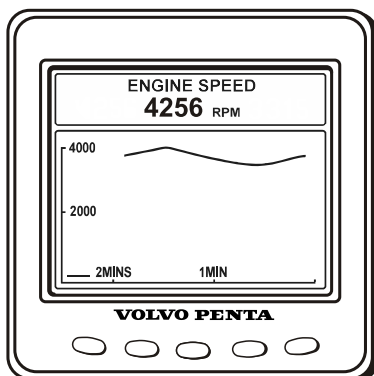
**Trip Fuel**, since last reset

**Fuel Rate**, fuel consumption

**Trip hours**, since last reset

**Engine hours**, total amount of operating hours

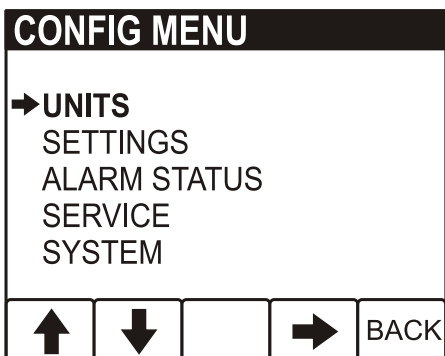
Reset by pressing button 3 for three seconds until a beep is heard.



P0014207

### Graph

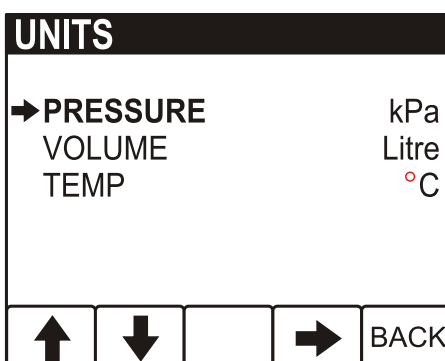
The information is shown as graphs. Press button 4 repeatedly to choose what information will be shown. The time interval is set in the Configuration menu. If the connection is broken there will be a straight line in the display.



P0014209

### Configuration menu

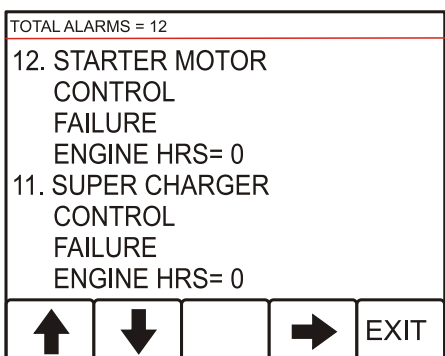
Press button 5 for three seconds to enter the Configuration menu. Navigate with the up and down arrows, select with the right arrow.



P0014210

### Units

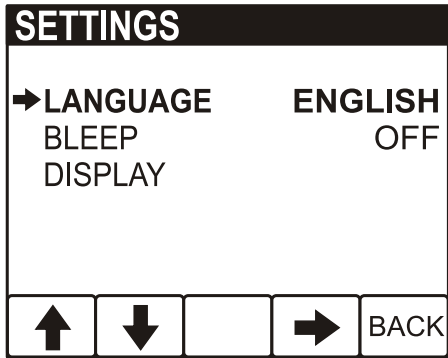
- PRESSURE; kPa, PSI
- VOLUME; LITRE, GAL, Imperial GAL.  
Fuel rate is adjusted according to volume unit, L/H, GAL/H, IGAL/H.
- TEMPERATURE; °C, °F



P0014212

### Alarm Status

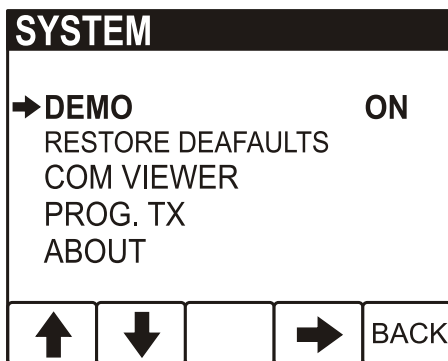
List of active alarms, refer to *Reading fault codes via the DU (Display Unit)*



P0014211

**Settings**

- LANGUAGE; setting of what language is to be used in the display.
- BLEEP; On/Off, setting if pressing the instrument buttons will be followed by a beep or not.
- DISPLAY; setting of ENGINE RPM gauges  
RPM ENGINE, 2500–9000 RPM, in steps of 500 RPM  
GRAPH RANGE, 2 minutes– 8 hours in the following steps,  
2MINS, 10MINS, 30MINS, 60MINS, 2HRS, 4HRS, 8HRS



P0014213

**SYSTEM**

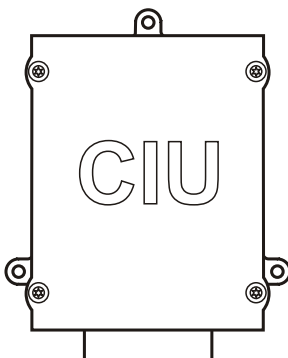
- DEMO, switches the DEMO mode ON/OFF.
- RESTORE DEEFAULTS, reset all configuration to default values.
- COM VIEWER, displays latest message on communication ports
- PROG TX, transfers content of the application on Flash memory to other CAN units on the same CAN bus.
- ABOUT, displays  
ID NO – display serial number  
EEPROM – number of write on EEPROM  
VERS – software version number  
CHK – Flash memory checksum  
PART No – Volvo software part number  
SOURCE – source of received data  
LABEL – Allocated Label on the same bus.

**CIU (Control Interface Unit)**

The CIU is a "translator" between the control unit (EMS) and the customer's own control panel. The CIU has two serial communication links, one fast and one slow.

The fast one is a so-called CAN link. All data related to instruments, indication lamps, connectors and potentiometers is controlled by this link.

The slow link manages diagnostic information for flashing codes etc.



P0002060

## Easy Link Instruments

The following Easy Link instruments are available:

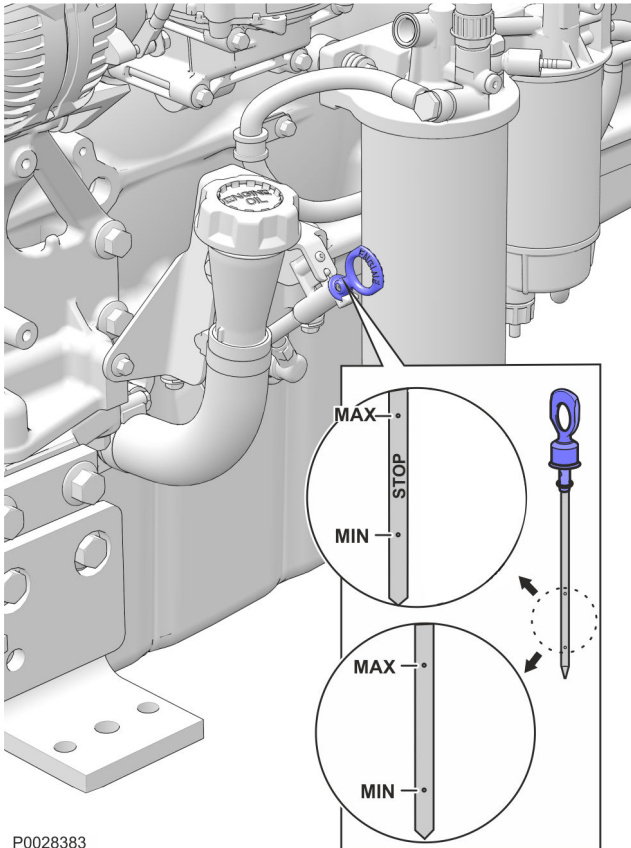
- Tachometer / hours counter (fault codes are also displayed on the tachometer display when the diagnostic button is pressed)
- Coolant temperature
- Oil pressure
- Oil temperature
- Battery voltage
- Alarm panel
- Turbo pressure

# Starting

Make it a habit of giving the engine and engine room a visual check before starting. This will help you to discover quickly if anything abnormal has happened, or is about to happen. Also check that instruments and warning displays show normal values after you have started the engine.

## **WARNING!**

Never use start spray or similar agents to start an engine. This may cause an explosion in the inlet manifold. Risk of personal injury.



P0028383

## Before Starting

- Check that the oil level is between the MIN and MAX marks.  
For filling refer to *Oil level, checking and topping up*.

**NOTICE!** The engine should be placed on a level position when the oil is checked. Dipstick can be read when the engine is stopped. Use the STOP side of the dipstick.

- Open the fuel valves.
- Check the fuel pre-filter; refer to *Draining condensate, fuel system, page 71*.
- Check the coolant level and that the radiator is not blocked externally. Refer to *Coolant Level, Checking and Topping Up, page 76* and *Charge Air Cooler, External Cleaning, page 78*

## **WARNING!**

Do not open the coolant filler cap when the engine is hot, except in emergencies, as this could cause serious personal injury. Steam or hot fluid could spray out.

- Check that no leakage of oil, fuel or coolant is present.
- Turn the main switch(es) on.
- Move the engine speed control to idle, and open the disengageable clutch/gearbox if installed.

## **IMPORTANT:**

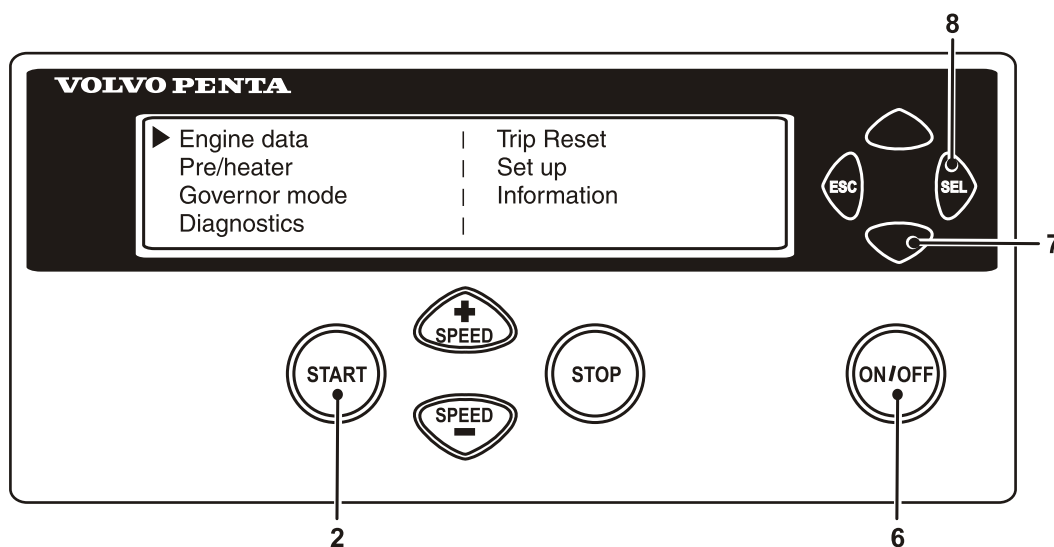
Never break the circuit with the main switch while the engine is running. Alternator and electronics could be damaged.

## Starting the Engine

The pre-heating time is adjusted to suit the engine temperature, and can last for up to 50 seconds both before and after starting.

The starter motor cranking time is maximized to 20 seconds. After that, the starter motor circuit is temporarily cut to protect the starter motor from overheating.

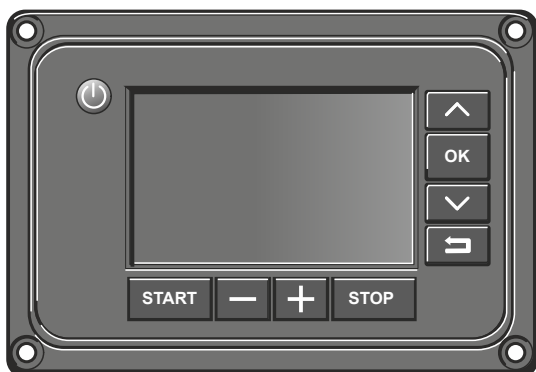
## DCU (Display Control Unit)



P0002079

### With pre-heating

- 1 Depress the **ON/OFF**-button (6).
- 2 Press the **SEL** button (8) to come to the main menu.
- 3 Scroll down to **Pre/heater** with scroll button (7), press **SEL**-button (8)
- 4 In the **pre-heater** menu, press the **SEL**-button (8) to select pre-heating.
- 5 Press the **START**- button (2).




P0018811

### Without pre-heating

- 1 Depress the **ON/OFF**-button (6).
- 2 Press the **START**-button (2).

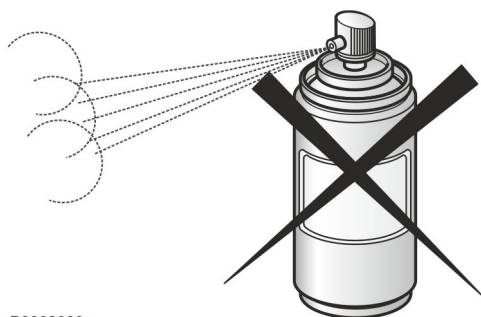
Leave the engine to idle for the first 10 seconds. Then warm the engine up at low speed and under low load. Never race the engine when it is cold.

- 1 Press the  button to switch on the ignition. The display switches on at the same time.
- 2 If preheat is activated, wait until heating icon has disappeared until START is requested.
- 3 Press the START button to start the engine.

## Starting in Extreme Cold

Certain preparations must be made to enable engine starting in extreme cold, and in some cases to make starting possible at all:

- Use a winter grade fuel (of a well-known make) that is approved for the prevailing temperature. This reduces the risk of paraffin wax precipitation in the fuel system. At extremely low temperatures, we recommend the use of a fuel heater.
- Use a synthetic engine oil of a viscosity recommended for the prevailing temperature to achieve satisfactory lubrication. Refer to *Viscosity, page 89*. Synthetic lubricants are able to handle a wider temperature range than mineral-based lubricants.
- Pre-heat the coolant with a separately-installed electric engine heater. In extreme cases, a diesel-fired engine heater may be necessary. Ask your Volvo Penta dealer for advice.
- Make sure the cooling system is filled with a coolant mixture. Refer to , *page 75*.
- The batteries must be in good condition. Cold weather reduces battery capacity. Increased battery capacity may be necessary.



P0002080

## Never Use Start Spray

### ⚠ WARNING!

Never use start spray or similar agents to start an engine. This may cause an explosion in the inlet manifold. Risk of personal injury.

## Starting Using Auxiliary Batteries

### ⚠ WARNING!

Explosion hazard. Batteries contain and give off an explosive gas which is highly flammable and explosive. A short circuit, open flame or spark could cause a violent explosion. Ventilate well.

- 1 Check that the auxiliary batteries are connected (series or parallel) so that the rated voltage corresponds to the engine system voltage.
- 2 First connect the red (+) jumper cable to the auxiliary battery, then to the flat battery. Then connect the black (-) jumper cable to the auxiliary battery and to a location that is **somewhere away from the discharged battery**, e.g. the main switch negative terminal or the negative terminal on the starter motor.
- 3 Start the engine.

### ⚠ WARNING!

Do not touch the connections during the start attempt: Risk of arcing.  
Do not bend over any of the batteries either.

- 4 Remove the cables in the reverse order.

### IMPORTANT:

The ordinary cables to the standard batteries must not under any circumstances be loosened.



# Operation

Correct operating technique is very important for both fuel economy, environmental protection and engine life. Always let the engine warm up to normal operating temperature before operating at full power.

## Reading the Instruments

Check all instruments directly after starting, and then regularly during operation.

**NOTICE!** On engines in continuous operation, it is recommended that the lubrication oil level is checked at least every 24 hours. Refer to *Oil level, checking and topping up*.

## Alarms

If the EMS receives abnormal signals from the engine, the control unit generates fault codes and alarms, in the form of lamps and audible warnings. This is done by means of CAN signals to the instrument.

More information about fault codes and fault tracing can be found in the chapter , *page 45*.

## Maneuvering

### Operation at low load

Avoid long-term operation at idle or at low load. It takes a long time for the engine to reach working temperature, resulting in high viscosity of the oil and large clearances in the engine mechanics. In cold climate, it takes even longer.

The combustion temperature and cylinder pressure can become so low that an effective combustion cannot be ensured. At these conditions unburned fuel could dilute the lubricant oil. Because of the low cylinder pressure, the piston ring performance could be affected causing oil from the crankcase to pass the rings and go further out with the exhaust gases. This mixture of unburned fuel and oil in exhaust gases is referred to as "slobber". A new engine produces more "slobber" at low load compared to an engine with more hours of operation.

At low load, the pressure in the turbocharger is low and oil could seep past the turbocharger seals and mix with the air into the engine. The consequences can be carbon build-up on valves, piston crowns and the exhaust turbine, which could affect engine performance.

Both conditions can lead to increased oil consumption and eventually external oil leakage from joints in the exhaust system. For example, leakage could be seen at the exhaust manifold, before and after the turbo, around the muffler and in worse case even in the exhaust end pipe. Consequences could lead to clogged exhaust gas recirculation systems and exhaust aftertreatment systems.

Signs of oil leaking caused by "slobber" do not indicate an engine problem but indicates low load operation. To minimize the risk of malfunctions caused by operation at low load, follow these points as a complement to normal maintenance:

- Run in the engine as soon as possible.
- Load the engine so it reaches working temperature as soon as possible.
- For VE: Turn off the engine instead of running on idle for longer periods.
- For genset turn off the engine instead of running unloaded for longer periods.
- Avoid load levels below 20% as constant operation.
- If the engine is regularly tested without load, limit the duration of the operation to 5 minutes. Run the engine at full load for about 4 hours once a year, for the carbon deposits in the engine and exhaust system to burn off.
- If visible slobber has occurred, it can be burned off by running the engine on at least 30% load for about 40-60 minutes.

# Engine Shutdown

During longer breaks in operation, the engine must be warmed up at least once every two weeks. This prevents corrosion in the engine. If you expect the engine to remain unused for two months or more, it must be preserved: Refer to the chapter , page 85.

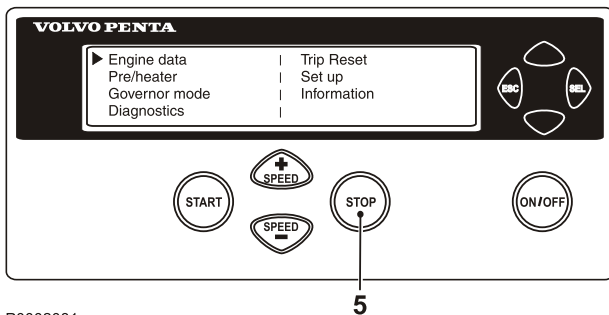
## Before Engine Shutdown

Let the engine run at high idle (1500 or 1800rpm) for a minimum of 5 minutes before the shutdown after normal use. Normal use is defined as minimum 50% load. After use with less than 50% load, high idle for approximately 3 minutes is sufficient. This allows engine temperature equalization and prevents boiling once stopped and also allows the turbochargers to cool down. This contributes to long, fault-free service life.

**NOTICE!** Do not turn off the main switch within 30 seconds after turning off the ignition. This is in order to save engine data to the engine control unit.

## Stop the Engine


- Disengage the clutch (if possible).
- Depress the **STOP**-button (5).



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- 1 Disengage the clutch, if possible.
- 2 Press the STOP button to turn off the engine.
- 3 Press the  button to turn off the ignition.



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## Auxiliary Stop

For location of the extra stop, refer to , *page 58*.

### **⚠ WARNING!**

Working with or approaching a running engine is a safety risk. Watch out for rotating components and hot surfaces.

## After Engine Shutdown

- 1 Check the engine and engine compartment for leaks.
- 2 Turn off the main switches before any long stoppage.
- 3 Carry out maintenance in accordance with the schedule.

### **For longer breaks in operation**

During longer breaks in operation, it is recommended that the engine is warmed up at least once every two weeks. This prevents corrosion in the engine.

If you expect the engine to be unused for two months or more, it should be conserved. Refer to , *page 85* .

### **IMPORTANT:**

If there is a risk of freezing, the coolant in the cooling system must have adequate antifreeze protection.

Refer to , *page 75*.

### **IMPORTANT:**

A poorly charged battery can freeze and burst.

Refer to *Battery, page 83*.

# Fault handling

Despite regular service in accordance with the planned maintenance schedule and perfect operating conditions, faults may occur that must be remedied before operations continue. This chapter describes the diagnostics function.

## Diagnostic Function

The purpose of the diagnostic function is to monitor, control and protect the engine and its surrounding system and components from damage, as well as to ensure a minimal environmental impact.

If a malfunction is detected the diagnostic function informs of the occurred fault in the form of a fault code. The fault code provides guidance when fault tracing. All fault codes and fault messages can be found in the *Fault Code Register*.

The operator is warned that there is a malfunction via the instruments. Depending on the instrumentation in use, the fault message is shown in various ways. Fault codes can also be read out by the Volvo Penta diagnostic tool.

Depending on the severity of the fault, the diagnostic function will take various actions to protect the engine and limit emissions (e.g. torque derate, idle speed only, engine shut down etc.)

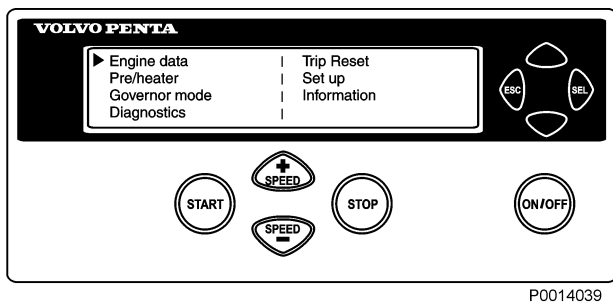
## DCU (Display Control unit)

Eng speed	1800 rpm	Boost prs	4 kpa	^
Cool Temp	85 °C	Boost tmp	59 °C	
Oil Pres	480 kpa	Oil Temp	87 °C	
!! ENGINE WARNING !!				v

Eng speed	1800 rpm	Boost prs	4 kpa	^
Cool Temp	85 °C	Boost tmp	59 °C	
Oil Pres	480 kpa	Oil Temp	87 °C	
Press SEL for information				v

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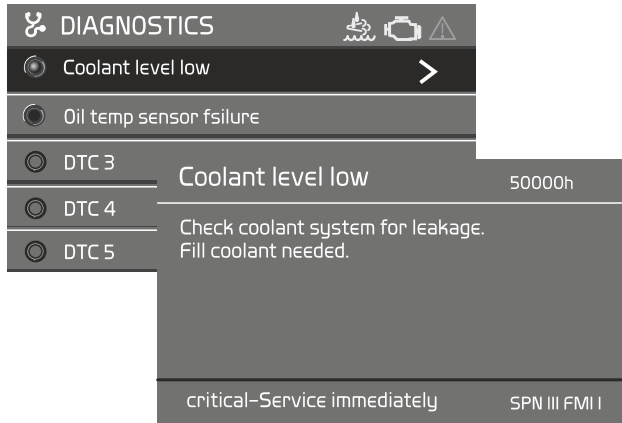
- 1 When a fault is detected the following text is displayed:  
**!! ENGINE WARNING !!** alternating with **Press SEL for information.**
- 2 Reduce engine speed to idle or shut down the engine.
- 3 Press the **SEL** button to get to the fault list. The fault list shows:
  - hours of operation
  - fault messages
  - active/non-active faults
- 4 Look up the fault code in the *Fault Code Register* and take the necessary actions.
- 5 Press **ESC** to leave the fault list.

**NOTICE!** To get to the fault list when no fault codes are set, press the **SEL** button and select **Diagnostics** from the menu.

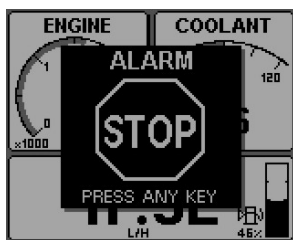
## DCU II (Display Control Unit)

### DIAGNOSTICS

If the system detects a malfunction the driver/operator is informed via a pop-up message on the display. The fault codes are listed in the diagnostics menu; active fault codes are at the top of the list and are denoted by a green dot. For more detailed information regarding the cause and remedies, use the arrow buttons to scroll to the fault concerned and press **OK**. This will also provide information about the number of engine hours when the fault became active and the SPN and FMI codes.

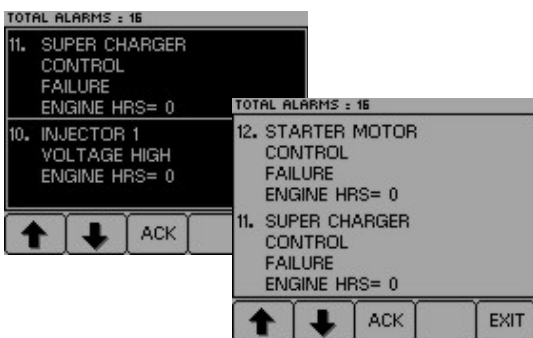


## DU (Display Unit)



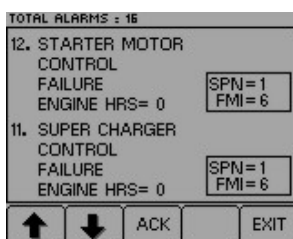
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- 1 If the system detects a fault, a pop-up is shown on the display. Depending on the severity of the fault the following text will appear **ALARM STOP / PRESS ANY KEY** or **WARNING! / PRESS ANY KEY**; a buzzer will sound.
- 2 Reduce engine speed to idle or shut down the engine.



P0014029

- 3 Press the SEL button to get to the fault list. The fault list shows fault messages and the number of hours of operation when the fault occurred.
- 4 Press **ACK** to acknowledge the fault code. The display background changes color (and the buzzer stops). The fault must be acknowledged before it can disappear from the fault list.
- 5 Look up the fault code in the *Fault Code Register* and take the necessary actions.



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- 6 Press button 4 for at least three seconds to view SPN and FMI codes.
- 7 Press **EXIT** to leave the fault list.



## CIU (Control Interface Unit)

When the system detects a malfunction, the diagnostics lamp flashes. If the diagnostics button is pressed and then released, a fault code is flashed out.

The fault code consists of two groups of flashes, separated by a pause of two seconds. A fault code is obtained by counting the number of flashes in each group.

### Example

•• pause •••• = fault code 2.4

The fault code is stored and can be read off as long as the malfunction remains. Information about causes, effects and actions required is available in the Fault Code chapter.

### Do as follows to read off the fault code:

- 1 Press the diagnostics button.
- 2 Release the diagnostics button and note down the fault that is flashed out.
- 3 Repeat items 1–2. A new fault code will be flashed out if more faults are stored. Repeat until the first fault code reappears.

**NOTICE!** When the first fault code reappears, all fault codes have been read off.

If the diagnostics button is pressed after the fault has been rectified and the fault codes have been erased, code 1.1 “No fault” will be displayed.

## Easy Link Instruments

- 1 When a malfunction is detected this is reported by the diagnostic lamp which starts to flash.
- 2 Press the diagnostics button. The fault code is shown as text in the tachometer display.
- 3 Look up the fault code in the *Fault Code Register* and take the necessary actions.
- 4 When the fault has been rectified, the fault code disappears from the display and the diagnostics lamp goes out.

## Erasing fault codes

The memory of the diagnostic function is reset when the power to the engine is disconnected. When the power is switched on again, the diagnostic function will check if there are any malfunctions in the system. If so a new fault codes is registered.

If a malfunction has not been corrected it will be registered once again and has to be acknowledged again.

## Fault Tracing

A number of symptoms and possible causes of engine malfunctions are described in the table below. Always contact your Volvo Penta dealer if any problems occur which you can not solve by yourself.

### IMPORTANT!

Read through the safety advice for care and maintenance work in the chapter *Safety precautions for maintenance and service operations* before you start work.

<b>Symptoms and possible causes</b>	
The diagnosis button lamp flashes	Please refer to <i>Diagnostic Function</i>
Engine can not be stopped	2, 5
Starter motor does not rotate	1, 2, 3, 4, 5, 6, 7, 24
Starter motor rotates slowly	1, 2
Starter motor rotates normally but engine does not start	8, 9, 10, 11,
Engine starts but stops again	8, 9, 10, 11, 13
Engine does not reach correct operating speed at full throttle	9, 10, 11, 12, 13, 21, 25, 26
Engine runs roughly	10, 11
High fuel consumption	12, 13, 15, 25
Black exhaust smoke	12, 13
Blue or white exhaust smoke	15, 22
Too low lubrication oil pressure	16
Excessive coolant temperature	17, 18, 19, 20, 28
Too low coolant temperature	20
No, or poor charge	2, 23
Too high exhaust temperature TWD1643GE, TWD1652/53	13, 17, 18, 19, 21, 25, 27, 28, 29, 30

- 1 Discharged batteries
- 2 Poor contact/open circuit in electrical wiring
- 3 Main switch turned off
- 4 Main fuse faulty
- 5 Faulty ignition lock
- 6 Faulty main relay
- 7 Faulty starter motor/-solenoid
- 8 No fuel:
  - fuel cocks closed
  - fuel tank empty/wrong tank connected
- 9 Blocked fuel fine-filter/pre-filter (due to contaminations, or stratification in the fuel at low temperature)
- 10 Air in the fuel system
- 11 Water/contamination in fuel
- 12 Faulty fuel injectors
- 13 In sufficient air supply to the engine:
  - blocked air filter
  - air leakage between the turbo and the engine's intake manifold
  - dirty compressor part in the turbocharger
  - faulty turbo compressor
  - poor engine room ventilation
- 14 Coolant temperature too high
- 15 Coolant temperature too low
- 16 Oil level too low
- 17 Coolant level too low
- 18 Air in the coolant system
- 19 Faulty circulation pump
- 20 Defective thermostat
- 21 Blocked charge air cooler
- 22 Oil level too high
- 23 Alternator drive belt slips
- 24 Water entry into engine
- 25 High back pressure in the exhaust system
- 26 Break in "Pot+" cable to throttle
- 27 High temperature, charge air cooler
- 28 Blocked radiator
- 29 No pressure in cooling system
- 30 Check wastegate function

# Fault Code Register

	SPN	PID	PPID	SID	PSID	Flash code Electrical fault/Value fault	FMI
Coolant Water Pressure	20	20					1,3,4,5,18
Percent Accelerator Pedal Position	91	91				2.7/- (EMS) 2.8/- (CIU)	9
Fuel Delivery Pressure <i>, page 71</i>	94	94				3.6/3.8	1, 3, 5, 7
Water in fuel indicator <i>Draining condensate, fuel system, page 71</i>	97	97				2.9/2.1	0, 3, 4
Engine Oil Level <i>Oil level, checking and topping up, page 68</i>	98	98				5.9/5.7	1, 3, 4, 5
Engine Oil Filter Differential Pressure	99						0
Engine Oil Pressure <i>Oil level, checking and topping up, page 68</i>	100	100				3.1/6.6	1, 3, 5, 18
Boost pressure	102	102					0, 3, 5, 16
Boost temperature	105	105				3.2/6.2	0, 4, 5, 16
Boost pressure	106	106				3.4/3.5	0, 3, 5, 16
Air filter pressure	107	107				5.5/5.5	0, 3, 4, 5
Ambient air pressure	108	108				-/-	2, 3, 4
Coolant Temperature <i>Coolant Level, Checking and Topping Up, page 76</i>	110	110				3.3/6.1	0, 4, 5, 16
Coolant Level <i>Coolant Level, Checking and Topping Up, page 76</i>	111	111				2.3/2.2	1, 3, 5
Crankcase pressure	153	153				7.8/7.7	0, 2, 3, 5
Battery voltage <i>Battery, Charging</i>	158	158				-/3.9 (EMS) -/6.9 (CIU)	1, 3, 4
Injection control pressure	164	164				8.3	2, 4, 5
Ambient Air Temperature Sensor	171	171					14
Ambient Air Temperature Sensor	172	172				7.9/-	4, 5
Engine Oil Temperature <i>Oil level, checking and topping up, page 68</i>	175	175				3.7/5.8	0, 4, 5, 16
Engine Speed	190	190				-/2.6	0, 16
Throttle position	608		98			-/-	9
Throttle calibrated position	608		132			2.8/-	9
SAE J1708 Data Link	608			250		9.2/-	
SAE J1939 Data Link	608				201		9
+5 V sensor supply	620			232		9.3/-	3, 4
Inlet Air Temperature	626	45				5.4/-	3, 4, 5
Program Memory	628			240		9.9/-	2, 12
Controller error	629			254		9.9/- (EMS) 9.8/- (CIU)	8, 12
Calibration Memory EEPROM	630			253		9.9/- (EMS) 9.8/- (CIU)	2, 12, 14
Camshaft sensor	636			21		2.5/-	2, 3, 8

	SPN	PID	PPID	SID	PSID	Flash code Electrical fault/Value fault	FMI
Flywheel sensor	637			22		2.4/-	2, 3, 8
SAE J1939 Data Link	639			231		6.5/- (EMS) 6.4/- (CIU)	2
Engine Fan Driver	647			33			3, 4, 5
Fuel Injector, Cylinder #1	651			1		7.1/-	3, 4, 5, 12
Fuel Injector, Cylinder #2	652			2		7.2/-	3, 4, 5, 12
Fuel Injector, Cylinder #3	653			3		7.3/-	3, 4, 5, 12
Fuel Injector, Cylinder #4	654			4		7.4/-	3, 4, 5, 12
Fuel Injector, Cylinder #5	655			5		7.5/-	3, 4, 5, 12
Fuel Injector, Cylinder #6	656			6		7.6/-	3, 4, 5, 12
Starter motor relay	677			39		4.6/-	3, 4, 5
Injection Control Pressure Regulator	679				42	8.3/-	3, 4, 5, 6,
Pressure Release Valve	679				97	8.3	0, 7, 11, 14
Starter element	729			70		8.6	3, 4, 5
Stop Input, EMS	970		6			4.8/- (EMS)	4
Fan speed	975	26					3
Compression break	1072		122				1, 3, 4, 5
+5 V sensor supply	1079			232		9.3/-	3, 4
+5 V sensor supply 2	1080			211		9.3/-	3, 4
ECU temperature high	1136		55			8.4	16
Exhaust gas temperature	1184	173				4.9/1.9	0, 4, 5, 16
Wastegate Valve	1188			32			3, 4, 5
SAE J1939 Data Link	1231				232		2
SAE J1939 Data Link	1231				229		9
Rail pressure system	1239				96	8.3	0, 1, 4, 7, 12, 16
Engine synchronizing	1377		98				9
Main relay output	1485		5			5.1/-	
Starter Output	1675		3				0, 3, 4, 5, 10
Starter Output	1675			39			0, 3, 4, 5, 10
Data link	2017				201		9
Internal EGR	2791		19			8.5	3, 4, 5, 7
Starter Output	2898		3				3, 4, 5
Starter Output	2899		3				3, 4
Thermostat bypass valve	2988		332				3, 4, 5
Exhaust gas temperature sensor #1	3241		386				0, 7, 4, 5
Sensor Supply Voltage #1 (+5 V DC)	3509			232			3, 4
Sensor Supply Voltage #2 (+5V DC)	3510			211			3, 4
Piston cooling oil pressure	4811		8				1, 2, 3, 5, 18
Piston cooling pressure	520192					6.8/6.7	1, 3

	SPN	PID	PPID	SID	PSID	Flash code Electrical fault/Value fault	FMI
Starter input sensor	520194		4			4.7/- (EMS) 5.2/- (CIU)	
Stop Input, CIU	520195		6			5.3/- (CIU)	4
Frequency select input			113				
Diagnostic request switch input			259				
Oil pressure warning lamp status			260			4.1/-	
Coolant level warning lamp status			261			4.5/-	
Diagnostic lamp status			262				
Run indication lamp status			263			4.3/-	
Over speed indication lamp status			264			4.4/-	
Coolant temperature warning lamp output			7			4.2/-	

**Fault codes, engine**

SPN	Component	FMI
20	Coolant Water Pressure	1, 3, 5, 18
51	Engine Throttle position (cold)	3, 5, 7, 12, 13
91	Accelerator Pedal position	0, 9, 19
94	Fuel Delivery Pressure <i>, page 71</i>	3, 5, 12, 18
97	Water in fuel indicator <i>Draining condensate, fuel system, page 71</i>	0, 4, 12
98	Engine Oil Level <i>Oil level, checking and topping up, page 68</i>	1, 4, 5, 18
99	Engine Oil Filter Differential Pressure	0
100	Engine Oil Pressure <i>Oil level, checking and topping up, page 68</i>	1, 3, 4, 5, 18
101	Crankcase pressure	0, 3, 5
102/106	Boost pressure	0, 3, 4, 5, 16
105	Boost temperature	0, 4, 5, 16
107	Air filter pressure	0, 3, 4, 5, 12
108	Ambient air pressure	5
110	Coolant Temperature <i>Coolant Level, Checking and Topping Up, page 76</i>	0, 4, 5, 16
111	Coolant Level <i>Coolant Level, Checking and Topping Up, page 76</i>	1, 3, 4, 5, 18
131	Exhaust back pressure	3, 5, 12
153	Crankcase pressure	0, 2, 3, 5
158	ECU battery potential <i>Battery, Charging</i>	0,1, 2
164	Injection control pressure	2, 4, 5
171	Ambient Air Temperature Sensor	14
172	Ambient Air Temperature Sensor	4, 5
173	Exhaust gas temperature	0, 16
175	Engine Oil Temperature <i>Oil level, checking and topping up, page 68</i>	0, 3, 4, 5, 16
190	Engine Speed	0, 16
608	Throttle position	9
626	Preheat relay	3, 4, 5
626	Inlet Air Temperature	3, 4, 5
628	Program Memory	2
629	Controller error	8, 12
636	Camshaft sensor	7, 8, 9
637	Crankshaft sensor	2, 8, 9
639	J1939 Network #1 Primary Vehicle Network	2
647	Engine Fan Driver	3, 4, 5
651	Fuel Injector, Cylinder #1	3, 5
652	Fuel Injector, Cylinder #2	3, 5
653	Fuel Injector, Cylinder #3	3, 5
654	Fuel Injector, Cylinder #4	3, 5
655	Fuel Injector, Cylinder #5	3, 5



SPN	Component	FMI
656	Fuel Injector, Cylinder #6	3, 5
677	Starter motor relay	3, 4, 5, 6
679	Injection Control Pressure Regulator	3, 4, 5, 6
679	Pressure Release Valve	0, 7, 11, 14
729	Preheater	5, 6, 7, 12
970	Engine stop switch	3, 4, 5, 11, 14
1136	ECU temperature high	16
1184	Exhaust gas temperature	0, 4, 5, 16
1188	Wastegate Valve	3, 4, 5
1485	ECM Main Relay	7
1639	Fan speed	3
1668	J1939 Network #4 (engine subnet)	2
2017	Lost Communication (Source Address 17)	9
2036	Lost Communication (Source Address 36)	9
2659	Engine Exhaust Gas Recirculation (EGR) Mass Flow Rate	18
2791	Internal EGR	7
2988	Thermostat bypass valve	3, 4, 5
3241	Exhaust gas temperature	19
3364	Aftertreatment Tank Reagent Quality	2, 17
3464	Engine throttle actuator (cold) Engine Throttle Actuator	3, 4, 5, 7, 10, 12
3509	Sensor Supply Voltage #1 (+5 V DC)	3, 4
3510	Sensor Supply Voltage #2 (+5V DC)	3, 4
3511	Sensor Supply Voltage #3 (+5V DC)	3, 4
520193	Sea Water Pressure	1, 3, 4, 5, 18
520335	ECU battery potential	5
520416	Lost communication with reductant control module on engine subnet	9
520567	Aftertreatment Exhaust Temperature - Wet	0, 3, 4, 5, 16
520570	Engine Oil Pressure Before Filter	3, 4, 5, 11
520688	Aftertreatment Exhaust Temperature - Dry	0, 3, 4, 5, 16
520689	EGR "A" / Volvo Compression Brake (VCB) Control Circuit	3, 4, 5
520690	EGR "A" Control / Turbocharger/Supercharger Wastegate Solenoid "A"	3, 5
520691	Torque Speed Control 1 Received With Errors (Counter or Checksum)	14

# Maintenance Schedule

Your Volvo Penta engine and its equipment are designed for high reliability and long life. The engines are built to have the smallest possible environmental impact. If given preventive maintenance, according to the maintenance schedule, these qualities will be retained and unnecessary malfunctions will be avoided. In order for the warranty to be valid, the owner must make sure that the services in the service intervals are performed.

**NOTICE!** For emission related warranty rights see Emission Control System Warranty Statement.

## Service Intervals

Service intervals and the service content can be found in the Service Protocol available for download at [www.volvopenta.com](http://www.volvopenta.com).

Where both operational and calendar times are specified, perform the maintenance item at whichever time is the sooner.

**NOTICE!** More information on how to perform service and maintenance can be found in the Service and Maintenance handbook. Information on how to download or purchase the Service and Maintenance handbook can be found at [www.volvopenta.com](http://www.volvopenta.com).

## Extended service intervals

The interval between engine oil changes may be extended in certain circumstances. To determine whether the service interval may be extended, Volvo Penta's conditions for extended service intervals must be met and an oil analysis performed. Contact your Volvo Penta dealer for further information.

# Maintenance

This chapter describes the most common maintenance items. Refer to *Maintenance Schedule* for service intervals. When ordering service or spare parts, always specify the engine and transmission identification number. Refer to , page 94.

**NOTICE!** More information on how to perform service and maintenance can be found in the Service and Maintenance handbook. Information on how to purchase the Service and Maintenance handbook can be found at [www.volvopenta.com](http://www.volvopenta.com).

## ⚠ CAUTION!

Read through the safety advice before starting any work.

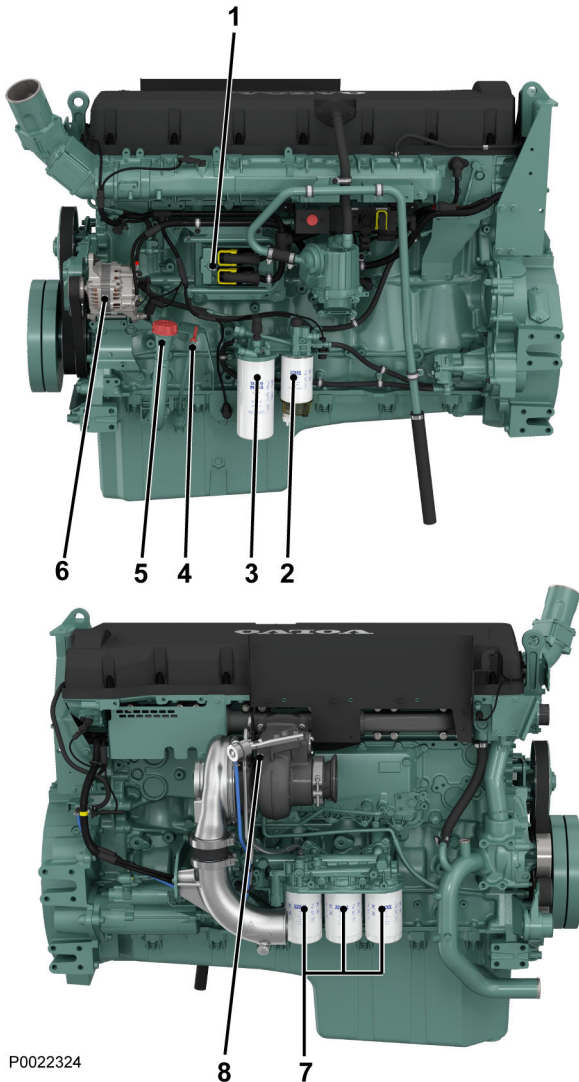
## ⚠ WARNING!

Care and maintenance work should be done with the engine stopped unless otherwise specified. Stop the engine before opening or removing the engine hatch/hood. Make it impossible to start the engine by removing the start key and cutting the system voltage with the main switches.

## Orientation

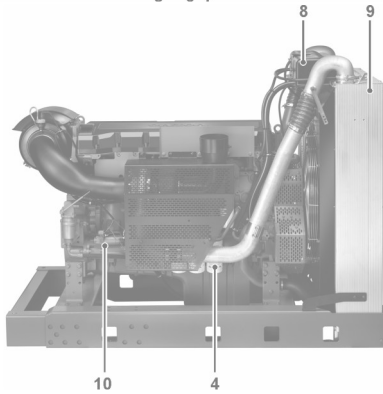
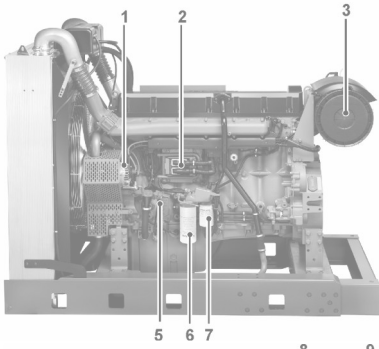
TAD1643VE-B

- 1 Control unit, EMS
- 2 Fuel pre-filter with water separator
- 3 Fuel filter
- 4 Oil dipstick
- 5 Oil filler cap
- 6 Alternator
- 7 Oil filter
- 8 Turbo



P0022324

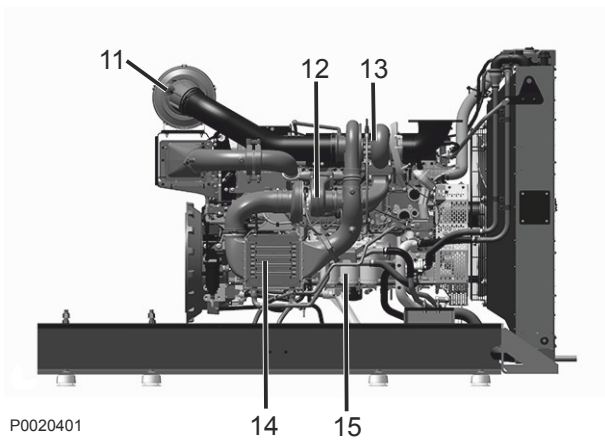
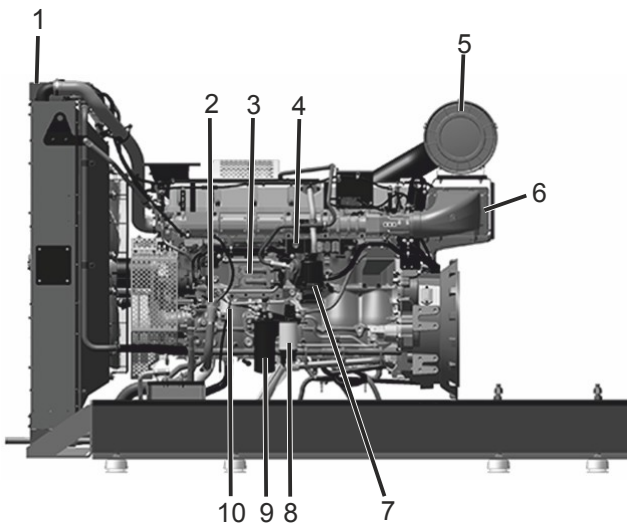
TAD1640VE-C, TAD1641GE-B, TAD1641VE-C,  
TAD1642GE-B, TAD1642VE-C, TAD1643VE



P0014600

- 1 AC generator
- 2 Control unit EMS 2
- 3 Air Filter
- 4 Oil filter
- 5 Oil dipstick
- 6 Fuel filter, with fuel pressure monitor
- 7 Fuel prefilter with water monitor
- 8 Expansion tank
- 9 Radiator
- 10 Starter motor

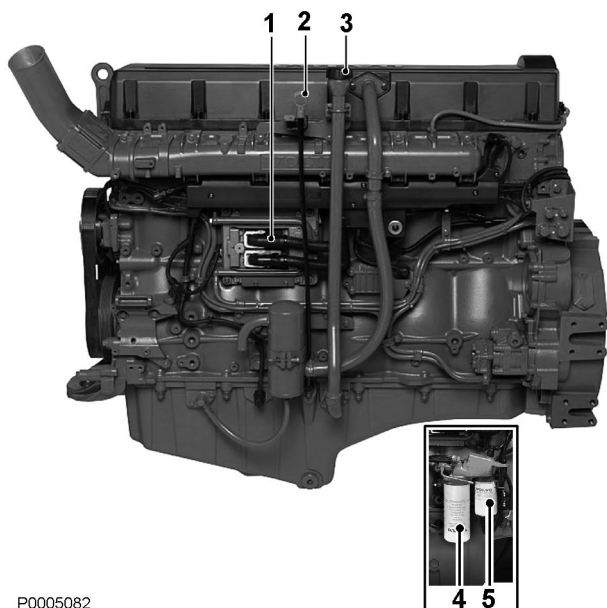
TWD1643GE, TWD1644GE, TWD1645GE,  
TWD1652GE, TWD1653GE



P0020401

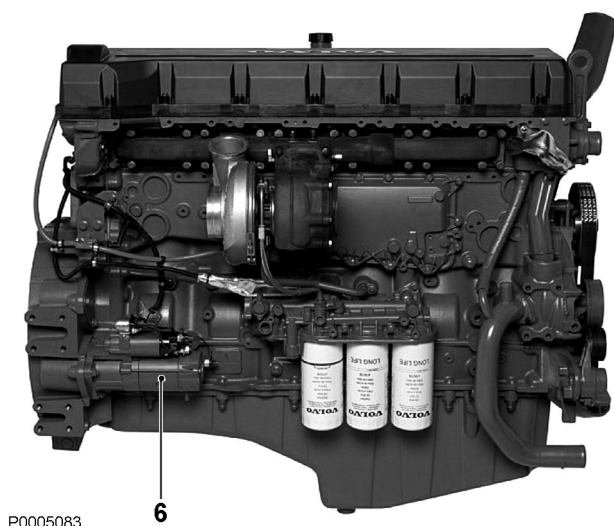
- 1 Expansion tanks
- 2 Oil filler cap, engine
- 3 Control Unit, EMS
- 4 Auxiliary Stop
- 5 Air Filter
- 6 Charge air cooler (High-Pressure Turbo)
- 7 Crankcase ventilation
- 8 Fuel filter, with fuel pressure monitor
- 9 Fuel prefilter with water monitor
- 10 Oil dipstick
- 11 Air filter indicator
- 12 Low-Pressure Turbo
- 13 High-Pressure Turbo
- 14 Charge air cooler (Low-Pressure Turbo)
- 15 Oil filter

## TAD1650GE, TAD1650VE, TAD1651GE

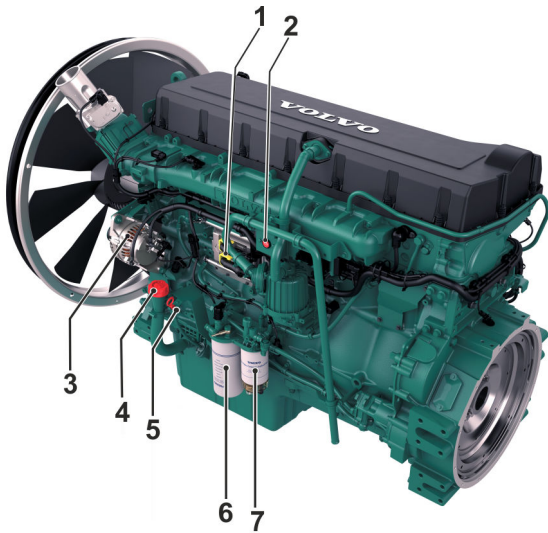


P0005082

- 1 Control unit, EMS
- 2 Oil filler
- 3 Oil dipstick
- 4 Fuel filter, to be installed separately
- 5 Fuel pre-filter with water monitor, to be installed separately
- 6 Starter motor

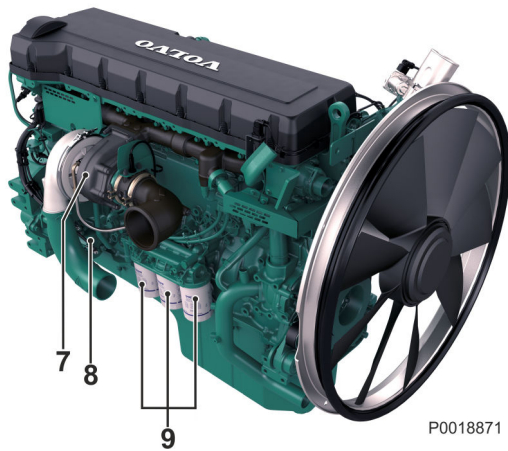


P0005083



TAD1650VE-B, TAD1651VE

- 1 Control Unit, EMS
- 2 Auxiliary stop
- 3 Alternator
- 4 Oil filler cap, engine
- 5 Oil dipstick
- 6 Fuel Filter
- 7 Fuel pre-filter with water separator
- 8 Turbo
- 9 Starter motor
- 10 Oil filter



P0018871

## Engine, General

### General inspection

Make it a habit to give the engine and engine compartment a visual inspection before starting the engine and after operation once the engine has stopped. This will help you to discover quickly if anything abnormal has happened, or is about to happen.

Look especially carefully at oil, fuel and coolant leakage, loose bolts, worn or poorly tensioned drive belts, loose connections, damaged hoses and electrical cables. This inspection only takes a few minutes and can prevent serious malfunctions and expensive repairs.

#### **⚠ WARNING!**

Risk of fire.

Remove all accumulations of fuel, oil and grease when detected on the engine or in the engine room.

#### **⚠ WARNING!**

If an oil, fuel or coolant leak is detected, the cause must be investigated and the fault rectified before the engine is started.

#### **IMPORTANT:**

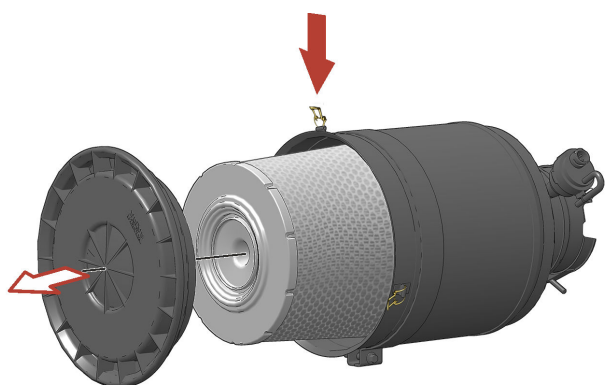
Washing with a power washer: Never aim the water jet at radiators, charge air cooler, seals, rubber hoses or electrical components.

### Air Filter, Check and Replace

The engine is equipped with electronic air filter indication.

The control unit provides an output signal which is announced as a warning on the instrument panel. The warning indicates a pressure drop in the air filter, which must then be checked and possibly changed.

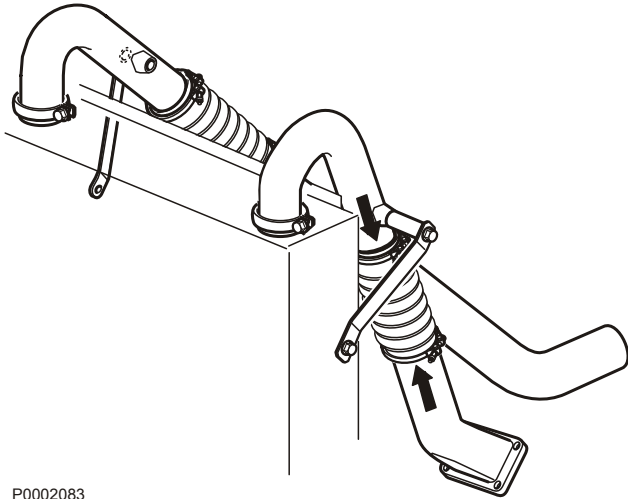
- Scrap the old filter. No cleaning or re-use is permissible
- In continuous operation, the filter should be checked every 8 hours. For operations in extremely dirty environments such as coal mines and rock crushing mills, special air filters must be used.



P0018636



## Charge Air Pipe, Leakage Check



P0002083

Inspect the condition of the charge air hoses, hose unions and clamps for cracks and other damage. Change as necessary.

Clamps must be tightened using a torque wrench to  $9 \pm 2$  Nm ( $6.6 \pm 1.5$  lbf.ft.).

## Drive Belt and Alternator Belt, Inspection

### **⚠ WARNING!**

Working with or approaching a running engine is a safety risk. Watch out for rotating components and hot surfaces.

### **IMPORTANT:**

Always change a belt which looks worn or cracked.

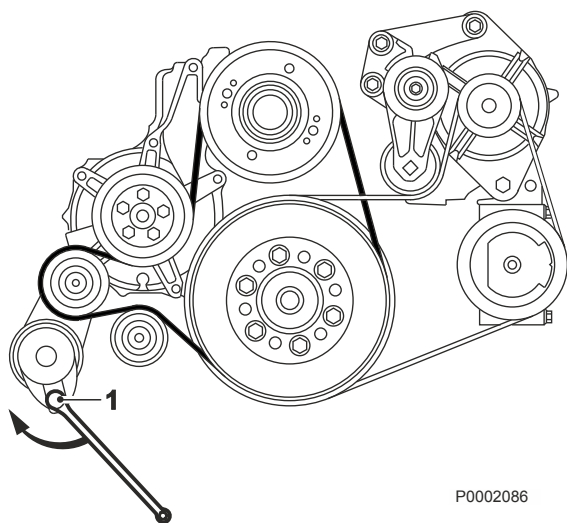
Inspections must be carried out after operations, while the belts are hot.

You should be able to depress the alternator belt and the drive belt about 3-4 mm between the pulleys.

The alternator belts and drive belts have automatic belt tensioners and do not need to be adjusted.

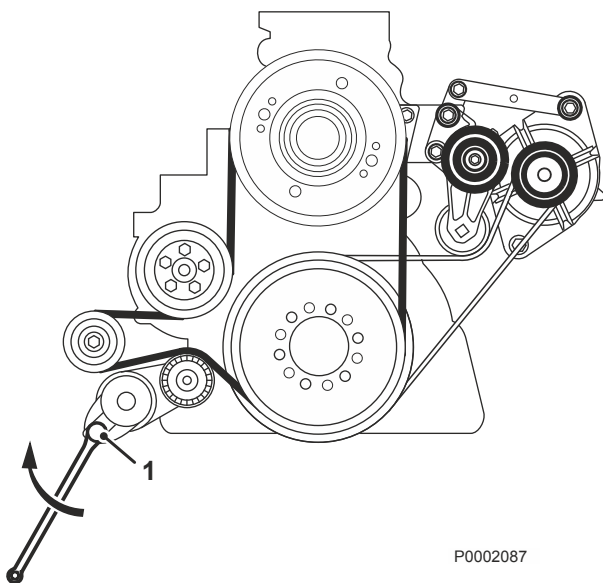
Check the condition of the drive belts. Replace as necessary; refer to *Alternator Belt, Replace, page 66* and *Drive Belt, Replace, page 65*.

## Drive Belt, Replace



TAD1641GE-B, TAD1642GE-B, TAD1650GE, TAD1651GE,  
TAD1640VE-C, TAD1641VE-C, TAD1642VE-C, TAD1643VE,  
TAD1643VE-B, TAD1650VE, TAD1650VE-B, TAD1651VE

- 1 Disconnect the main switch(es) and check that the engine is not connected to system voltage.
- 2 Remove the fan guard and fan ring round the cooling fan.
- 3 Remove the belt guard.
- 4 Insert a 1/2" square wrench in the belt tensioner (1). Lift the wrench and remove the drive belt.
- 5 Thread the drive belt round the fan and remove it.
- 6 Check that the pulleys are clean and undamaged.
- 7 Thread the new drive belt over the fan.
- 8 Lift the 1/2" wrench and install the new drive belt.
- 9 Install the belt guards.
- 10 Install the fan guard and fan ring round the cooling fan.
- 11 Start the engine and do a function check.

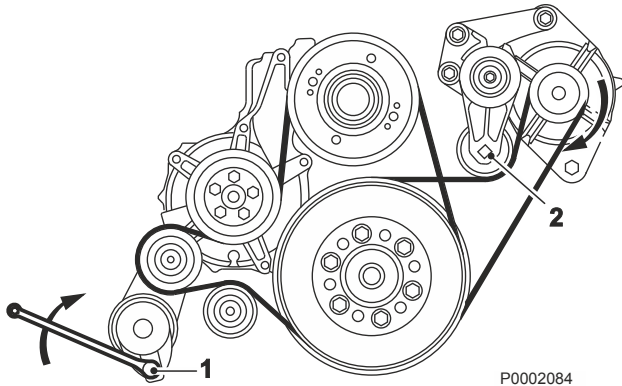


TWD1643GE, TWD1644GE, TWD1645GE, TWD1652GE,  
TWD1653GE

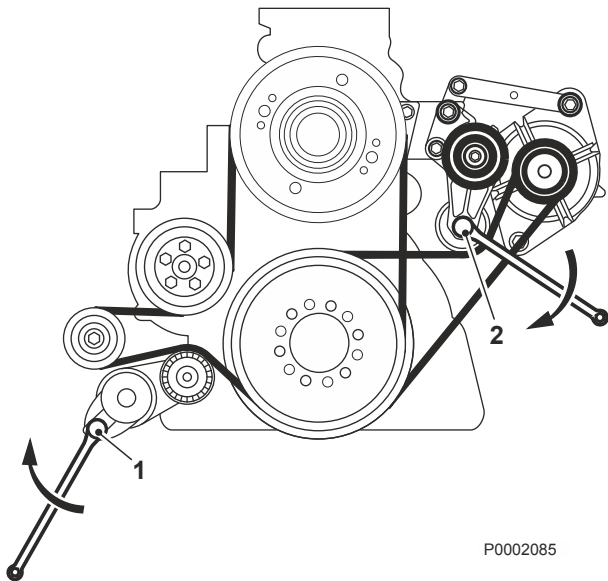
## Alternator Belt, Replace

### IMPORTANT!

Always change a drive belt which appears worn or cracked.



TAD1641GE-B, TAD1642GE-B, TAD1650GE, TAD1651GE,  
TAD1640VE-C, TAD1641VE-C, TAD1642VE-C, TAD1643VE,  
TAD1643VE-B, TAD1650VE, TAD1650VE-B, TAD1651VE



TWD1643GE, TWD1644GE, TWD1645GE, TWD1652GE,  
TWD1653GE

- 1 Disconnect the main switch(es) and check that the engine is not connected to system voltage.
- 2 Remove the fan guard and fan ring round the cooling fan.
- 3 Remove the belt guard.
- 4 Insert a 1/2" square wrench in the belt tensioner (1). Lift the wrench up and lift the water pump drive belt off.
- 5 Insert a 1/2" square wrench in the belt tensioner (2). Press the wrench down and remove the alternator belts.
- 6 Check that the pulleys are clean and undamaged.
- 7 Press the 1/2" wrench in the belt tensioner (2) down and install the new alternator drive belt.
- 8 Lift the 1/2" wrench in the belt tensioner (2) and install the new water pump drive belt.
- 9 Install the belt guards.
- 10 Install the fan guard and fan ring round the cooling fan.
- 11 Start the engine and do a function check.

## Lubrication System



P0002089

Volvo Penta only recommends the use of genuine Volvo Penta oils with the correct VDS (Volvo Drain Specification) standards.

Genuine Volvo Penta oils are extensively tested and quality assured by Volvo Penta to optimize performance, reduce fuel consumption and maximize the life of the engine.

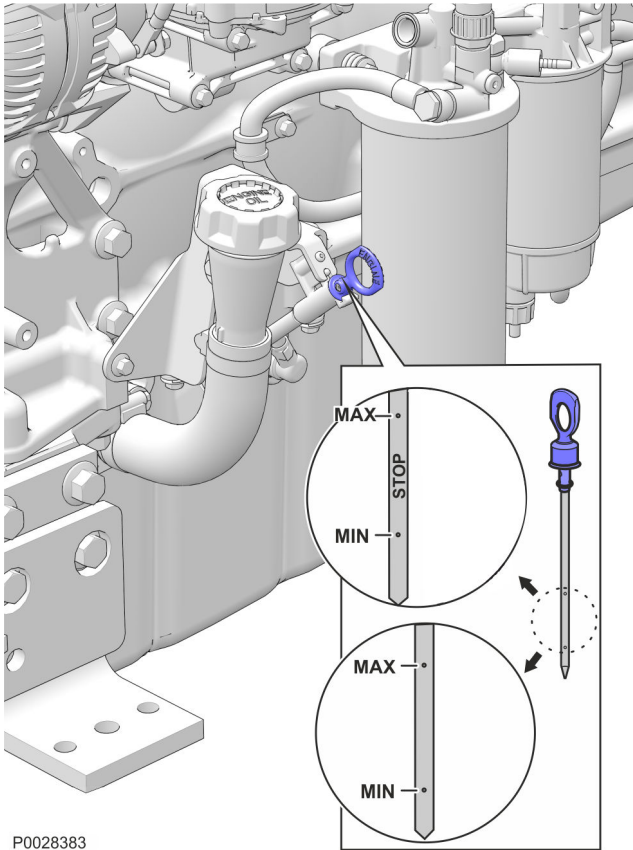
More detailed information regarding oil quality, viscosity and oil drain interval, refer to chapter *Lubrication System*.

## Oil level, checking and topping up

### **⚠ WARNING!**

Working with or approaching a running engine is a safety risk. Watch out for rotating components and hot surfaces.

- The engine should be placed on a level position when the oil is checked.
- The oil level is to be checked when the engine is stopped. Wait a few minutes before reading off the level, so that the oil has time to run down into the oil sump.
- Dipstick marked **STOP** can be read when the engine is stopped. Use the STOP side of the dipstick when the engine is stopped.
- The oil level must be inside the marked area on the dipstick. Never fill above the maximum limit on the oil dipstick.
- Only fill oil when the engine is stopped.
- Only use Volvo Penta recommended oils; refer to , page 89.
- The oil level sensor only measures the oil level when the ignition is switched to on, not continuously during operation.

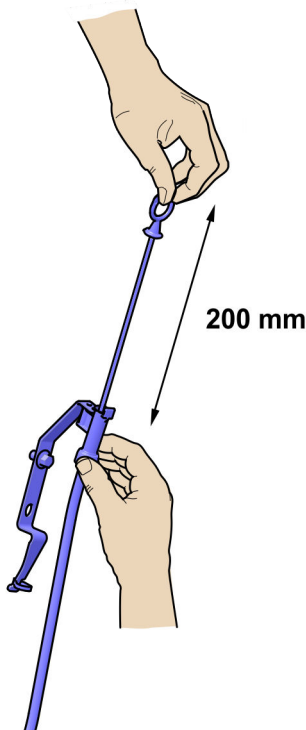


P0028383

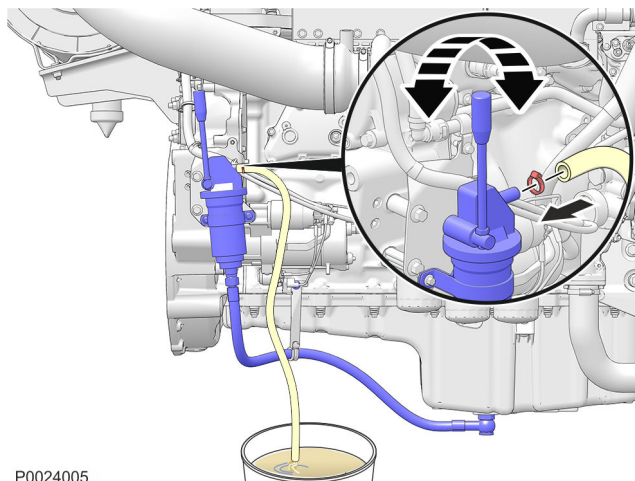
### Checking the oil with a flexible dipstick

#### **IMPORTANT:**

Insert the dipstick in increments of around 200 mm, without bending the wire, for the entire length of the plastic tube.



P0026405



## Engine Oil, Replace

### **⚠ WARNING!**

Hot oil and hot surfaces can cause burns.

Oil changes must be done when the engine is hot.

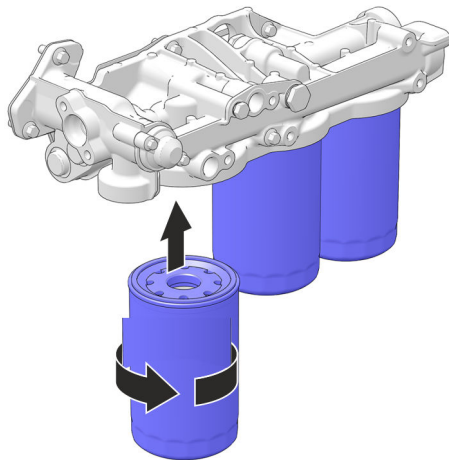
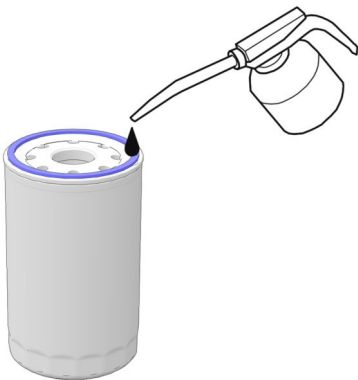
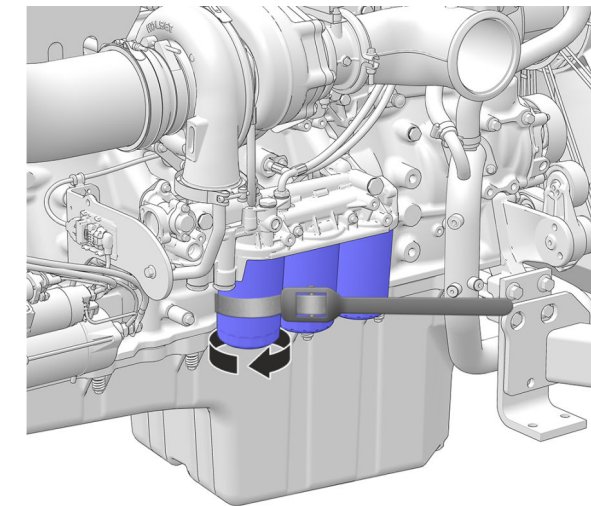
- 1 Connect the drain hose to the oil drain pump and check that no leakage can occur.
- 2 Pump the oil out (or remove the bottom drain plug and drain the oil).  
Collect all the old oil and old filters, and hand them to a re-cycling station for destruction.
- 3 Remove the drain hose (or install the bottom drain plug).
- 4 Fill with engine oil.  
For change volume, please refer to , *page 89*.

## Oil Filter/By-pass Filter, Replace

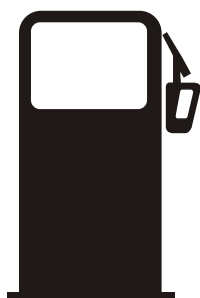
### **⚠ WARNING!**

Hot oil and hot surfaces can cause burns.

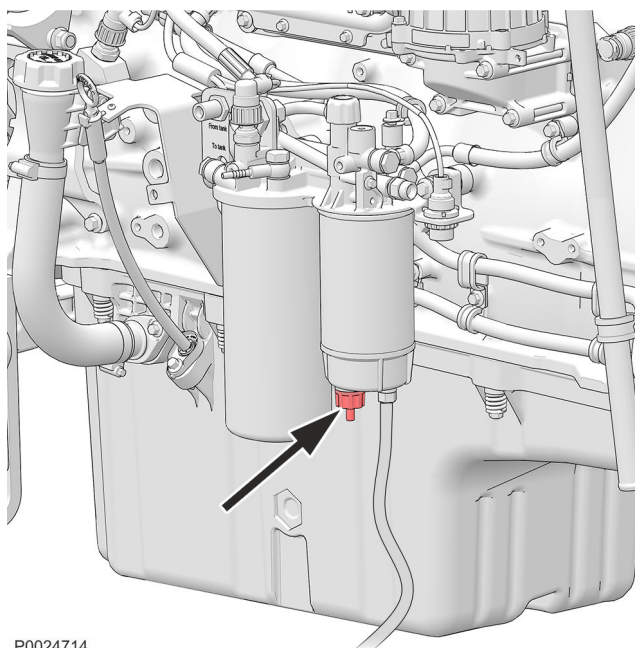
- 1 Clean the oil filter bracket (2).
- 2 Remove all oil filters with a suitable oil filter extractor (1).
- 3 Clean the mating surface of the oil filter bracket. Make sure that no pieces of old oil seal are left behind. Carefully clean round the inside of the protective rim (2) on the oil filter bracket.
- 4 Put a thin layer of engine oil on the seal rings of the new fuel filters.
- 5 Install the new oil filters. Tighten the filters  $\frac{3}{4}$ –1 turn after they touch.
- 6 Top up with engine oil, start the engine and let it run for 20-30 seconds.
- 7 Turn off the engine, check the oil level and top up as required.
- 8 Check sealing round the oil filters.



P0025685



P0002101



P0024714

## Fuel System

### **⚠ WARNING!**

Fire hazard. When carrying out work on the fuel system make sure the engine is cold. A fuel spill onto a hot surface or an electrical component can cause a fire. Store fuel soaked rags so that they cannot cause fire.

### **IMPORTANT:**

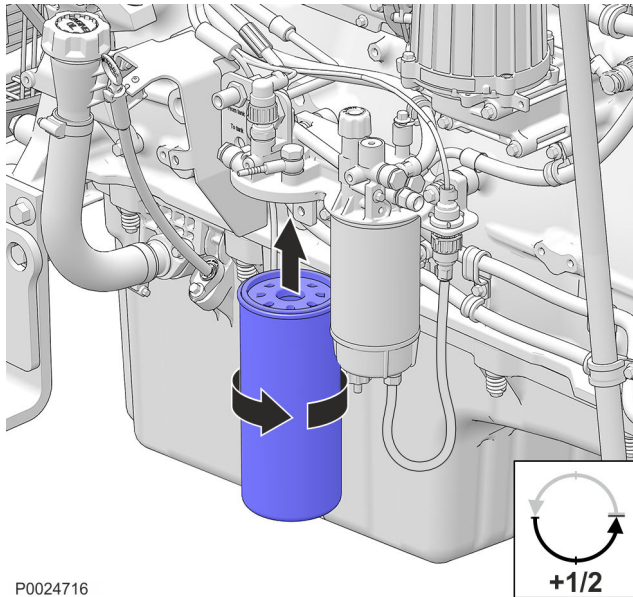
Always observe the greatest cleanliness during refueling and work on the fuel system. Only use the grades of fuel recommended in the fuel specification.

## Draining condensate, fuel system

**NOTICE!** Put a collection vessel under the fuel filter to collect the condensate and fuel.

- 1 Open the drain nipple in the base of the fuel pre-filter.
- 2 Tighten the drain tap when fuel without water starts to run out.





P0024716

## Engine Fuel Filter Replacement

### **⚠ WARNING!**

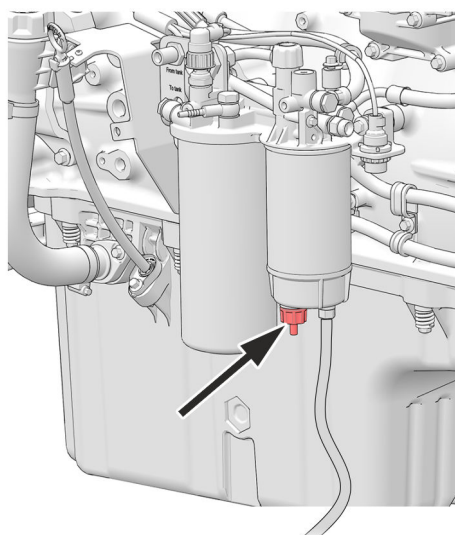
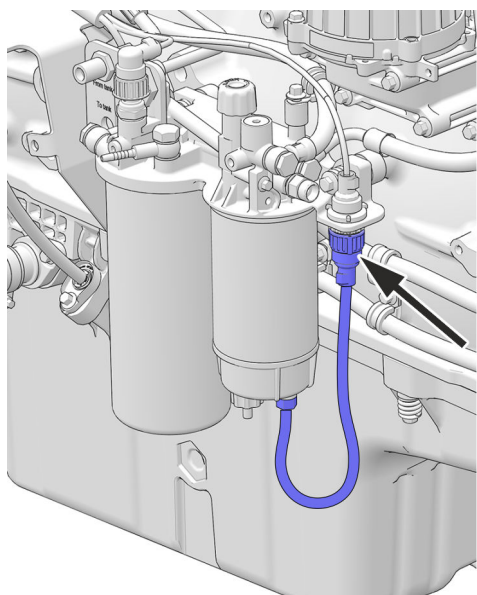
Fire hazard. When carrying out work on the fuel system make sure the engine is cold. A fuel spill onto a hot surface or an electrical component can cause a fire. Store fuel soaked rags so that they cannot cause fire.

### **IMPORTANT:**

Do not fill the new fuel filter with fuel before assembly. There is a risk that contamination could get into the system and cause malfunctions or damage.

- 1 Clean round the fuel filter.
- 2 Remove the filter with a suitable filter remover. Collect any spilled fuel in a collection vessel.
- 3 Clean the filter mating surface on the filter bracket.
- 4 Lubricate the seal with diesel fuel and install the new fuel filter. Tighten the fuel filter in accordance with the instructions on the fuel filter.
- 5 If necessary, vent the fuel system, please refer to *Fuel system, bleeding, page 74*.

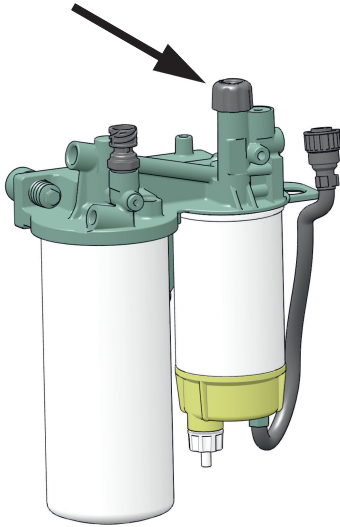
## Fuel Pre-filter, Replace



- 1 Undo the cable from the water trap sensor.
- 2 Remove the water trap filter from the filter housing. Collect any spilled fuel in a container.
- 3 Remove the lower part of the water trap from the filter.
- 4 Clean the lower part of the water trap with a soft rag. Check that the drain hole in the lower part is not blocked.
- 5 Install a new seal on the lower part and lubricate the seal with diesel fuel. Re-install the lower part of the filter.
- 6 Lubricate the seal with diesel fuel. Screw the filter onto the filter bracket by hand until the rubber seal just touches the mating surface. Then tighten a further half turn, no more.
- 7 Connect the cable to the water trap sensor.
- 8 If necessary, vent the fuel system, please refer to *Bleeding the Fuel System*.

P0025686

## Fuel system, bleeding



P0025497

- 1 Check that there is sufficient fuel in the tank, and that any fuel taps are open.
- 2 Release the hand pump on the fuel bracket by pushing down and twisting the plastic handle.
- 3 Vent the fuel system by pumping with the hand pump.  
Air is vented to the tank via the fuel return pipe. No breathing nipples need be opened.
- 4 Lock the hand pump, push down and twist the handle.
- 5 Start the engine and allow it to idle fast for about 10 minutes.
- 6 Perform a leakage and function check.



P0038119

## Cooling System

The cooling system ensures that the engine operates at the correct temperature. It is a closed system that should always be filled with a coolant mixture.

### IMPORTANT:

Coolant of a suitable chemical composition must be used all year round to protect the engine against internal corrosion, cavitation and freeze bursting. This even applies when there is no risk for freeze damage, to make sure the engine always has a complete corrosion protection.

Therefore, the use of anti-corrosion agents alone, or water alone as a coolant, is not permitted in Volvo Penta engines.

The coolant must be based on Organic Acid Technology (OAT). Using an improper coolant or mixing with another coolant will rapidly reduce the performance and lifetime of the engine. Material incompatibility can lead to leakages, which - in the worst case - can cause engine breakdown.

Volvo Penta strongly recommend the use of our own coolants, "Volvo Penta Coolant VCS-2 Ready Mixed" or the concentrate "Volvo Penta Coolant VCS-2", which ensure the protection of the cooling system components from corrosion, ageing, swelling and cracking, thereby ensuring optimal engine lifetime.

Over time the corrosion protection additives become less effective, and consequently the coolant must be changed at regular intervals to maintain sufficient protection of the engine. The latest Service Protocol that specifies service intervals can be found at [volvopenta.com](http://volvopenta.com).

### Coolant, Mixing

It is extremely important that the system is filled with the correct coolant concentration; refer to *Coolant, Mixing, page 93*.

The coolant should be mixed with distilled, deionized water. For Volvo Penta specified water requirements; refer to *Coolant, Mixing, page 93*.

**NOTICE!** If water quality can not be guaranteed, use ready mixed coolant.

## Coolant Level, Checking and Topping Up

### ⚠ WARNING!

Do not open the coolant filler cap when the engine is hot, except in emergencies, as this could cause serious personal injury. Steam or hot fluid could spray out.

### IMPORTANT!

Only use coolant recommended by Volvo Penta. Fill up with the same type of coolant that is in the system. VCS-2 will be backwards compatible with current VCS and they are mixable without risks.

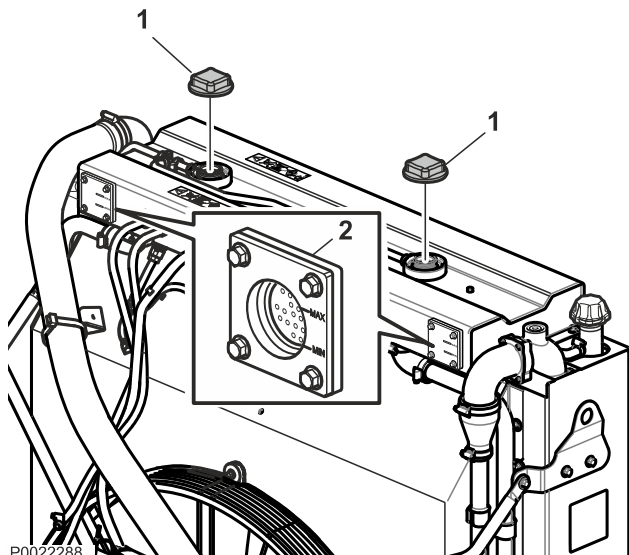
Filling of coolant must be performed with the engine stopped. Fill up slowly, to allow the air to flow out. Check the coolant level daily before start.

### TWD16

- 1 Open the filler caps (1).
- 2 Check that the coolant reaches the MAX mark on the sight glass (2). Top up with coolant as required.
- 3 Close the filler caps.

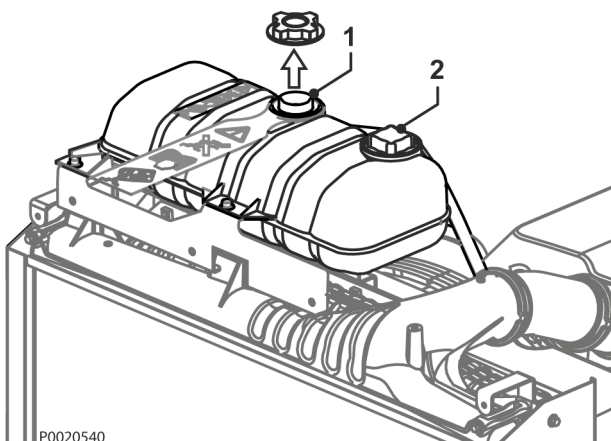
### TAD16

- 1 Open **only** the filler cap (1). Do not open the pressure cap (2).
- 2 Check that the coolant level is between the MIN and MAX marks on the expansion tank (1). Top up with coolant as required.
- 3 Close the filler cap.



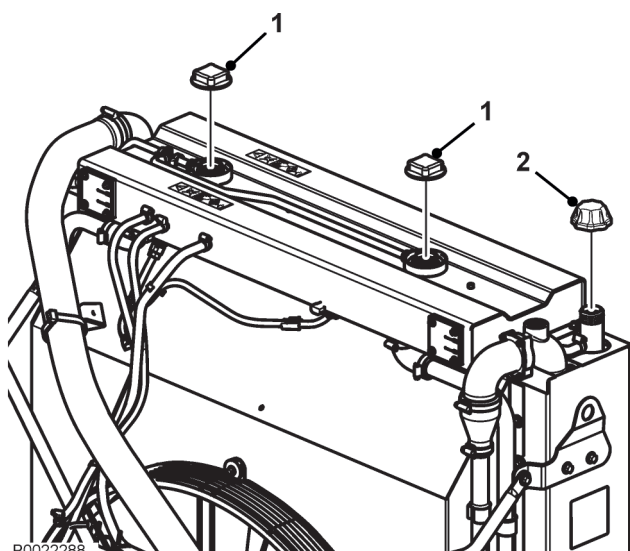
P0022288

TWD16



P0020540

TAD16



P0022288

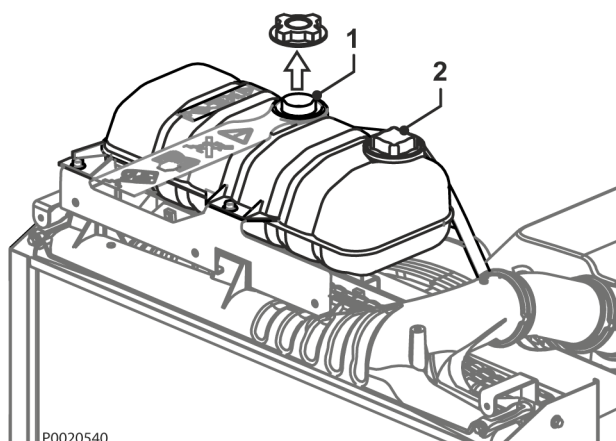
TWD16

## Filling a completely empty system

**NOTICE!** Mix the correct amount of coolant in advance, to ensure that the cooling system is completely filled. Refer to , page 92 for the correct coolant volume.

Do not start the engine until the cooling system is completely filled and vented.

**NOTICE!** If a heating unit is connected to the engine cooling system, the heating control valve should be opened and the installation vented during filling.



P0020540

TAD16

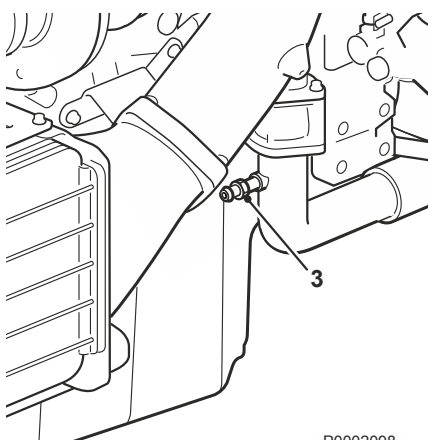
1 Check that all drain points are closed.

### 2 TWD16

Open the caps to both the expansion tank (1) and the radiator (2). Fill the expansion tank so that the coolant reaches the MAX mark on the sight glass. Close the filler caps.

### TAD16

Open **only** the filler cap (1). Fill the expansion tank so that the coolant level is between the MIN and MAX marks. Close the filler cap.



P0002098

3 Bleed the system at the bleeding nipple (3).

4 Start the engine when the coolant system is completely filled and vented.

Open any bleeding nipples a short while after starting, to allow trapped air to escape.

5 Start the engine after approx. one hour and check the coolant level. Top up with coolant as required.



## Coolant, Draining

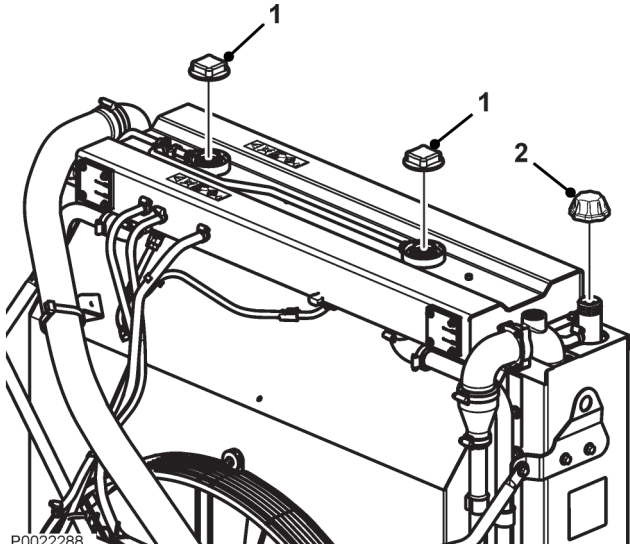
### ⚠ WARNING!

Do not open the coolant filler cap when the engine is hot, except in emergencies, as this could cause serious personal injury. Steam or hot fluid could spray out.

### IMPORTANT!

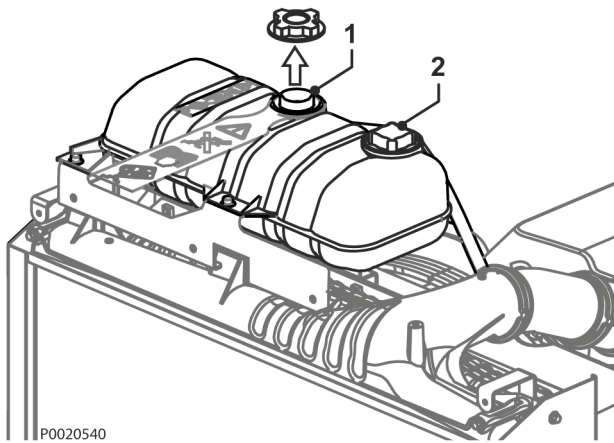
On engines which are to be put in storage, the engine cooling system should **not** be drained. The coolant contains corrosion inhibiting additives.

- 1 Stop the engine before draining.
- 2 **TWD16**  
Open both the pressure caps on the expansion tank (1) and the filler cap to the radiator (2).  
**TAD16**  
Open the filler cap (1). Do not remove the pressure cap (2).
- 3 Open all drain points. Drain the coolant from the radiator and engine block, using the drain hose. The drain nipples are situated under the radiator on the right side of the engine block.
- 4 Check that all coolant drains out. Deposits may be found inside the drain plug/tap, and need to be cleared away. There is otherwise a risk that the coolant could remain and cause frost damage. Check whether the installation has any further taps or plugs at the lowest points of the cooling water pipes.
- 5 Close any taps and check that the spring-loaded covers on the nipples close completely. Install the rubber plugs and the filler cap(s).



P0022288

TWD16



P0020540

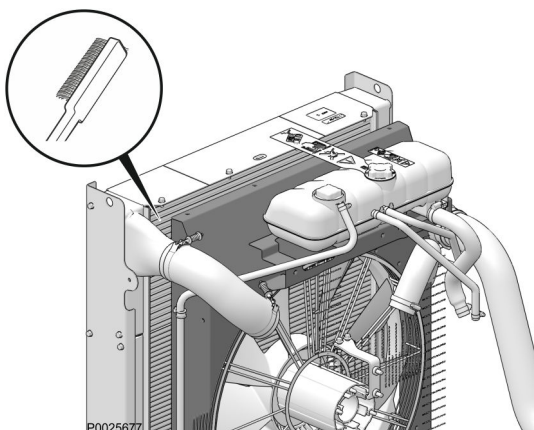
TAD16

## Charge Air Cooler, External Cleaning

### IMPORTANT:

Do not use a high pressure power washer.

Remove guards as necessary, to access the radiator. Clean with water and a mild detergent. Use a soft brush. Be careful not to damage the radiator vanes. Reinstall removed parts.



P0025677

## Cooling System, Cleaning

### **WARNING!**

All coolant is hazardous and harmful to the environment. Do not consume. Coolant is flammable.

### **IMPORTANT:**

Never clean the cooling system if there is any risk of freezing, since the cleaning solution does not have any antifreeze properties.

### **IMPORTANT:**

It is extremely important that the correct concentration and volume of coolant is added to the system. Mix in a separate clean vessel before filling the cooling system. Make sure that the liquids mix.

### **IMPORTANT:**

Always follow local safety instructions and regulations.

Cooling performance is reduced by deposits in the radiator and cooling galleries. The cooling system should be cleaned out when the coolant is changed.



- 1 Empty the cooling system. Refer to *Coolant, Draining, page 78*.
- 2 Put a hose into the expansion tank filling hole and flush with clean water, as specified by Volvo Penta—refer to section *Water quality in , page 92* until the water draining out is completely clear.
- 3 If there should still be some contamination left after flushing for a long time, cleaning can be done with coolant. Otherwise, continue as in item 8 below.
- 4 Fill the cooling system with 15-20 % mixture of concentrated coolant. Use only Volvo Penta recommended concentrated coolant mixed with clean water.
- 5 Drain the coolant after 1-2 days of operation. Remove the filler cap and possibly the lower radiator hose to increase the speed of emptying. To prevent suspended material from settling back in the system emptying should be done rapidly, within the space of 10 minutes, when the engine has not been standing still for a long time.
- 6 Flush the system immediately and thoroughly with clean hot water to prevent dirt from settling in the inner areas. Flush until the water that runs out is completely clean. Make sure that any heater controls are set to full heating during emptying.
- 7 If contamination should still be left after a long period of flushing, cleanout using Volvo Penta radiator cleaner, followed by finishing-off with Volvo Penta neutralizer. Carefully follow the instructions on the package. Otherwise, continue as in item 8 below.
- 8 When the cooling system is completely free from contamination, close the drain taps and plugs.
- 9 Fill up with Volvo Penta recommended coolant, following the instructions in the chapters entitled *, page 75* and *Coolant Level, Checking and Topping Up, page 76*.

## Cooling air filter

### **⚠ WARNING!**

Stop the engine before doing any maintenance work.

A newly-installed cooling air filter reduces cooling performance by 4 %.

### Installation

- 1 Slide one half of the filter over the fan cover (as in fig.1).
- 2 Turn the half filter until it is able to hang loosely on the fan cover (see fig. 2).
- 3 Slide on the other filter half and secure the two halves together with self-affixing velcro tape (as in fig. 3a).
- 4 Fasten the outer velcro tape around the fan cover guard (as in fig. 3b and 3c).

### Removal and cleaning

- 1 Remove the cooling filter.
- 2 Brush away any heavy dirt with a soft brush.
- 3 Rinse the filter with water.

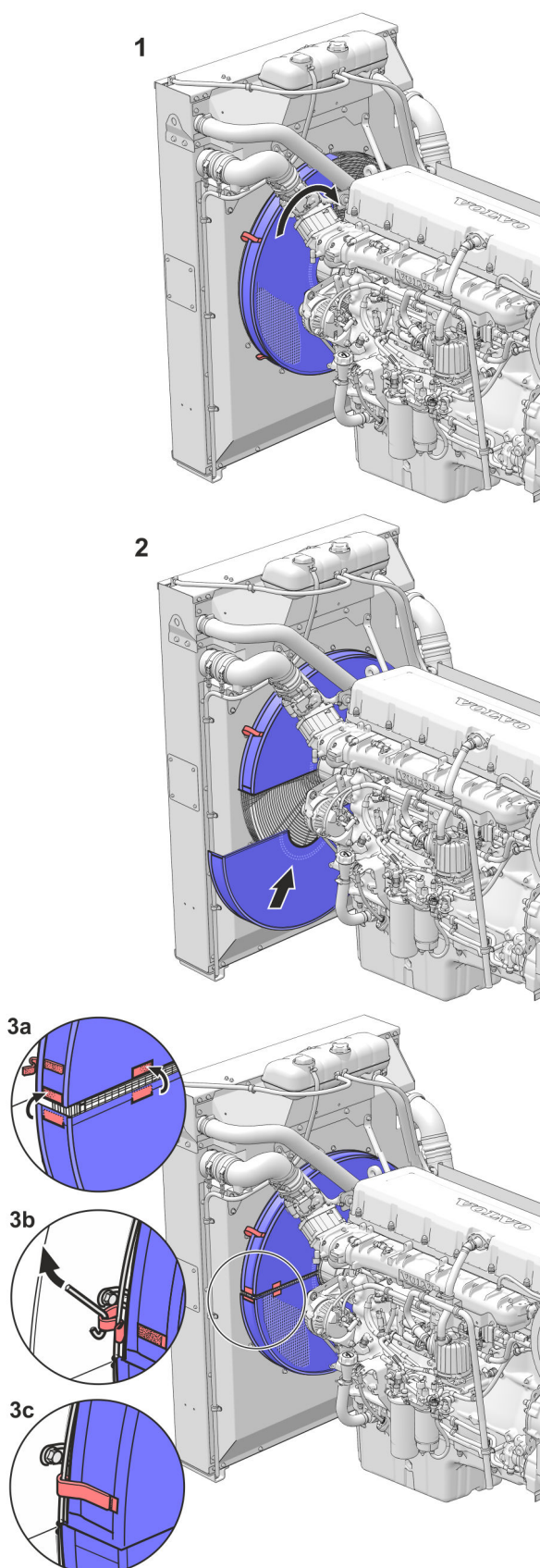
**NOTICE!** If a cleaning agent is necessary, an eco-friendly degreaser (e.g. coconut oil based) must be used as a first choice. Alternatively, use a paraffin fraction as a second choice.

Spray on the degreaser or apply it using a sponge. Allow it to act for a few minutes and then rinse with tap water.

### **IMPORTANT:**

Do not use gasoline, steam, a high-pressure washer or other cleaning agents.

- 4 Re-install the filter according to instructions.



P0025788

## Electrical System

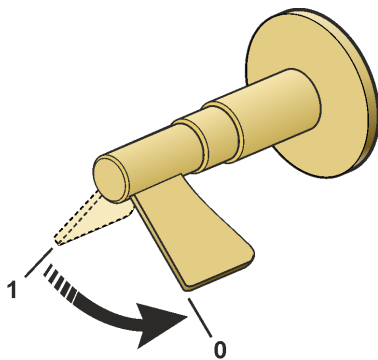
The engine is equipped with a 2-pole electrical system and an alternator.

**⚠ WARNING!**

Always stop the engine and break the current using the main switches before working on the engine.

**IMPORTANT:**

Contact a Volvo Penta dealer for information if any arc welding will be performed on the application. Arc welding can cause damage to the engine and the electronics.



P0002576

## Main switch

**IMPORTANT:**

Never disconnect the current using the main switches when the engine is running or by disconnecting the battery cables.

The alternator and electronics could be damaged.

The main switches must never be switched off before the engine has stopped. If the circuit between the alternator and the battery is disconnected when the engine is running, the alternator and electronics may be damaged. For the same reason, the charging circuits must never be re-connected with the engine running.

## Fuses

The engine is equipped with a 10 A circuit breaker which cuts the current if overloaded.

The circuit breaker is located on the left-hand side of the engine.

The engine stops if the fuse trips. If the circuit breaker trips frequently, an authorized Volvo Penta workshop should be contacted to investigate the cause of the overload.

## Electrical Connections

Check that electrical connections are dry, free from oxide, and that they are securely tightened.



P0002107

## Battery

### ⚠ WARNING!

Risk of fire and explosion. Never allow an open flame or electric sparks near the batteries.

### ⚠ WARNING!

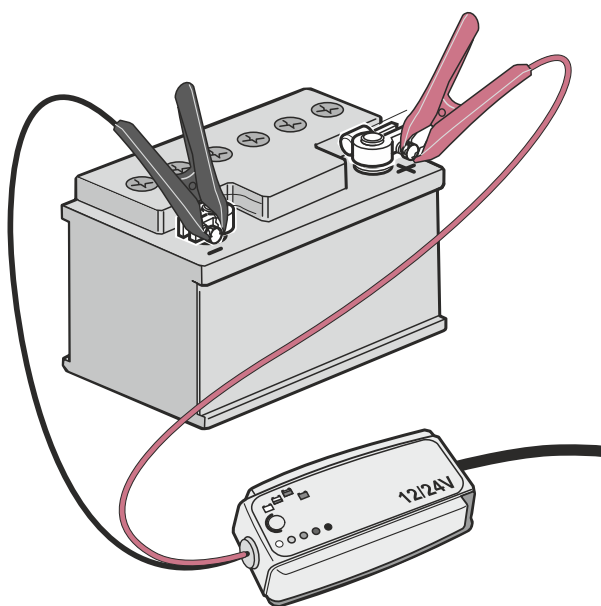
Battery electrolyte is a corrosive acid and should be handled with care. If you spill or splash electrolyte on any part of the body, immediately flush the exposed area with liberal amounts of water and seek medical attention as soon as possible.

### ⚠ WARNING!

Ventilate the engine compartment before working on batteries or battery connections.

### IMPORTANT:

Batteries can be damaged if they are left discharged, and can also freeze and burst easier in cold weather. If the engine is not going to be used for a longer period of time, the batteries should be fully charged, trickle charged if possible.



P0022892

## Maintenance

It is important to always follow the battery manufacturer's recommendation and instruction when replacing and charging batteries. Depending on battery type, the instructions for maintenance and charging may vary.

Modern batteries are normally maintenance free, but there are some actions that are recommended to increase the battery service life and avoid accidents:

- Keep the batteries clean and dry. Contamination and oxide on the batteries and battery poles can result in stray currents, voltage drop and discharge, especially in wet weather.
- Remove oxidation from the battery poles and terminals, using a brass brush.
- Tighten the terminals securely and grease them with terminal grease or petroleum jelly. Loose battery connections may cause damage to the engine's electrical system.
- Charge the battery regularly. A battery that is kept fully loaded has a maximum service life. The easiest way to check if a battery needs charging is to use a voltmeter.

**NOTICE!** If low starter battery alarm occur, the battery may get drained which might result in loss of functions and engine stopping.

## Replacing Battery

### IMPORTANT:

Make sure that the new battery fulfills the specifications in *Technical Data*. Read the information supplied with the battery before you begin the installation.

### IMPORTANT:

Do not disconnect the batteries with the engine running. Sensitive electrical components can be immediately damaged.

### ⚠ WARNING!

Never confuse the positive and negative poles on the batteries. Risk of arcing and explosion.

### Disconnecting (A)

- 1 Untighten the nut and remove the – cable (black).
- 2 Untighten the nut and remove the + cable (red).

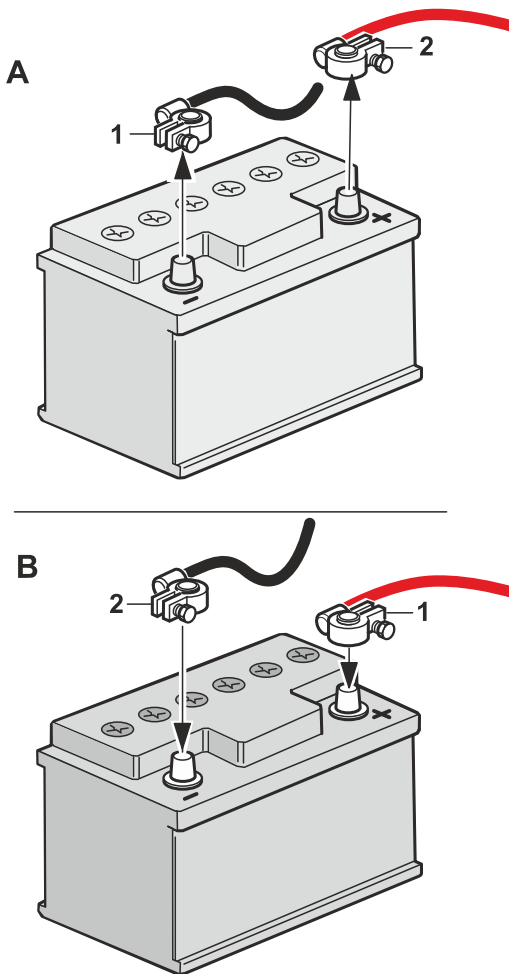
Remove the battery.

### Connecting (B)

Place the new battery.

- 1 Connect the + cable (red) to the + pole on the battery and tighten the nut.
- 2 Connect the – cable (black) to the – pole on the battery and tighten the nut.

**NOTICE!** Hand in the old battery to a re-cycling station.



P0022893

# Storage

To prevent the engine and other equipment from being harmed during long (2 months or more) periods out of service, it must be conserved. Conservation protects the engine from freezing and corrosion damages.

It is of utmost importance that the conservation is performed correctly, therefore we have compiled a checklist covering the most important points. Before taking the engine out of service for long periods, Volvo Penta recommends that the engine is checked by a qualified workshop for possible need for overhaul or repair.

## ⚠ CAUTION!

Read the chapter on Maintenance in the Operator's Manual before starting work. It contains instructions on how to carry out maintenance and service operations in a safe and technical correct manner.

## ⚠ WARNING!

Conservations oils can be flammable and dangerous to inhale. Ensure good ventilation. Use a protective face mask when spraying.

## IMPORTANT:

Washing with a power washer: Never aim the water jet at radiators, charge air cooler, seals, rubber hoses or electrical components.



P0002089

- **For up to 8 month's stoppage:**  
Change the oil and oil filter on the engine, then run the engine until warm.
- **More than 8 month's stoppage:**  
Conserve the lubrication and fuel systems with conservation oil. Refer to the section *Conservation of the lubrication and fuel systems for more than 8 months' stoppage*.
- Make sure the coolant has adequate antifreeze properties. Top up as necessary. Alternatively, you can drain the coolant (also drain the coolant filter).
- Drain any water and contamination from the fuel filters and fuel tank. Fill the fuel tank completely, to avoid condensation.
- Disconnect the battery cables, clean and charge the batteries. Trickle charge the batteries while the equipment is in storage. **A poorly charged battery can freeze and burst.**
- Clean the outside of the engine. Do not use a high pressure washer for engine cleaning. Touch up paint damage with Volvo Penta original paint.
- Put a note on the engine with the date, type of conservation and the conservation oil used.
- Cover the air filter, exhaust pipe and engine if necessary.
- Empty the AdBlue/DEF tank and rinse it with distilled water.

## Bringing Out of Storage

- Remove any covers from the engine, air filter and exhaust pipe.
- Fill the engine with the correct quality and viscosity oil into the engine, as necessary, refer to *Technical Data, Lubrication System*. Install a new oil filter if the filter was not changed during conservation.
- Install new fuel filters and bleed the fuel system.
- Check the drive belt(s).
- Check the condition of all rubber hoses, and retighten the hose clamps.
- Close the drain taps and install any drain plugs.
- Check the coolant level. Top up as necessary.
- Connect the fully charged batteries.
- Start the engine and warm it up at fast idle with no load.
- Check that no oil, fuel or coolant leakage occurs.
- Fill the AdBlue/DEF tank. The solution must fulfill ISO 22241 standards.

## Conservation of the lubrication and fuel systems for more than 8 months' stoppage:

- Drain the engine oil and fill up with **conservation oil\*** to just over the MIN marking on the dipstick.
- Connect the fuel suction and return hoses to a 1/3 full jerrican containing **conservation oil\*** and 2/3 diesel fuel.
- Bleed the fuel system.
- Start the engine and run at a fast idle until about 2 liters (0.6 US gal) of the fluid in the jerrican have been used. Stop the engine and re-connect the fuel suction and return lines.
- Drain the conservation oil from the engine.
- Follow the other instructions on the previous page.

\* Conservation oils are sold by oil companies.

# Technical Data

## Engines

Type designation	TAD1641GE-B	TAD1642GE-B	TWD1643GE
Power	Refer to the sales literature		
Torque	Refer to the sales literature		
No. of cylinders	6	6	6
Bore, mm (inch)	144 (5.67)	144 (5.67)	144 (5.67)
Stroke, mm (inch)	165 (6.50)	165 (6.50)	165 (6.50)
Displacement, liter (inch <sup>3</sup> )	16.12 (983.9)	16.12 (983.9)	16.12 (983.9)
Weight, dry, kg (lb)	1480 (3263)	1480 (3263)	1700 (3748)
Weight, wet, kg (lb)	1550 (3417)	1550 (3417)	1770 (3902)
Firing order	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4
Compression ratio	16.5:1	16.5:1	16.5:1
Low idle, r/min.	900	900	900

Type designation	TWD1644GE	TWD1645GE
Power	Refer to the sales literature	
Torque	Refer to the sales literature	
No. of cylinders	6	6
Bore, mm (inch)	144 (5.67)	144 (5.67)
Stroke, mm (inch)	165 (6.50)	165 (6.50)
Displacement, liter (inch <sup>3</sup> )	16.12 (983.9)	16.12 (983.9)
Weight, dry, kg (lb)	1700 (3748)	1700 (3748)
Weight, wet, kg (lb)	1770 (3902)	1770 (3902)
Firing order	1-5-3-6-2-4	1-5-3-6-2-4
Compression ratio	16.8:1	16.8:1
Low idle, r/min.	900	900

Type designation	TAD1650GE	TAD1651GE	TWD1652GE	TWD1653GE
Power	Refer to the sales literature			
Torque	Refer to the sales literature			
No. of cylinders	6	6	6	6
Bore mm (inch)	144 (5.67)	144 (5.67)	144 (5.67)	144 (5.67)
Stroke mm (inch)	165 (6.50)	165 (6.50)	165 (6.50)	165 (6.50)
Displacement liter (inch <sup>3</sup> )	16.12 (983.9)	16.12 (983.9)	16.12 (983.9)	16.12 (983.9)
Weight, dry kg (lb)	1550 (3417)	1550 (3417)	1755 (3869)	1755 (3869)
Weight, wet kg (lb)	1751 (3860)	1751 (3860)	2065 (4553)	2065 (4553)
Firing order	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4
Compression ratio	16.5:1	16.5:1	16.5:1	16.5:1
Low idle, r/min.	900	900	900	900



Type designation	TAD1640VE-C	TAD1641VE-C	TAD1642VE-C	TAD1643VE
Power	Refer to the sales literature			
Torque	Refer to the sales literature			
No. of cylinders	6	6	6	6
Bore mm (inch)	144 (5.67)	144 (5.67)	144 (5.67)	144 (5.67)
Stroke mm (inch)	165 (6.50)	165 (6.50)	165 (6.50)	165 (6.50)
Displacement liter (inch <sup>3</sup> )	16.12 (983.9)	16.12 (983.9)	16.12 (983.9)	16.12 (983.9)
Weight, dry kg (lb)	—	—	—	1440 (3175)
Weight, wet kg (lb)	1440 (3175)	1440 (3175)	1440 (3175)	1510 (3329)
Firing order	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4
Compression ratio	16.8:1	16.8:1	16.8:1	17.5:1
Low idle, r/min.	600	600	600	600–900

Type designation	TAD1643VE-B	TAD1650VE	TAD1650VE-B,	TAD1651VE
Power	Refer to the sales literature			
Torque	Refer to the sales literature			
No. of cylinders	6	6	6	6
Bore mm (inch)	144 (5.67)	144 (5.67)	144 (5.67)	144 (5.67)
Stroke mm (inch)	165 (6.50)	165 (6.50)	165 (6.50)	165 (6.50)
Displacement liter (inch <sup>3</sup> )	16.12 (983.9)	16.12 (983.9)	16.12 (983.9)	16.12 (983.9)
Weight, dry kg (lb)	—	1425 (3142)	—	—
Weight, wet kg (lb)	1440 (3175)	—	1395 (3075)	1395 (3075)
Firing order	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4
Compression ratio	17.0:1	18.0:1	17.0:1	17.0:1
Low idle, r/min.	600–900	600–900	600–900	600–900

## Lubrication System

<b>Oil change volume, including filter change</b>	
Plastic sump (Standard)	48 liters (12.68 US gal)
Aluminum sump (Optional)	55 liters (14.53 US gal)
TAD1643VE-B, TAD1650/51VE: Aluminum sump (Optional)	46 liters (12.15 US gal)
Additional volume: Remote oil filters (Optional)	3 liters (0.80 US gal)
<b>Oil pressure, hot engine</b>	
at rated speed	300-650 kPa (44–94 psi)
<b>Oil filter</b>	
Full flow filter	2
By-pass filter	1
<b>Lube oil pump</b>	
Type	Gear driven

### Oil recommendations

Type designation	Oil quality	Oil change interval, reached first in operation:
TAD1641GE-B, TAD1642GE-B, TWD1643GE, TWD1644GE, TWD1645GE, TAD1650GE, TAD1651GE, TWD1652GE, TWD1653GE TAD1640-42VE-C, TAD1643VE, TAD1650VE	VDS-3 VDS-4 VDS-4.5	<b>600</b> hours or 12 months
TAD1650VE-B, TAD1651VE TAD1643VE-B	VDS-3 VDS-4 VDS-4.5	<b>500</b> hours or 12 months

**NOTICE!** Lube oil change intervals shall be halved, when Bio fuel B11-30 applied.

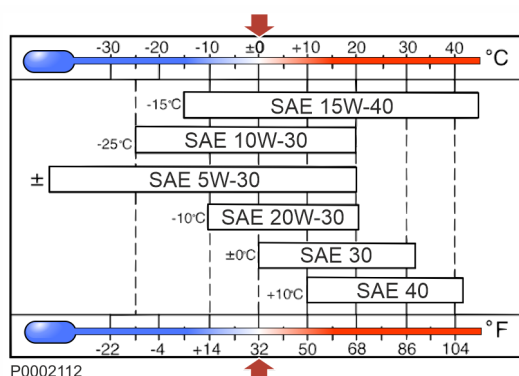
**VDS = Volvo Drain Specification**

### Viscosity

Select the viscosity according to the table.

The temperature values refer to stable ambient temperatures.

**NOTICE!** Volvo Penta recommendation for lowest possible fuel consumption and optimal durability is to use SAE 10W-30 oil when the viscosity table allows.



## Fuel System

<b>Feed pump</b>	
Feed pressure at 900 rpm	min 100 kPa (14.5 psi)
Feed pressure at 1800 rpm	min 300 kPa (43,5 psi)
Feed pressure at full load	min 300 kPa (43,5 psi)
<b>Bypass valve</b>	
Opening pressure	400-550 kPa (58–80 psi)

### General requirements

Volvo Penta diesel engines are certified for compliance with emission legislations with the diesel test fuels specified by law. These fuels correspond with diesel fuel standards EN 590, ASTM D975, JIS K2204 and paraffinic diesel fuel standard EN 15940. Volvo Penta guarantees compliance with emission legislation and fulfillment of expected lifetime as long as the specified restrictions are followed.

It is the responsibility of the fuel suppliers to always ensure that their fuels meet relevant requirements and are fit for their intended purpose. Their responsibility includes any use of additives for proper engine performance and function.

Special requirements are placed on cold-flow properties, that is, temperature limit values of fuel filterability during operation in winter conditions.

### Restrictions for specified diesel fuels

- **Max density for ASTM D975 No 2-D: 860 kg/m<sup>3</sup>**  
Insufficient density reduces the power and increases the fuel consumption. Excessive density endangers the durability and function of the fuel injection equipment.
- **Max lubricity (wsd 1.4) for JIS K 2204: 460 µm**  
Sufficient fuel lubricity is essential to protect the fuel injection system against excessive wear.

### Restrictions for other diesel fuels

Volvo Penta also approves the use of other diesel fuels as long as the here specified restrictions are followed. However Volvo Penta does not guarantee compliance with emission legislation or fulfillment of expected lifetime with these other diesel fuels.

**NOTICE!** Operators must check permission for usage of these fuels according to regional, national or local regulations.

- **Min cetane number: 40**  
An insufficient cetane number (“ignitability”) leads to poor startability and increased exhaust emissions.
- **Max density at 15 °C: 860 kg/m<sup>3</sup>**  
Insufficient density reduces the power and increases the fuel consumption. Excessive density endangers the durability and function of the fuel injection equipment.
- **Viscosity between 1.9 to 4.6 mm/s<sup>2</sup> at 40 °C**  
Insufficient viscosity reduces the power and increases the fuel consumption. Excessive viscosity endangers the durability and function of the fuel injection equipment.
- **Max lubricity (wsd 1.4): 520 µm**  
Sufficient fuel lubricity is essential to protect the fuel injection system against excessive wear.
- **Max FAME (biodiesel) content: 10% (V/V)**  
FAME is blended into diesel fuel.
- **Max sulfur content: 5000 mg/kg**

### Paraffinic fuels - HVO and GTL

Paraffinic diesel fuels ("Synthetic Diesel") have higher cetane numbers and lower densities than diesel fuels. HVO (Hydrotreated Vegetable Oils) is renewable paraffinic fuels. GTL (Gas-To-Liquid) is fossil paraffinic fuels.

Volvo Penta approves the use of paraffinic diesel fuels that complies with standard EN 15940. The fuel guarantees compliance with emission legislation and fulfills the expected lifetime as long as the service requirements are followed.

Volvo Penta also approves the use of fuel blends between these paraffinic fuels and diesel fuels that comply with the quality requirements.

### Biodiesel fuels

Alternative fuels, including biodiesel, that are not substantially similar to the required test fuels may adversely affect engine emissions compliance. As a result, Volvo Penta does not warrant the engine will conform to applicable emissions limits when operated on, or having been operated on, biodiesel or other alternative fuels that are not substantially similar to specified test fuels used for certification.

The use of biodiesel up to maximum 10% (B10) in and of itself, will not affect the manufacturers mechanical warranty, provided the biodiesel used in blend conforms to EN590, EN16734, ASTM D975 and ASTM D7467. Other relevant local fuel standards that fulfill the above mentioned standards may also be used. A minor drop in engine power will occur when using biodiesel.

**NOTICE!** Biodiesel manufactured by FAME (Fatty Acid Methyl Esther) process is hygroscopic and therefore increase the risk of bacterial growth in the fuel. This may lead to blocked fuel filters. Engine not consuming a full fuel tank within 4 weeks must not use biodiesel.

Higher levels of biodiesel, up to B30, may be used with restrictions. Fuel according to EN 16709 or ASTM D7467, or relevant local fuel standards that fulfill mentioned biodiesel fuel standards, must be used. Volvo Penta does not warrant the engine will conform to applicable emissions limits when operated on biodiesel or another alternative fuels, that are not substantially similar to specified test fuels used for certification.

#### Service restrictions for diesel fuel with FAME content between 11% and 30% (B11 to B30)

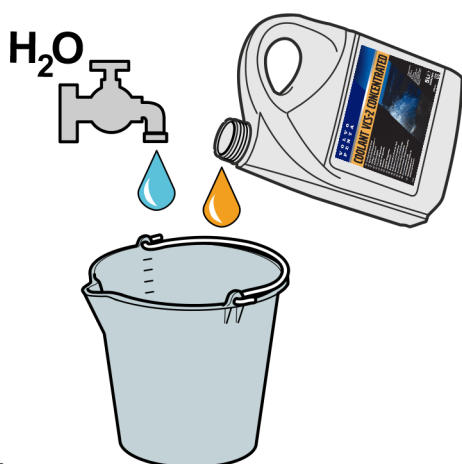
- Lube oil quality VDS-4 or VDS-4.5 shall be used.
- Oil dilution may occur. Make sure that oil level is not exceeding maximum level, in that case change the oil.
- Lube oil change intervals shall be halved, or utilize oil sampling analysis.
- The engines should be fitted with fuel filters with water separators.
- A fuel heater is required, when high FAME diesel fuels are used below freezing point.
- Biodiesel is aggressive to some materials used in fuel system components. Inspect seals, hoses, rubber and plastic components daily. Replace any component that is damaged, softened or leaking. Clean biodiesel from painted surfaces immediately to prevent paint damage.
- Do not use these fuels for engines with long downtime periods.
- If the engine has not been used for a period of 4 weeks or more, the tank and the fuel system shall be flushed clean by running the engine on at least one full tank of diesel fuel.
- When shifting from diesel fuel to high FAME diesel fuel.
  - The fuel hoses and sealings shall be replaced.
  - The fuel tank shall be cleaned and the fuel filter shall be replaced after 50 h.

## Cooling System

<b>Type</b>	Pressurized, sealed
<b>Pressure cap, max opening pressure</b>	75 kPa (10.88 PSI)
<b>Volume (Volvo Penta cooling system)</b>	
TAD1641GE-B, TAD1642GE-B, TAD1650GE, TAD1651GE	
Engine with standard radiator and hoses (Pusher system)	61 liters (16.1 US gal)
Engine with HD radiator and hoses (Pusher system)	56 liters (14.8 US gal)
TAD1643VE TAD1650VE, TAD1651VE TAD1640-42VE-C, TAD1643VE-B, TAD1650VE-B	
Engine with standard radiator and hoses (Pusher system)	61 liters (16.1 US gal)
Engine with standard radiator and hoses (Puller system)	54 liters (14.3 US gal)
Engine with HD radiator and hoses (Pusher and puller system)	56 liters (14.8 US gal)
TWD1643GE, TWD1644GE, TWD1645GE, TWD1652GE, TAD1653GE	
Engine circuit Total coolant volume engine circuit	59.5 liters (15.72 US gal)
Charge air cooler circuit Total coolant volume CAC circuit	30,5 liters (8.06 US gal)
<b>Thermostat</b>	
Qty	1 st
Opening temperature	82 °C (179.6 °F)



P0038119



P0038120



P0002094

## Coolant, Mixing

### **⚠ WARNING!**

All coolant is hazardous and harmful to the environment. Do not consume. Coolant is flammable.

**NOTICE!** Always use the same type of coolant that is already in the engine.

VCS-2 will be backwards compatible with current VCS and they are mixable without risks.

**Coolant shall be based on Organic Acid Technology (OAT).**

**Follow the mixing recommendation on the product.**

The coolant should be mixed with distilled, deionized water. For Volvo Penta specified water requirements; refer to *Water Quality*, page 93.

**NOTICE!** Always use “Ready Mixed” coolant if water quality cannot be determined or if it does not fulfill ASTM D4985.

**NOTICE!** Never mix more than 60% concentrated coolant with water. A greater concentration provides reduced cooling effect with the risk for overheating and reduced freeze protection.

## Water Quality

### ASTM D4985:

Total solid particles	<340 ppm
Total hardness	<9,5° dH
Chloride	<40 ppm
Sulfate	<100 ppm
pH value	5.5–9
Silica (acc. ASTM D859)	<20 mg SiO <sub>2</sub> /l
Iron (acc. ASTM D1068)	<0.10 ppm
Manganese (acc. ASTM D858)	<0.05 ppm
Conductivity (acc. ASTM D1125)	<500 µS/cm
Organic content, COD <sub>Mn</sub> (acc. ISO8467)	<15 mg KMnO <sub>4</sub> /l

## Electrical System

System voltage	24V
Alternator	
Voltage/max. amperage	28V/110A
Power	2800W
Alternative generating equipment (optional)	
Voltage/max. amperage	28V/150A
Power	4000W
Battery capacity	2 pcs. series connected 12 V, max. 220 Ah
Battery electrolyte density at +25°C °	
Fully charged battery	1,28 g/cm <sup>3</sup> (1,24 g/cm <sup>3</sup> )*
Battery recharged at	1,20 g/cm <sup>3</sup> (1,20 g/cm <sup>3</sup> )*

**NOTICE!** \* Applies to batteries with tropical acid.

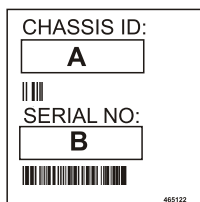
### Electrical platform

EMS 2.0	TAD1643VE, TWD1643GE
EMS 2.2	TAD1650VE TAD1650GE, TAD1651GE TWD1652GE, TWD1653GE
EMS 2.3	TAD1643VE-B TWD1644GE, TWD1645GE TAD1650VE-B TAD1651VE
EMS 2.4	TAD1641GE-B, TAD1642GE-B, TAD1640VE-C, TAD1641VE-C, TAD1642VE-C

## Identification Numbers

**NOTICE!** The engine labels are placed on the valve cover.

- A Chassis ID
- B Serial number



P0002051

<b>VOLVO PENTA</b>		
<u>PRODUCT INFORMATION</u>		
PRODUCT DESIGNATION:	B	<div style="border: 1px solid black; width: 20px; height: 20px; margin: 0 auto; display: flex; align-items: center; justify-content: center;">A</div> Part No.
SPECIFICATION No.:	C	
CHASSI ID:	D	
SERIAL No.:	E	
POWER (kW):	F	
SPEED (rpm):	G	
MADE IN:	H	

P0024526

- A Label part number
- B Product designation
- C Specification number
- D Chassis ID
- E Serial number
- F Power (kW)
- G Engine speed (rpm)
- H Country of manufacturing



# VOLVO PENTA

Declaration of incorporation for the installation of partially completed machinery in accordance with Machinery Directive 2006/42/EC, Annex II, 1B

**Engine Manufacturer:**

AB Volvo Penta  
Gropegårdsgatan 11  
SE 405 08 Gothenburg, Sweden

**Product designation:**

Engine size	Model
5 liter, VE	TAD540VE - TAD541VE - TAD542VE - TAD550VE - TAD551VE - TAD552VE - TAD570VE - TAD571VE - TAD572VE - TAD580VE - TAD581VE - TAD582VE - TAD583VE
8 liter, VE	TAD840VE - TAD841VE - TAD842VE - TAD843VE - TAD850VE - TAD851VE - TAD852VE - TAD853VE - TAD870VE - TAD871VE - TAD872VE - TAD873VE - TAD880VE - TAD881VE - TAD882VE - TAD883VE - TAD884VE
8 liter, GE	TAD840GE - TAD840GE-B - TAD841GE - TAD842GE - TAD843GE - TAD880GE - TAD881GE - TAD882GE - TAD851GE - TAD852GE - TAD853GE
11 liter, VE	TAD1140VE - TAD1141VE - TAD1142VE - TAD1150VE - TAD1151VE - TAD1152VE - TAD1170VE - TAD1171VE - TAD1172VE - TAD1180VE - TAD1181VE - TAD1182VE - TAD1183VE
13 liter, VE	TAD1340VE - TAD1341VE - TAD1342VE - TAD1343VE - TAD1344VE - TAD1345VE - TAD1350VE - TAD1351VE - TAD1352VE - TAD1353VE - TAD1371VE - TAD1372VE - TAD1373VE - TAD1374VE - TAD1375VE - TAD1381VE - TAD1382VE - TAD1383VE - TAD1384VE - TAD1385VE
13 liter, GE	TAD1341GE-B - TAD1342GE-B - TAD1342GE-B - TAD1343GE-B - TAD1344GE-B - TAD1345GE-B - TAD1346GE - TAD1350GE - TAD1351GE - TAD1352GE - TAD1353GE - TAD1354GE - TAD1355GE - TAD1380GE - TAD1381GE - TAD1382GE
16 liter, VE	TAD1640VE-B - TAD1641VE-B - TAD1642VE-B - TAD1640VE-C - TAD1641VE-C - TAD1642VE-C - TAD1643VE - TAD1643VE-B - TAD1650VE-B - TAD1651VE - TAD1670VE - TAD1671VE - TAD1672VE - TWD1683VE
16 liter, GE	TAD1640GE-B - TAD1641GE-B - TAD1642GE-B - TWD1644GE - TWD1645GE - TAD1650GE - TAD1651GE - TAD1652GE - TAD1653GE - TWD1672GE - TWD1673GE - TWD1683GE - TWD1683GE-B

**Description:** 4-cycle diesel engine.

Fundamental health and safety requirements applied to, and fulfilled by, the above-mentioned engines are described in the following items in Annex I:

1.1.3, 1.1.5, 1.5.2, 1.5.3, 1.5.4, 1.5.6, 1.5.13, 1.6.1, 1.6.2, 1.7.1, 1.7.4, 1.7.4.1 and 1.7.4.3.

The relevant technical documentation is compiled as described in part B of Annex VII.

It is also in conformity with the relevant union harmonization legislation: EMC 2014/30/EU

The following harmonized standards have been applied:

EN ISO 12100:2010 // EN 1679-1+A1:2011 //

EN 61000-6-1:2007 // EN 61000-6-2:2005 // EN 61000-6-3:2007 // EN 61000-6-4:2007 //

EN 12895:2015 + A1:2019 // EN-ISO 14982:2009 // EN 13766-1:2018

For engines equipped with Volvo Penta control interface module:

Paragraph 6.4 (Emergency stop) in 1679-1 + A1 2011 is not verified for engines equipped with Volvo Penta Control Interface Module. Responsibility lies with the machine manufacturer to add one or several emergencies stops in accordance with paragraph 1.2.4.3 (2006/42/EC).

For engines equipped with the Volvo Penta Start/Stop System the responsibility for the functional safety of the system lies with the machine manufacturer performing the integration.

Relevant information concerning the partially completed machinery will be provided in suitable form upon justified requests from competent national authorities. The individual authorized to compile the relevant technical documentation is the signer of this declaration.

The engines covered by this declaration may not be put into operation before the completed machinery into which they are to be installed has been declared to conform with the provision of Machinery Directive 2006/42/EC.

**Name and function:**

*Anders B Berle, Director Safety Compliance*

(The identity of the individual authorized to sign on behalf of the engine manufacturer or the latter's authorized representative.)

**Signature and title:**



Date and place of issue: 2023-01-20 Gothenburg

Phoenix no. 50334799

# VOLVO PENTA

Declaration of incorporation for the installation of partially completed machinery in accordance with Supply of machinery (Safety) Regulations 2008, placed on the UK-market

**Engine Manufacturer:**

AB Volvo Penta  
 Gropegårdsgatan 11  
 SE 405 08 Gothenburg, Sweden

**Product designation:**

Engine size	Model
5 liter, VE	TAD540VE - TAD541VE - TAD542VE - TAD550VE - TAD551VE - TAD552VE - TAD570VE - TAD571VE - TAD572VE - TAD580VE - TAD581VE - TAD582VE - TAD583VE
8 liter, VE	TAD840VE - TAD841VE - TAD842VE - TAD843VE - TAD850VE - TAD851VE - TAD852VE - TAD853VE - TAD870VE - TAD871VE - TAD872VE - TAD873VE - TAD880VE - TAD881VE - TAD882VE - TAD883VE - TAD884VE
8 liter, GE	TAD840GE - TAD840GE-B - TAD841GE - TAD842GE - TAD843GE - TAD880GE - TAD881GE - TAD882GE - TAD851GE - TAD852GE - TAD853GE
11 liter, VE	TAD1140VE - TAD1141VE - TAD1142VE - TAD1150VE - TAD1151VE - TAD1152VE - TAD1170VE - TAD1171VE - TAD1172VE - TAD1180VE - TAD1181VE - TAD1182VE - TAD1183VE
13 liter, VE	TAD1340VE - TAD1341VE - TAD1342VE - TAD1343VE - TAD1344VE - TAD1345VE - TAD1350VE - TAD1351VE - TAD1352VE - TAD1353VE - TAD1371VE - TAD1372VE - TAD1373VE - TAD1374VE - TAD1375VE - TAD1381VE - TAD1382VE - TAD1383VE - TAD1384VE - TAD1385VE
13 liter, GE	TAD1341GE-B - TAD1342GE-B - TAD1342GE-B - TAD1343GE-B - TAD1344GE-B - TAD1345GE-B - TAD1346GE - TAD1350GE - TAD1351GE - TAD1352GE - TAD1353GE - TAD1354GE - TAD1355GE - TAD1380GE - TAD1381GE - TAD1382GE
16 liter, VE	TAD1640VE-B - TAD1641VE-B - TAD1642VE-B - TAD1640VE-C - TAD1641VE-C - TAD1642VE-C - TAD1643VE - TAD1643VE-B - TAD1650VE-B - TAD1651VE - TAD1670VE - TAD1671VE - TAD1672VE - TWD1683VE
16 liter, GE	TAD1640GE-B - TAD1641GE-B - TAD1642GE-B - TWD1644GE - TWD1645GE - TAD1650GE - TAD1651GE - TAD1652GE - TAD1653GE - TWD1672GE - TWD1673GE - TWD1683GE - TWD1683GE-B

**Description:** 4-cycle diesel engine.

Fundamental health and safety requirements applied to, and fulfilled by, the above-mentioned engines are described in the following items in Annex I:

1.1.3, 1.1.5, 1.5.2, 1.5.3, 1.5.4, 1.5.6, 1.5.13, 1.6.1, 1.6.2, 1.7.1, 1.7.4, 1.7.4.1 and 1.7.4.3.

The relevant technical documentation is compiled as described in part B of Annex VII.

It is also in conformity with the relevant union harmonization legislation: EMC 2014/30/EU

The following harmonized standards have been applied:

EN ISO 12100:2010 // EN 1679-1+A1:2011 //

EN 61000-6-1:2007 // EN 61000-6-2:2005 // EN 61000-6-3:2007 // EN 61000-6-4:2007 //

EN 12895:2015 + A1:2019 // EN-ISO 14982:2009 // EN 13766-1:2018

For engines equipped with Volvo Penta control interface module:

Paragraph 6.4 (Emergency stop) in 1679-1 + A1 2011 is not verified for engines equipped with Volvo Penta Control Interface Module. Responsibility lies with the machine manufacturer to add one or several emergencies stops in accordance with paragraph 1.2.4.3 (2006/42/EC).

For engines equipped with the Volvo Penta Start/Stop System the responsibility for the functional safety of the system lies with the machine manufacturer performing the integration.

Relevant information concerning the partially completed machinery will be provided in suitable form upon justified requests from competent national authorities. The individual authorized to compile the relevant technical documentation is the signer of this declaration.

The engines covered by this declaration may not be put into operation before the completed machinery into which they are to be installed has been declared to conform with the provision of Machinery Directive 2006/42/EC.

**Name and function:**

*Anders B Berle, Director Safety Compliance*

(The identity of the individual authorized to sign on behalf of the engine manufacturer or the latter's authorized representative.)

**Signature and title:**



Date and place of issue: 2023-01-20 Gothenburg

Phoenix no. 50334795



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**ENG**

This Operator's Manual may be ordered in a different language free of charge up to 12 months after delivery, via internet.

<http://manual.volvopenta.com/coupon/>

If internet access isn't possible, please contact your Volvo Penta dealer.

**GER**

Diese Betriebsanleitung kann bis zu 12 Monate nach der Lieferung über Internet kostenlos in einer anderen Sprache bestellt werden.

<http://manual.volvopenta.com/coupon/>

Wenn Sie keinen Internet-Zugriff haben, kontaktieren Sie bitte Ihren Volvo Penta-Händler.

**FRE**

Ce manuel d'utilisation peut être commandé gratuitement sur Internet en différentes langues, jusqu'à 12 mois après la date de livraison.

<http://manual.volvopenta.com/coupon/>

Veuillez contacter votre Distributeur Volvo Penta si vous avez un problème d'accès à l'Internet.

**SPA**

El presente libro de instrucciones puede solicitarse en otro idioma diferente, libre de cargo, hasta 12 meses después de la entrega, mediante internet.

<http://manual.volvopenta.com/coupon/>

Si no se tiene acceso a internet, contacten al su concesionario Volvo Penta.

**ITA**

Il manuale per l'operatore può essere ordinato tramite Internet, in varie lingue e per consegna gratuita, entro 12 mesi dalla consegna del prodotto

<http://manual.volvopenta.com/coupon/>

Se l'accesso a Internet risulta impossibile, contattare la concessionaria Volvo Penta.

**SWE**

Denna instruktionsbok kan beställas via internet på ett annat språk gratis i upp till 12 månader efter leverans.

<http://manual.volvopenta.com/coupon/>

Kontakta din Volvo Penta-återförsäljare om du inte har tillgång till internet.

**DUT**

Dit instructieboek kan gratis via internet in een andere taal worden besteld tot 12 maanden na aflevering.

<http://manual.volvopenta.com/coupon/>

Als toegang tot het internet niet mogelijk is, neem dan contact op met uw Volvo Penta dealer.

**DAN**

Denne instruktionsbog kan bestilles gratis på et andet sprog via Internettet i op til 12 måneder efter leveringen.

<http://manual.volvopenta.com/coupon/>

Hvis det ikke er muligt at bestille via Internettet, bedes du kontakte din Volvo Penta forhandler.

**FIN**

Tämä käyttöohjekirja on tilattavissa Internetin kautta veloituksetta eri kielillä 12 kuukauden ajan toimituksen jälkeen.

<http://manual.volvopenta.com/coupon/>

Jos sinulla ei ole Internet-yhteyttä, ota yhteys lähimpään Volvo Penta jälleenmyyjään.

**POR**

Este Manual do Operador pode ser encomendada em idiomas diferentes isento de custos até 12 meses após entrega, via internet.

<http://manual.volvopenta.com/coupon/>

Se não for possível aceder à internet, contacte o seu concessionário Volvo Penta.

**GRC**

Το παρόν Βιβλίο Χρήσης μπορεί να παραγγελθεί δωρεάν σε άλλη γλώσσα μέχρι 12 μήνες μετά την παράδοση, μέσω διαδικτύου.

<http://manual.volvopenta.com/coupon/>

Εάν δεν είναι δυνατή η πρόσβαση στο ιαδίκτυο, παρακαλούμε επικοινωνήστε με το δικό σας αντιπρόσωπο της Volvo Penta.

**TUR**

Bu Kullanım Kılavuzu, teslimden 12 ay sonrasına kadar İnternet yoluyla ücretsiz olarak farklı bir dilde sipariş edilebilir.

<http://manual.volvopenta.com/coupon/>

İnternet mümkün değilse, lütfen Volvo Penta yetkili satıcınızla temasa geçin.

**CHI**

本操作手册可通过互联网以不同的语言进行订购，交付后可免费使用达12个月。

<http://manual.volvopenta.com/coupon/>

如果无法访问互联网，请与沃尔沃遍达经销商联系。

**BZS**

Este Manual de operador pode ser encomendado em um idioma diferente, gratuitamente, até 12 meses após a entrega, via internet.

<http://manual.volvopenta.com/coupon/>

Caso o acesso à internet não for possível, contatar seu distribuidor Volvo Penta.

**JPN**

このオペレーターズ マニュアルの他言語版が、発行後最高12か月間、インターネットより無料で発注可能です。

<http://manual.volvopenta.com/coupon/>

インターネットにアクセスできない場合は、担当のボルボペンタディーラーまでご連絡ください。

**ARA**

من الممكن طلب دليل المشغل بلغة أخرى مجاناً عبر الإنترنت لفترة تصل إلى ١٢ شهرًا من بعد التسليم.

[http:// manual.volvopenta.com/coupon](http://manual.volvopenta.com/coupon/)

إذا كان الوصول إلى الإنترنت غير متاح، فالرجاء الاتصال بوكيل Volvo Penta.

**V O L V O P E N T A**



# Operation

## Industrial Generator Set



Models:

**80-200REOZJF**  
**125/180REOZJG**  
**230-275REOZJE**  
**300-500REOZJ**  
**350-500REOZJB**  
**350-500REOZJC**  
**350/400REOZJD**  
**500REOZVC**  
**550/600REOZVB**

Controller:

**APM603**

**KOHLER®**

TP-7100 2/21b

**⚠ WARNING:** This product can expose you to chemicals, including carbon monoxide and benzene, which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to [www.P65warnings.ca.gov](http://www.P65warnings.ca.gov)

**⚠ WARNING:** Breathing diesel engine exhaust exposes you to chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

- Always start and operate the engine in a well-ventilated area.
- If in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system.
- Do not idle the engine except as necessary.

For more information go to [www.P65warnings.ca.gov/diesel](http://www.P65warnings.ca.gov/diesel)

## Product Identification Information

---

Product identification numbers determine service parts. Record the product identification numbers in the spaces below immediately after unpacking the products so that the numbers are readily available for future reference. Record field-installed kit numbers after installing the kits.

### Generator Set Identification Numbers

Record the product identification numbers from the engine nameplate(s).

Model Designation \_\_\_\_\_

Specification Number \_\_\_\_\_

Serial Number: \_\_\_\_\_

### Controller Identification

Record the controller description from the generator set operation manual, spec sheet, or sales invoice.

Controller Description \_\_\_\_\_

### Engine Identification

Record the product identification information from the engine nameplate.

Manufacturer \_\_\_\_\_

Model Designation \_\_\_\_\_

Serial Number \_\_\_\_\_

Accessory Number	Accessory Description

Accessory Number	Accessory Description

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# Safety Precautions and Instructions

IMPORTANT SAFETY INSTRUCTIONS. Electromechanical equipment, including generator sets, transfer switches, switchgear, and accessories, can cause bodily harm and pose life-threatening danger when improperly installed, operated, or maintained. To prevent accidents be aware of potential dangers and act safely. Read and follow all safety precautions and instructions. SAVE THESE INSTRUCTIONS.

This manual has several types of safety precautions and instructions: Danger, Warning, Caution, and Notice.



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



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



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

## NOTICE

NOTICE is used to address practices not related to physical injury.

Safety decals affixed to the equipment in prominent places alert the operator or service technician to potential hazards and explain how to act safely. The decals are shown throughout this publication to improve operator recognition. Replace missing or damaged decals.

## Accidental Starting

	<p><b>Accidental starting.</b> <b>Can cause severe injury or death.</b></p> <p>Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.</p>

**Disabling the generator set. Accidental starting can cause severe injury or death.** Before working on the generator set or equipment connected to the set, disable the generator set as follows: (1) Press the generator set off/reset button to shut down the generator set. (2) Disconnect the power to the battery charger, if equipped. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent the starting of the generator set by the remote start/stop switch.

### Note:


For Volvo units, Estop button must be pressed before disconnecting/reconnecting the batteries.

## Battery

	<p><b>Explosion.</b> <b>Can cause severe injury or death.</b> <b>Relays in the battery charger cause arcs or sparks.</b></p> <p>Locate the battery in a well-ventilated area. Isolate the battery charger from explosive fumes.</p>





## Engine Backfire/Flash Fire

 <b>WARNING</b>	<b>Risk of fire.</b> <b>Can cause severe injury or death.</b>
	Do not smoke or permit flames or sparks near fuels or the fuel system.

**Combustible materials. A fire can cause severe injury or death.** Generator set engine fuels and fuel vapors are flammable and explosive. Handle these materials carefully to minimize the risk of fire or explosion. Equip the compartment or nearby area with a fully charged fire extinguisher. Select a fire extinguisher rated ABC or BC for electrical fires or as recommended by the local fire code or an authorized agency. Train all personnel on fire extinguisher operation and fire prevention procedures.

## Exhaust System

 <b>WARNING</b>	<b>Carbon monoxide.</b> <b>Can cause severe nausea, fainting, or death.</b>
	The exhaust system must be leakproof and routinely inspected.




**Generator set operation. Carbon monoxide can cause severe nausea, fainting, or death.** Carbon monoxide is an odorless, colorless, tasteless, nonirritating gas that can cause death if inhaled for even a short time. Avoid breathing exhaust fumes when working on or near the generator set. Never operate the generator set inside a building unless the exhaust gas is piped safely outside. Never operate the generator set where exhaust gas could accumulate and seep back inside a potentially occupied building.

**Carbon monoxide symptoms. Carbon monoxide can cause severe nausea, fainting, or death.** Carbon monoxide is a poisonous gas present in exhaust gases. Carbon monoxide is an odorless, colorless, tasteless, nonirritating gas that can cause death if inhaled for even a short time. Carbon monoxide poisoning symptoms include but are not limited to the following:

- Light-headedness, dizziness
- Physical fatigue, weakness in joints and muscles
- Sleepiness, mental fatigue, inability to concentrate or speak clearly, blurred vision
- Stomachache, vomiting, nausea

If experiencing any of these symptoms and carbon monoxide poisoning is possible, seek fresh air immediately and remain active. Do not sit, lie down, or fall asleep. Alert others to the possibility of carbon monoxide poisoning. Seek medical attention if the condition of affected persons does not improve within minutes of breathing fresh air.



## Fuel System

 <b>WARNING</b>	<b>Explosive fuel vapors.</b> <b>Can cause severe injury or death.</b>
 	Use extreme care when handling, storing, and using fuels.

**The fuel system. Explosive fuel vapors can cause severe injury or death.** Vaporized fuels are highly explosive. Use extreme care when handling and storing fuels. Store fuels in a well-ventilated area away from spark-producing equipment and out of the reach of children. Never add fuel to the tank while the engine is running because spilled fuel may ignite on contact with hot parts or from sparks. Do not smoke or permit flames or sparks to occur near sources of spilled fuel or fuel vapors. Keep the fuel lines and connections tight and in good condition. Do not replace flexible fuel lines with rigid lines. Use flexible sections to avoid fuel line breakage caused by vibration. Do not operate the generator set in the presence of fuel leaks, fuel accumulation, or sparks. Repair fuel systems before resuming generator set operation.



**Fuel tanks. Explosive fuel vapors can cause severe injury or death.** Gasoline and other volatile fuels stored in day tanks or subbase fuel tanks can cause an explosion. Store only diesel fuel in tanks.




## Hazardous Noise

 <b>CAUTION</b>	<b>Hazardous noise.</b> <b>Can cause hearing loss.</b>
	Never operate the generator set without a muffler or with a faulty exhaust system.



**Engine noise. Hazardous noise can cause hearing loss.** Generator sets not equipped with sound enclosures can produce noise levels greater than 105 dBA. Prolonged exposure to noise levels greater than 85 dBA can cause permanent hearing loss. Wear hearing protection when near an operating generator set.

## Hazardous Voltage/Moving Parts

 <b>DANGER</b>	<b>Hazardous voltage.</b> <b>Will cause severe injury or death.</b>
	Disconnect all power sources before opening the enclosure.

 <b>DANGER</b>	<b>Hazardous voltage. Moving parts.</b> <b>Will cause severe injury or death.</b>
 	Operate the generator set only when all guards and electrical enclosures are in place.

## Hot Parts

 <b>WARNING</b>	<b>Hot engine and exhaust system. Can cause severe injury or death.</b>
	Do not work on the generator set until it cools.

This manual provides operation instructions for the diesel generator sets listed on the front cover when equipped with the **APM603 controller**.

This manual contains generator set operation instructions for readers with user-level or operator-level access to the APM603 controller. Selected accessory information is also included.

Refer to the generator set maintenance manual and the engine operation manual for scheduled maintenance information.

Information in this publication represents data available at the time of print. Kohler Co. reserves the right to change this publication and the products represented without notice and without any obligation or liability whatsoever.

Read this manual and carefully follow all procedures and safety precautions to ensure proper equipment operation and to avoid bodily injury. Read and follow the Safety Precautions and Instructions section at the beginning of this manual. Keep this manual with the equipment for future reference.

The equipment service requirements are very important for safe and efficient operation. Inspect the parts often and perform required service at the prescribed intervals. Maintenance work must be performed by appropriately skilled and suitably trained maintenance personnel familiar with generator set operation and service.

## List of Related Materials

Separate literature contains installation and maintenance information not provided in this manual. Figure 1 lists the available literature part numbers.

The engine electronic controls indicate engine fault codes in addition to the generator set controller. The engine operation and service literature provide information for identifying engine fault codes. For the latest literature part numbers, see the generator set parts catalog.

Literature Description	Literature Part No.
Generator Set Installation Manual	TP-5700
Generator Set Maintenance Manual	TP-7138
Generator Set/Controller Wiring Diagram Manual	
80-300 kW (John Deere Units)	TP-6798
350-500 kW (John Deere Units)	TP-6797
500-600 kW (Volvo Units)	TP-6777
Communications Protocol Operation Manual	TP-7151
SiteTech™ Software Manual	TP-6701
Remote Serial Annunciator III (RSA III) Instructions	TT-1625

Figure 1 Related Literature

## Abbreviations

This publication makes use of numerous abbreviations. Typically, the word(s) are spelled out along with the abbreviation in parentheses when shown for the first time in a section. Appendix A, Abbreviations, also includes many abbreviation definitions.

## SiteTech™ Software

A personal computer and Kohler SiteTech™ software may be required for programming the APM603 controller if the factory default settings are not appropriate for the application. SiteTech software is also needed for assigning configurable inputs/outputs and for updating the controller application code. Kohler SiteTech software is available only to Kohler-trained and authorized distributors and dealers. Contact your local distributor/dealer for assistance.

# Service Assistance

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For professional advice and conscientious service, please contact your nearest Kohler distributor or dealer.

- Visit the Kohler Co. website at KOHLERPower.com.
- Look at the labels and decals on your Kohler product or review the appropriate literature or documents included with the product.
- Call toll free in the US and Canada 1-800-544-2444.
- Outside the US and Canada, call the nearest regional office.

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# Section 1. Controller Specifications and Features

## 1.1 Introduction

The specification sheet for each generator set provides model-specific generator and engine information. The controller specification sheet provides specifications for this controller. Refer to the respective specification sheet for data not supplied in this manual. Refer to the generator set service manual, installation manual, engine operation manual, and engine service manual for additional specifications.

## 1.2 Controller Specifications

APM603 Controller	
Power source with circuit protection	12 or 24VDC
Power draw	800 mAmps at 12VDC 400 mAmps at 24VDC
Humidity range	5-95% non-condensing
Operating temperature	-40° to 70°C (-40° to 158°F)
Storage temperature	-40° to 85°C (-40° to 185°F)

## 1.3 Controller Features

The controller features include the annunciator LED, touchscreen display, USB ports, switches and controls, and terminal blocks. See Figure 2 for an illustration of the controller front panel.

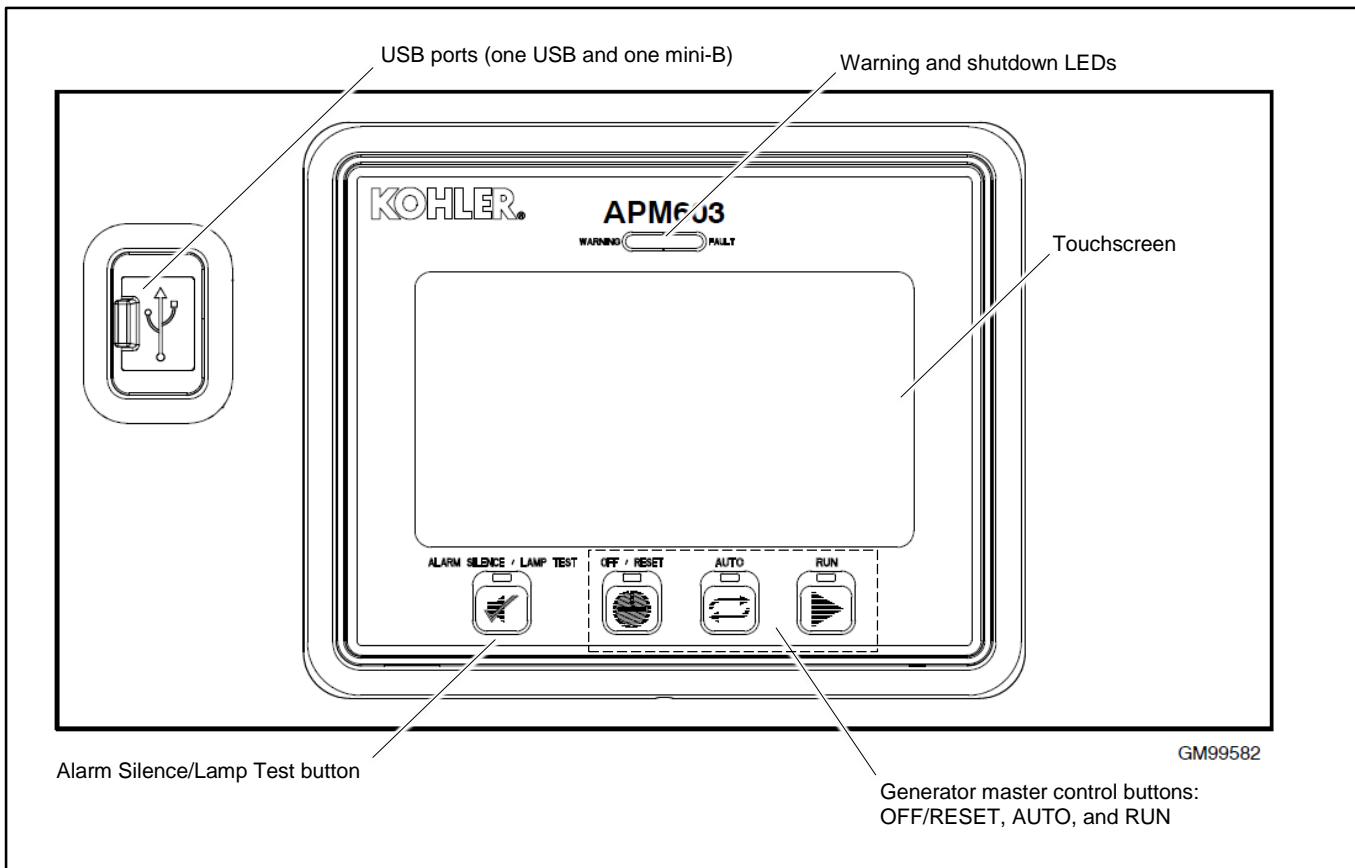


Figure 2 APM603 Controller

## Controller Features:

- Large color touchscreen provides:
  - Intuitive operation
  - System status and metering displays
  - Data logging and trending
  - Event display and fault reset
- Master control buttons with status LEDs
- Fault LEDs:
  - Yellow = Warning
  - Red = Shutdown
- Alarm horn and alarm silence button with LED
- USB connector for downloading data files, uploading files, and data logging
- Mini USB connector for controller setup using a PC with SiteTech™ software

The controller features, accessories, and menu displays depend upon the engine electronic control module (ECM) setup and features.

### 1.3.1 Switches and Controls

**Alarm Horn.** The alarm horn alerts the operator or other attendants that a warning or shutdown condition exists.

**Alarm (Horn) Silence.** The alarm silence switch silences the alarm horn at the operator's discretion. Press the master control switch AUTO button before pressing the alarm silence button. The alarm horn cannot be silenced unless the master control switch AUTO button is pressed.

Restore alarm horn switches at all locations, including those on remote annunciators, after correcting the fault condition and resetting the controller. See Resetting the Controller in Section 2 for instructions to reset the controller.

**Generator Set Master Control (OFF/RESET-AUTO-RUN).** These buttons reset the controller fault LEDs and start/stop the generator set. Additional information is shown in Section 2, Operation.

**LED Test.** Press and hold the Alarm Silence/Lamp Test button to test the controller indicator LEDs and fault LEDs.

### 1.3.2 Annunciator LEDs

The controller has red and yellow annunciator fault LEDs that provide visual indication that a warning or shutdown is active. In addition, each master control button has a status-indicating LED. See Figure 3.

LED/Button	LED Color	Description
Alarm (Fault) LED	Yellow (Warning) or Red (Shutdown)	Yellow LED indicates a fault condition that does not shut down the generator set. Correct all system warnings as soon as practical. Red LED indicates that the generator set has shut down because of a fault condition. The unit will not start until the condition is corrected and the controller is reset.
Off/Reset Button	Blue	Indicates the generator set is stopped.
Auto Button	Blue (System Ready)	Indicates the system is in standby mode and senses no faults. The unit is ready to start by remote command.
Run Button	Blue	Indicates the generator set is cranking or running from a local command.
Alarm Silence Button	Orange	Indicates the alarm horn was silenced.

Figure 3 Annunciator LEDs

### 1.3.3 Touchscreen Display

The touchscreen display provides generator set and engine data, parameter settings, system status, and fault information. Some values will display zero or N/A (not available) if the generator set is not running.

The main menus are listed below. Within each main menu are multiple submenus as described in Section 3.

- Metering
- Setup
- Data Log
- Paralleling (if enabled)
- Active Events (Bell icon)
- Controller Settings

Figure 4 shows the important parts of the touchscreen.

- Two tabs in the upper left corner allow the viewer to toggle between two independent screens.
- The navigation menu on the left side of the screen can be expanded and contracted as shown.
- The breadcrumb panel at the top identifies the current screen and the path.
- The bell icon at the upper right indicates active alerts. Touch to view active events and event history.
- The controller settings icon allows access to settings such as display brightness and date/time. This icon also contains the link to the logon screen for the different access levels.
- A scroll bar appears on the right side of the screen when there are multiple pages that can be viewed or accessed.
- The boxes on the bottom of the Home screens allow the viewer to move between two screens.



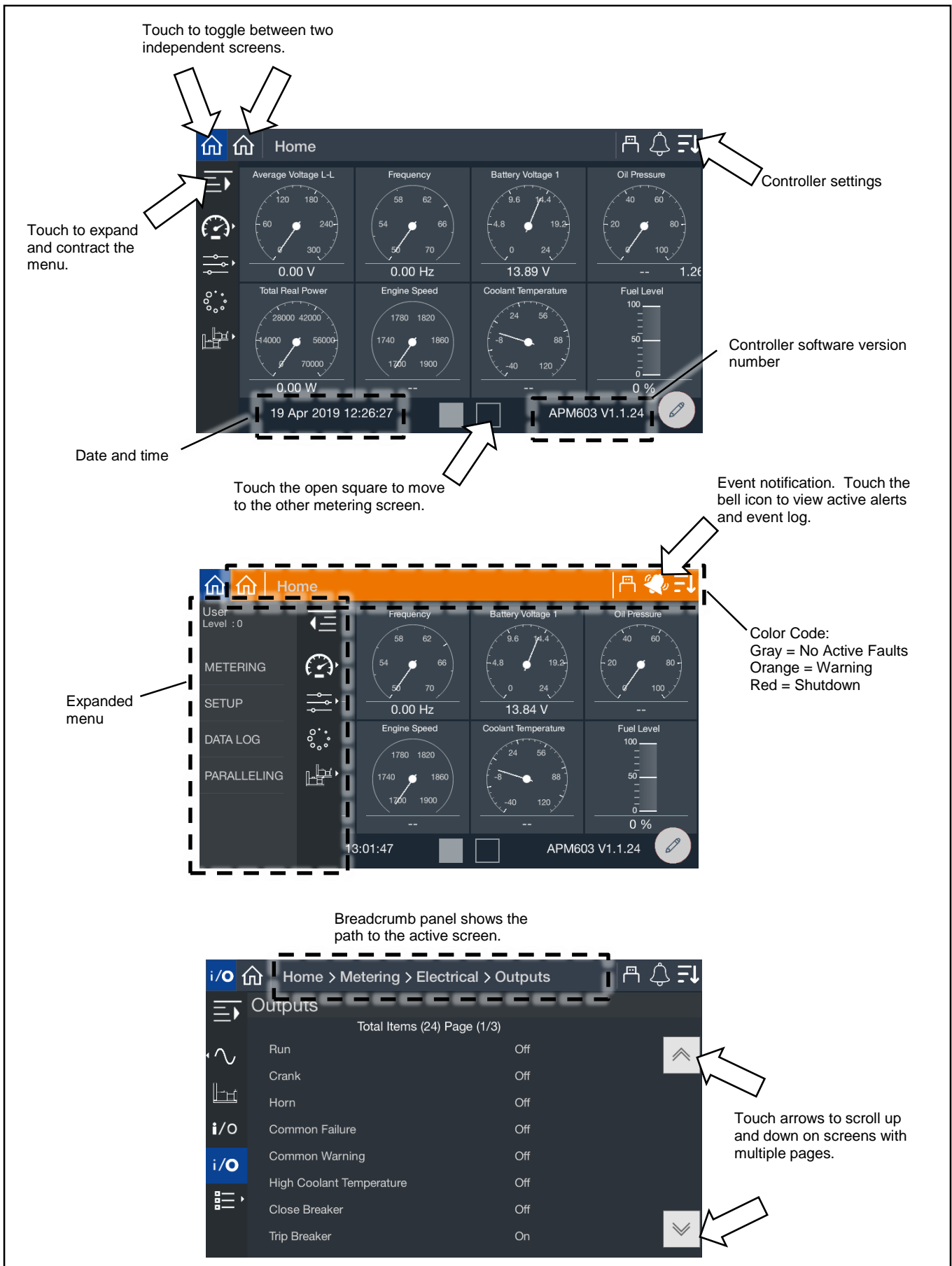


Figure 4 Screen Features and Functions

### 1.3.4 Access Levels

**Note:**

Have setup and adjustments of the controller performed only by an authorized Kohler distributor. The setup and adjustments are password protected.

Different access levels are used to protect the controller from inadvertent changes that can adversely affect the generator set operation. Access levels are described in Figure 5. The current access level is shown in the upper left corner of the screen when the navigation menu is expanded as shown in Figure 6. The User level is the default level.

Some parameter settings are displayed at the user level but require operator access or higher to change the setting. Password-controlled access is granted to trained, qualified Kohler distributors and dealers. See the Controller Settings Section for instructions to log on at the Operator or Distributor access level.

After a set amount of time, the access automatically returns to the User level. The default session time duration is one hour. The session time can be changed in the Controller Settings menu.

Access Level	Password	Description
User (0)	None	Can start and stop the generator set. Can navigate through the controller menus and view, but not change, the settings..
Operator (1)	9879	Includes all User level functions, plus allows trained maintenance personnel to adjust selected settings.
Technician (2)	Provided to Kohler trained and authorized distributors and dealers.	Includes all Operator level functions, plus allows trained and authorized Kohler distributors or dealers to adjust controller settings.
Factory (3)	Confidential	For factory use only.

Figure 5 Access Levels

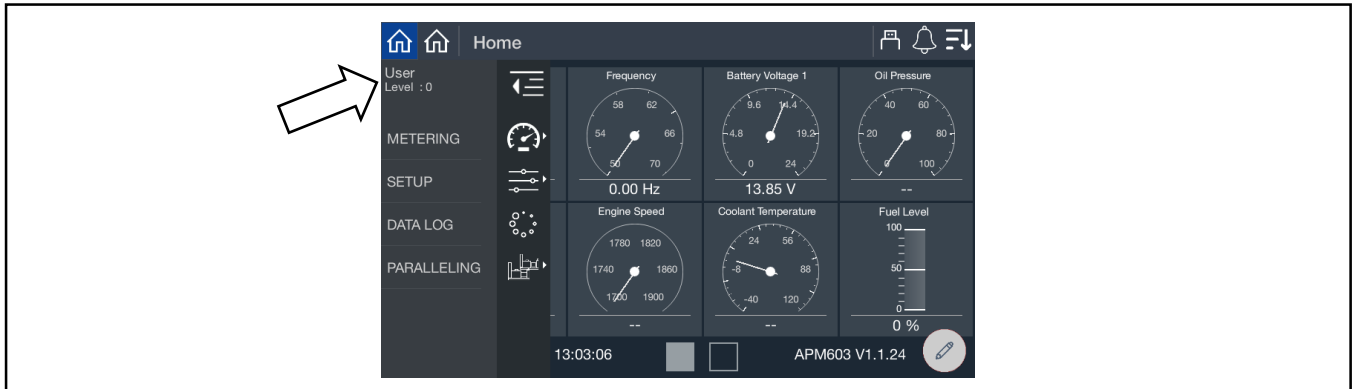


Figure 6 Access Level Indication

## 1.4 Touchscreen Calibration

Use your finger, the blunt end of a pen, or a stylus to navigate through the controller menus. Press or gently touch the words or symbols on the screen as described in the procedures in this manual. Do not use a sharp instrument on the touchscreen; it may damage the surface.

The touchscreen surface is calibrated at the factory. However, if touching an area on the screen seems to open the wrong menu, or if there are other problems navigating the screen, it may be necessary to recalibrate the screen.

### Procedure to Recalibrate the Touchscreen Display

1. Press and hold the ALARM SILENCE/LAMP TEST button for 5 seconds.
2. A window appears, asking “Do you want to recalibrate the touchscreen?” Touch Yes.
3. A spinning circle with a red dot in the center will appear on the screen. Carefully touch the center of the circle to define its position on the screen. A small stylus may be more accurate than your finger for this operation. Do not use a sharp pencil or other sharp tool.
4. Repeat step 3 for each circle that appears on the screen.
5. Touch Accept in the window that appears on the screen.
6. The controller will take a few minutes to reset. Wait for the Home screen to appear.
7. To check the touchscreen calibration, touch a few items on the screen, including items near the edges of the screen, to see if the controller responds as expected. Repeat the calibration process, if necessary.

## 1.5 Using a Mouse with the APM603 Controller

A computer mouse can be used to navigate the menus, select parameters, and enter settings on the APM603 Controller. The mouse can also be used to change controller settings such as date and time or to log on with a password.

Because of the large number of available mouse brands and styles, there is no guarantee that every mouse will work with the controller.

A wired or wireless mouse can be used. Connect the mouse to the USB (type A) port on the front of the APM603 controller. See the APM603 controller illustration on the previous page for the USB port location. A cursor appears on the controller’s display. Use the mouse to move the cursor on the screen and click the left mouse button to select menus and parameters. Most of the actions that can be performed by touching an item on the screen can also be accomplished using the mouse.

**Note:** A mouse and a flashdrive cannot be connected to the controller at the same. When a flash drive is needed for data logging, taking screenshots, saving data files, or uploading files to the controller, the mouse must be disconnected.

## 1.6 Inputs and Outputs

The controller is equipped with the standard, dedicated inputs and outputs shown in Figure 7 and Figure 8. These onboard inputs and outputs are factory set and cannot be adjusted.

Inputs	Input Type
Remote Engine Start	Two-Wire Input
Coolant Temperature, Degrees	Analog Input
Fuel Level, %	
Auxiliary Fault (Shutdown)	Digital Input
Auxiliary Warning	
Battery Charger Fault	
Breaker Closed	
Breaker Tripped	
Excitation Overvoltage	
Fuel Leak Alarm	
Ground Fault Relay	
Key Switch Auto	
Key Switch Run	
Low Fuel Level Switch	
Remote Emergency Stop	
Speed Bias	
Voltage Bias	

Figure 7 Standard Dedicated User Inputs

Outputs	Output Type
Run	RDO1
Crank (John Deere models) ECU Wakeup/Keyswitch (Volvo models)	RDO2
Horn	RDO3
Common Fault	RDO4
Reserved	RDO5
Reserved	RDO6
Close Breaker	RDO7
Trip Breaker	RDO8

Figure 8 Standard Dedicated User Outputs

An optional four-input, fifteen-output module is available. See the Accessories section for more information. A personal computer and Kohler SiteTech™ software are required to assign input and output functions to the inputs and outputs on the I/O modules. SiteTech is available to Kohler authorized distributors and dealers.




## 1.7 Run Relay

The run relay is provided as standard equipment with the APM603 controller. The run relay kit energizes only when the generator set runs. Use the run relay kit to control air intake and radiator louvers, alarms, and/or other signaling devices. Refer to the generator set Installation Manual and the generator set wiring diagrams for connections.



### 2.1 Prestart Checklist

To ensure continued satisfactory operation, perform the following checks or inspections before or at each startup, as designated, and at the intervals specified in the service schedule. In addition, some checks require verification after the unit starts.

 <b>DANGER</b>	<p><b>Hazardous voltage. Moving parts.</b> <b>Will cause severe injury or death.</b></p> <p>Operate the generator set only when all guards and electrical enclosures are in place.</p>
 	

**Note:**

Use the procedures in this document after the generator set has been installed according to the instructions in the generator set Installation Manual.

<p><b>Air Cleaner.</b> Check for a clean and installed air cleaner element to prevent unfiltered air from entering engine.</p>
<p><b>Air Inlets.</b> Check for clean and unobstructed air inlets.</p>
<p><b>Battery.</b> Check for tight battery connections. Consult the battery manufacturer's instructions regarding battery care and maintenance.</p>
<p><b>Coolant Level.</b> Check the coolant level according to the cooling system maintenance information.  <b>Note: Block Heater Damage.</b>          The block heater will fail if the energized heater element is not immersed in coolant. Fill the cooling system before turning on the block heater. Run the engine until it is warm, and refill the radiator to purge the air from the system before energizing the block heater.</p>
<p><b>Diesel Exhaust Fluid (DEF) Tank, if equipped.</b> Ensure that there is an adequate DEF supply; keep the DEF tank full. When filling, watch that the DEF tank is not overfilled.</p>
<p><b>Drive Belts.</b> Check the belt condition and tension of the radiator fan, water pump, and battery charging alternator belt(s) according to the drive belt system maintenance information.</p>
<p><b>Enclosure Doors, if equipped.</b> Check that the service access doors are closed and secured. Leaving the doors open will create excessive noise. Check that the enclosure door to the load connection panel is closed and secured. Some units have a micro switch safety feature that will trip (by shunt trip) the main line circuit breaker if the load connection panel is open.</p>
<p><b>Exhaust System.</b> Check for exhaust leaks and blockages. Check the silencer and piping condition and check for tight exhaust system connections.</p> <ul style="list-style-type: none"> <li>• Inspect the exhaust system components (exhaust manifold, exhaust line, flexible exhaust, clamps, silencer, and outlet pipe) for cracks, leaks, and corrosion.</li> <li>• Check for corroded or broken metal parts and replace them as needed.</li> <li>• Check for loose, corroded, or missing clamps and hangers. Tighten or replace the exhaust clamps and/or hangers as needed.</li> <li>• Check that the exhaust outlet is unobstructed.</li> <li>• Visually inspect for exhaust leaks (<i>blowby</i>). Check for carbon or soot residue on exhaust components. Carbon and soot residue indicates an exhaust leak. Seal leaks as needed.</li> </ul>
<p><b>Fuel Level.</b> Check the fuel level and keep the tank(s) full to ensure adequate fuel supply. (diesel models)</p>
<p><b>Lamp Test.</b> Press the lamp-test button to verify all controller LEDs are operational.</p>
<p><b>Oil Level.</b> Check the oil level. Maintain the oil level at or near, not over, the full mark on the dipstick.</p>
<p><b>Operating Area.</b> Check for obstructions that could block the flow of cooling air. Keep the air intake area clean. Do not leave rags, tools, or debris on or near the generator set.</p>
<p><b>Radiator.</b> Check that the radiator fins and air inlets/outlets are clean of leaves, insects, dirt, and other debris. Use compressed air to clear the obstructed passages as needed.</p>
<p><b>Visual Inspection.</b> Walk around the generator set and look for leaking fluids, loose or dangling wiring, and loose or missing hardware. Repair as needed before starting the generator set. Repeat the visual inspection routinely while the unit is running.</p>

## 2.2 Generator Set Operation

The controller allows operation of the generator set as detailed below.

### 2.2.1 Starting and Stopping Functions for a Single Generator Set

There are three primary modes of operation, selected by pressing the controller buttons.

Button	Description
OFF/RESET	Press the OFF/RESET button to stop the generator set immediately, with no engine cooldown. The generator set remains off and will not respond to a remote start signal. Press and HOLD the OFF/RESET button for 3 seconds to reset an active fault (shutdown). Be sure to identify and correct the problem that caused the shutdown before clearing the fault.
AUTO	Press AUTO to place the generator set into automatic (standby) mode. The generator set will respond to remote start and remote stop signals.
RUN	Press the RUN button to start the generator set. The generator set runs until the OFF/RESET or AUTO button is pressed or until a fault condition causes the generator set to shut down.

Figure 9 Controller Button Operation

#### Notes:

- The alarm horn sounds and the Not-In-Auto Warning display appears whenever the generator set is not in the AUTO mode.
- The transient start/stop function of the controller prevents accidental cranking of the rotating engine. The generator set stops and recranks when the OFF/RESET button is momentarily pressed and then the RUN button is pressed.
- The controller provides up to 30 seconds of programmable cyclic cranking and up to 60 seconds rest with up to 6 cycles. The default setting is 15 seconds cranking and 15 seconds rest for 3 cycles. An authorized Kohler distributor or dealer can make cyclic cranking adjustments using SiteTech™ software.

### 2.2.2 Start Signal

When the generator set is in AUTO mode, it can respond to a start signal. A start signal can include any of the following:

- A remote start signal via contacts 3 and 4 (closing a contact between 3 and 4 on terminal block TB-12), typically received from an automatic transfer switch (ATS) or a remote panel. A closed contact across 3 and 4 takes precedence over all other start signals. If the generator set is already running, it will keep running and the original source of that start signal will be ignored.
- System Start (AUTO-START). Press AUTO and RUN simultaneously to send a start signal.
- Communications-based start command from SiteTech™ or a Modbus-based remote panel.

### 2.2.3 Stop Signal

A stop signal can include any of the following:

- Removal of start signal via contacts 3 and 4 (opening the contact between 3 and 4).
- System Stop (AUTO-OFF). Press AUTO and OFF simultaneously on any controller in the system to send a stop signal to cancel the system start.

#### Note:

Pressing AUTO and OFF simultaneously has no effect if the system start is not active or if the system is receiving a start signal from another source.

- Communications-based stop command from SiteTech™ or a Modbus-based remote panel.

### 2.2.4 Engine Cooldown

The engine cooldown cycle runs the generator set with no load to allow hot engine components time to cool slowly before the engine is stopped.

When the generator set is running in AUTO mode, an engine cooldown cycle begins when the remote start input is deactivated or a stop signal is received.

The cooldown cycle runs until the cooldown temperature is reached or a predetermined amount of time expires. The cooldown time and cooldown temperature are adjustable parameters. See the Engine Setup section for more information about the engine cooldown settings.

**Note:**

No engine cooldown cycle occurs if the OFF button is pressed or if a fault occurs. The shutdown is immediate. If possible, run the generator set without load for at least 5 minutes to ensure adequate engine cooldown.

### **2.2.5 Emergency Stop**

**Note:**

Use the emergency stop switch(es) for emergency shutdowns only. Use the generator set OFF/RESET button for normal shutdowns.

The emergency stop switch shuts down the generator set *immediately*. The controller fault LED lights and the unit shuts down without running the engine cooldown cycle.

Use the following procedure to reset the generator set after shutdown by a local or remote emergency stop switch. Refer to the Controller Resetting procedure to restart the generator set following a fault shutdown.

#### **Procedure to Reset the Generator Set after Emergency Stop**

1. Investigate and correct the cause of the emergency stop.
2. Reset the emergency stop switch.
3. Press and hold the generator set OFF/RESET button for 3 seconds.
4. After resetting all faults using the controller reset procedure, press the generator set RUN and/or AUTO button to restart the generator set. The generator set will not crank until the reset procedure is completed.



## 2.2.6 Starting and Stopping Functions for a Generator Set in a Paralleled System

The modes of operation for a generator set that is part of a multi-unit paralleled system are shown below. Select the modes by pressing the controller buttons as shown.

Button	Description
OFF/RESET	<p>Press the OFF/RESET button to stop the generator set immediately, with no engine cooldown. The generator set remains off and will not respond to a remote start signal.</p> <p>Press and hold the OFF/RESET button for 3 seconds to reset an active fault (shutdown). Be sure to identify and correct the problem that caused the shutdown before clearing the fault.</p>
RUN	<p>Press the RUN button to start the generator set. No other generator sets in the system will start.</p>
AUTO	<p>Press AUTO to place the generator set into automatic (standby) mode. The generator set will respond to remote start and remote stop signals.</p> <p>The generator set will start and run when a start signal is received via a remote start, local auto-start, or communications-based start.</p> <p>All generator sets in the system (connected by PGEN paralleling communications and in Standby Mode by pressing AUTO) will start when any one of the generator sets receives a start signal. However, any generator set in the system that is not in AUTO mode will not start.</p> <p>If Generator Management is on, the generator set may shut down after a period of time.</p> <p>When the start signal is removed, the generator set will shut down with the appropriate engine cooldown.</p>
AUTO-RUN	<p>Press AUTO and RUN together for a system start signal.</p> <p>All generator sets in the system start and run, close to bus, synchronize, parallel, share load, etc. Some generator sets may shut down after a period of time (indicated by Generator Management) but they remain in Standby Mode ready to start and run if needed.</p>
AUTO-OFF	<p>Press AUTO and OFF together to remove a system start signal, if AUTO-RUN is active.</p> <p>All generator sets in the system open their breakers, enter engine cooldown, shut down, and enter Standby Mode. Closing the remote start contacts has no effect. Generator sets in the system will enter Standby Mode.</p> <p><b>Note:</b> Pressing AUTO and OFF together stops the generator sets only if there are no other system start signals present.</p>

## 2.3 Operation in Cold Weather Climates

Cold weather operation should be addressed in areas where the ambient temperatures fall below freezing, 0°C (32°F). The following items are recommended for cold weather starting and/or operation when the unit is located in an enclosure or unheated structure. Have a licensed electrician install 120 VAC, 15 amp outlets as needed if not already in the immediate area.

Refer to the engine operation manual regarding engine oil viscosity, fuel composition, and coolant mixture recommendations.

- The **engine block heater** is generally recommended for most units when operated below 0°C (32°F) and required as part of NFPA 110. Refer to the generator set specification sheet for temperature recommendations in available options.
- A **battery heater** is generally recommended for most units when operated below 0°C (32°F). Refer to the respective specification sheet for model availability.
- A **generator heater** is available for most generator sets providing a heat source to prevent moisture and frost buildup.
- **Heater tape** is recommended when the generator set is equipped with a closed crankcase ventilation system and operated at or below 50% of rated load. Wrap the UL/CSA compliant heater tape around the crankcase canister/breather system hose that runs from the crankcase to the air intake and use cable ties as needed to secure the heater tape. If the heater tape is within 152 mm (6 in.) of the exhaust system, use thermal insulation material to protect the heater tape.

## 2.4 Exercising the Generator Set

Operate the generator set under load once each week for one hour. Perform the exercise in the presence of an operator when the generator set does not have an automatic transfer switch with an exercise option.

During the exercise period apply a minimum of 35% load based on the nameplate standby rating, unless otherwise instructed in the engine operation manual.

The operator should perform all of the prestart checks before starting the manual exercise procedure. Start the generator set according to the starting procedure in Section 2.2, Controller Operation. While the generator set is operating, listen for a smooth-running engine and visually inspect generator set for fluid or exhaust leaks.

The generator set controller does not provide weekly scheduled exercise periods. If the system is equipped with an automatic transfer switch (ATS), refer to the ATS literature for information about scheduled exercise periods.

## 2.5 Warnings and Faults

Yellow and red LEDs above the controller's touchscreen indicate warnings and faults.

An inhibit time or time delay may affect warnings and faults.

**Inhibit time:** This time delay prevents the fault from triggering immediately when the engine starts. The inhibit time allows the engine to come up to speed and stabilize before triggering a fault. For example, the low oil pressure fault event typically has an inhibit time of 10 seconds to allow oil pressure in the engine to build up.

**Time Delay.** This time delay prevents a fault from triggering immediately when a condition is first detected. This delay prevents nuisance warnings or shutdowns caused by momentary changes in the signal, which could be false signals or electrical noise. For example, the overvoltage fault event typically has a time delay of 30 seconds. The overvoltage condition must be detected for 30 seconds before the fault is triggered.

### 2.5.1 Yellow System Warning LED and Fault Messages

The yellow WARNING LED turns on and the alarm horn sounds to indicate a warning but does not shut down the generator set. See Section 2.5.4, Notifications, for a list of fault and warning events and messages.

Press the Alarm Silence button to silence the alarm horn at the operator's discretion. If the controller is set up for an NFPA 110 application, press the AUTO button before silencing the alarm horn.

Warnings are automatically cleared from the controller when the condition is corrected.

When a system warning continues, it may lead to a fault and cause a system shutdown.

### 2.5.2 Red System Fault Shutdown LED and Fault Messages

When a fault condition is detected, the red system FAULT LED turns on, the alarm horn sounds, and the unit shuts down. See Section 2.5.4, Notifications, for a list of fault shutdown messages.

Use the Alarm Silence button to silence the alarm horn at the operator's discretion. If the controller is setup for an NFPA 110 application, press the AUTO button before silencing the alarm horn.

See Section 2.5.4, Resetting the Controller, for information to reset a system shutdown.

### 2.5.3 Fault, Notice, and Status Displays

New warning or shutdown messages appear in a banner across the top of the screen. See Figure 10. Touch ACKNOWLEDGE ALL to close the banner. Touch VIEW ACTIVE ALERTS or the Bell icon to see a list of all active faults.

Warnings and shutdowns appear on the Active Alerts screen and become part of the event log. The Event Log also includes status messages.

- Shutdown messages are written in red and include a red symbol with an X.
- Warning messages are yellow and include a yellow triangle with a ! symbol.
- Status messages are written in white.

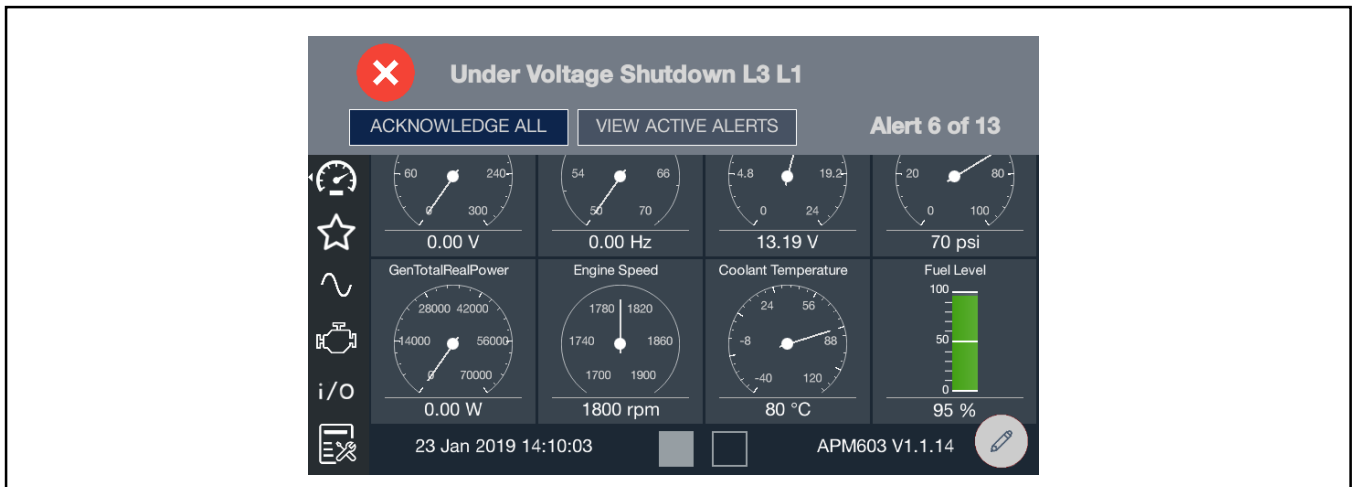


Figure 10 Fault Message Banner

## 2.5.4 Notifications (Bell icon)

The bell icon provides quick access to the Event Log. If the bell appears straight up and down, there are no active warnings or faults. If the bell is “ringing,” indicated by the bell at an angle with waves, there is at least one active warning or fault. The breadcrumb bar at the top of the page also changes color if there are active warnings or faults. If there are no active warnings or faults, the area is gray. If a warning is active, it is yellow. If a fault is active, it is red.

Touch the Bell icon to review active alerts and the event log. Event details lists the name, severity, and time and date for the event. Some events provide a snapshot of data just before and after the event. Touch View Snapshot to see data captured 7.5 seconds before and after the event. The items displayed in the Snapshot are factory selected. For example, in Figure 12 the generator power is displayed for each phase in a window around the time of the fault. To save the snapshot data to a file, insert a flash drive into the USB port on the front of the controller. Then touch the Save button on the screen. The data is saved in a .csv file, which can be opened as a spreadsheet on your PC.

When a fault is indicated, be sure to identify and correct the cause of the fault before resetting the controller. Contact an authorized Kohler distributor or dealer for service, if necessary.

When the fault condition has been corrected, press and hold the OFF/RESET button for 3 seconds to clear the fault from the controller. If the fault occurs again, contact an authorized Kohler distributor or dealer for service. Do not start the generator set until the condition has been corrected.

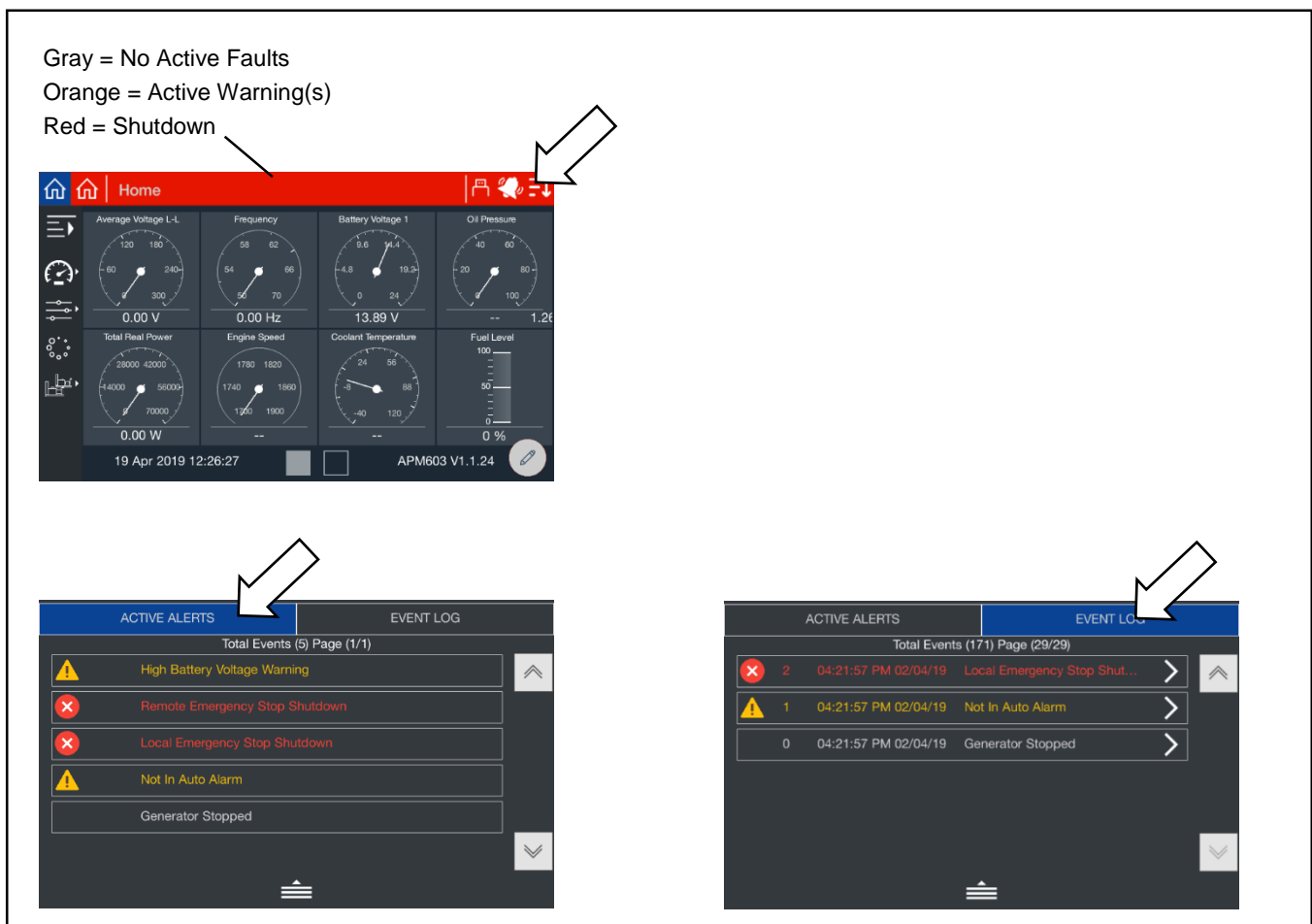


Figure 11 Notifications (Active Alerts and Event Log)

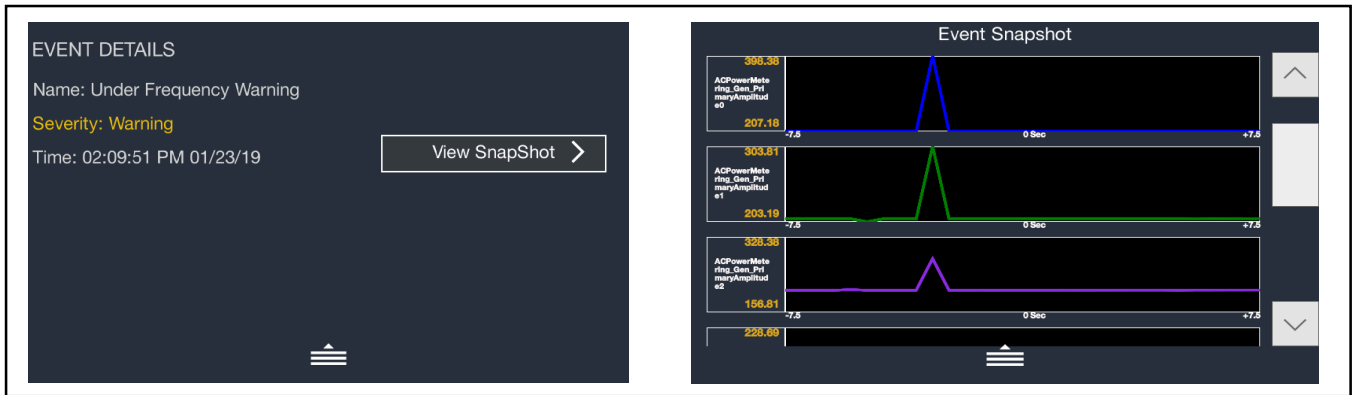


Figure 12 Event Details and Snapshot

**Event Log:**

This menu allows the user to review up to 10,000 entries of generator set system events including shutdowns, warnings, notices, and status events with date and time stamp.

A message is sent each time there is a change in a monitored engine condition (i.e. fault becomes active, fault is cleared). Upon broadcast of this message, the controller will request another message that contains the following information for each fault:

- FMI (Failure Mode Indicator) is a two-digit code that represents the type of fault that occurred (i.e. short circuit, out of range). The following figures provides descriptions of system events and their types – warning, shutdown, status, or notice.

Event ID/Parameter at Local Display	Level
<b>See the Engine Documentation for SPN.</b>	
Power On Initialization	Notice
Key Switch Initialization Fault	Shutdown
Key Switch To Off	Status
Key Switch To Auto	Status
Key Switch To Run	Status
Over Crank Shutdown	Shutdown
Under Frequency Warning	Warning
Under Frequency Shutdown	Shutdown
Over Frequency Warning	Warning
Over Frequency Shutdown	Shutdown
Over Power Warning	Warning
Over Power Shutdown	Shutdown
Low Coolant Temperature Warning	Warning
Local Emergency Stop Shutdown	Shutdown
Remote Emergency Stop Shutdown	Shutdown
Over Speed Shutdown	Shutdown
Loss ECM Comms Shutdown	Shutdown
ECM Mismatch Shutdown	Shutdown
ECM Diagnostic Event	Warning
Generator Running	Notice
Generator Stopped	Notice
Low Battery Voltage Warning	Warning
High Battery Voltage Warning	Warning
Alternator Protection Shutdown L1	Shutdown
Alternator Protection Shutdown L2	Shutdown
Alternator Protection Shutdown L3	Shutdown
Emergency Power Source Supplying Power	Notice
Not In Auto Alarm	Warning
Load Shed Overload	Notice
Fuel Leak Alarm	Warning

Event ID/Parameter at Local Display	Level
<b>See the Engine Documentation for SPN.</b>	
Load Shed Under Frequency	Notice
Maintenance Reminder 1	Warning
Maintenance Reminder 2	Warning
Maintenance Reminder 3	Warning
Weak Cranking Battery	Warning
Auto Button Pressed	Status
Off Button Pressed	Status
Run Button Pressed	Status
Protective Relay Trip Over Voltage	Warning
Protective Relay Trip Under Voltage	Warning
Protective Relay Trip Over Current	Warning
Protective Relay Trip Over Frequency	Warning
Protective Relay Trip Under Frequency	Warning
Protective Relay Trip Reverse Power	Warning
Protective Relay Trip Reverse VA R	Warning
Protective Relay Trip Over Power	Warning
Protective Relay Shutdown Over Power	Shutdown
Under Voltage Warning L1 L2	Warning
Under Voltage Warning L2 L3	Warning
Under Voltage Warning L3 L1	Warning
Under Voltage Warning L1 N	Warning
Under Voltage Warning L2 N	Warning
Under Voltage Warning L3 N	Warning
Under Voltage Shutdown L1 L2	Shutdown
Under Voltage Shutdown L2 L3	Shutdown
Under Voltage Shutdown L3 L1	Shutdown
Under Voltage Shutdown L1 N	Shutdown
Under Voltage Shutdown L2 N	Shutdown
Under Voltage Shutdown L3 N	Shutdown
Over Voltage Warning L1 L2	Warning
Over Voltage Warning L2 L3	Warning
Over Voltage Warning L3 L1	Warning
Over Voltage Warning L1 N	Warning
Over Voltage Warning L2 N	Warning
Over Voltage Warning L3 N	Warning
Over Voltage Shutdown L1 L2	Shutdown
Over Voltage Shutdown L2 L3	Shutdown
Over Voltage Shutdown L3 L1	Shutdown
Over Voltage Shutdown L1 N	Shutdown
Over Voltage Shutdown L2 N	Shutdown
Over Voltage Shutdown L3 N	Shutdown
Over Current L1 Warning	Warning
Over Current L2 Warning	Warning
Over Current L3 Warning	Warning
Over Current L1 Shutdown	Shutdown
Over Current L2 Shutdown	Shutdown
Over Current L3 Shutdown	Shutdown
Loss Of Signal Low Coolant Level Voltage	Warning
RSA Event Programmable Digital Input 1	Status
RSA Event Programmable Digital Input 2	Status
RSA Event Programmable Digital Input 3	Status
RSA Event Programmable Digital Input 4	Status
RSA Event Programmable Digital Input 5	Notice
RSA Event Programmable Digital Input 6	Notice

Event ID/Parameter at Local Display	Level
<b>See the Engine Documentation for SPN.</b>	
RSA Event Programmable Digital Input 7	Notice
RSA Event Programmable Digital Input 8	Notice
High Fuel Level Warning	Warning
Low Fuel Level Warning	Warning
Critically Low Fuel Level Warning	Warning
Low Fuel Level Shutdown	Shutdown
Low Coolant Level Shutdown	Shutdown
CAN Option Board 1 Chip 1 Comm Loss Warning	Warning
CAN Option Board 1 Chip 2 Comm Loss Warning	Warning
CAN Option Board 1 Chip 3 Comm Loss Warning	Warning
Replace Clock Battery	Warning
Maximum Power Shutdown	Shutdown
Maximum Power Warning	Warning
CAN Battery Charger 1 Fault	Warning
CAN Battery Charger 2 Fault	Warning
CAN Battery Charger 3 Fault	Warning
CAN Battery Charger 4 Fault	Warning
Aux Warning	Warning
Aux Shutdown	Shutdown
Low Fuel Switch Shutdown	Shutdown
Battery Charger Fault Warning	Warning
GFCI Warning	Warning
Excitation Over Voltage Shutdown	Shutdown
System Not Ready	Notice
Loss Of Sensing Shutdown L1	Shutdown
Loss Of Sensing Shutdown L2	Shutdown
Loss Of Sensing Shutdown L3	Shutdown
Underspeed Shutdown	Shutdown
Continuous Under Frequency Shutdown	Shutdown
Breaker Open Warning	Warning
Coolant Temp Sensor Disconnect Warning	Warning
Breaker Fail To Open Warning	Warning
Breaker Fail To Close Warning	Warning
Breaker Fail To Close Shutdown	Shutdown
Engine Stalled Shutdown	Shutdown
Starter Frequency Interlock	Status

Figure 13 Standard System Event, John Deere and Volvo Engine

Event ID/Parameter at Local Display	Level
<b>See the Engine Documentation for SPN.</b>	
Accelerator Pedal Position 3 Shorted High	Warning
Accelerator Pedal Position 3 Shorted Low	Warning
Accelerator Pedal Position 2 Shorted High	Warning
Accelerator Pedal Position 2 Shorted Low	Warning
Accelerator Pedal Position 1 Shorted High	Warning
Accelerator Pedal Position 1 Shorted Low	Warning
Fuel Supply Pressure Severely Low	Warning
Fuel Supply Pressure Shorted High	Warning
Fuel Supply Pressure Shorted Low	Warning
Fuel Supply Pressure Abnormal Change Rate	Warning
Fuel Supply Pressure Out Of Calibration	Shutdown
Fuel Supply Pressure Moderately High	Warning
Fuel Supply Pressure Low	Warning
Fuel Supply Pressure Moderately Low	Warning
Water In Fuel Severely High	Shutdown

Event ID/Parameter at Local Display	Level
<b>See the Engine Documentation for SPN.</b>	
Water In Fuel Shorted High	Warning
Water In Fuel Shorted Low	Warning
Water In Fuel Moderately High	Shutdown
Water In Fuel Condition Exists	Warning
Oil Pressure Severely Low	Shutdown
Oil Pressure Shorted High	Warning
Oil Pressure Shorted Low	Warning
Oil Pressure Moderately High	Warning
Oil Pressure Low	Warning
Oil Pressure Moderately Low	Warning
Oil Pressure Condition Exists	Warning
Intake Manifold Temperature Severely High	Shutdown
Intake Manifold Temperature Shorted High	Warning
Intake Manifold Temperature Shorted Low	Warning
Intake Manifold Temperature High	Warning
Intake Manifold Temperature Moderately High	Warning
Air Filter Pressure Condition Exists	Warning
Barometric Pressure Plausibility	Warning
Coolant Temperature Severely High	Shutdown
Coolant Temperature Shorted High	Warning
Coolant Temperature Shorted Low	Warning
Coolant Temperature High	Warning
Coolant Temperature Moderately High	Warning
Coolant Level Severely Low	Shutdown
Rail 1 Pressure Severely Low	Shutdown
Rail 1 Pressure Shorted High	Shutdown
Rail 1 Pressure Shorted Low	Warning
Rail 1 Pressure Moderately High	Warning
Rail 1 Pressure Low	Warning
Rail 1 Pressure Moderately Low	Warning
ECU Keyswitch Battery Voltage Low	Warning
Fuel Temperature Severely High	Shutdown
Fuel Temperature Shorted High	Warning
Fuel Temperature Shorted Low	Warning
Fuel Temperature High	Warning
Fuel Temperature Moderately High	Warning
Fuel Temperature Condition Exists	Warning
Oil Temperature Shorted High	Warning
Oil Temperature Shorted Low	Warning
Engine Rated Speed Severely High	Shutdown
Engine Rated Speed Condition Exists	Warning
Engine Speed Severely High	Shutdown
Engine Speed Severely Low	Warning
Engine Speed Moderately High	Warning
Engine Speed Moderately Low	Warning
Injector Wiring Shorted High	Warning
Injector Wiring Shorted Low	Warning
Sensor Supply Shorted High	Warning
Sensor Supply Shorted Low	Warning
ECU Power Supply Severely Low	Warning
ECU Power Supply Shorted Low	Warning
ECU Power Supply Moderately Low	Warning
Controller 1 Device Failure	Warning
Controller 1 Data Error	Warning



Event ID/Parameter at Local Display	Level
<b>See the Engine Documentation for SPN.</b>	
Engine Fuel Shutoff 1 Control Plausibility	Warning
Engine Fuel Shutoff 1 Control Open Circuit	Warning
Engine Position Sensor Plausibility	Warning
Engine Position Sensor Open Circuit	Warning
Engine Position Sensor Grounded Circuit	Warning
Engine Position Sensor Abnormal Signal	Warning
Engine Position Sensor Abnormal Change Rate	Warning
Engine Timing Sensor Plausibility	Warning
Engine Timing Sensor Open Circuit	Warning
Engine Timing Sensor Grounded Circuit	Warning
Engine Timing Sensor Mechanical Error	Warning
Engine Timing Sensor Abnormal Signal	Warning
Engine Timing Sensor Abnormal Change Rate	Warning
External Speed Command Plausibility	Warning
Injector 1 Severely High	Warning
Injector 1 Severely Low	Warning
Injector 1 Plausibility	Warning
Injector 1 Open Circuit	Warning
Injector 1 Grounded Circuit	Warning
Injector 1 Mechanical Error	Warning
Injector 1 Out Of Calibration	Warning
Injector 2 Severely High	Warning
Injector 2 Severely Low	Warning
Injector 2 Plausibility	Warning
Injector 2 Open Circuit	Warning
Injector 2 Grounded Circuit	Warning
Injector 2 Mechanical Error	Warning
Injector 2 Out Of Calibration	Warning
Injector 3 Severely High	Warning
Injector 3 Severely Low	Warning
Injector 3 Plausibility	Warning
Injector 3 Open Circuit	Warning
Injector 3 Grounded Circuit	Warning
Injector 3 Mechanical Error	Warning
Injector 3 Out Of Calibration	Warning
Injector 4 Severely High	Warning
Injector 4 Severely Low	Warning
Injector 4 Plausibility	Warning
Injector 4 Open Circuit	Warning
Injector 4 Grounded Circuit	Warning
Injector 4 Mechanical Error	Warning
Injector 4 Out Of Calibration	Warning
Injector 5 Severely High	Warning
Injector 5 Severely Low	Warning
Injector 5 Plausibility	Warning
Injector 5 Open Circuit	Warning
Injector 5 Grounded Circuit	Warning
Injector 5 Mechanical Error	Warning
Injector 5 Out Of Calibration	Warning
Injector 6 Severely High	Warning
Injector 6 Severely Low	Warning
Injector 6 Plausibility	Warning
Injector 6 Open Circuit	Warning
Injector 6 Grounded Circuit	Warning

Event ID/Parameter at Local Display	Level
<b>See the Engine Documentation for SPN.</b>	
Injector 6 Mechanical Error	Warning
Injector 6 Out Of Calibration	Warning
Glow Plug Relay Shorted High	Warning
Glow Plug Relay Open Circuit	Warning
Inlet Air Heater Shorted High	Warning
Inlet Air Heater Open Circuit	Warning
Key Switch Condition Exists	Warning
Fuel Lift Pump Open Circuit	Warning
Fuel Lift Pump Device Failure	Warning
Injection Pump Control Valve Severely High	Warning
Injection Pump Control Valve Severely Low	Warning
Injection Pump Control Valve Plausibility	Warning
Injection Pump Control Valve Shorted High	Warning
Injection Pump Control Valve Open Circuit	Warning
Injection Pump Control Valve Grounded Circuit	Warning
Injection Pump Control Valve Mechanical Error	Warning
Injection Pump Control Valve Abnormal Change Rate	Warning
Injection Pump Control Valve Out Of Calibration	Warning
Injection Pump Mechanical Error	Warning
Injection Pump Unknown Failure	Warning
Injection Pump Device Failure	Warning
Injection Pump Data Error	Warning
Injection Pump Condition Exists	Warning
Injection Pump Speed Mechanical Error	Warning
Injection Pump Speed Unknown Failure	Warning
Injection Pump Speed Condition Exists	Warning
5V Sensor Supply Voltage 1 Shorted High	Warning
5V Sensor Supply Voltage 1 Shorted Low	Warning
5V Sensor Supply Voltage 2 Shorted High	Warning
5V Sensor Supply Voltage 2 Shorted Low	Warning
Engine Protection Condition Exists	Warning
Engine Protection Shutdown Condition Exists	Warning
ECU Temperature Severely High	Warning
ECU Temperature Moderately High	Warning
Fuel Pump 1 Shorted High	Warning
Fuel Pump 1 Open Circuit	Warning
Fuel Pump 1 Mechanical Error	Warning
Fuel Pump 1 Abnormal Change Rate	Warning
Fuel Pump 2 Open Circuit	Warning
Fuel Pump 2 Abnormal Change Rate	Warning
ECU Main Relay Plausibility	Warning
Engine Fuel Derate Condition Exists	Warning
CAN Source Address 0 Grounded Circuit	Warning
Sensor Voltage 1 Shorted High	Warning
Sensor Voltage 1 Shorted Low	Warning
Sensor Voltage 2 Shorted High	Warning
Sensor Voltage 2 Shorted Low	Warning
Sensor Voltage 3 Shorted High	Warning
Sensor Voltage 3 Shorted Low	Warning
Sensor Voltage 4 Shorted High	Warning
Sensor Voltage 4 Shorted Low	Warning
Sensor Voltage 5 Shorted High	Warning
Sensor Voltage 5 Shorted Low	Warning

Figure 14 ECU Event, John Deere Engine

<b>Notices Excluded From Display</b>	
Common Fault	Notice
Common Warning	Notice
System Ready	Notice
Remote Start Command Issued	Notice
Run Button Acknowledged	Notice
Close Breaker	Notice
Remove Breaker Trip	Notice
Standalone Operation	Status
Load Enable	Status
Baseload Mode	Status
System Control Mode	Status
System Sync Mode	Status
Enable Trims	Status
* Sensor dependent.	

Figure 15 Notices Excluded from Display

<b>Event ID/Parameter at Local Display</b>	<b>Level</b>
<b>See the Engine Documentation for SPN.</b>	
Accelerator Pedal Position 3 Plausibility	Warning
Accelerator Pedal Position 2 Plausibility	Warning
Accelerator Pedal Position 2 Shorted High	Warning
Accelerator Pedal Position 2 Shorted Low	Warning
Accelerator Pedal Position 2 Open Circuit	Warning
Engine Throttle Valve 1 Position Shorted High	Warning
Engine Throttle Valve 1 Position Open Circuit	Warning
Engine Throttle Valve 1 Position Mechanical Error	Warning
Engine Throttle Valve 1 Position Device Failure	Warning
Engine Throttle Valve 1 Position Out Of Calibration	Warning
Accelerator Pedal Position 1 Severely High	Warning
Accelerator Pedal Position 1 Plausibility	Warning
Accelerator Pedal Position 1 Shorted High	Warning
Accelerator Pedal Position 1 Shorted Low	Warning
Accelerator Pedal Position 1 Open Circuit	Warning
Accelerator Pedal Position 1 Abnormal Data Rate	Warning
Accelerator Pedal Position 1 Out Of Calibration	Warning
Accelerator Pedal Position 1 Data Error	Warning
Fuel Supply Pressure Shorted High	Warning
Fuel Supply Pressure Open Circuit	Warning
Fuel Supply Pressure Device Failure	Warning
Fuel Supply Pressure Moderately Low	Warning
Water in Fuel Severely High	Warning
Water in Fuel Shorted Low	Warning
Water in Fuel Device Failure	Warning
Engine Oil Level Severely Low	Warning
Engine Oil Level Shorted Low	Warning
Engine Oil Level Open Circuit	Warning
Engine Oil Level Moderately Low	Warning
Oil Pressure Severely Low	Shutdown
Oil Pressure Shorted High	Warning
Oil Pressure Open Circuit	Warning
Oil Pressure Moderately Low	Warning
Crankcase Pressure Severely High	Shutdown
Crankcase Pressure Shorted High	Warning

Event ID/Parameter at Local Display	Level
<b>See the Engine Documentation for SPN.</b>	
Crankcase Pressure Open Circuit	Warning
Intake Manifold Pressure Severely High	Shutdown
Intake Manifold Pressure Shorted High	Warning
Intake Manifold Pressure Open Circuit	Warning
Intake Manifold Pressure Moderately High	Warning
Intake Manifold Temperature Severely High	Shutdown
Intake Manifold Temperature Shorted Low	Warning
Intake Manifold Temperature Open Circuit	Warning
Intake Manifold Temperature Moderately High	Warning
Air Filter Pressure Severely High	Warning
Air Filter Pressure Shorted High	Warning
Air Filter Pressure Shorted Low	Warning
Air Filter Pressure Open Circuit	Warning
Air Filter Pressure Device Failure	Warning
Barometric Pressure Open Circuit	Warning
Coolant Temperature Severely High	Shutdown
Coolant Temperature Shorted Low	Warning
Coolant Temperature Open Circuit	Warning
Coolant Temperature Moderately High	Warning
Coolant Level Severely Low	Shutdown
Coolant Level Shorted High	Warning
Coolant Level Shorted Low	Warning
Coolant Level Open Circuit	Warning
Coolant Level Moderately Low	Warning
ECU Keyswitch Battery Voltage Severely High	Warning
ECU Keyswitch Battery Voltage Severely Low	Warning
ECU Keyswitch Battery Voltage Plausibility	Warning
ECU Keyswitch Battery Voltage Shorted High	Warning
ECU Keyswitch Battery Voltage Shorted Low	Warning
Engine Air Intake Temperature Shorted Low	Warning
Engine Air Intake Temperature Open Circuit	Warning
Engine Exhaust Gas Temperature Severely High	Warning
Engine Exhaust Gas Temperature Moderately High	Warning
Oil Temperature Severely High	Shutdown
Oil Temperature Shorted Low	Warning
Oil Temperature Open Circuit	Warning
Oil Temperature Moderately High	Warning
Engine Speed Severely High	Warning
Engine Speed Moderately High	Warning
Engine Starting Aid Plausibility	Warning
Engine Starting Aid Shorted High	Warning
Engine Starting Aid Shorted Low	Warning
Engine Starting Aid Open Circuit	Warning
Program Memory Plausibility	Warning
Program Memory Device Failure	Warning
Controller 1 Device Failure	Warning
Calibration Memory Plausibility	Warning
Calibration Memory Device Failure	Warning
Engine Position Sensor Mechanical Error	Warning
Engine Position Sensor Abnormal Signal	Warning
Engine Position Sensor Abnormal Data Rate	Warning

Event ID/Parameter at Local Display	Level
<b>See the Engine Documentation for SPN.</b>	
Engine Timing Sensor Plausibility	Warning
Engine Timing Sensor Abnormal Signal	Warning
Engine Timing Sensor Abnormal Data Rate	Warning
Primary J1939 Network 1 Plausibility	Warning
Primary J1939 Network 1 Abnormal Data Rate	Warning
Engine Fan Control 1 Shorted High	Warning
Engine Fan Control 1 Shorted Low	Warning
Engine Fan Control 1 Open Circuit	Warning
Injector 1 Shorted High	Warning
Injector 1 Open Circuit	Warning
Injector 2 Shorted High	Warning
Injector 2 Open Circuit	Warning
Injector 3 Shorted High	Warning
Injector 3 Open Circuit	Warning
Injector 4 Shorted High	Warning
Injector 4 Open Circuit	Warning
Injector 5 Shorted High	Warning
Injector 5 Open Circuit	Warning
Injector 6 Shorted High	Warning
Injector 6 Open Circuit	Warning
Starter Relay Shorted High	Warning
Starter Relay Shorted Low	Warning
Starter Relay Open Circuit	Warning
Starter Relay Grounded Circuit	Warning
Inlet Air Heater Open Circuit	Warning
Inlet Air Heater Grounded Circuit	Shutdown
Inlet Air Heater Mechanical Error	Warning
Inlet Air Heater Device Failure	Warning
Key Switch Shorted High	Warning
Key Switch Shorted Low	Warning
Key Switch Open Circuit	Warning
Key Switch Unknown Failure	Warning
Key Switch Special Instructions	Warning
Turbo Wastegate Actuator 1 Position Shorted High	Warning
Turbo Wastegate Actuator 1 Position Shorted Low	Warning
Turbo Wastegate Actuator 1 Position Open Circuit	Warning
ECU Main Relay Mechanical Error	Warning
Fan Speed Shorted High	Warning
J1939 Network 4 Plausibility	Warning
Aftertreatment 1 DEF Tank Level Device Failure	Warning
Aftertreatment 1 DEF Tank Level Low	Warning
Aftertreatment 1 DEF Tank Level Moderately Low	Warning
CAN Source Address 17 Abnormal Data Rate	Warning
CAN Source Address 36 Abnormal Data Rate	Warning
EGR 1 Max Flow Rate Moderately Low	Warning
EGR 1 Valve Control Mechanical Error	Warning
Aftertreatment 1 DEF Tank Temperature Device Failure	Warning
Aftertreatment 1 Intake Nox Plausibility	Warning
Aftertreatment 1 Intake Nox Shorted High	Warning
Aftertreatment 1 Intake Nox Open Circuit	Warning
Aftertreatment 1 Intake Nox Abnormal Data Rate	Warning

Event ID/Parameter at Local Display	Level
<b>See the Engine Documentation for SPN.</b>	
Aftertreatment 1 Intake Nox Unknown Failure	Warning
Aftertreatment 1 Intake Nox Device Failure	Warning
Aftertreatment 1 Intake Nox Out Of Calibration	Warning
Aftertreatment 1 Intake Nox Special Instructions	Warning
Aftertreatment 1 Outlet Nox Plausibility	Warning
Aftertreatment 1 Outlet Nox Shorted High	Warning
Aftertreatment 1 Outlet Nox Open Circuit	Warning
Aftertreatment 1 Outlet Nox Mechanical Error	Warning
Aftertreatment 1 Outlet Nox Abnormal Data Rate	Warning
Aftertreatment 1 Outlet Nox Device Failure	Warning
Aftertreatment 1 Outlet Nox Out Of Calibration	Warning
Aftertreatment 1 Outlet Nox Special Instructions	Warning
Aftertreatment 1 Exhaust Gas Temperature 1 Data Error	Warning
Aftertreatment 1 DEF Dosing Unit Device Failure	Warning
Aftertreatment 1 DEF Tank Quality Device Failure	Warning
Aftertreatment 1 DEF Tank Quality Low	Warning
Throttle Actuator 1 Control Command Shorted High	Warning
Throttle Actuator 1 Control Command Shorted Low	Warning
Throttle Actuator 1 Control Command Open Circuit	Warning
Throttle Actuator 1 Control Command Mechanical Error	Warning
Throttle Actuator 1 Control Command Abnormal Change Rate	Warning
Throttle Actuator 1 Control Command Device Failure	Warning
Sensor Voltage 1 Shorted High	Warning
Sensor Voltage 1 Shorted Low	Warning
Sensor Voltage 2 Shorted High	Warning
Sensor Voltage 2 Shorted Low	Warning
Sensor Voltage 3 Shorted High	Warning
Sensor Voltage 3 Shorted Low	Warning
Aftertreatment 1 SCR Conversion Efficiency Severely Low	Warning
Aftertreatment 1 SCR Conversion Efficiency Condition Exists	Warning
Aftertreatment DEF Dosing Valve Device Failure	Warning
Electronic Control Unit Open Circuit	Warning
Engine Subnet Reductant Module Comm Lost Abnormal Data Rate	Warning
Exhaust Gas Temperature Sensor Wet Shorted High	Warning
Exhaust Gas Temperature Sensor Wet Shorted Low	Warning
Exhaust Gas Temperature Sensor Dry Severely High	Warning
Exhaust Gas Temperature Sensor Dry Shorted High	Warning
Exhaust Gas Temperature Sensor Dry Shorted Low	Warning
Exhaust Gas Temperature Sensor Dry Open Circuit	Warning
Exhaust Gas Temperature Sensor Dry Moderately High	Warning
EGR A Compression Brake Control Shorted High	Warning
EGR A Compression Brake Control Shorted Low	Warning
EGR A Compression Brake Control Open Circuit	Warning
Turbo Wastegate Solenoid A Shorted Low	Warning
Turbo Wastegate Solenoid a Open Circuit	Warning
Torque Speed Control Command Error Special Instructions	Warning

Figure 16 System Events, Volvo Engine

## 2.6 Resetting the Controller (Following System Shutdown)

Use the following procedure to restart the generator set after a system shutdown. This procedure includes the resetting of the optional remote annunciator.

Refer to Section 2.2.5, Emergency Stop, to reset the generator set after an emergency stop.

1. Disconnect the generator set load using the line circuit breaker or automatic transfer switch.
2. Correct the cause of the fault shutdown or warning. See the Safety Precautions and Instructions section of this manual before proceeding.
3. Reset the fault by pressing and holding the OFF/RESET button for 3 seconds.
4. Start the generator set by pressing the RUN button.
5. When equipped, the remote annunciator alarm horn sounds. Press the ALARM SILENCE/LAMP TEST button to stop the alarm horn. The alarm silenced LED turns on if the alarm is silenced.
6. Allow the generator set to run long enough to verify that the fault condition has been corrected.
7. Press the generator set OFF/RESET button to stop the generator set.
8. Press the generator set AUTO button.
9. Silence the controller alarm horn by pressing the ALARM SILENCE button.
10. Reconnect the generator set load via the line circuit breaker or automatic transfer switch.
11. When equipped, the remote annunciator alarm horn sounds. Press the ALARM SILENCE/LAMP TEST button to stop the alarm horn. The alarm silence LED turns on if the alarm is silenced.

## 2.7 Controller Settings

Touch the down arrow icon at the upper right corner of the screen to access the controller settings.

- Display Brightness  
Adjusts the brightness of the controller's touchscreen display. Touch the sun icons at either end of the bar to increase or decrease the brightness of the display.
- LED Brightness  
Adjusts the brightness of the Warning and Fault LEDs above the display. Touch the sun icons at either end of the bar to increase or decrease the brightness of the LEDs.
- Date/Time  
Set the date, time, and time zone at the controller's location. The date and time are displayed on the Home screens and are used in the event log and for data logging.
- Language.  
For future development. At this time, English is the only available option.
- Controller Session Login Timeout  
Controls the session time for access levels above the user level. The access level returns to the lowest (user) level after the session timeout to prevent unauthorized access after an operator or service technician has finished working.
- Access Level

This is where an operator or technician can log into the controller using an Operator or Technician password. The Operator and Technician level passwords allow access to view and change settings that are not available at the default user level.

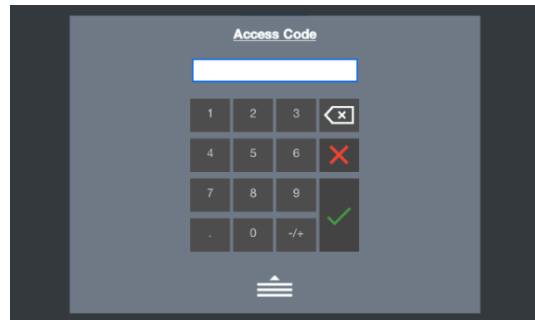
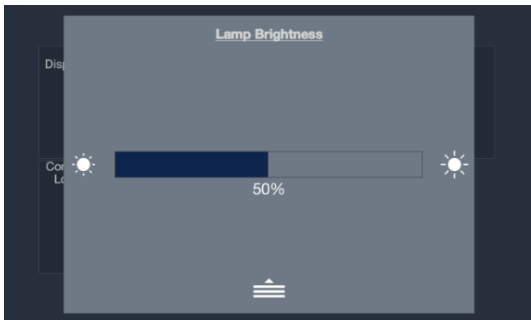
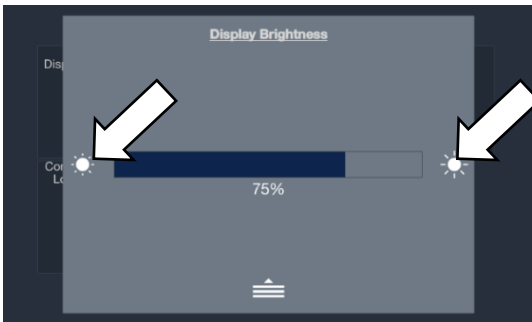
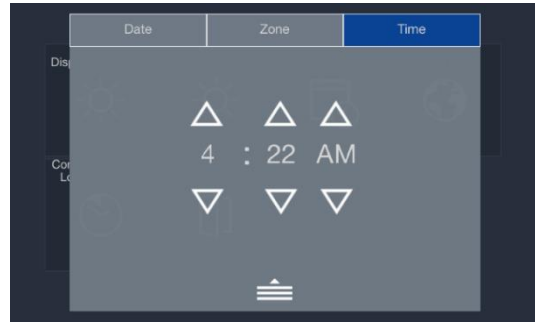
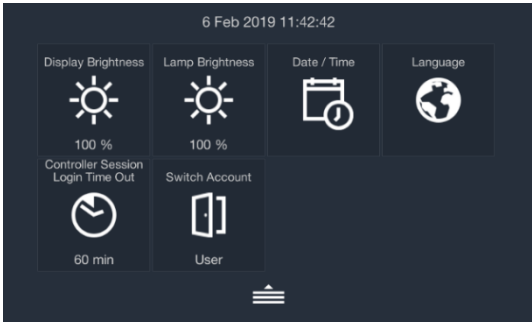
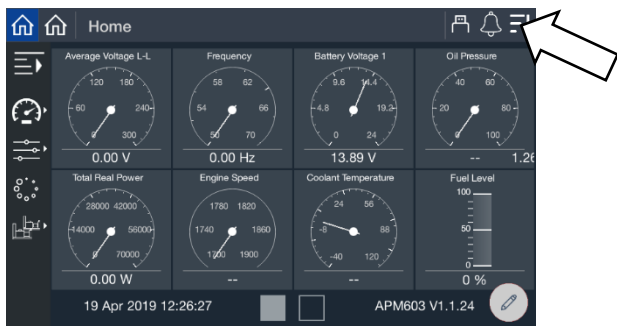


Figure 17 Controller Settings and Access Levels



## 2.8 Screen Shots

It is possible to save screen shots showing the controller display. Screen shots showing the controller display can be saved to a flash drive. The screens shots are saved as png files, which can be viewed using a photo viewer on your PC.

Refer to Section 1.3 for the locations of the USB port and the Alarm Silence/Lamp Test button on the controller, if necessary.

### Procedure to Create Screen Shot Files

1. Insert a flash drive into the USB port on the front of the APM603 controller.
2. Navigate to the desired screen and press the Alarm Silence/Lamp Test button once.
3. Wait at least 5 seconds to allow the png file to be saved to the flash drive. If the flash drive has an LED indicator, wait for the LED to stop flickering.
4. If multiple screen shots are needed, repeat steps 2 and 3 for each screen.
5. Remove the flash drive from the controller and insert it into a USB port on your PC. Open the files to verify that the screen shots were saved correctly.

## 2.9 Menu Navigation

The APM603 controller provides menus and submenus that display controller settings, generator set status, and paralleling information. The following list shows the locations of the menus and submenus on the controller.

- Metering
  - Favorites
  - Electrical
    - Generator
    - Inputs
    - Outputs
    - Battery Charger
  - Engine
  - Op Records
  - Load Management
    - Overview
    - Status
      - System
      - Load
    - Setup Details
- Setup
  - Electrical
    - Generator
    - Battery Charger
    - Paralleling
  - Engine
  - Communications
  - Event Config
  - Genset Info
- Data Log
- Paralleling
  - Metering
    - Overview
    - Status
    - Details
    - PGEN
  - Setup
    - PGEN
    - Protect Relay
  - Gen Management
    - Overview
    - Status
      - System
      - Generator
    - Setup Details



### 3.1 Metering Screens

The metering screens allow the user to view generator set status and operation records. The home screens display frequently-viewed parameters including generator set voltage, frequency, current and power, as well as engine data such as RPM and oil pressure. The home screens can be modified to display your choice of up to 16 system parameters using four different display formats.

The Favorites screen provides another way to display your choice of data. Separate favorites screens can be set up for each access level: user, operator, and technician.

The metering screens are designed for viewing only. Settings cannot be changed through the metering screens.

The metering screens display:

- Favorites
- Electrical, including generator set, inputs, outputs, and battery charger
- Engine
- Operation records
- Load Management

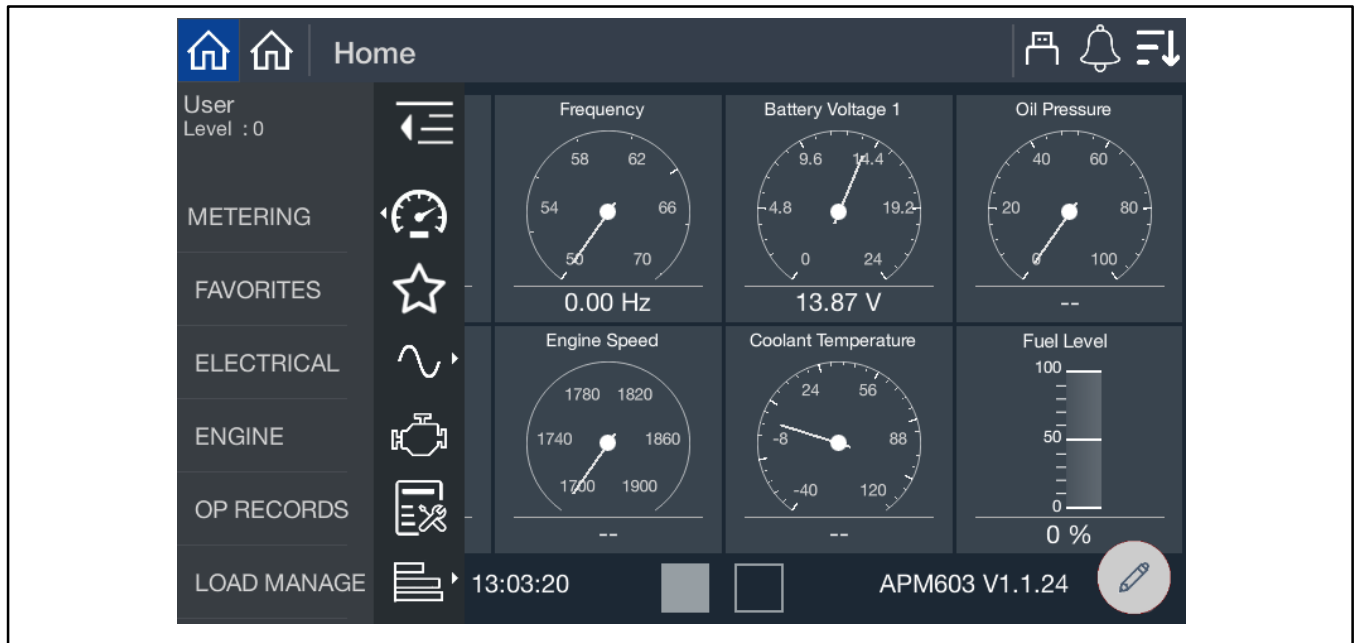


Figure 18 Metering Menu, Expanded

### 3.1.1 Home

At startup, the controller displays the home screen shown in Figure 19. Two home screens showing up to 16 different generator set values can be displayed. Touch the square buttons at the bottom of the screen to move between the two home screen displays.

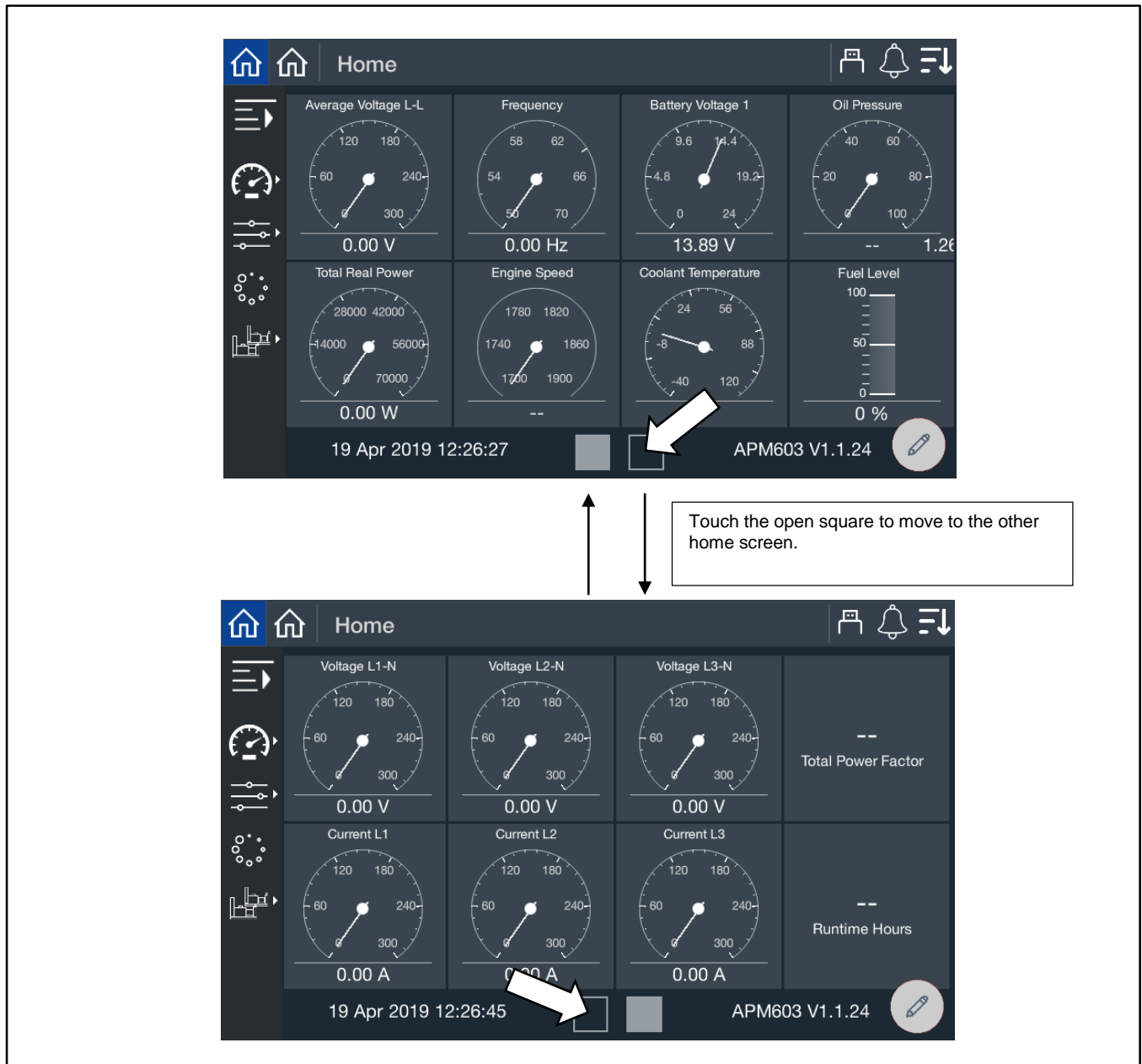


Figure 19 Home Screens

The parameters shown below are displayed on the home screens by default. Follow the instructions in the next section to change the parameters displayed. Up to 16 system parameters can be selected for display on the two Home screens.

Default Parameters
Average Voltage L to L
Frequency
Battery Voltage
Oil Pressure
Total Real Power
Speed
Coolant Temperature
Fuel Level
Voltage L1-N
Voltage L2-N
Voltage L3-N
Total Power Factor
Current L1
Current L2
Current L3
Runtime Hours

Figure 20 Default Parameters Shown on the Home Screens

### 3.1.2 Customizing the Home Screens

The displayed values and the gauge styles for the Home screens can be changed as desired.

To add a gauge, there must be at least one empty space available on the screen. It may be necessary to remove a gauge to create an empty space. When any gauge is removed, the remaining gauges shift to fill the vacated space, and the new open space will appear at the end of the second screen. To change the order of the gauges, it is necessary to remove the gauges using the trash can icon and then replace them in the desired order.

Choose up to 16 values from the following categories:

- Electrical – Generator
- Electrical – Inputs
- Electrical – Outputs
- Electrical – Battery Charger1 (no battery charger data is available for KD models)
- Electrical – Battery Charger 2 (no battery charger data is available for KD models)
- Engine
- Operation Records
- Load Management
- Paralleling

Full gauge, half gauge, vertical gauge, or tile (text only) styles are available.

## Procedure to Remove Gauges from the Home Screens

Refer to Figure 21 during this procedure.

1. Touch the pencil icon.
2. Touch the trash can icon. Trash cans will then appear on each tile.
3. Touch the trash can for the gauge (or gauges) to be removed.
4. Touch the green check mark. Notice that the last position is now empty.

The numbers below correspond to the numbered steps in the Procedure to Remove Gauges from the Home Screen..



Figure 21 Removing Gauges from the Home Screen

## Procedure to Add New Gauges to the Home Screen

Refer to Figure 22 during the following procedure.

1. Touch the pencil icon.
2. Touch the + icon.
3. Select the category for the parameter to be displayed.
4. Touch the parameter.
5. Four gauge styles will appear. Touch to choose the style.
6. The new gauge is added. Notice that the newly added gauge appears in the last open space.

### Note:

A maximum of 16 values can be displayed. One or more blank tiles must be available before gauges can be added.

The numbers below correspond to the numbered steps in the Procedure to Add New Gauges to the Home Screen.

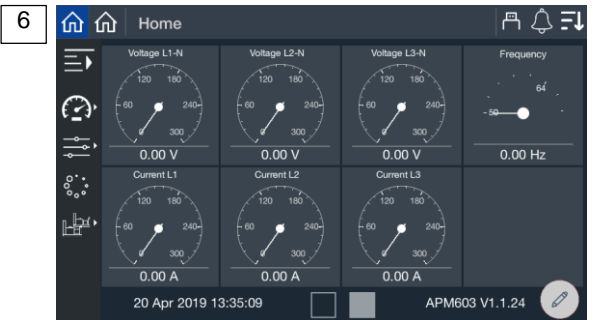
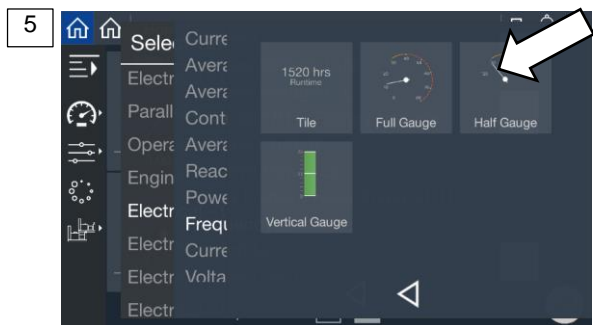
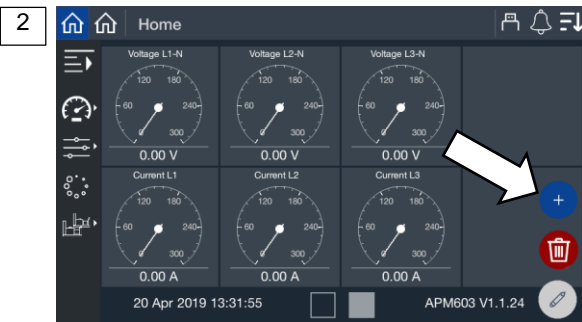


Figure 22 Adding Gauges to the Home Screen



### 3.1.3 Favorites

The Favorites screen allows the user, operator, and technician to view selected parameters from different categories on one screen.

#### Procedure to View Favorites

1. Touch Metering or the gauge symbol.
2. Touch Favorites or the star symbol.
3. Favorite parameters are displayed.

The numbers below correspond to the numbered steps in the Procedure to View Favorites.



Figure 23 Metering, Favorites

A user can select the parameters to display in the Favorites screen. A different set of favorites can be selected for each access level. The operator and technician can select different favorites than the user. There is no limit to the number of favorites that can be selected. See Figure 24 for instructions to select parameters from nine different categories:

- Electrical – Generator
- Electrical – Inputs
- Electrical – Outputs
- Electrical – Battery Charger1 (no battery charger data is available for KD models)
- Electrical – Battery Charger 2 (no battery charger data is available for KD models)
- Engine
- Operation Records
- Load Management
- Paralleling

**Note:**

The parameters are listed on the Favorites screen in the order selected.

## Procedure to Select Favorites

First, go to the Favorites screen as described in Figure 23.

1. Touch the Star icon in the upper right corner of the screen.
2. Touch the category.
3. Touch the stars for one or more parameters to be included in the Favorites display. The selected stars turn solid white.
4. Touch the left arrow symbol to close the selection box. Repeat steps 2 and 3 for other categories.
5. Observe that the selected parameters are now displayed in the order they were selected.

The numbers below correspond to the numbered steps in the Procedure to Select Favorites.

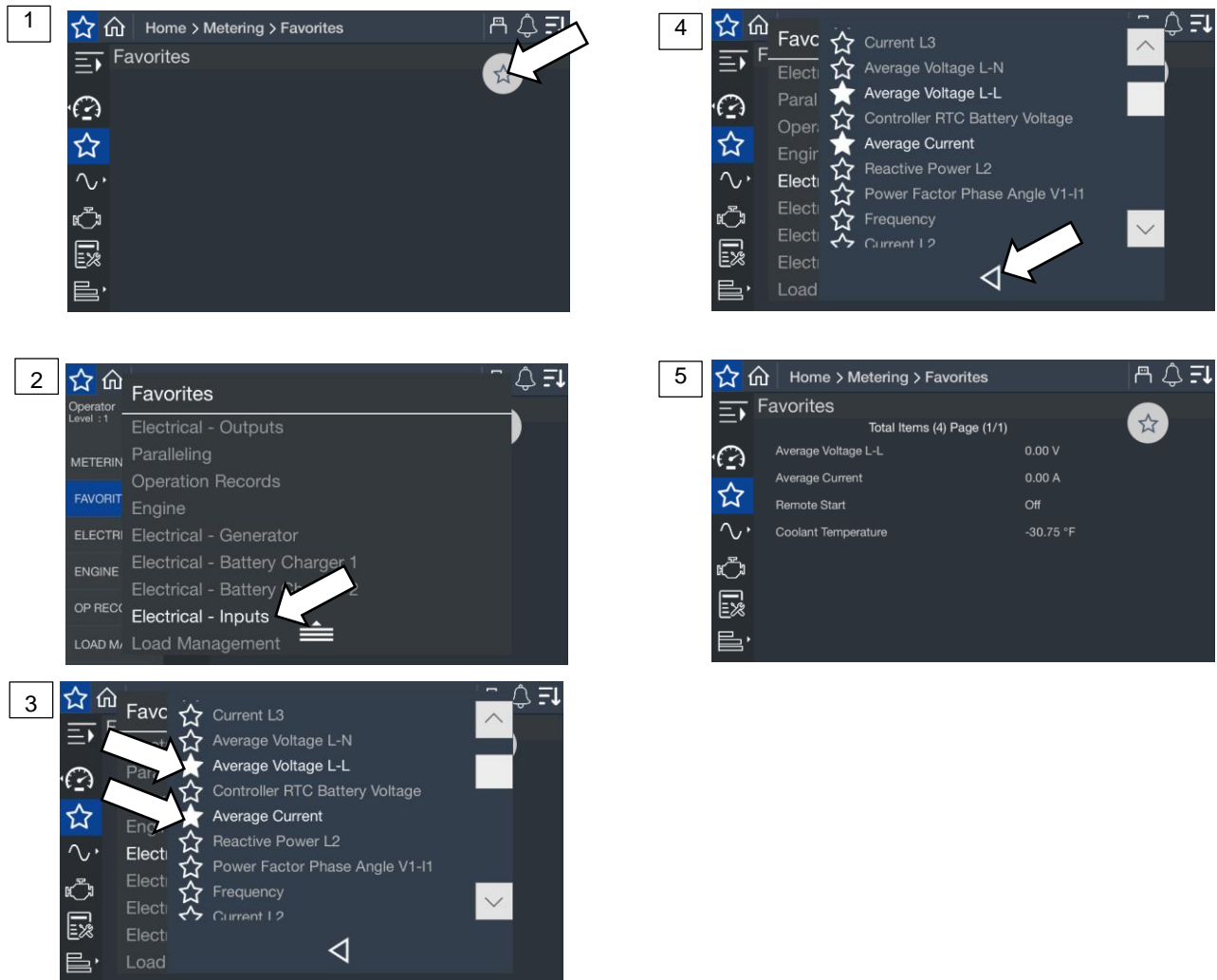


Figure 24 Selecting Favorites

## 3.2 Electrical

### 3.2.1 Metering Screens, Electrical, Generator

The Generator Metering screens display generator set electrical information such as output voltage, frequency, current, and other electrical data listed in Figure 26. The metering screens display information only. Parameter settings cannot be changed from the metering screens.

#### Procedure to View Generator Electrical Metering Screens

1. In the navigation panel on the left side of the screen, touch Metering or the gauge symbol.
2. Touch Electrical or the sine wave symbol.
3. Touch Generator or the generator symbol.
4. Touch the arrows on the right side of the screen to scroll through the electrical metering screens.

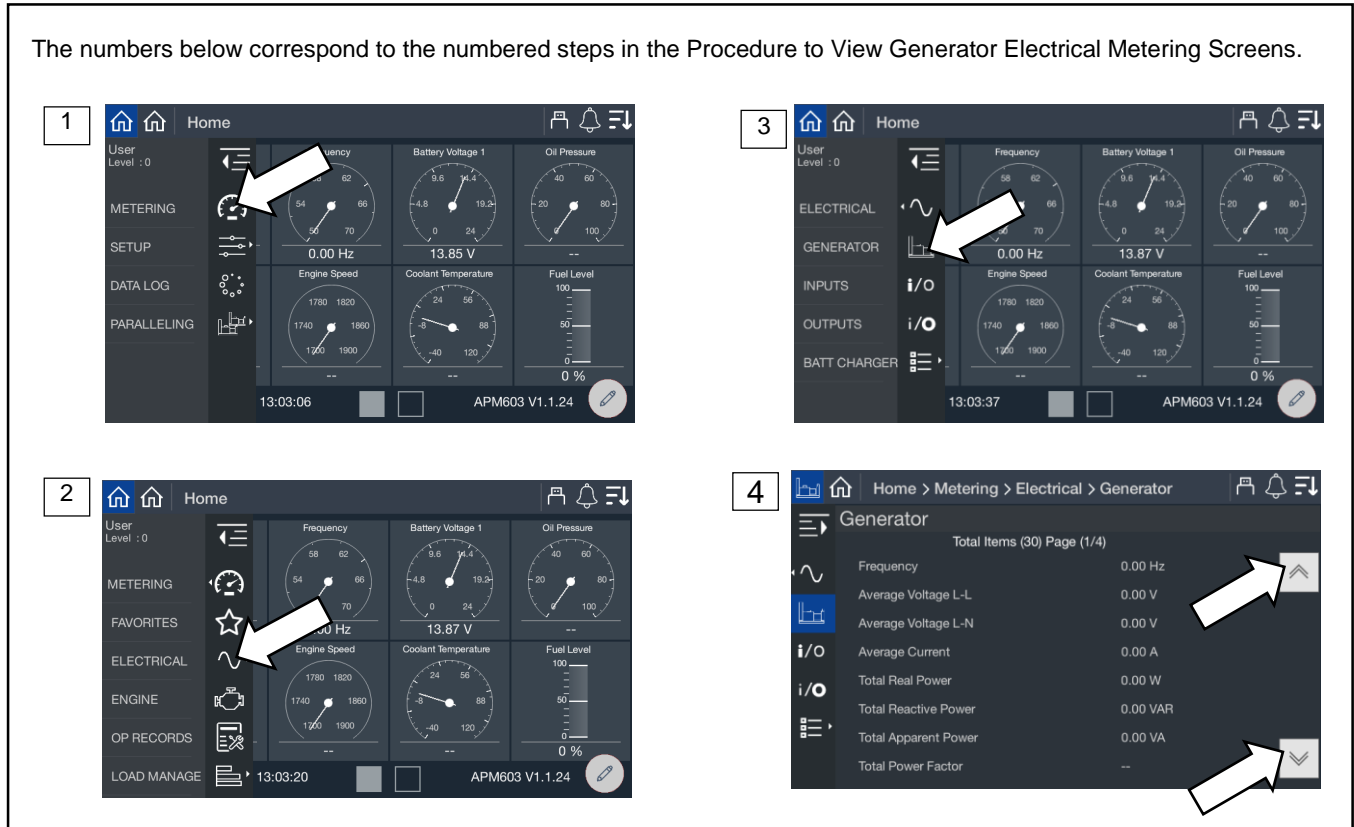


Figure 25 Electrical Metering Screen

The generator metering screen displays the values shown below.

Parameter	Units
Frequency	Hz
Average Voltage L-L	V
Average Voltage L-N	V
Average Current	kA
Three Phase Average Current*	kA
Total Real Power	kW
Total Reactive Power	kVAR
Total Apparent Power	kVA
Total Power Factor	
Battery Voltage	V
Controller RTC Battery Voltage	V
Voltage L1-L2	V
Voltage L2-L3	V
Voltage L3-L1	V
Voltage L1-N	V
Voltage L2-N	V
Voltage L3-N	V
Current L1	A or kA
Current L2	A or kA
Current L3	A or kA
Real Power L1	kW
Real Power L2	kW
Real Power L3	kW
Reactive Power L1	kVAR
Reactive Power L2	kVAR
Reactive Power L3	kVAR
Apparent Power L1	kVA
Apparent Power L2	kVA
Apparent Power L3	kVA
Voltage Phase Angle L1-L2	Degrees
Voltage Phase Angle L1-L3	Degrees
* For 500REOVZC, 550/600REOVZVB Models only.	

Figure 26 Generator Metering Data

### 3.2.2 Input Metering

Input status is displayed on the Metering, Electrical, Inputs screen.

The standard, dedicated inputs are listed in Section 1 Figure 8. An optional four-input, fifteen-output module is available. The optional module provides two additional analog inputs and four additional digital inputs.

A personal computer and Kohler SiteTech™ software are required to assign input functions to the inputs on the I/O modules. SiteTech is available to Kohler authorized distributors and dealers.

#### Procedure to View Input Status

1. In the navigation panel on the left side of the screen, touch Metering or the gauge symbol.
2. Touch Electrical or the sine wave symbol.
3. Touch Inputs or the i/o symbol with the bold i.
4. Touch the up and down arrows on the right side of the screen to view the inputs.

The numbers below correspond to the numbered steps in the Procedure to View Input and Output Status.

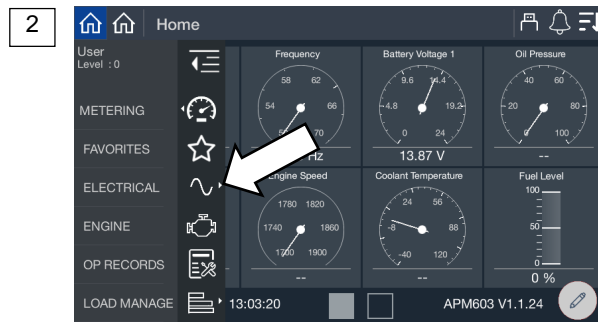
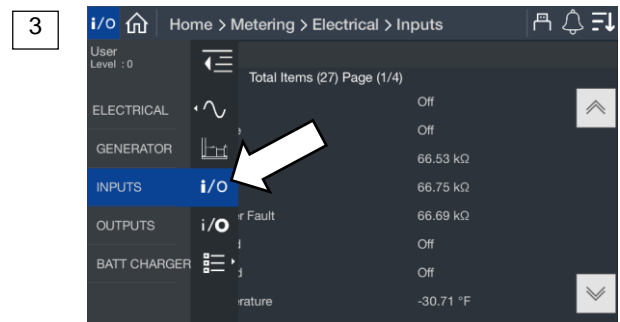


Figure 27 Inputs Metering Screen

<b>Parameter</b>	<b>Units</b>
E-Stop Local	On/Off
E-Stop Remote	On/Off
Aux Warning	True/False
Aux Fault	True/False
Battery Charger Fault	True/False
Breaker Closed	On/Off
Breaker Tripped	On/Off
Coolant Temperature	Degrees
Excitation Over Voltage	On/Off
Fuel Level	%
Fuel Leak Alarm	On/Off
Low Fuel Level Switch	True/False
Ground Fault Relay	On/Off
Key Switch Auto	On/Off
Key Switch Run	On/Off
Remote Start	On/Off
OFF Button	On/Off
RUN Button	On/Off
AUTO Button	On/Off
Speed Bias	V
Voltage Bias	V
Analog Input 1	
Analog Input 2	
Digital Input 1	On/Off
Digital Input 2	On/Off
Digital Input 3	On/Off
Digital Input 4	On/Off

Figure 28 Inputs Included in the Inputs Metering Screen

### 3.2.3 Output Metering

The Electrical Metering screen for outputs displays the status of the outputs.

The standard, dedicated outputs are listed in Section 1. An optional four-input, fifteen-output module is available. The I/O module provides 14 additional programmable outputs. Relay K15 is factory-set to common fault and is not adjustable.

A personal computer and Kohler SiteTech™ software are required to assign output functions to the programmable outputs on the I/O module. SiteTech is available to Kohler authorized distributors and dealers.

#### Procedure to View Output Status

1. In the navigation panel on the left side of the screen, touch Metering or the gauge symbol.
2. Touch Electrical or the sine wave symbol.
3. Touch outputs or the i/o symbol with the bold letter o.
4. Touch the up and down arrows on the right side of the screen to view the outputs.

The numbers below correspond to the numbered steps in the Procedure to View Output Status.

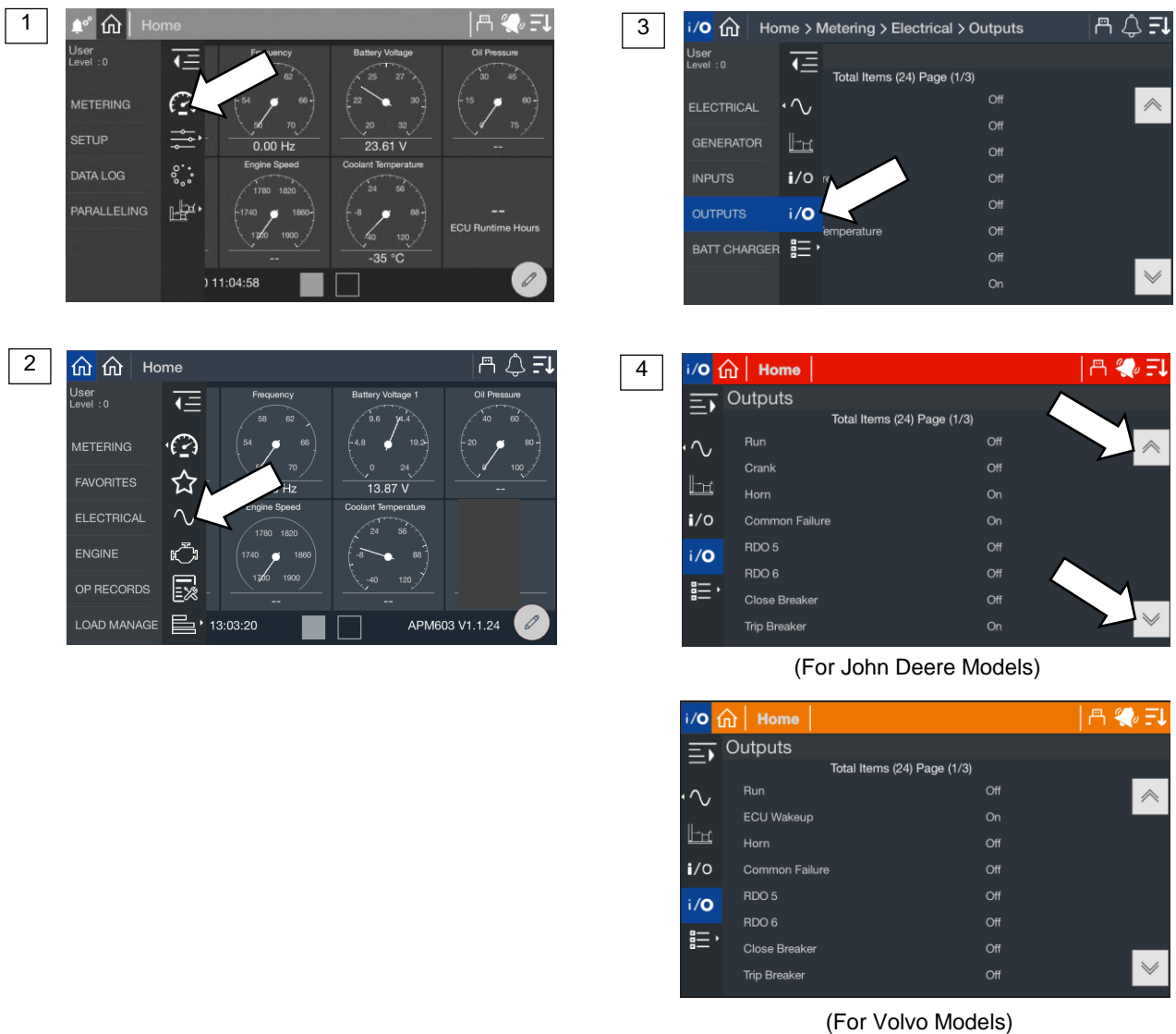


Figure 29 Outputs Metering Screen

Output		
Run		RDO1
Crank (For John Deere Units)		RDO2
ECU Wakeup (For Volvo Units)		
Horn		RDO3
Common Failure		RDO4
Reserved Output		RDO5
Reserved Output		RDO6
Close Breaker		RDO7
Trip Breaker		RDO8
Alternator Excitation	%	PWM
Common Fault		I/O Module
Relay K1		I/O Module
Relay K2		I/O Module
Relay K3		I/O Module
Relay K4		I/O Module
Relay K5		I/O Module
Relay K6		I/O Module
Relay K7		I/O Module
Relay K8		I/O Module
Relay K9		I/O Module
Relay K10		I/O Module
Relay K11		I/O Module
Relay K12		I/O Module
Relay K13		I/O Module
Relay K14		I/O Module

Figure 30 Outputs Displayed in the Outputs Metering Screen



### 3.2.4 Battery Charger

View the status for battery charger 1 and 2 as shown in Figure 31.

#### Procedure to View Battery Charger Status:

1. In the navigation menu on the left side of the screen, touch Metering or the gauge symbol.
2. Touch Electrical or the sine wave symbol.
3. Touch Battery Charger or the details symbol.
4. Touch Charger 1 or Charger 2 or the battery symbol for either.
5. View the battery charger status.

For instructions to change settings, refer to the Electrical, Battery Charger Section in the Setup Section of this manual.

#### Note:

The generator may have only one battery charger. If this is the case, Battery Charger 2 will show blank values.

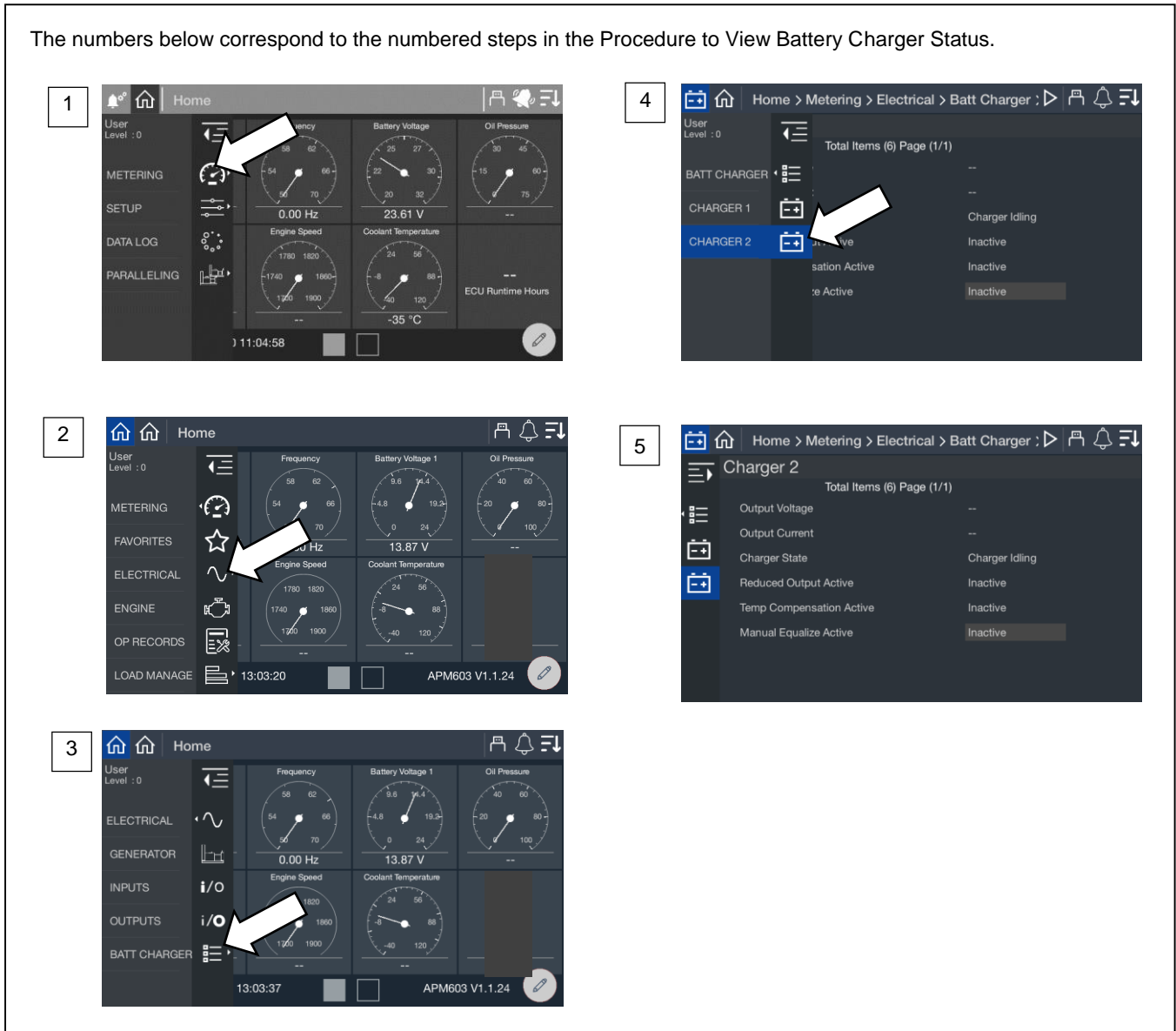


Figure 31 Battery Charger Metering Screens

The parameters listed in Figure 32 are available for each charger.

<b>Parameter</b>	<b>Units</b>
Output Voltage	V
Output Current	A
Charger State	
Reduced Output Active	Active/Inactive
Temp Compensation Active	Active/Inactive
Manual Equalize Active	Active/Inactive

Figure 32 Battery Charger Metering Parameters

### 3.3 Engine

The Engine Metering screen displays the engine data shown in Figure 34..

#### Procedure to View the Engine Metering Screen

1. In the navigation panel on the left side of the screen, touch Metering or the gauge symbol.
2. Touch Engine or the engine symbol.
3. Observe the engine data shown on the screen.

The numbers below correspond to the numbered steps in the Procedure to View the Engine Metering Screen.

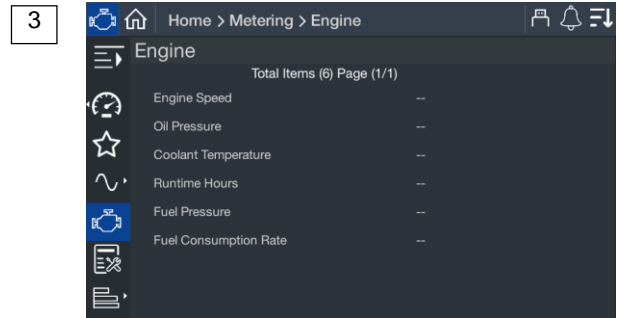
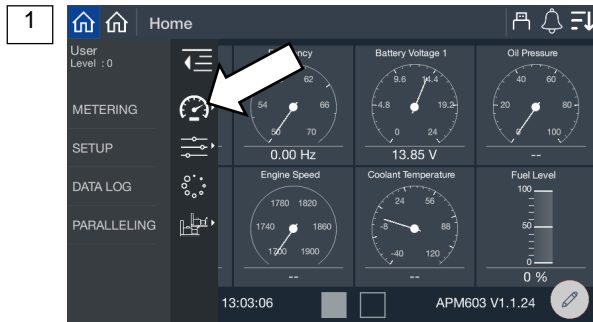


Figure 33 Metering, Engine

Item	Units
Engine Speed	RPM
Oil Pressure	PSI
Oil Temperature*	°F or °C
Coolant Temperature	°F or °C
Intercooler Temperature*	°F or °C
ECU Runtime Hours*	Hours
Ambient Temperature*	°F or °C
Barometric Pressure*	PSI or kPa
Air Intake Temperature*	°F or °C
Air Intake Pressure*	PSI or kPa
Intake Manifold Pressure*	PSI or kPa
Intake Manifold Temperature*	°F or °C
Runtime Hours	Hours
Fuel Pressure	PSI
Fuel Consumption Rate	Gallons/hour Liters/hour*
Mechanical Engine Load*	%
ECU Battery Voltage*	V
* For 500REOZVC, 550/600REOZVB Models only.	

Figure 34 Engine Metering Data

### 3.4 Operation Records

The Op Records screen displays generator set operation records such as engine run time, last start date, and other information shown in Figure 36.

To reset the maintenance records after performing scheduled oil changes and other maintenance tasks, log in as Technician. The password is required.

#### Procedure to View Operation Records

1. In the navigation panel on the left side of the screen, touch Metering or the gauge symbol.
2. Touch Op Records or the notepad symbol.
3. Touch the up and down arrows on the right side of the screen to scroll through the generator set operation records.

The numbers below correspond to the numbered steps in the Procedure to View Operation Records.



Figure 35 Metering Screen, Operation (Op) Records

<b>Parameter</b>	<b>Units</b>
Total Run Time Hours	Hours
Total Loaded Hours	Hours
Total Unloaded Hours	Hours
Total kW Hours	kWh, MWh
Controller Hours	Hours
Controller Run Time Hours	Hours
ECM Run Time Hours	Hours
Number of Starts	
Number of Crank Attempts	
Last Crank Duration	Seconds
Last Start Runtime Duration	Hours
Last Start Time of Day Hours	
Last Start Time of Day Minutes	
Last Start Date (Day)	
Last Start Date (Month)	
Last Start Date (Year)	
Last Stop Time of Day Hours	
Last Stop Time of Day Minutes	
Last Stop Date (Day)	
Last Stop Date (Month)	
Last Stop Date (Year)	
Total Run Time Since Maintenance	Hours
kW Hours Since Maintenance	kWh, MWh
Reset Maintenance Records	Yes/No *
* The Technician password is required to reset maintenance records.	

Figure 36 Operation Records

## 3.5 Load Management

Load management allows a generator set to support load which may occasionally exceed the rated capacity of the generator set.

**Note:**

Life safety and critical loads should never be connected to a device that is managed as a priority through load management. Load management should only be used on loads that can be turned on and off as required to allow the generator system to operate reliably for life safety and critical loads that are always connected.

In single-generator set applications, load management may shed unimportant but highly demanding loads when the generator set is overloaded, preventing a power outage caused by the generator set going offline.

In paralleling systems, load management permits the bus to stay at rated voltage and frequency while an additional generator set is synchronizing to it. It ensures the total load on the bus does not exceed the total capacity of the generators online at a given moment. Load management may shed lower priority loads in the event that a generator fails or the system is waiting for a generator to synchronize and close to the bus.

The load management function in the generator set controller supports up to 16 load control priorities. In a single-generator set application, the system will be limited to 14 load control priorities. In paralleling systems, the full 16 load control priorities can be used. These priorities generate internal notices for the add and shed conditions. The internal notices are generated any time a load is add or shed, but they will only operate a load control relay if they are configured to a digital output.

The optional 4 input / 15 output relay module is required, providing up to 14 RDO outputs to be accessed and configured to control up to 14 loads (each load priority can interrupt several devices) from a single generator. In paralleling applications, up to 16 load priorities can be accessed and the load priorities can be divided among all of the generator sets. For instance, Generator #1 can support Load Priorities 1 and 4, Generator #2 can support Priorities 2 and 5 and Generator #3 can support Priorities 3 and 6. This configuration requires the optional relay module on each generator and permits partial load control functionality even if one controller is powered down or fails (redundancy).

Load Priority 1 is shed last and added first. The priorities are added in increasing sequence and shed in decreasing sequence.

All load priorities are immediately shed when load control is initiated. Load control is initiated when the system receives a start signal (a system start, a remote start, or a start by communication). In a paralleling application, the controller can receive a start signal from any generator set which is connected to the PGEN communication network. Pressing RUN on the controller will not cause the loads to shed.

All loads are added immediately when load control is de-activated. Load control is de-activated when the start signal is removed.

Load management adds loads based on the capacity of the system—loads will add more quickly if the available capacity is higher.

Load management sheds loads based on the degree of overload of the system—loads will shed more quickly as the degree of the system overload increases.

**Note:**

If paralleling and using generator management, the Generator Management Start Percentage setting should be significantly lower than the Overload Shed Threshold so that additional generator sets will come online before a load is shed. Go to the Gen Management group in SiteTech to adjust the Generator Management Start Percentage setting. The Overload Shed Threshold can be adjusted at Metering>Load Manage>Status>System. See the Load Management Setup Section for more information.

An under frequency event or overload event will also shed load. If a load priority is shed due to one of these events, the load management system can be configured to leave the priorities as shed until a related event occurs to allow them to be add back. This prevents the system from entering a shed and add cycle. For example, if the load is shed due to overload and removing the load removes the overload condition, if the load is added back it could cause the overload condition again and shed the load again.

The load control will shed subsequent loads more quickly if shedding a load did not remove the overload or underfrequency condition.

In a single-generator set application the load management logic uses the generator metering.

In a paralleling application the load management logic uses the bus metering. The priorities are set as a system so the load management settings are identical in each controller and each controller will shed and add a given load priority at the same time.

In a paralleling application where Generator Management is used, some generator sets may be shut down (turned Off) by the Generator Management. Even if the generator set is Off, it will manage load priorities as part of the system, performing a load add and load shed as needed. This may seem contrary to intuition, but the generator sets are acting as a system. If voltage and frequency of the paralleling bus are adequate, and Load Add accumulators are met, the loads will be enabled, even if a particular generator set is shut down by the Generator Management.

### 3.5.1 Metering, Load Management Overview Screen

The overview provides a simple graphical view of the load management system.

#### Procedure to View Load Management Overview

1. In the navigation panel on the left side, touch Metering or the gauge symbol.
2. Touch Load Manage or the three horizontal bars symbol.
3. Touch Overview or the globe symbol.
4. Observe the load management status.

The numbers below correspond to the numbered steps in the Procedure to View Load Management Overview.



Figure 37 Metering Screens, Load Management Overview

The loads are listed in order of priority. If the loads were provided a custom name during the system set up, the name will appear. If not, the name will appear as Priority X, where X is the priority number.

**Note:**

Custom names for loads can be set up through SiteTech™. Contact a Kohler authorized distributor or dealer.



If a load is in the process of being add or shed, the load will have an indication of % until that occurs. It is shown as a percentage since the time varies based on the capacity available. When the % reached 100%, the load management will initiate the add or shed.

The key at the bottom of the display shows the current load as well as the total online capacity and available capacity. If a generator is offline (either due to a shutdown via Generator Management or a fault or the generator is not communicating via PGEN), unavailable capacity will be shown as well.

**Total Load** is the value of all the loads on the system. This includes loads that are not assigned a priority and are always connected.

**Online Capacity** is the capability of the system with all the generators that are currently online. For a single-generator set application, this is the total capacity of the generator. For a paralleling system, this is the sum of capacity for all online generators.

**Available Capacity** indicates the difference between the Online Capacity and the Total Load. It is remaining capacity available for additional loads to be potentially added.

### 3.5.2 Metering, Load Management, Status

The status screens provide a listing of the load management metered values as well as key settings for reference.

#### 3.5.2.1 Status, System

The Load Management System Status provides indication of key settings and values related to the overall operation of the load management system.

#### Procedure to View Load Management System Status

1. In the navigation panel on the left side, touch Metering or the gauge symbol.
2. Touch Load Manage or the three horizontal bars symbol.
3. Touch Status or the list icon.
4. Touch System or the list icon.

The numbers below correspond to the numbered steps in the Procedure to View Load Management System Status.



Figure 38 Metering, Load Management, Status, System

Parameter	Units
Load Management Enabled	Yes/No
Total Load	kW
Online Capacity	kW
Available Capacity	kW
Total Bus Capacity	kW
Generators Online	
Generators Failed	
Next Priority to Shed	
Time Based Load Add Enabled	Yes/No
Time Based Add Time	Seconds
Time Based Load Add Timer Active	Yes/No
kW Capacity Add Threshold	%
kW Capacity Add Accumulator	%
Require Reset After kW Shed	Yes/No
Overload Shed Threshold	%
Overload Shed Accumulator	%
Under Frequency Shed Threshold	%
Under Frequency Shed Accumulator	%
Require Reset After UF Shed	Yes/No
Under Frequency Inhibit Enabled	Yes/No
Under Frequency Inhibit Time	Seconds
Under Frequency Inhibit Time Remaining	Seconds
New Gen Online As Reset	Yes/No
Stage Loads After Utility Return	Yes/No

Figure 39 Load Management System Status Parameters

**Load Management Enabled** indicates a Yes if the load management system is being used on the generator or paralleling system. If No, load management is not being used and will not drive any of the outputs.

**Total Load** indicates the value of all the loads on the system. This includes loads that are not assigned a priority and are always connected.

**Online Capacity** indicates the capability of the system with all the generators that are currently online. For a single-generator set application, this is the total capacity of the generator. For a paralleling system, this is the sum of capacity for all online generators.

**Available Capacity** indicates the difference between the Online Capacity and the Total Load. It is remaining capacity available for additional loads to be potentially added.

**Generators Online** indicates the number of generators online. For a single-generator set application, this will be 1. For paralleling systems, it will be the total number of generators that are on the closed to the bus.

**Generators Failed** indicates in a paralleling system if any of the generators on PGEN are in a shutdown (fault) condition. Note that as long as the controller is still communicating on PGEN, load management can control the outputs on the controller for a generator this is in a shutdown condition. For a single-generator set application this will be 0.

**Next Priority to Shed** indicates the priority number of the next load that will be shed should the system enter a condition that requires a load shed.

**Time Based Load Add Enabled** indicates if the Time Based Load Add functionality is enabled. This function will add the loads in the priority order based on time once the system has reached an acceptable voltage and frequency. This technique does not consider load capacity or expected kW for each priority. The loads are staged sequentially at a time interval defined by the Time Based Load Add Time. For example, if the Time Based Load Add Time is set to 10 seconds, once the system reaches an acceptable voltage and frequency, a 10 seconds timer will start. When that time expires, Priority 1 will be added. The 10 second timer will start again and Priority 2 will be added when it expires. This will continue until all priorities are added.

**Note:**

Time Based Load Add does not consider the capacity of the generator set or generator system or the expected load of each priority before adding and may overload the system. If an under frequency or overload shed becomes active, Time Based Load Add will abort and not add any additional loads.

Time Based Load Add sheds all priorities at startup. It is not configurable to shed fewer loads.

**Time Based Load Add Time** is the amount of time between each load priority addition when using Time Based Load Add.

**Time Based Load Add Timer Active** indicates if a timer is currently in use and the system is preparing to add a load when the timer expires. If this is Yes, the system will add a load when it expires. If this is No, no additional loads will be added based on Time Based Load Add.

**kW Capacity Add Threshold** sets the maximum total load that the load management system will intentionally add to the generator set or generator system. To determine whether adding the next priority load will push the system over the threshold, the resulting total is calculated by adding the expected load to the current load. For example, if the threshold is set at 90%, the current load is at 70% of total capacity, and adding the next priority load will add 15% of total capacity, adding the load will put the system at 85% of total capacity, which is below the threshold. The kW Capacity Add Accumulator will start. If adding the load would put the system at 92% capacity, the load will not be added.

The total load may exceed the kW Capacity Add Threshold value if the power required by a load is higher than the expected kW.

**kW Capacity Add Accumulator** indicates progress until the next priority load will be added. The timer starts if adding the next priority load will not exceed the kW Capacity Add Threshold for the system. Load management will add the next priority load when the kW Capacity Add Accumulator reaches 100%.

The kW Capacity Add Accumulator is a weighted timer. The Accumulator will speed up or slow down depending upon the available capacity and the expected kW. The time required will increase as the calculated total load increases and will decrease as the calculated total load decreases.

**Require Reset After kW Shed** forces the system to lock out adding loads if an overload shed occurs. The overload shed is not expected to operate, so an overload condition is an indication of a misconfiguration of the system (such as an incorrect expected kW load level for a priority). Requiring a reset prevents load cycling due to a misconfiguration. See New Gen Online As Reset.

**Overload Shed Threshold** is an indication of the amount of overload a system can experience before load shed initiates. For example, if this is set to 100%, if the total load exceeds 100% then the Overload Shed Accumulator starts. Load management will shed the next priority load when the Overload Shed Accumulator reaches 100%.

**Overload Shed Accumulator** is an indication of progress until the load will be shed due to an overload situation.

The time to shed a priority will increase as the overload condition increases and will decrease as the overload condition decreases. The Accumulator is not a fixed time but will speed up or slow down depending upon the overload.

**Under Frequency Shed Threshold** is the frequency droop (operation below nominal) allowed before the system will shed a load. For example, if this is set to 90% and the frequency of the generator drops below 90% of nominal then the Under Frequency Shed Accumulator starts. When the Under Frequency Shed Accumulator reaches 100%, load management will shed the next priority load.

**Under Frequency Shed Accumulator** is an indication of progress until the load will be shed due to an under frequency situation.

The time to shed a priority will increase as the under frequency condition increases and will decrease as the under frequency condition decreases. The Accumulator is not a fixed time but will speed up or slow down depending upon the amount exceeding the under frequency threshold.

**Require Reset After UF Shed** forces the system to lock out adding loads if an under frequency shed occurs. The under frequency shed is not expected to operate, so an under frequency condition is an indication of a misconfiguration of the system (such as an incorrect expected kW load level for a priority). Requiring a reset prevents load cycling due to a misconfiguration. See New Gen Online as Reset.

**Under Frequency Inhibit Enabled** indicates if the load management system will ignore any under frequency conditions for a period of time as the generator is starting up. This allows the system to reach the rated voltage and frequency before the under frequency shed is detected and forces a load shed.

**Note:**

This setting is only necessary on applications where some of the load priorities are not shed on start up.

**Under Frequency Inhibit Time** is the period of time during start up when an under frequency condition is ignored. This is only applicable if the Under Frequency Inhibit is enabled.

**Under Frequency Inhibit Time Remaining** indicates the amount of time left before the under frequency shed logic will begin operating.

**New Gen Online as Reset** allows the load management to see an additional generator connecting the paralleling bus as a reset condition. If a load was shed based on an overload shed or under frequency shed, the load will now be considered for addition again if the kW Capacity threshold is met.

**Stage Loads After Utility Return** reduces the inrush loading to the utility when returning loads after a power failure. This is used to reduce fluctuations in the utility voltage during a transition from the generator system to the utility when the utility source impedance is relatively high. The loads are added based on Time Based Add Time settings.

**3.5.2.2 Load Management Status, Load**

The Load Management Status Load screen provides indication of the shed status for each load priority.

**Procedure to View Load Management Status, Load**

1. In the navigation panel on the left side, touch Metering or the gauge symbol.
2. Touch Load Manage or the three horizontal bars symbol.
3. Touch Status or the list icon.
4. Touch Load or the horizontal bars icon.

The numbers below correspond to the numbered steps in the Procedure to View Load Management Status, Load.

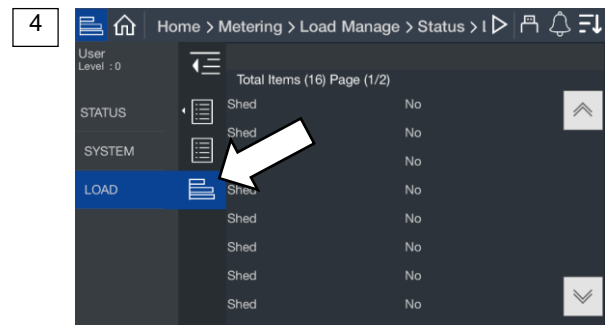
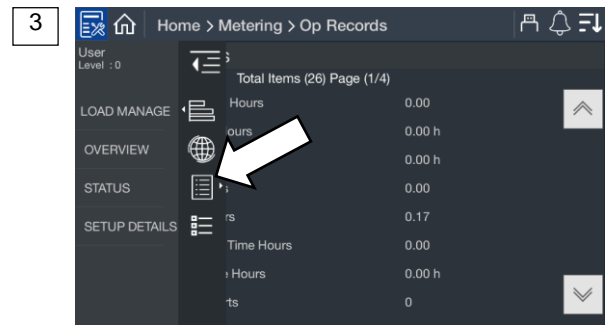


Figure 40 Load Management Status, Load

<b>Parameter</b>	<b>Units</b>
Priority 1 Load Shed	Yes/No
Priority 2 Load Shed	Yes/No
Priority 3 Load Shed	Yes/No
Priority 4 Load Shed	Yes/No
Priority 5 Load Shed	Yes/No
Priority 6 Load Shed	Yes/No
Priority 7 Load Shed	Yes/No
Priority 8 Load Shed	Yes/No
Priority 9 Load Shed	Yes/No
Priority 10 Load Shed	Yes/No
Priority 11 Load Shed	Yes/No
Priority 12 Load Shed	Yes/No
Priority 13 Load Shed	Yes/No
Priority 14 Load Shed	Yes/No
Priority 15 Load Shed	Yes/No
Priority 16 Load Shed	Yes/No

Figure 41 Load Shed Status Parameters

A Yes indicates the load is currently shed due to load management. A No indicates that load management is not requiring the load to be shed. If load management indicates No and the load is not powered, there are other issues in the system.

### 3.5.3 Load Management Setup Details

The setup details screen provides a table view of key settings for the load management configuration.

#### Procedure to View Load Management Setup Details

1. In the navigation panel on the left side, touch Metering or the gauge symbol.
2. Touch Load Manage or the three horizontal bars symbol.
3. Touch Setup Details or the details symbol.

The numbers below correspond to the numbered steps in the Procedure to View Load Management Setup Details.



Figure 42 Metering, Load Management, Setup Details

The loads are listed in order of priority. If the loads were provided a custom name during the system set up, the name will appear. If not, the name will appear as Priority X, where X is the priority number.

**Note:**

Custom names for loads can be set up through SiteTech. Contact a Kohler authorized distributor or dealer.

The table indicates the expected kW for each load.



### 4.1 Setup Menus

Parameter settings are loaded onto the controller using a configuration file. Configuration files are created and loaded at the factory. Configuration files are created according to the model and options ordered for each generator set. Custom configuration files can be provided on request if the default settings are not correct for the application.

The values displayed in the Setup Menus are parameter settings. They are not actual measured values. Refer to the Metering Displays for measured values.

The Setup Menus display the controller configuration settings as shown in the following sections. Some of the settings can be adjusted by an operator, installer, or service technician with Operator access or higher.

The setup screens include:

- Electrical, including generator, battery charger, and paralleling
- Engine
- Communication
- Event Configuration
- Genset Info

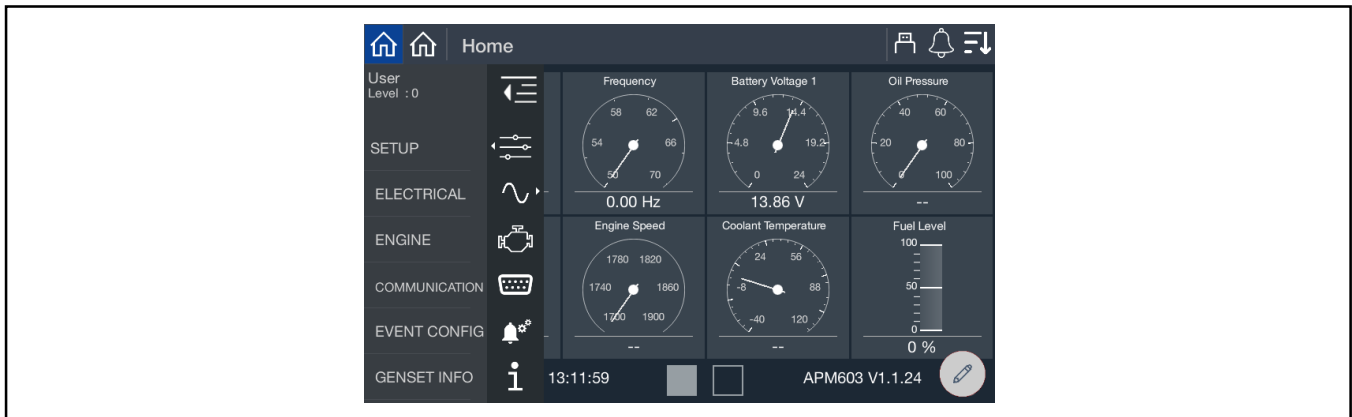


Figure 43 Setup Menu

#### 4.1.1 Changing Settings

Some settings can be changed by an operator or service technician with Operator access or higher.

**Note:**

Have setup and adjustments of the generator set controller performed only by an authorized Kohler distributor. The setup and adjustments are password protected.

#### General Procedure to Change Settings

1. Go to Controller Settings and log in with the Operator level password. See the Controller Settings section for instructions.

**Note:**

The access level login expires after 1 hour. See the Controller Settings Section for instructions to change the session duration, if necessary.

2. In the navigation menu on the left side of the screen, touch Setup.
3. Touch the desired category (Generator, Communication, etc.)
4. Touch the desired subcategory.
5. The settings are displayed. Settings that can be changed appear in a blue box.
6. Touch the blue box with the setting that you wish to change. A keypad window opens on the screen.
7. Use the keypad to enter the new setting and touch the green arrow.
8. Check the setting for the new value.



## 4.2 Electrical Setup

### 4.2.1 Generator Electrical Setup

The generator setup screens display generator electrical settings such as system voltage, frequency, kW ratings, and other electrical data listed in Figure 45.

#### Procedure to View Generator Setup Parameters

1. In the navigation menu on the left side of the screen, touch Setup or the settings symbol.
2. Touch Electrical or the sine wave symbol.
3. Touch Generator or the generator symbol.

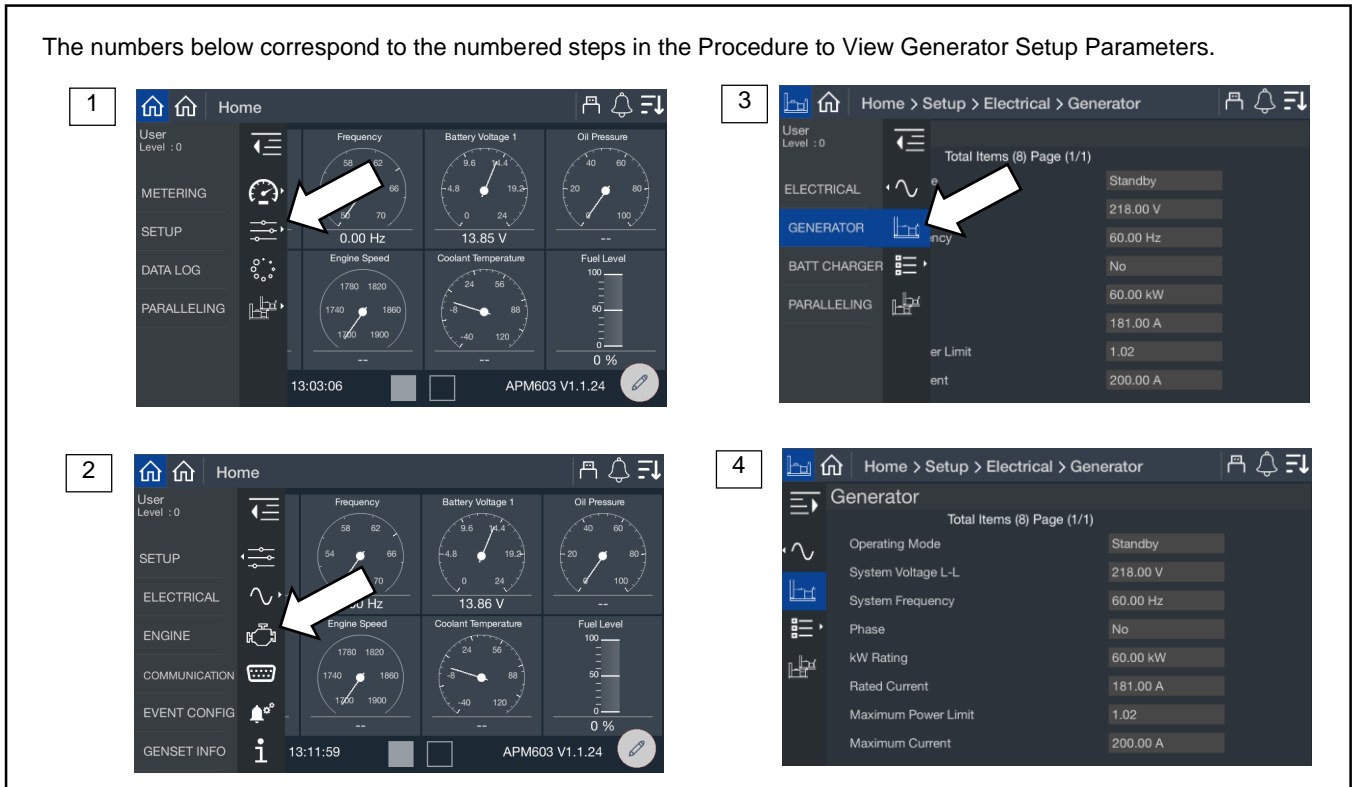


Figure 44 Generator Setup Screen

Parameter	Units	Write Access	Notes
Operating Mode	Standby/Prime	N/A	Factory configured
System Voltage L-L	V	Technician	
System Frequency	Hz	Technician	
Phase	Single or Three	Technician	
kW Rating	kW	Technician	
Rated Current	A	Technician	
Maximum Power Limit	kW	N/A	102% of Standby Rating, 112% of Prime Rating
Maximum Current	A	N/A	Factory configured

Figure 45 Generator Settings, Electrical Setup

## 4.2.2 Battery Charger Setup

View the settings for one or two battery chargers as shown in Figure 47.

### Procedure to View Battery Charger Setup Parameters

1. In the navigation menu on the left side of the screen, touch Setup or the settings symbol.
2. Touch Electrical or the sine wave symbol.
3. Touch Battery Charger or the details symbol.
4. Touch Charger 1 or Charger 2 or the battery symbol for either.

The numbers below correspond to the numbered steps in the Procedure to View Battery Charger Setup Parameters.



Figure 46 Battery Charger Setup Screen

Parameter	Units
Battery Topology	Default, VRLA, AGM, Gel, Ni Cd
System Voltage	V
Custom Charging Profile Enabled	Yes/No
Bulk Voltage	V
Maximum Bulk Time	Minutes
Absorption Voltage	V
Maximum Absorption Time	Minutes
Float Voltage	V
Equalize Voltage	V
Bulk State Return Voltage	V
Automatic Equalize Enabled	Yes/No
Absorption Termination	A
Temp Compensation Enabled	Yes/No
Temp Compensation Slope	mV/°C

Figure 47 Battery Charger Setup Parameters, Electrical Setup

### 4.2.3 Paralleling Setup

The paralleling setup screen indicates if the system has onboard paralleling enabled and if the speed and voltage bias inputs are configured.

**Note:**

The Paralleling menu will appear on the Home screen if Paralleling Enabled is set to Yes in this menu.

**Procedure to View Paralleling Setup Parameters**

1. In the navigation menu on the left side of the screen, touch Setup or the settings symbol.
2. Touch Electrical or the sine wave symbol.
3. Touch Paralleling or the two generator symbol.
4. Observe the paralleling parameters.

The numbers below correspond to the numbered steps in the Procedure to View Paralleling Setup Parameters.

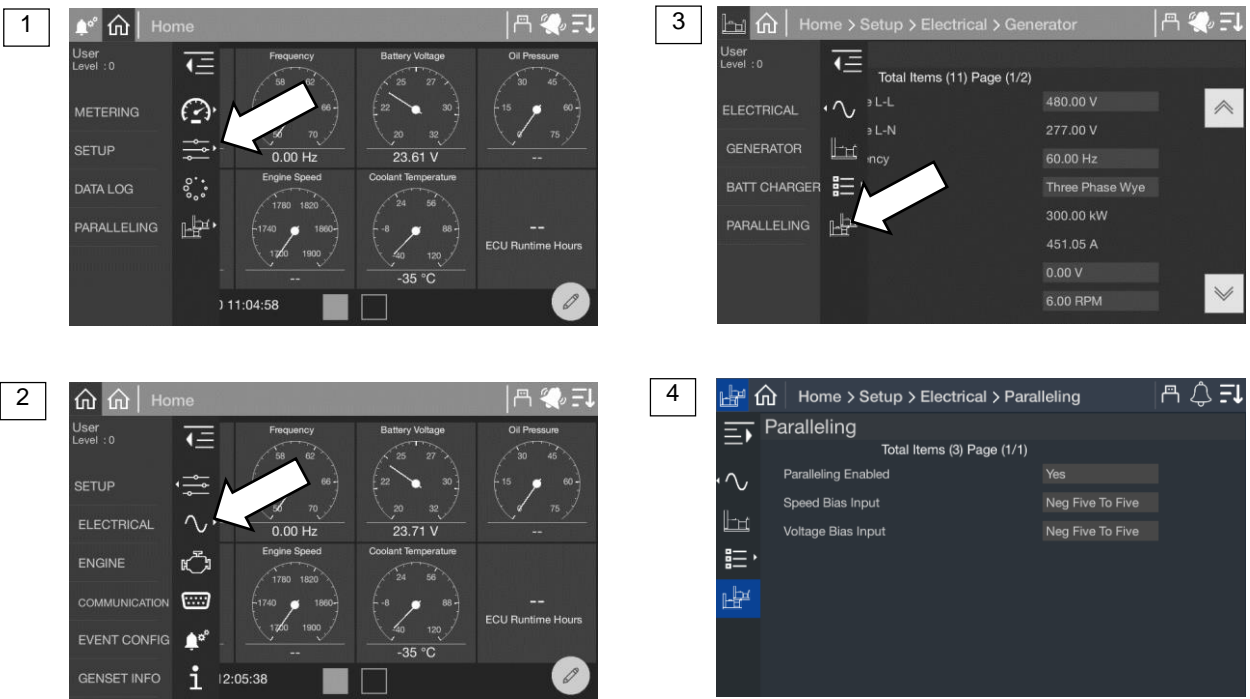


Figure 48 Paralleling Setup Screen

Parameter	Units	Write Access Level
Paralleling Enabled	Yes/No	Technician
Speed Bias Input	Off	Operator
Voltage Bias Input	0 to 5 Neg (-) 5 to 5 0 to 10 Neg (-)10 to 10	Operator

Figure 49 Paralleling Setup Parameters, Electrical Setup

## 4.3 Engine Setup

The Engine Setup screen includes the engine settings shown below.

### Procedure to View Engine Settings

1. In the navigation panel on the left side of the screen, touch Setup or the setup symbol.
2. Touch Engine or the engine symbol.
3. Touch the arrows to scroll through the screens.

The numbers below correspond to the numbered steps in the Procedure to View Engine Settings.



Figure 50 Setup Screen, Engine

Parameter	Units	Write Access Level
ECU Power Override	On/Off	Operator
Generator Rated Speed	RPM	N/A
Crank Disconnect Speed	RPM	N/A
Start Aid Time	Seconds	Technician
Cranking Start Aid Time	Seconds	Technician
Crank On Time	Seconds	Technician
Crank Off Time	Seconds	Technician
Crank Cycle Limit	Integer	Technician
Cooldown Time Limit	Seconds	Technician
Cooldown Temp Limit	Degrees (F)	Technician

Figure 51 Engine Setup Parameters

**ECU Power Override** provides power to the engine's ECU without cranking the engine. This feature may be turned on for some troubleshooting or service procedures; otherwise, it should be off.

**Engine Speed** displays the target engine speed. Typically, this is 1800 RPM but may be adjusted if the system is required to operate at a slightly modified speed.

**Crank Turning Speed** is the limit between engine rotating and engine stopped. When the engine speed (RPM) is above this limit, the controller considers the engine to be turning. Until the speed falls below this limit, the controller will prevent reengagement of the starter.

**Start Aid Time** displays the time programmed to allow the engine starting aid to warm up before cranking the engine.

**Cranking Start Aid Time** indicates the time programmed to allow operation of a preheat or ether system during the engine crank cycle.

**Crank On Time** indicates the time allocated for generator set crank in seconds, from 10 to 30 seconds.

**Crank Off Time** indicates the time allocated for generator crank pause in seconds, from 1 to 60 seconds.

**Crank Cycle Limit** indicates the allowed number of crank attempts before the system indicates that crank failed, from 1 to 6 cycles.

**Cooldown Time Limit** indicates the amount of time allocated for the engine cooldown period.

**Cooldown Temp Limit** indicates the required temperature the engine must reach during cooldown before the engine will shut off.

**Note:**

When the engine is signaled to stop, it will continue to run through the cooldown cycle unless the unit is OFF or a shutdown fault occurs. In a paralleling application, if a shutdown occurs the generator will still perform a cool down for a period of time defined by Trip to Shutdown Delay in Protective Relay functions.

The cool down will run until the engine reaches the cooldown temperature limit or the cooldown time expires, whichever happens first. If you want to skip a cool down, set the Time Limit to 0. To force the unit to run the full Time Limit every time, set the Temp Limit to an extremely low number that cannot possibly be achieved before the Time Limit expires.

## 4.4 Setup, Communication Screen

The communication setup screen provides a list of Modbus and network communication settings.

### Procedure to view Communication Setup:

1. In the navigation panel on the left side, touch Setup or the settings symbol.
2. Touch Communication or the serial connector symbol.
3. Touch the arrows on the right to scroll through the communication settings.

The numbers below correspond to the numbered steps in the Procedure to View Communications Setup.

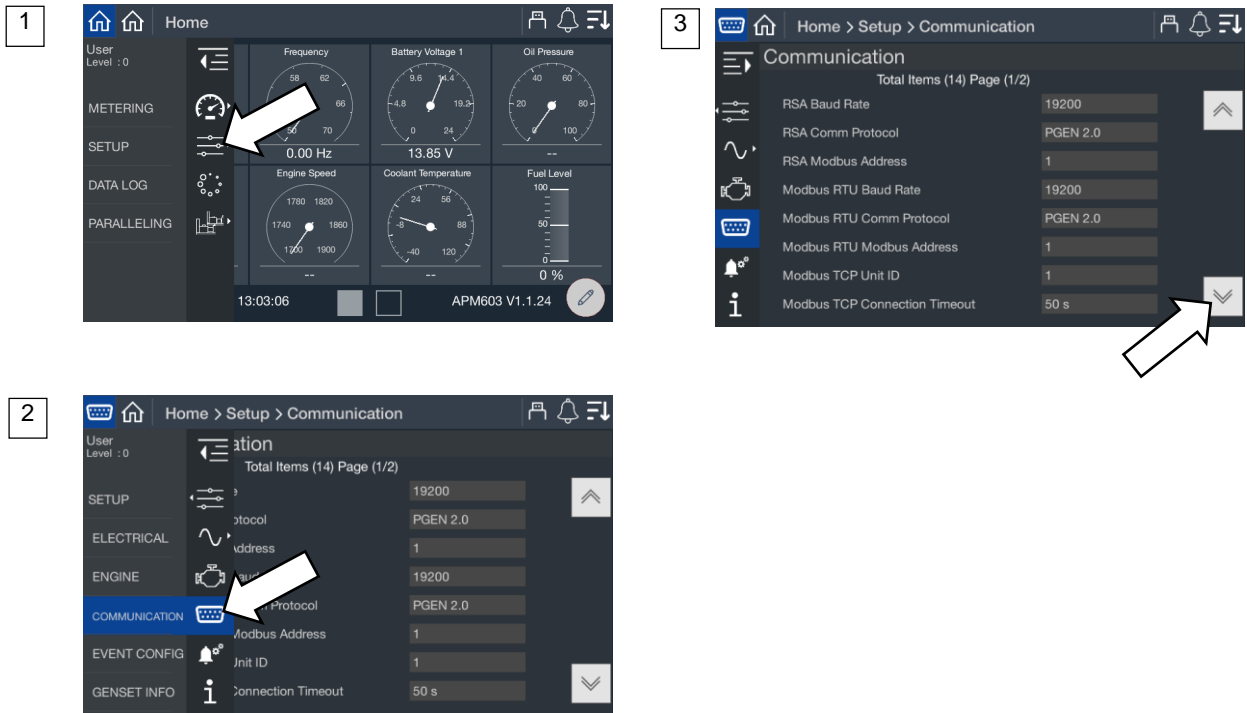


Figure 52 Setup, Communication, Modbus

The following Modbus interfaces are available:

Connection	Description	Customer Connection Terminals
RS-485 isolated	Dedicated connection for paralleling (PGEN)	TB12-8, 9, 10
RS-485 isolated	For connection to Modbus devices	TB12-19, 20, 21
RS-485 non-isolated	For connection to the RSA III remote serial annunciator	TB12-22, 23, 24
RJ-45 Ethernet connection	For Modbus TCP, SNMP, and BACnet®	Ethernet module

BACnet® is a registered trademark of ASHRAE.

The communication protocol for each port is factory set and not adjustable. Operator-level access is required to change the other communication settings. Contact a Kohler authorized distributor or dealer for assistance.

### Communication Protocol

The RS-485 ports are factory-set for the communication protocol applicable to each port.

## Baud Rates

The following baud rates can be selected. All devices in the Modbus network must use the same baud rate.

- None
- 9600 bps
- 19200bps
- 38400 bps
- 57600 bps
- 115200 bps

## Modbus Address

Each generator set controller in a system must have a unique Modbus® address.

## Modbus TCP Unit ID

A unit ID is required for Modbus over TCP communication (Ethernet). The unit ID for TCP communication is analogous to the Modbus address for serial communication.

Parameter	Write Access Level
RSA Baud Rate	Operator
RSA Comm Protocol	Factory-set
RSA Modbus Address	Operator
Modbus RTU Baud Rate	Operator
Modbus RTU Comm Protocol	Factory-set
Modbus RTU Modbus Address	Operator
Modbus TCP Unit ID	Operator
DHCP Enabled	Operator
IP Address	Operator
Subnet Mask	Operator
Default Gateway	Operator
DNS Server 1	Operator
DNS Server 2	Operator
Modbus TCP Connection Timeout	Operator

Figure 53 Communication Settings

## Modbus® Communications

The controller communicates using Modbus® as a slave connection with the Modbus® master initiating the communication. The controller seeks the parameters and diagnostic information then responds back to the Modbus® master. In addition, the controller accepts information to alter controller parameters including generator set starting and stopping. Refer to the List of Related Materials for available Modbus® literature.

### Note:

Only one Modbus® master can be connected to the controller when using Modbus RTU. Examples include the remote serial annunciator, monitoring software, and switchgear applications.

Modbus® is a registered trademark of Schneider Electric USA, Inc.

## 4.5 Event Configuration

The Event Configuration (Config) screen displays the setup of fault messages (warnings and shutdowns). Time delays, warning limits, and shutdown limits for the faults are shown.

### Procedure to View Event Configuration

1. In the navigation panel on the left, touch Setup.
2. Touch Event Config or the bell symbol with gears.
3. Touch the up and down arrows on the right to scroll through the event settings.

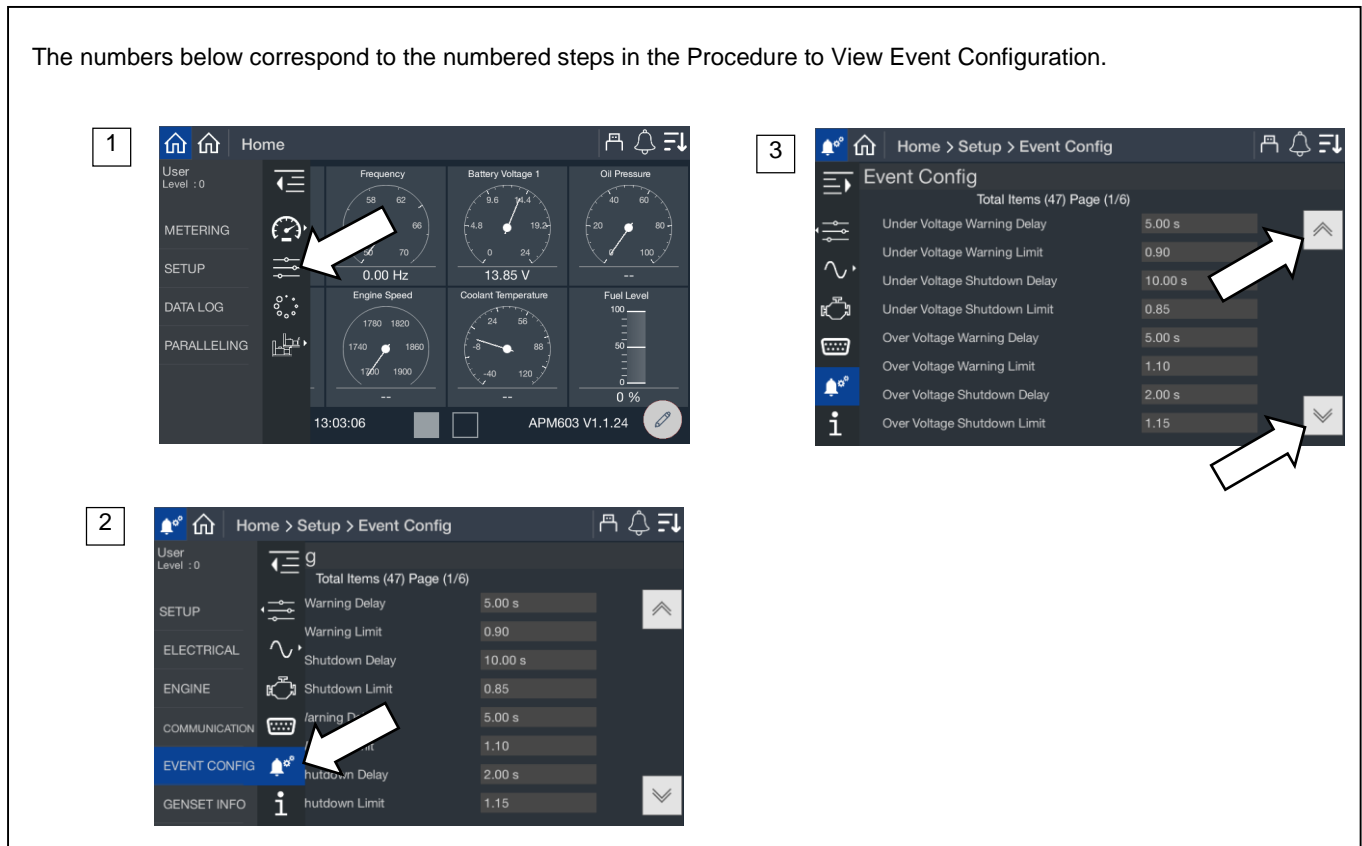


Figure 54 Setup, Event Config



<b>Event</b>	<b>Units</b>	<b>Write Access</b>
Under Voltage Warning Delay	Seconds	Technician
Under Voltage Warning Limit	per unit	Technician
Under Voltage Shutdown Delay	Seconds	Technician
Under Voltage Shutdown Limit	per unit	Technician
Over Voltage Warning Delay	Seconds	Technician
Over Voltage Warning Limit	per unit	Technician
Over Voltage Shutdown Delay	Seconds	Technician
Over Voltage Shutdown Limit	per unit	Technician
Under Frequency Warning Delay	Seconds	Technician
Under Frequency Warning Limit	per unit	Technician
Under Frequency Shutdown Delay	Seconds	Technician
Under Frequency Shutdown Limit	per unit	Technician
Over Frequency Warning Delay	Seconds	Technician
Over Frequency Warning Limit	per unit	Technician
Over Frequency Shutdown Delay	Seconds	Technician
Over Frequency Shutdown Limit	per unit	Technician
Over Power Warning Delay	Seconds	Technician
Over Power Warning Limit	per unit	Technician
Over Power Shutdown Delay	Seconds	Technician
Over Power Shutdown Limit	per unit	Technician
Over Current Warning Delay	Seconds	Technician
Over Current Warning Limit	per unit	Technician
Over Current Shutdown Delay	Seconds	Technician
Over Current Shutdown Limit	per unit	Technician
AC Signal Recovery Time	Seconds	Technician
Over Speed Shutdown Delay	Seconds	Technician
Over Speed Shutdown Limit	per unit	Technician
Low Battery Voltage Warning Delay	Seconds	Technician
Low Battery Voltage Warning Limit	per unit	Technician
High Battery Voltage Warning Delay	Seconds	Technician
High Battery Voltage Warning Limit	per unit	Technician
Weak Cranking Battery Delay	Seconds	Technician
Weak Cranking Battery Limit	per unit	Technician
Battery Voltage Event Recovery Delay	Seconds	Technician
Low RTC Battery Delay	Seconds	Technician
Low RTC Battery Limit	per unit	Technician
EPS Supplying Load Delay	Seconds	Technician
EPS Supplying Load On Limit		Technician
EPS Supplying Load Off Limit		Technician
Low Fuel Level Warning Limit	%	Technician

Critically Low Fuel Level Warning Limit	%	Technician
Low Fuel Level Shutdown Limit		Technician
High Fuel Level Warning Limit	%	Technician
Fuel Level Delay	Seconds	Technician
Maximum Power Warning Delay	Seconds	Technician
Battery Charger 1 Fault		Technician
Battery Charger 2 Fault		Technician

Figure 55 Status and Event Configuration

**Note:**

In Figure 55, per unit indicates a value relative to nominal. For example, a limit of 0.9 for the Under Voltage Warning means the limit is the nominal voltage times 0.9. For a 480 volt system, this is  $480 \times 0.9 = 432$  Volts.

The delay for each event indicates how long the condition must be present to trigger the event. The limit on each event indicates the condition that triggers the time delay to begin. If the condition corrects itself before the time delay expires, no event is indicated and the timer resets. If the condition reappears, the timer starts over.

**Under Voltage** displays the percentage of the system voltage that the generator set must drop below for an undervoltage condition to be indicated.

**Over Voltage** displays the percentage of the system voltage that the generator set must exceed before an overvoltage condition be indicated.

**Under Frequency** displays the percentage of the system frequency that the generator set frequency must drop below for an under frequency condition to be indicated.

**Over Frequency** displays the percentage of the system frequency that the generator set frequency must exceed before an over frequency condition be indicated.

**Over Power** indicates the percentage of the system rated power that the generator set must exceed before an over power condition be indicated.

**Over Current** indicates the percentage of the system rated current that the generator set must exceed before an over current condition be indicated.

**AC Signal Recovery Time** is the amount of time allowed for AC signal to be lost before an AC Loss is indicated.

**Over Speed** is the engine speed that the engine must exceed for an overspeed condition to be indicated.

**Low Battery Voltage** displays the system battery voltage that the battery must drop below for a low battery voltage condition to be indicated.

**High Battery Voltage** displays the system battery voltage that the battery must exceed for a high battery voltage condition to be indicated.

**Weak Cranking Battery** displays the system battery voltage that the battery must drop below during engine crank for a weak cranking battery condition to be indicated.

**Battery Voltage Event Recovery Delay** indicates the amount of time allowed for the battery voltage to recover from a fault. The controller uses this delay to recognize the voltage as fully recovered and to prevent multiple warnings due to oscillating or fluctuating battery voltage.

**Low RTC Battery** indicates the Real Time Clock battery voltage that the voltage must drop below for a low RTC battery condition to be indicated.

**EPS Supplying Load On Limit and Off Limit** define the % of load the generator must be supplying to be considered supplying load.

**Low Fuel Level** and **Critically Low Fuel Level** define the fuel level limits as a percentage that must be met before indication is provided.

**High Fuel Level** indicates the fuel level limit to be exceeded before indication is provided.

**Battery Charger Fault** indicates if a fault is detected by the battery charger.

### 4.5.1 Generator Set Information (Genset Info)

The genset info screen displays information about the generator set, including the model and serial number, and engine and alternator information. The generator set information is loaded at the factory or read from the engine ECM. The genset info information cannot be changed in the field.

#### Procedure to View Generator Set Information

1. In the navigation menu on the left side of the screen, touch Setup.
2. Touch Genset Info or the **i** symbol.
3. Observe the generator set serial number and other information.

The numbers below correspond to the numbered steps in the Procedure to View Generator Set Information.

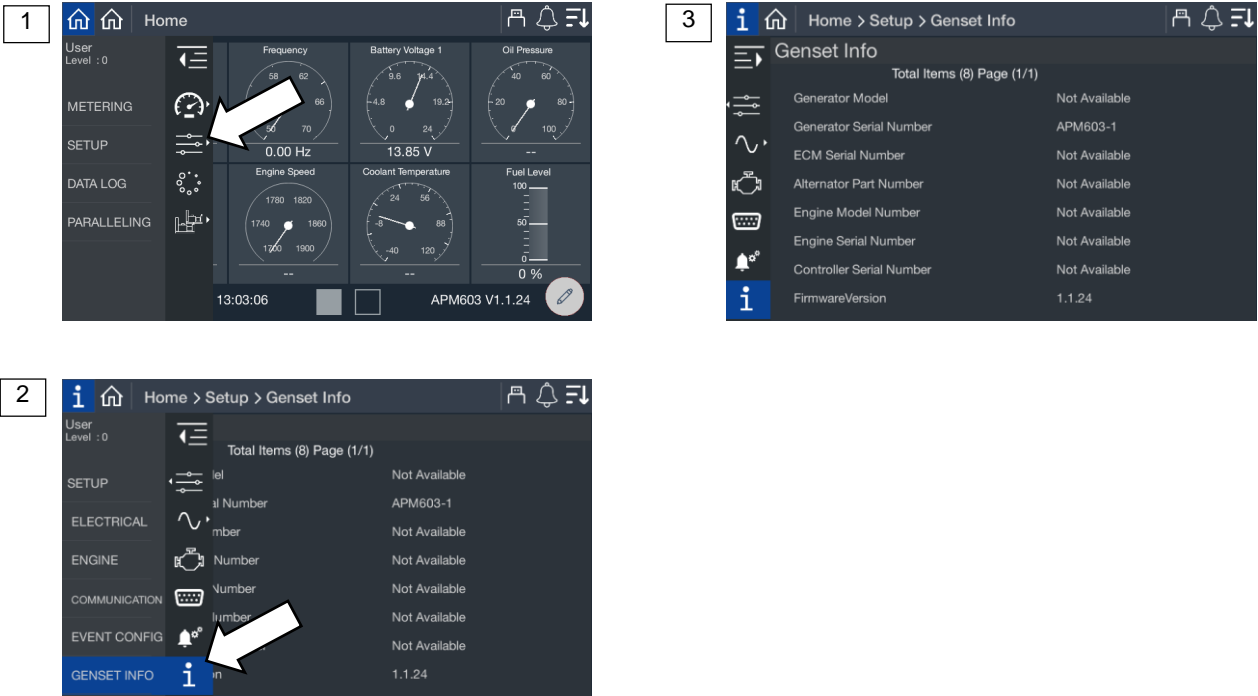


Figure 56 Genset Info Screen

Information
Generator Model
Generator Serial Number
ECM Serial Number
Alternator Part Number
Engine Model Number
Engine Serial Number
Controller Serial Number
Firmware Version

Figure 57 Generator Set Information (Genset Info)

## 4.6 Data Log Screens

Data log files can be created and saved to a flash drive.

Before starting the data log, insert a flash drive into the USB port on the front of the controller. When the controller recognizes the flash drive, the symbol appears at the top of the screen. Select one or more parameters to log over a period of time, and select the log rate (intervals from once per second to once a day).

The data logger will collect data until STOP is selected on the screen or until the flash drive runs out of memory.

When complete, remove the flash drive from the controller and insert it into a personal computer to view the data files. The data file name includes the date, an alpha-numeric code, and the .csv extension. The file can be opened using a spreadsheet program like Microsoft Excel. A word-processing program or Notepad can also open the file. The data entries in the file are time- and date-stamped.

### Data Logging Procedure

Refer to Figure 58 during this procedure.

1. Check for the flash drive symbol at the top of the screen to verify that the controller recognizes the flash drive installed in the USB port.
2. In the navigation menu on the left side of the screen, touch Data Log.
3. Confirm that USB Connected appears on the screen. Touch the Circle icon with three dots near the upper right corner of the screen. A list of categories opens.
4. Touch to select a category. A list of parameters within that category opens.
5. Touch each parameter that you want to log. Multiple parameters from different categories can be logged at the same time. A check mark appears in the boxes for the selected parameters. Touch the left arrow at the bottom to close the selection window. Repeat steps 4 and 5 for other categories and parameters as needed. The parameters to be logged are listed on the left side of the screen.
6. Click on the blue box labeled Log Rate, located in the lower right corner of the screen. The Data Logger Sample Rate window opens.
7. Select the desired log rate and touch the up arrow to close the window. The new log rate appears in the blue box at the bottom of the screen.
8. Touch START LOG to begin collecting data. Data Log In Progress is displayed. The data is stored to the flash drive.
9. Touch STOP to end the data logging process. Wait at least 5 seconds to allow the data to be written to the files before removing the flash drive from the controller.

**Note:**

If the flash drive memory becomes full, the controller will stop logging data.

To view the data, insert the flash drive into your PC and open the .csv file.

The numbers below correspond to the numbered steps in the Data Logging Procedure.

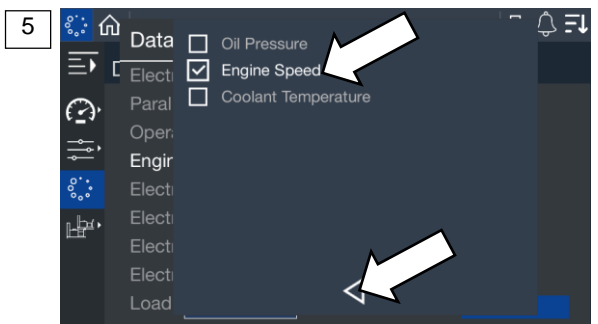
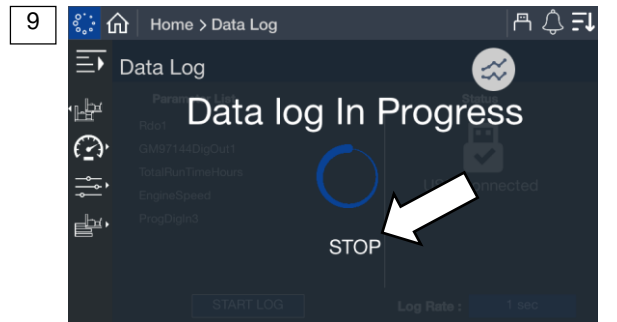
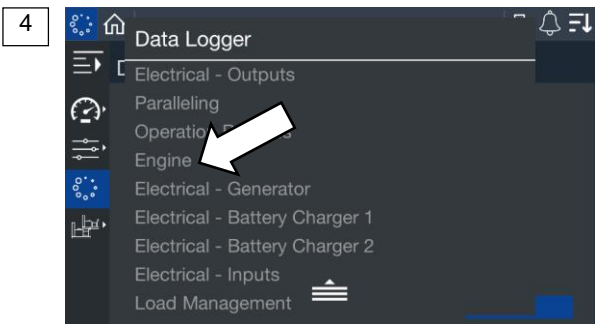
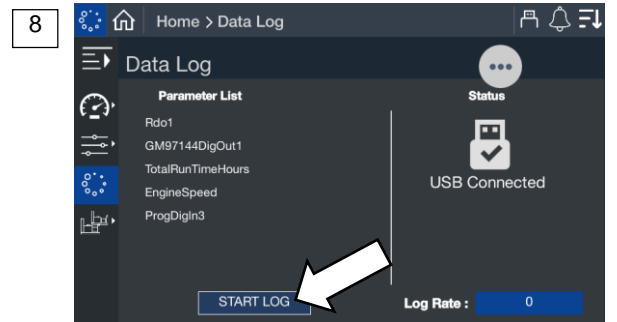
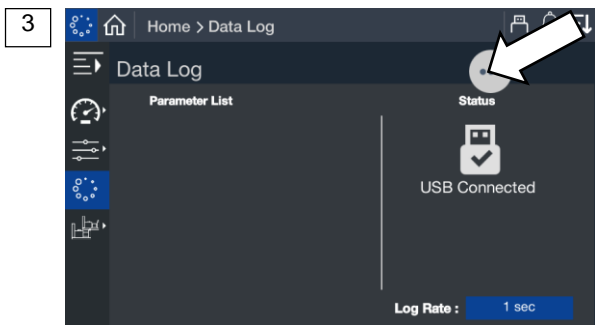
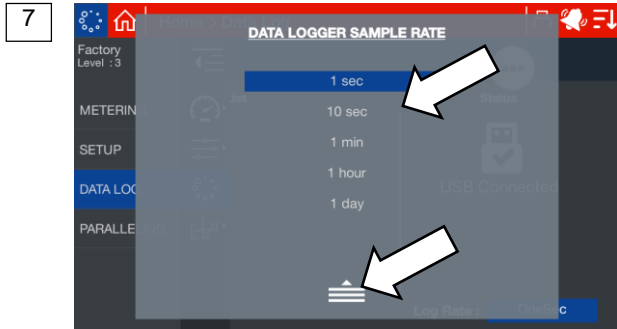
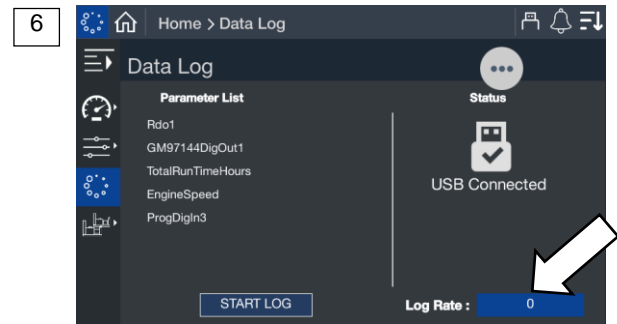


Figure 58 Data Logging

### 5.1 Introduction

#### Note:

The Paralleling menu will appear if paralleling is enabled in the Setup>Electrical>Paralleling menu.

While it may be common for a facility to install a single large generator to meet its power needs, paralleling two or more generators offers a number of practical benefits and advantages over a single-generator system.

#### Redundancy

The redundancy provided by the paralleling of two or more generators delivers greater reliability and flexibility than a single generator can provide. In critical applications, having more than one generator connected to the bus at all times ensures continuous generator power in the unlikely event that a generator fails.

#### Efficiency

Instead of one large generator that might operate at an inefficiently low kW, several small generators can be paralleled together and turned on and off as necessary to efficiently support the varying demands of the load.

#### How Paralleling Works

When a loss of utility power occurs, almost every system responds with the basic sequence shown here.

1. **Engine Start Delay.** A timer starts when there is a loss of utility. If utility returns before the timer expires, the system does not start. If the utility outage is long enough for the timer to expire, the system will commit to transferring to generator power.
2. **Start / Start-Up Load Shed.** All available generators start. If the system is designed to supply power to loads as soon as one generator is online (typical for systems serving critical and life-safety loads), low-priority loads are shed or are inhibited from transferring. This prevents the first-on generator from being overloaded.
3. **First Generator Breaker Closes.** The first generator to reach the rated voltage and frequency closes to the bus. First-on logic prevents multiple generators from simultaneously closing to the bus. The bus is now energized, and power is available to the load. Low-priority loads may remain shed.
4. **Synchronization.** The incoming generator's voltage, frequency and phase are matched to the running bus. When matched, the generator paralleling breaker closes.
5. **Second Generator Breaker Closes/Load Sharing.** Additional generator power is available to the load. The system's load-sharing controls actively control the kW and kVAR output of each generator in order to proportionally share the load (maintain the same percent load on each generator) and maintain rated frequency and voltage.
6. **Load Management.** As additional generators close to the bus, more power is available for the load. The load management of the system actively adds loads based on bus capacity available.
7. **Generator Management.** Generator management optimizes the number of online generators based on the load's kW demand, starting and stopping as required. Generators are sequenced on in order of operator-assigned priority (or based on runtime) and taken off in reverse priority. Defined setpoints determine the percent load level and time delay at which the generator set will be brought on or taken offline.

#### Synchronization

The automatic synchronizer matches the incoming generator's output (waveform) to the running bus. When the voltage, frequency and phase are all matched, the synchronizer will close the incoming generator's breaker.

**Voltage Match.** The synchronizer adjusts the incoming generator's voltage to match the running bus.

**Frequency Match.** The synchronizer adjusts the incoming generator's speed to match the frequency of the running bus.

**Phase Match.** The synchronizer adjusts the incoming generator's speed to match the phase of the running bus. When all three are matched, the two sine waves will be the same.

## 5.2 Metering

### 5.2.1 Paralleling, Metering, Overview

The overview provides a simple graphical view of the paralleling system.

#### Procedure to View Paralleling Overview

1. In the navigation panel on the left side, touch Paralleling or the symbol of two generators.
2. Touch Metering or the gauge symbol.
3. Touch Overview or the globe symbol.
4. Observe the Overview graphic, which is described below.

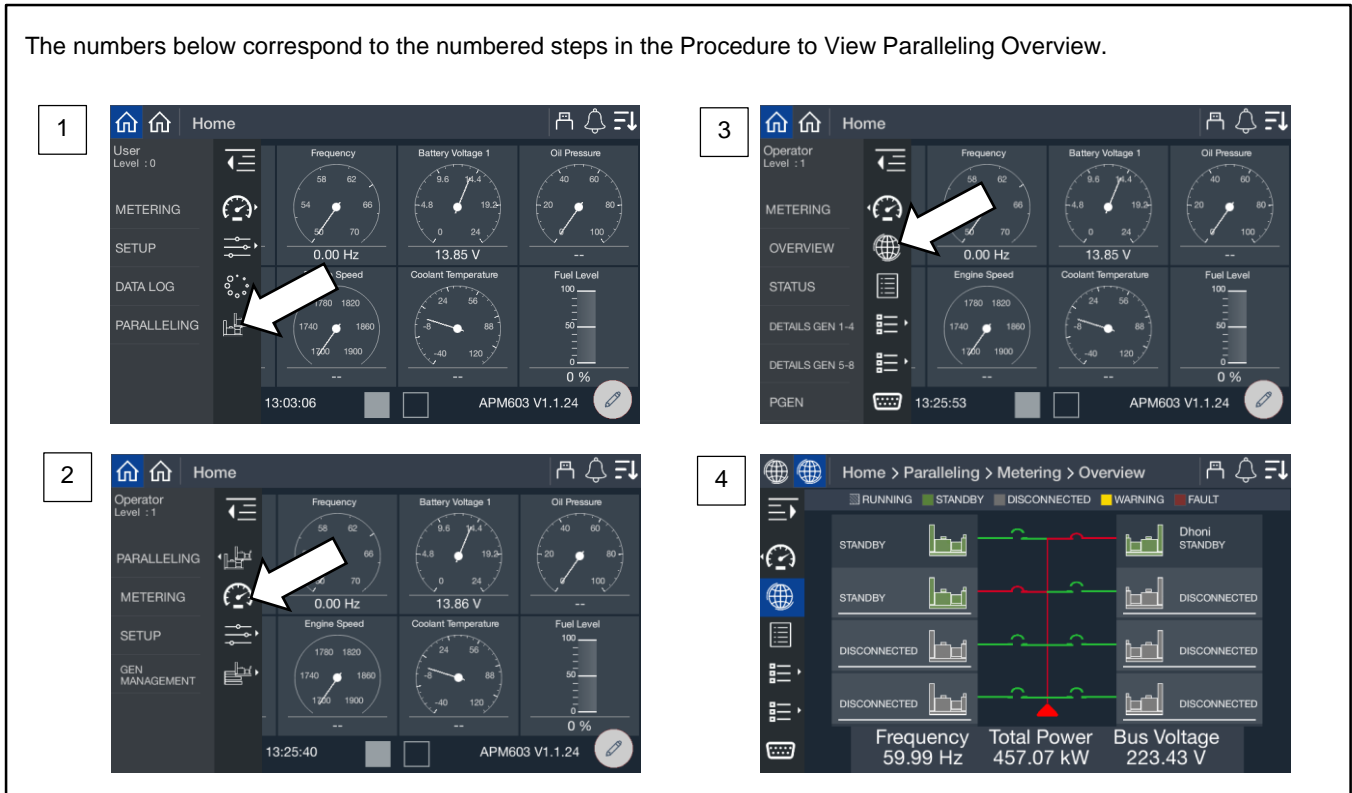


Figure 59 Paralleling, Metering, Overview Screen

From the overview screen, you get a simplified view of the status of each generator and the paralleling bus. Each generator in the system is shown on either the right side or left side of the display. If the generators were provided a custom name during the system set up, the name will appear. If not, the name will appear as Gen X, where X is the system assigned generator number.

#### Note:

Custom names for generators can be set up through SiteTech™. Contact a Kohler authorized distributor or dealer.

The top of the display provides a key to explain the color designation.

- A generator shown in green with lines through it is running. It may or may not be on the bus depending upon the status of the electrically operated breaker or contactor.
- A generator in solid green is in standby and disconnected from the bus. The generator is ready to start as required.
- A generator in blue is in cool down. It is disconnected from the bus but still running.
- A generator in yellow has a warning. This generator may be running and connected to the bus or it may be in cooldown or it could be in standby waiting for a start signal.
- A generator in red has a shutdown fault. It is not running, not connected to the bus and not available for paralleling.

Along with each color, a text description is provided to indicate the generator status.

**Note:**

The fact that a generator is not running does not automatically mean it has a fault. Generator Management may shut down a generator when it is not needed.

The lines on the display indicate the status of the bus and electrically operated breaker or contactor.

- Green indicates that the component is not powered.
- Red indicates the component is powered.

Each generator has a breaker symbol to indicate if the electrically operated breaker or contactor is open or closed. When the breaker is open, the breaker symbol does not appear connected to the bus lines and the breaker symbol is green. When the breaker is closed, the breaker symbol will appear connected to the bus lines and the breaker symbol will be red.

As soon as one generator closes to the bus, the bus line up the center of the display will show as red. As each generator closes, the bus line changes to red.

The bottom of the display shows the frequency, load and voltage of the bus. It does not show the information for a single generator but each generator closed to the bus should have a matching frequency and voltage. Each generator closed to the bus will share load so that each generator has an equal percentage loaded.

### 5.2.2 Paralleling, Metering Status

The status screens provide a listing of the paralleling metered values.

The Paralleling System Status provides indication of key settings and values related to the overall operation of the paralleling system.

#### Procedure to View Paralleling System Status Metering

1. In the navigation panel on the left side, touch Paralleling or the symbol with two generators.
2. Touch Metering or the gauge symbol.
3. Touch Status or the list symbol.
4. Touch the up and down arrows on the right to view the status parameters, which are described below.

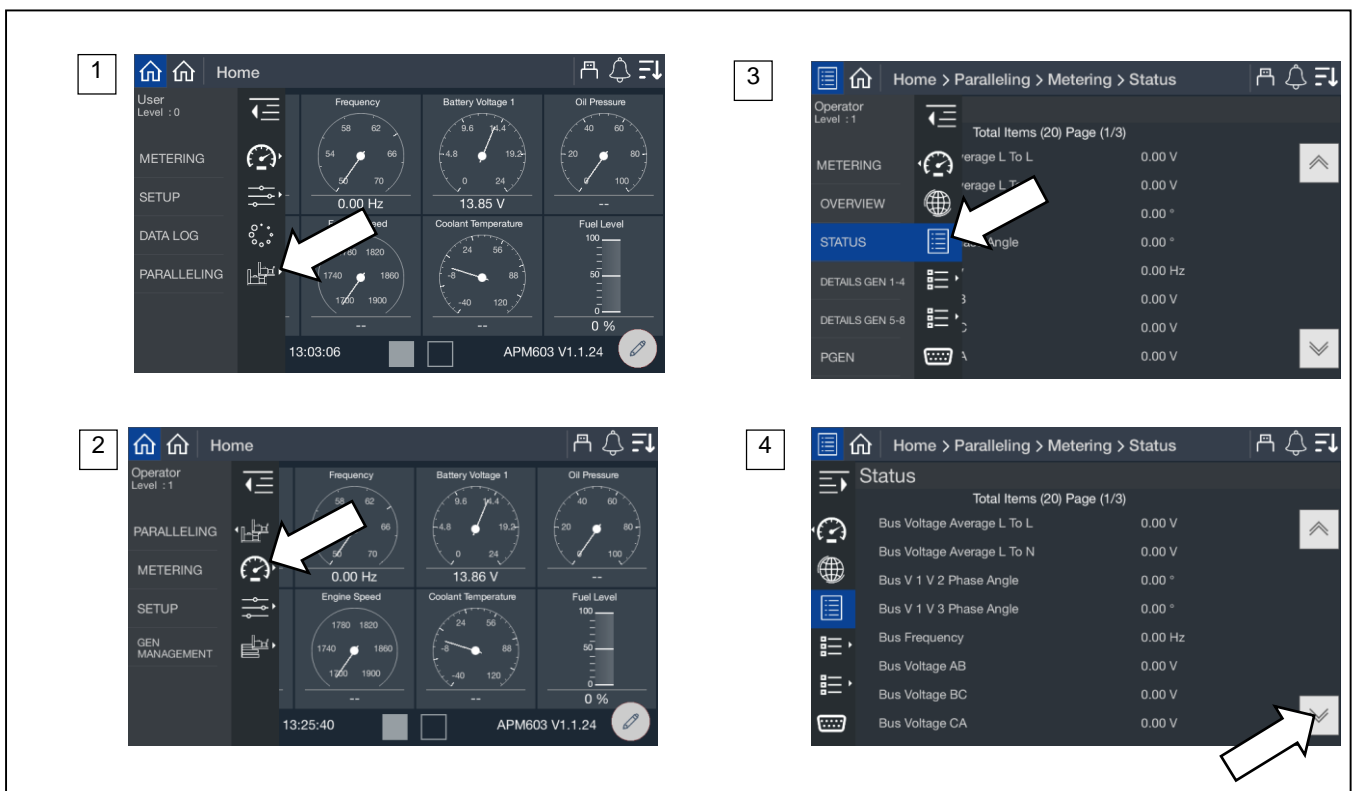


Figure 60 Paralleling, Metering Status Screen



Parameter	Units
Bus Voltage Average L to L	V
Bus Voltage Average L to N	V
Bus L1 L2 Phase Angle	Degrees
Bus L1 L3 Phase Angle	Degrees
Bus Frequency	Hz
Bus Voltage L1 L2	V
Bus Voltage L2 L3	V
Bus Voltage L3 L1	V
Bus Voltage L1 L0	V
Bus Voltage L2 L0	V
Bus Voltage L3 L0	V
Paralleling State	
Start Active	Yes/No
Synch Active	Yes/No
In Sync	Yes/No
Frequency Matched	Yes/No
Phase Matched	Yes/No
Voltage Matched	Yes/No
Close Breaker	True/False
Trip Breaker	True/False

Figure 61 Paralleling Metering Status Parameters

The electrical metering of the bus is shown. If the generator is not closed to the bus but trying to synchronize, the generator is adjusting the speed and voltage outputs to match the voltage, frequency and phase of the bus in order to close.

**Start Active** indicates if the generator has a start signal. This signal could be from a transfer switch, from the control buttons on the front of the generator or through PGEN.

**Synch Active** indicates if the generator is trying to sync to the bus.

**In Sync** indicates if the generator has successfully synced to the bus. The generator has not yet closed to the bus. All three parameters that follow, Frequency Matched, Phase Matched and Voltage Matched must be Yes for In Sync to be Yes.

**Frequency Matched** indicates the difference between the generator set frequency and the bus frequency is within the acceptable window.

**Phase Matched** indicates the difference between the generator set phase and the bus phase is within the acceptable window.

**Voltage Matched** indicates the difference between the generator set voltage and the bus voltage is within the acceptable window.

**Close Breaker** indicates if the controller has commanded the electrically operated breaker or contactor to close.

**Trip Breaker** indicates if the controller has commanded the electrically operated breaker or contactor to trip based on a protective function.

### 5.2.3 Paralleling, Metering, Details

The Paralleling System Generator Details provides details for each generator in the system. It provides the ability to view key data on other generators in the system from a single generator.

#### Procedure to View Paralleling System Generator Metering

1. In the navigation panel on the left side, touch Paralleling or the symbol of two generators.
2. Touch Metering or the gauge symbol.
3. Touch Details Gen 1-4 or Details Gen 5-8 or the list symbol for either.
4. Touch the specific generator to view.
5. Touch the up and down arrows on the right to view the parameters, which are described below.

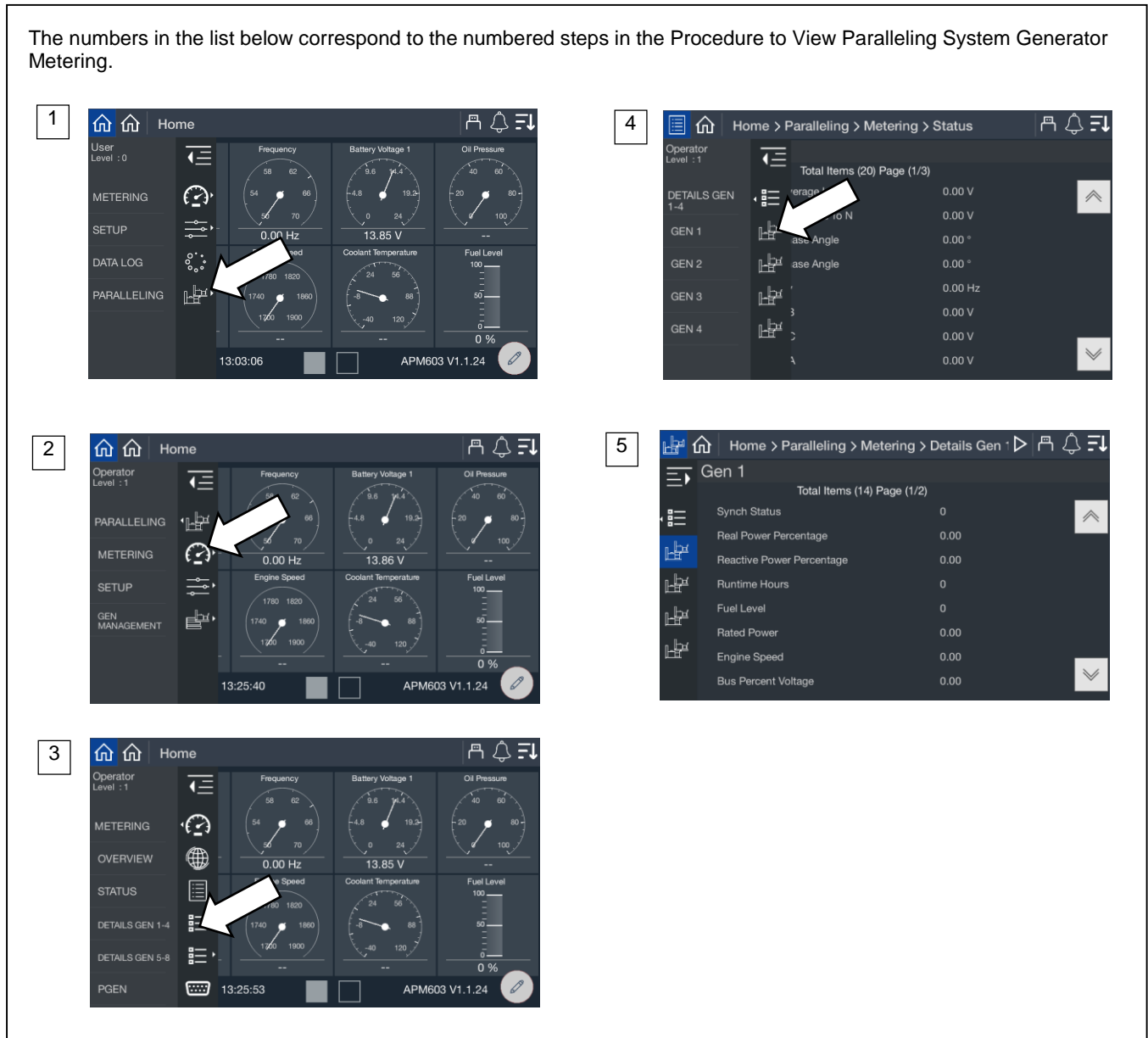


Figure 62 Paralleling, Metering, Details

Parameter	Units
Synch Status	
Real Power Percentage	%
Reactive Power Percentage	%
Run Time Hours	Hours
Fuel Level	%
Rated Power	kW
Engine Speed	RPM
Bus Percent Voltage	%
Connected	Yes/No
Was Connected	Yes/No
Online	Yes/No
Faulted	Yes/No
Bus Energized	Yes/No
Start Signal	Yes/No

Figure 63 Paralleling System Details Parameters

**Synch Status** indicates the synchronization status for the generator.

**Real Power Percentage** indicates the percentage load on the generator of real power (kW). All generators paralleled together should share load in order to have equal percentage.

**Reactive Power Percentage** indicates the percentage load on the generator of reactive power (kVAR). All generators paralleled together should share load in order to have equal percentage.

**Run Time Hours** indicates the total run time hours on the generator.

**Fuel Level** indicates the percentage of fuel level for the generator.

**Rated Power** indicates the rated power of the generator.

**Engine Speed** indicates the current engine speed for the generator.

**Bus Percent Voltage** indicates the measured voltage as percent of system voltage.

**Connected** indicates if the generator is connected through the PGEN communication with the other generators.

**Was Connected** indicates at one point the generator was connected through the PGEN communication with other generators but is not connected at this time.

**Online** indicates if the generator is currently closed to the paralleling bus.

**Faulted** indicates if the generator is faulted and not available for paralleling.

**Note:** If the controller is still communicating through PGEN with other generators, the load management implemented on the generator controller is still operational.

**Bus Energized** indicates if the generator is sensing that the bus has voltage and frequency.

Start Signal indicates if the generator has a start signal. This signal could be from a transfer switch, from the control buttons on the front of the generator or through PGEN.

## 5.2.4 Paralleling, Metering, PGEN

The PGEN metering provides details related to the paralleling system communication.

### Procedure to view Paralleling PGEN Metering

1. In the navigation panel on the left side, touch Paralleling or the symbol of two generators.
2. Touch Metering or the gauge symbol.
3. Touch PGEN or the serial connector symbol.
4. Observe the PGEN information, which is described below.



Figure 64 Paralleling, Metering, PGEN

PGEN Metering Parameters
Connected Nodes
Disconnected Nodes
Scheduler ID

Figure 65 PGEN Metering Parameters

**Connected Nodes** indicates how many generators are currently on the PGEN communication network. This should match the total number of paralleled generators in the system.

**Disconnected Nodes** indicates how many generators have been on the PGEN communication network before but are not communicating at this time. In a fully functioning system this would be 0. If a unit is out of service or the controller has stopped communicating, then there will be a value greater than 0.

**Scheduler ID** indicates which controller, based on PGEN ID, is the master in the system.

#### Note:

If a master scheduler controller stops communicating another controller takes over the as the Scheduler ID.

## 5.3 Setup

### 5.3.1 Paralleling, Setup, PGEN

The Paralleling System PGEN provides indication of key settings related to the PGEN communication network.

#### Procedure to view Paralleling System PGEN Setup

1. In the navigation panel on the left side, touch Paralleling or symbol with two generators.
2. Touch Setup or the setup symbol.
3. Touch PGEN or the serial connector symbol.
4. Observe the PGEN parameters, which are described below.

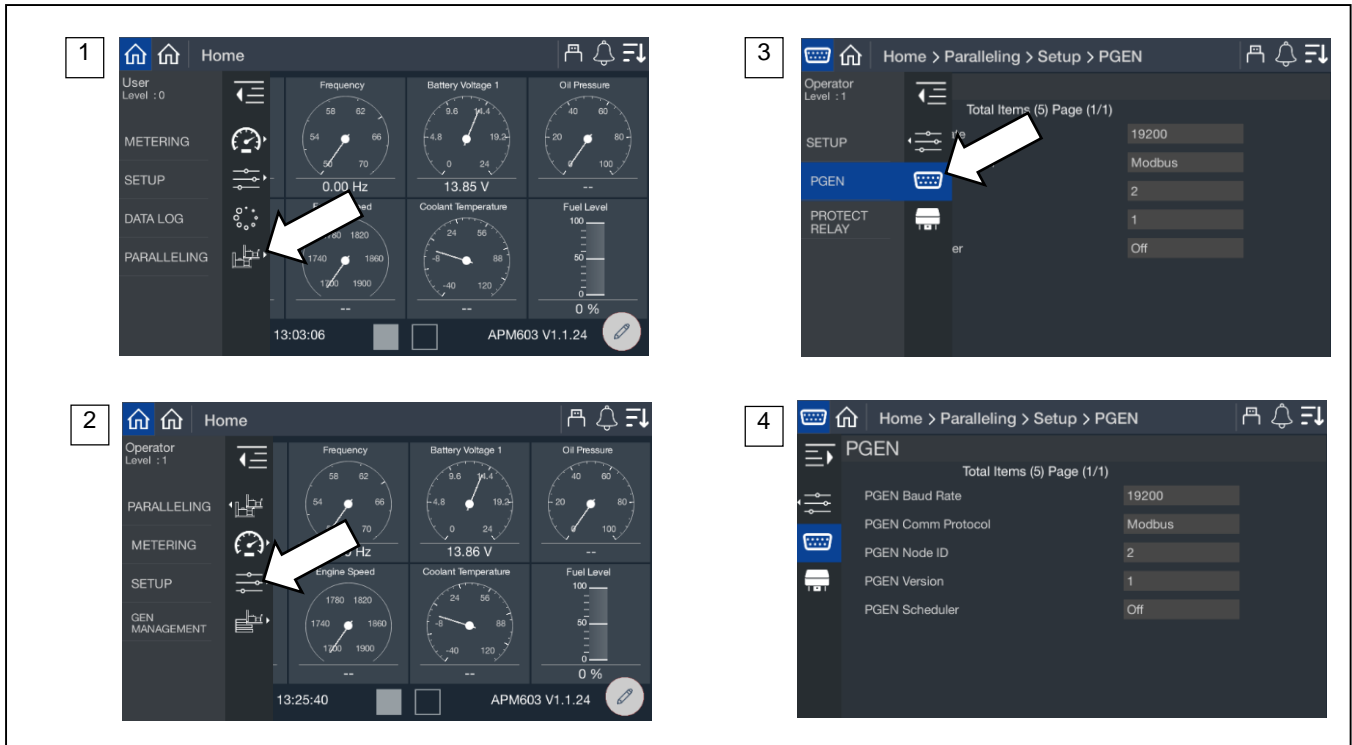


Figure 66 Paralleling, Setup, PGEN Screens

Parameter	Units	Write Access Level
PGEN Baud Rate	BPS	Factory set
PGEN Comm Protocol		Factory set
PGEN Node ID		Technician
PGEN Version		N/A
PGEN Scheduler	Yes/No	Technician

Figure 67 PGEN Setup Parameters

**PGEN Baud Rate** is fixed from the factory. All controllers must use the same baud rate and the rate is fixed for optimal performance.

**PGEN Comm Protocol** is fixed from the factory to support the same setting on all controllers in the system.

**PGEN Node ID** is unique for each controller in the system.

**PGEN Version** indicates the version of PGEN communication used in the system and is fixed from the factory.

**PGEN Scheduler** indicates Yes if the controller is the master scheduler in the system.

### 5.3.2 Paralleling, Setup, Protect Relay Screen

The Paralleling System Protective Relays provides indication of key settings related to the protective relay functions related to paralleling.

#### Procedure to View Paralleling System Protective Relays Setup

1. In the navigation panel on the left side, touch Paralleling or symbol with two generators.
2. Touch Setup or the setup symbol.
3. Touch Protect Relay or the relay symbol.
4. Touch the up and down arrows on the right to view the protective relay setup parameters, which are described below.



Figure 68 Paralleling, Setup, Protect Relay Screen

Parameters	Units	Write Access Level
Under Voltage Trip Delay	Seconds	Technician
Under Voltage Trip Limit	%	Technician
Over Voltage Trip Delay	Seconds	Technician
Over Voltage Trip Limit	%	Technician
Over Current Trip Delay	Seconds	Technician
Over Current Trip Limit	%	Technician
Under Frequency Trip Delay	Seconds	Technician
Under Frequency Trip Limit	%	Technician
Over Frequency Trip Delay	Seconds	Technician
Over Frequency Trip Limit	%	Technician
Over Power Trip Delay	Seconds	Technician
Over Power Trip Limit	%	Technician
Reverse Power Trip Delay	Seconds	Technician
Reverse Power Trip Limit	%	Technician
Reverse VAR Trip Delay	Seconds	Technician
Reverse VAR Trip Limit	%	
Trip to Shutdown Delay	Seconds	

Figure 69 Protective Relay Parameters

**Trip to Shutdown Delay** indicates the time allowed to clear the trip condition to avoid the shutdown. It also serves as a cooldown period for the generator in a case where the protective relay function is causing the trip.

## 5.4 Generator Management

Generator Management is intended to minimize wear and tear, fuel consumption, pollutant/sound emissions, and generated heat. It acts by signaling each generator set to stop when it is unneeded. If generator management for a generator set is disabled, the generator set will start (if already stopped by generator management) or be prevented from turning off in the future.

Generator management sequences the generators off in an order determined by configuration parameters and operating conditions (load, runtime, fuel level). The highest order generator sets stop first (when load is low enough) and re-start last (when load is too high). The order can be viewed on the front panel of the controller, but can only be adjusted under certain conditions (see Gen Management Order later in this section).

The time to start a generator set (if the load increases) varies with the degree of overload as a percent of online capacity (applicable to those generators which are connected to bus).

The time to stop a generator set (if the load is low enough) varies with the degree of load as a percent of total available capacity. (applicable to all generators in the system whether connected to bus or not).

### Note:

Receipt of a start signal will cause all generator sets to start, synchronize, and close to the bus. Generator management requires that the generator sets are available (not faulted) in order to be permitted to stop. If a generator set is faulted or manually stopped and then placed back in Auto, generator management will require the generator set to start and connect to the bus before it is considered available (and permitted to stop) again—even if generator management had previously signaled the generator set to stop.

The overview provides a simple graphical view of the generator management status.

### Procedure to View Generator Management Overview

1. In the navigation panel on the left side, touch PARALLELING or the symbol of two generators.
2. Touch GEN MANAGEMENT or the three horizontal bars with a generator symbol.
3. Touch OVERVIEW or the globe symbol.
4. View the graphical display.



Figure 70 Paralleling Screens, Gen Management Overview



## Understanding the Overview Screen

The generators are listed in order of priority. If the generators were provided a custom name during the system set up, the name will appear. If not, the name will appear as Gen X, where X is the system assigned generator number.

- Custom names for generators can be set up through SiteTech.
- Depending upon the Generator Management Mode, the priority of a generator can change over time. For example, if the mode is Fuel Level, as the fuel level of each generator changes the order of priority for each generator will change.

The top of the screen provides a key to explain the symbol and color designation used on the overview. A timer face in white indicates a timer is active to either turn a generator on or off. The timer face will appear on the line of the generator for which the timer applies. A red circle indicates the stop kW setting for the generator. A green arrow indicates the start kW setting for the generator. If a generator is running, it will show the stop setting. If a generator is stopped, it will show the start setting.

The key at the bottom of the display shows the current load as well as the total online capacity (green) and available capacity (yellow). If a generator is offline (either due to a shutdown via Generator Management or a fault, or the generator is not communicating via PGEN), the capacity of that generator is shown as unavailable (white). A vertical blue dotted line indicates the current load on the system.

### 5.4.1 Paralleling, Generator Management Status

The status screens provide a listing of the generator management metered values as well as key settings for reference.

#### 5.4.1.1 Status, System

The Gen Management System Status provides indication of key settings and values related to the overall operation of the load management system.

#### Procedure to View Generator Management System Status

1. In the navigation panel on the left side, touch Paralleling or the symbol of two generators.
2. Touch Gen Manage or the three horizontal bars with a generator symbol.
3. Touch Status or the list symbol.
4. Touch System or the generator symbol.

The numbers below correspond to the numbered steps in the Procedure to View Paralleling System Status Metering.

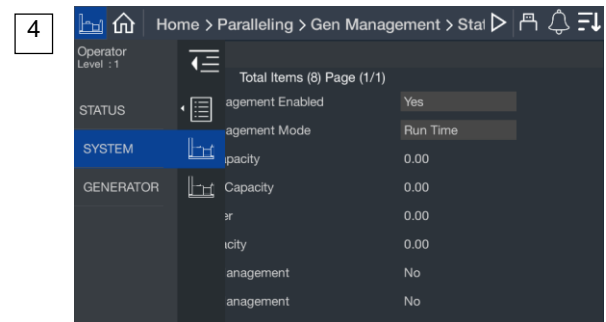
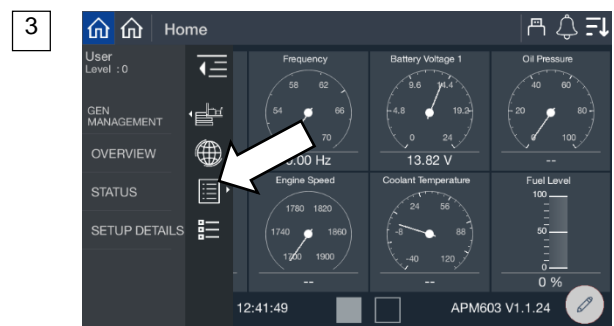


Figure 71 Paralleling Screens, Generator Management Status

Parameter	Units	Write Access Level
Generator Management Enabled	Yes/No	Technician
Generator Management Mode	See below	Technician
Total Online Capacity	kW	N/A
Total Available Capacity	kW	N/A
Total Bus Power	kW	N/A
Total Bus Capacity	kW	N/A
Remove for Maintenance	Yes/No	Operator

Figure 72 Generator Management Status Parameters

**Generator Management Enabled** indicates whether generator management is turned on for the generator.

**Note:**

This parameter can be set individually for each generator set and will inhibit the Generator Management Configuration Mismatch Warning for this generator set if set to OFF.

**Note:**

Disabling the generator management on one generator set in a paralleling system will not keep the other generator sets in the paralleling system from alarming if the generator management configuration of any of the other nodes differs from the disabled generator set.

**Note:**

Generator sets with Generator Management disabled are not taken into consideration for generator management on the other generator sets. It is not recommended to disable any of the generator sets in a paralleling system where generator management is intended to be used; the generator management may operate too many generator sets in these cases.

**Generator Management Mode** indicates which form of generator management is active. See Section 5.4.2 for descriptions of the available modes.

**Total Online Capacity** indicates the capability of the system with all the generators that are currently online.

**Total Available Capacity** indicates the difference between the Online Capacity and the Total Load.

**Total Bus Power** indicates the total load on the system.

**Total Bus Capacity** indicates the capability of the system if all the generators available were online.

**Stop by Gen Management** indicates whether the generator set has been stopped by the gen management function.

**Start by Gen Management** indicates whether the generator set has been started by the gen management function.

### 5.4.2 Gen Management Modes

The Gen Management Mode is the method that generator management uses to determine the starting and stopping order of the available generator sets. All of the generator sets in the system must have the same setting for this parameter for the generator management to operate correctly. This parameter can be set to one of the following:

**Manual/Fixed.** The order of the generator sets is manually set. In this mode, the order is set once by the user.

**Note:**

The controllers require that the order be valid. If two nodes share a common order or there is a gap in the order sequence, the controllers will attempt to re-sort the order until it is valid. If the order is not valid (automatic re-sorting failed) generator management will be disabled and all generator sets will run all of the time.

**Run Time.** The generator management start/stop order is determined by the runtime hours on the generator sets. In this mode, the order is determined to ensure that the generator set with the fewest runtime hours is the last to stop. Each subsequent order is assigned to generator sets with increasing runtime hours.

If a generator set is not running, the system will add the Run Time Threshold to the runtime hours for that generator set before it considers it in the order—this allows the generator sets to avoid starting and stopping continuously. The actual runtime will have to differ by more than the threshold to force the generator set order to switch (the stopped generator set will start, synchronize to the paralleling bus, and begin sharing load—the running generator set will soft-unload, disconnect from the bus, cool down and stop).

The generator management order is not user adjustable in runtime mode.

**Note:**

If the load on the system requires an additional generator set to start, the generator set with the most runtime hours will always be the first one to stop if the load decreases enough to permit it (the threshold is no longer taken into consideration as soon as the generator set is connected to the paralleling bus).

**Fuel Level.** The generator management start/stop order of the generator sets is determined by the level of the fuel in the tank which supplies each generator set. In this mode, the order is determined to ensure that the generator set with the most fuel is the last to stop. Each subsequent order is assigned to generator sets with decreasing fuel percentage.

If a generator set is running, the system will add the Fuel Level Threshold to the measured Fuel Level for that generator set before it considers it in the order. This allows the generator sets to avoid starting and stopping continuously. The actual fuel level will have to differ by more than the threshold to force the generator set order to switch. The stopped generator set will start,

synchronize to the paralleling bus, and begin sharing load. The running generator set will soft-unload, disconnect from the bus, cool down, and stop.

The generator management order is not user-adjustable in Fuel Level mode.

**Note:**

Fuel Level Order Selection mode requires separate fuel tanks for the generator sets and fuel level senders connected to the controller to operate. Operation of Fuel Level mode without sensors is not defined.

**Note:**

If the load on the system requires an additional generator set to start, the generator set with the lowest fuel level will always be the one to stop (the threshold is no longer taken into consideration as soon as the generator set is connected to the paralleling bus).

**5.4.3 Gen Management System Status, Generator**

The Gen Management System Generator provides details on each generator in the system. Each generator has a page of data so as you page down you will see the information for each generator on a single screen.

**Procedure to View Generator Management System Generator**

1. In the navigation panel on the left side, touch Paralleling or the symbol of two generators.
2. Touch Gen Manage or the three horizontal bars with a generator symbol.
3. Touch Status or the list symbol.
4. Touch Generator or the generator symbol.

The numbers below correspond to the numbered steps in the Procedure to View Generator Management System Status, Generator.

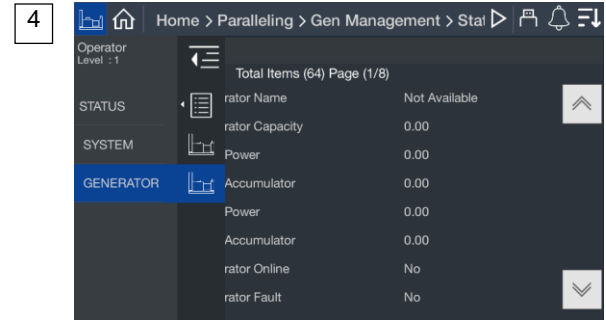
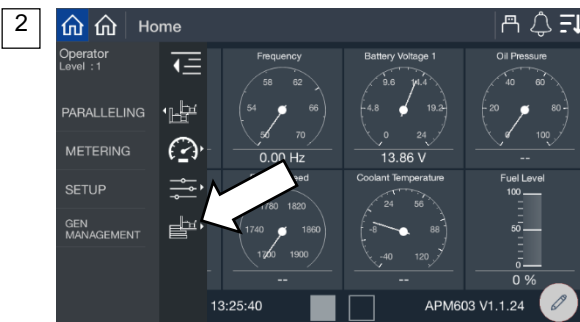
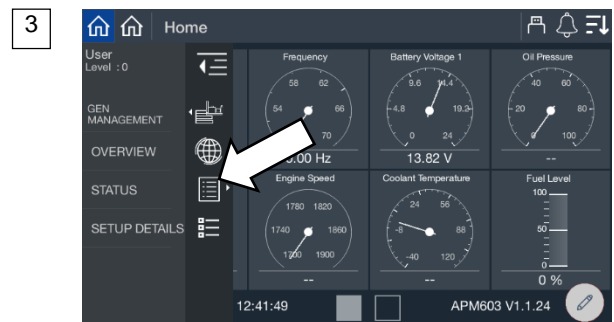


Figure 73 Paralleling, Gen Management, Status, Generator

Parameter	Units
Priority 1 Generator Name	String
Priority 1 Generator Capacity	kW
Priority 1 Start Power	kW
Priority 1 Start Accumulator	%
Priority 1 Stop Power	kW
Priority 1 Stop Accumulator	%
Priority 1 Generator Online	Yes/No
Priority 1 Generator Fault	Yes/No

Figure 74 Generator Management Status, Generator Parameters

**Note:**

The order of generators in this list is fixed by priority so if a generator priority is changed, its order in the list will change. The first value in the list is Generator Name to provide clarity as to which generator is referenced.

**Generator Name** is the descriptive name of the generator. If the generators were provided a custom name during the system set up, the name will appear. If not, the name will appear as Gen X, where X is the system assigned generator number.

**Note:**

Custom names for generators can be set up through SiteTech™. Contact a Kohler authorized distributor or dealer.

**Generator Capacity** indicates the rated capacity of the generator.

**Start Power** indicates the kW setting that needs to be exceeded in order for the generator management to begin a timer to add the generator back to the bus.

**Start Accumulator** is an indication of progress until generator management will start the generator.

**Note:**

The time to start will decrease as the load demand increases and will decrease as the load demand decreases. The Accumulator is not a fixed time but will speed up or slow down depending upon the load demand.

**Stop Power** indicates the lower limit kW setting for gen management. When the load drops below this kW limit, generator management starts a timer to stop the generator.

**Stop Accumulator** is an indication of progress until generator management will stop the generator.

**Note:**

The time to stop will decrease as the load demand decreases and will increase as the load demand decreases. The Accumulator is not a fixed time but will speed up or slow down depending upon the load demand.

**Generator Online** indicates if the generator is currently on the bus.

**Generator Fault** indicates if the generator has a fault and is not connected to the bus.

### 5.4.4 Paralleling, Gen Management, Setup Details

The setup details screen provides a table view of key settings for the generator management configuration. See Figure 75 for an illustration of the screen, which is located at PARALLELING>GEN MANAGEMENT>SETUP DETAILS.

#### Procedure to View Generator Management Setup Details

1. In the navigation panel on the left side, touch PARALLELING or the symbol of two generators.
2. Touch GEN MANAGEMENT or the three horizontal bars with a generator symbol.
3. Touch SETUP DETAILS or the details symbol.
4. View the setup details for each generator in the system.

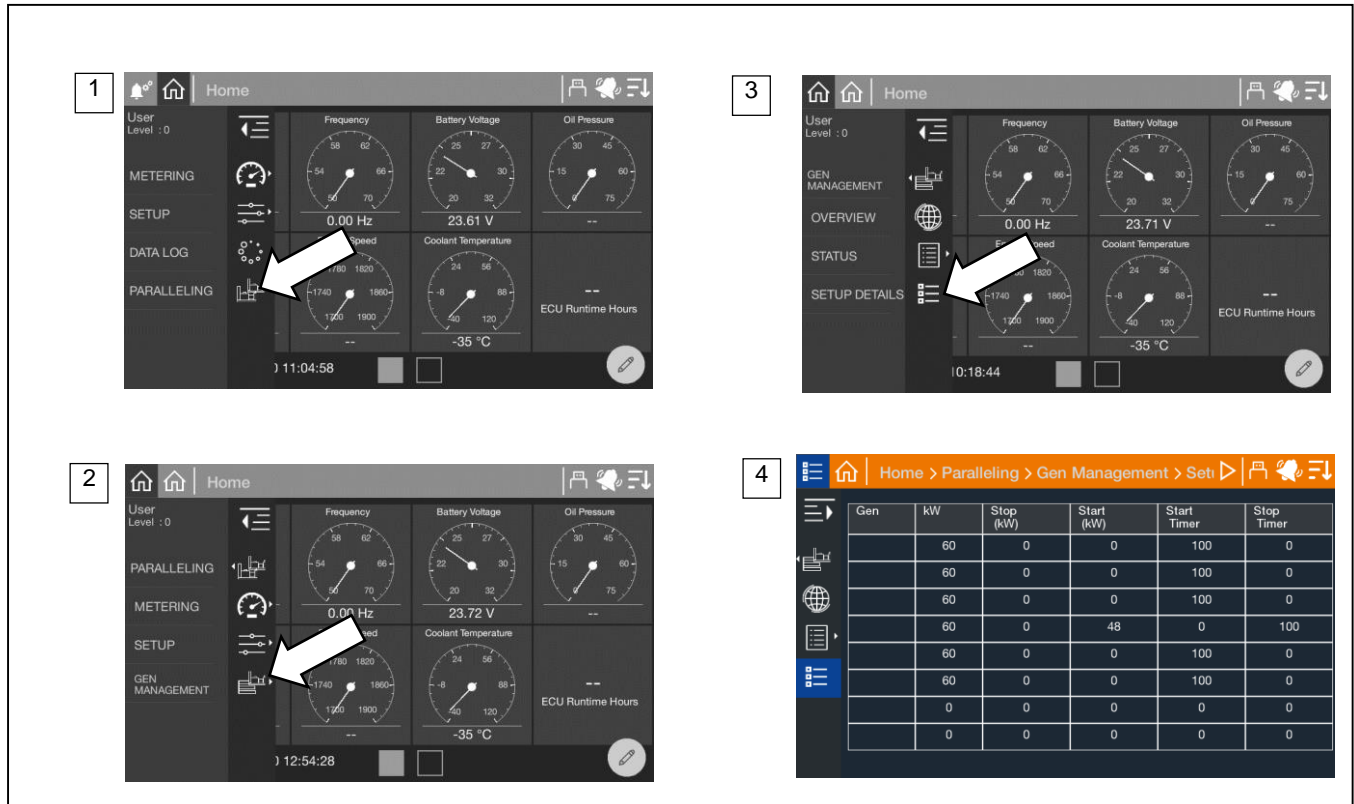


Figure 75 Paralleling Screens, Gen Management Setup Details

The generators are listed in order of priority. If the generators were provided a custom name during the system set up, the name will appear. If not, the name will appear as Gen X, where X is the system assigned generator number.

**Note:**

Custom names for generators can be set up through SiteTech.

The table indicates the kW Capacity of the generator along with the Start kW and Stop kW settings and the start and stop timer settings. Generator Start kW, Stop kW, Start Time and Stop Time can be adjusted using SiteTech. See Figure 76 for the SiteTech Group. Start and Stop kW values are calculated from the configuration parameters and the respective capacity values. The actual settings are made using percentages: parameters Start Percentage and Stop Percentage.

<span>⤴</span> <b>GenManagement Setting</b>	
Generator Management Mode	Manual Fixed
Start Percentage	80.00
Stop Percentage	60.00
Generator Management Enabled	Yes
Min. LoadShed Priority	16
Additional Gens Online	No
Stability Delay	60
Max. Runtime Difference	120.00
Max. Fuel Level Difference	10
Manual Order	1
Start Time	5.00
Stop Time	30.00
Config Update Time Window	5.00
Order Negotiation Time	5.00

Figure 76 Generator Management Settings Adjustable in SiteTech

### 6.1 Introduction

This section contains generator set, controller, and general engine troubleshooting information. This section may refer to other literature for procedures and additional information. See the list of related materials in the Introduction of this manual for literature part numbers. The information in this section is a guideline for generator set operating technicians.

Corrective action and testing often require knowledge of electrical and electronic circuits. To avoid additional problems caused by incorrect repairs, have an authorized service distributor/dealer perform service.

Use the following charts to diagnose and correct common problems. First check for simple causes such as a dead engine starting battery or an open circuit breaker. The charts include a list of common problems, possible causes of the problem, recommended corrective actions, and references to detailed information or repair procedures.

Maintain a record of repairs and adjustments performed on the equipment. Use the record to help describe the problem and repairs or adjustments made to the equipment.

### 6.2 Generator Set and Controller

Refer to the following charts for generator set and controller troubleshooting. Generator set maintenance schedules and procedures are covered in the Generator Set Maintenance Manual. Some of the corrective actions may reference the alternator and/or controller service manual for additional troubleshooting information.

### 6.3 Engine

Refer to the following charts for general engine troubleshooting. Refer to the engine operation manual and/or engine service manual for all specific engine troubleshooting.

### 6.4 Transfer Switch

Some applications may use an automatic transfer switch. Some of the following charts may reference transfer switch components and/or literature. Refer to the transfer switch manuals as needed.



## 6.5 General Troubleshooting Chart

Trouble Symptoms		Probable Causes	Recommended Actions	Section or Publication Reference*
Does not crank	X	Controller circuit board(s) inoperative	Replace the controller. †	Gen. S/M
Cranks but does not start	X	Wiring fault	Check the wiring.	W/D
Starts hard		Controller fault	Troubleshoot the controller. †	Gen. S/M
No or low output voltage	X	Power to the controller is interrupted; no power to the controller.	Check for power battery power to the controller. If fuse does not auto-reset troubleshoot the controller wiring. †	W/D, Controller S/M
Stops suddenly	X	Controller master control buttons inoperative	Replace the controller. †	Controller S/M
Lacks power	X	Controller master control button in the OFF/RESET mode	Press the controller RUN or AUTO button.	Section 2
Overheats		Engine start circuit open	Press the controller master control RUN button to test the generator set. Troubleshoot the engine start circuit and time delays.	Section 2, W/D, Gen. I/M, S/M, ATS O/M, S/M
High fuel consumption		Emergency stop switch activated, if equipped	Reset the emergency stop switch. Check the remote emergency stop switch, if equipped.	Section 2
Excessive or abnormal noise		Voltage regulation inoperative	Replace the junction box sensing fuses. If the fuse blows again, troubleshoot the controller. †	W/D, Gen. S/M
Displays error message/locks up	X	Controller firmware error	Review the controller display troubleshooting chart.	Section 5.7
Exercise run time and/or event records inoperative	X	Controller communication error	Verify that RS-485 cable shield wire is connected on only one end.	W/D

\* Sec./Section - numbered section of this manual; ATS - Automatic Transfer Switch; Eng. - Engine; Gen. - Generator Set; I/M - Installation Manual; O/M - Operation Manual; M/M - Maintenance Manual; S/M - Service Manual; S/S - Spec Sheet; W/D - Wiring Diagram Manual  
 †Have an authorized service distributor/dealer perform this service.

Trouble Symptoms	Probable Causes	Recommended Actions	Section or Publication Reference*									
				Exercise run time and/or event records inoperative	Displays error message/locks up	Excessive or abnormal noise	High fuel consumption	Low oil pressure	Overheats	Lacks power	Stops suddenly	No or low output voltage
<b>Alternator</b>												
X		Reset the breaker and check for AC voltage at the generator set side of the circuit breaker.										
		Move the transfer switch test switch to the AUTO position.	ATS O/M									
		Move the ATS test switch to the AUTO position. Troubleshoot the transfer circuit and time delays.	ATS O/M, S/M									
		Check for continuity.	Gen. S/M, W/D									
		Test and/or replace the rotor. †	Gen. S/M									
		Test and/or replace the stator. †	Gen. S/M									
		Tighten loose components. †										
		Check and adjust the voltage regulator. †										
<b>Electrical System (DC Circuits)</b>												
X		Verify that the battery connections are correct, clean, and tight.	I/M or M/M									
X		Recharge or replace the battery. The spec sheet provides recommended battery CCA rating.	S/S									
X		Replace the starter or starter solenoid.	Eng. S/M									
X		Disconnect the engine harness connector(s) then reconnect it to the controller.	W/D									
		Identify and correct the fault condition. Then reset the fault on the controller..	Section 2									

\* Sec./Section - numbered section of this manual; ATS - Automatic Transfer Switch; Eng. - Engine; Gen. - Generator Set; I/M - Installation Manual; O/M - Operation Manual;

M/M - Maintenance Manual; S/M - Service Manual; S/S - Spec Sheet; W/D - Wiring Diagram Manual

†Have an authorized service distributor/dealer perform this service.

Trouble Symptoms	Probable Causes	Recommended Actions	Section or Publication Reference*											
				Exercise run time and/or event records inoperative	Displays error message/locks up	Excessive or abnormal noise	High fuel consumption	Low oil pressure	Overheats	Lacks power	Stops suddenly	No or low output voltage	Starts hard	Cranks but does not start
<b>Engine</b>														
X	X	Air cleaner clogged	Clean or replace the filter element.	Eng. O/M										
X	X	Compression weak	Check the compression. †	Eng. S/M			X							
		Engine overload	Reduce the electrical load. See the generator set spec sheet for wattage specifications.	S/S			X							
		Exhaust system leak	Inspect the exhaust system. Replace damaged or broken exhaust system components. †	I/M			X							
		Exhaust system not securely installed	Inspect the exhaust system. Tighten the loose exhaust system components. †	I/M			X							
		Governor inoperative	Adjust the governor. †	Eng. S/M			X							
		Valve clearance incorrect	Adjust the valves †	Eng. S/M			X							
		Vibration excessive	Tighten all loose hardware.				X							
X	X	Engine ECM and/or sensors	Troubleshoot the engine ECM and/or sensors. †	Eng. O/M, Eng. S/M							X			
<b>Cooling System</b>														
		Air openings clogged	Clean the air openings.				X							
		Coolant level low	Restore the coolant to normal operating level.	M/M or Eng. O/M				X						
		Cooling water pump inoperative	Tighten or replace the belt, if applicable. Replace the water pump.	Eng. O/M or S/M				X						
		High temperature shutdown	Allow the engine to cool down. Then troubleshoot the cooling system.	M/M, or Eng. O/M					X					
		Low coolant level shutdown, if equipped	Restore the coolant to normal operating level.	M/M or Engine O/M					X					
		Thermostat inoperative	Replace the thermostat.	Eng. S/M						X				

\* Sec./Section - numbered section of this manual; ATS - Automatic Transfer Switch; Eng. - Engine; Gen. - Generator Set; I/M - Installation Manual; O/M - Operation Manual; M/M - Maintenance Manual; S/M - Service Manual; S/S - Spec Sheet; W/D - Wiring Diagram Manual  
†Have an authorized service distributor/dealer perform this service.

Trouble Symptoms	Probable Causes	Recommended Actions	Section or Publication Reference*
Exercise run time and/or event records inoperative			
Displays error message/locks up			
Excessive or abnormal noise			
High fuel consumption			
Low oil pressure			
Overheats			
Lacks power			
Stops suddenly	X		
No or low output voltage			
Starts hard	X		
Cranks but does not start	X		
Does not crank	X		
<b>Fuel System</b>			
	Fuel tank empty or fuel valve shut off	Add fuel and move the fuel valve to the ON position.	
	Air in fuel system (diesel only)	Bleed the diesel fuel system.	Eng. O/M
	Fuel filter restriction	Clean or replace the fuel filter.	M/M or Eng. O/M
	Fuel or fuel injectors dirty or faulty (diesel only)	Clean, test, and/or replace the dirty or faulty fuel injector. †	Eng. S/M
	Fuel solenoid inoperative	Troubleshoot the fuel solenoid. †	Eng. S/M
	Fuel injection timing out of adjustment (diesel only)	Adjust the fuel injection timing. †	Eng. S/M
	Fuel feed or injection pump inoperative (diesel only)	Rebuild or replace the injection pump. †	Eng. S/M
<b>Lube System</b>			
	Oil level low	Restore the oil level. Inspect the generator set for oil leaks.	M/M or Eng. O/M
	Low oil pressure shutdown	Check the oil level.	M/M or Eng. O/M
	Crankcase oil type incorrect for ambient temperature	Change the oil. Use oil with a viscosity suitable for the operating climate.	M/M or Eng. O/M

\* Sec./Section - numbered section of this manual; ATS - Automatic Transfer Switch; Eng. - Engine; Gen. - Generator Set; I/M - Installation Manual; O/M - Operation Manual;  
M/M - Maintenance Manual; S/M - Service Manual; S/S - Spec Sheet; W/D - Wiring Diagram Manual  
†Have an authorized service distributor/dealer perform this service.

## 6.6 Controller Display and Voltage Regulation Troubleshooting Chart

Trouble Symptoms	Probable Causes	Recommended Actions	Section or Publication Reference*
<b>Controller Display and Voltage Regulator</b>			
Display is black/off	No/low battery charge	Recharge/replace battery	Generator M/M
Display is black/off	Controller requires reset	Disconnect and reconnect battery voltage to the controller	
Display locks up	No/low battery charge	Recharge/replace battery	Generator M/M
Output voltage ramps	Faulty or damaged exciter winding. Voltage ramp on startup is normal, but ramping past the target without recovering may indicate additional failures in the alternator or excitation circuit.	Troubleshoot alternator components †	Generator S/M
Output voltage unstable	Voltage regulation calibration incorrect	Readjust voltage regulation. †	Controller S/M

\* Sec./Section - numbered section of this manual; ATS - Automatic Transfer Switch; Eng. - Engine; Gen. - Generator Set; I/M - Installation Manual; O/M - Operation Manual; M/M - Maintenance Manual; S/M - Service Manual; S/S - Spec Sheet; W/D - Wiring Diagram Manual  
 †Have an authorized service distributor/dealer perform this service.

## Section 7. Accessories

Accessories are available to help finalize installation, add convenience to operation and service, and establish state and local code compliance. This section describes controller-related accessories available at print time of this publication. See Figure 77. Obtain the most current accessory information from your local authorized service distributor/dealer.

Kit Description
Battery Chargers, 6 Amp and 10 Amp
Failure Relay
Four Input/Fifteen Output Module
Low Fuel Level Switch
Manual Key Switch
Remote Emergency Stop
Remote Serial Annunciator
Shunt Trip Line Circuit Breaker

Figure 77 Optional Accessories

Some accessories are available as factory-installed kits only. Others are available as loose kits for installation in the field by a Kohler trained and authorized distributor or dealer. Accessory kits generally include installation instructions. See the wiring diagram manual for electrical connections. See the installation instructions and drawings supplied with the kit for information on kit mounting location.

### 7.1 Battery Chargers

The following battery chargers are available for the generator sets covered in this manual:

- 6 amp, 12 volt battery charger
- 10 amp battery charger with alarms (meets NFPA requirements)

Refer to the documentation provided with the battery charger for installation and operation instructions.

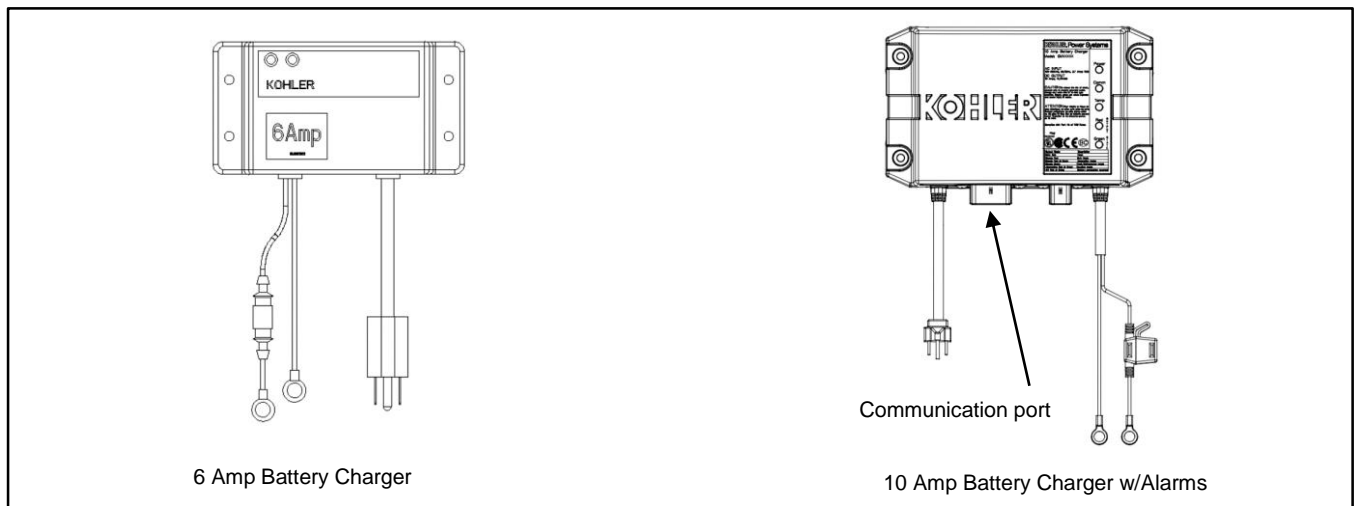


Figure 78 Battery Chargers

## 7.2 Common Failure Relay

The common failure relay kit provides one set of contacts to trigger user-provided warning devices if a fault occurs. The events shown in Figure 79 are factory-assigned to the common fault relay output. A Kohler authorized distributor or dealer can change the events assigned to the common fault relay using a personal computer and Kohler SiteTech™ software.

Alternator Thermal Protection Shutdown
ECM Mismatch Shutdown
High Oil Temperature Shutdown
High Coolant Temperature Shutdown ECM DTC
High Coolant Temperature Shutdown
Local Emergency Stop Shutdown
Low Oil Pressure Shutdown ECM DTC
Loss ECM Comms Shutdown
Low Fuel Level Shutdown
Low Oil Pressure Shutdown
Over Crank Shutdown
Over Current L1 Shutdown
Over Frequency Shutdown
Over Power Shutdown
Over Voltage Shutdown Line-Line
Over Voltage Shutdown Line-Neutral
Over Speed Shutdown
Protective Relay Shutdown Reverse VAR
Protective Relay Shutdown Reverse Power
Protective Relay Shutdown Over Current
Protective Relay Shutdown Over Power
Remote Emergency Stop Shutdown
UL Over Power Shutdown
Under Frequency Shutdown
Under Voltage Shutdown Line-Line
Under Voltage Shutdown Line-Neutral

Figure 79 Factory-Set Common Faults

### 7.3 Four-Input/Fifteen-Output Module

The optional four-input/fifteen-output module provides the following inputs and outputs for connection to customer equipment.

- Four digital inputs
- Two analog inputs
- One common fault relay output
- Fourteen programmable relay outputs

The relay outputs provide normally open or normally closed contacts to activate warning devices and other user-provided accessories, allowing remote monitoring of the generator set. Connect any controller fault output to the input/output module. Typically, lamps, audible alarms, or other devices signal the fault conditions.

A personal computer and Kohler® SiteTech™ software are required for assigning the inputs and outputs. Contact a Kohler authorized distributor or dealer to set up the four-input/fifteen-output module.

When a generator fault condition occurs, the corresponding relay energizes. The relay contact corresponds to the controller output being activated.

Refer to the generator set Installation manual or instructions provided with the kit for installation instructions. Check the electrical requirements of the user-supplied accessories prior to installation of the module. User-supplied accessories require their own electrical source and must not exceed the relay contact ratings shown in Figure 80. For electrical connections, see the generator set wiring diagrams in the Wiring Diagram Manual.

Output Contacts	Ratings
K1 to K14 Normally Open (NO) / Normally Closed (NC) Relay Contacts	10 amps @ 120 VAC 10 amps @ 28 VDC (max.) 0.01 amp @ 28 VDC (min.)
K15 Common Fault Relay Contact	500 mA @ 125 VAC 2 amps @ 30 VDC

Figure 80 Output Contact Specifications



## 7.4 Manual Key Switch

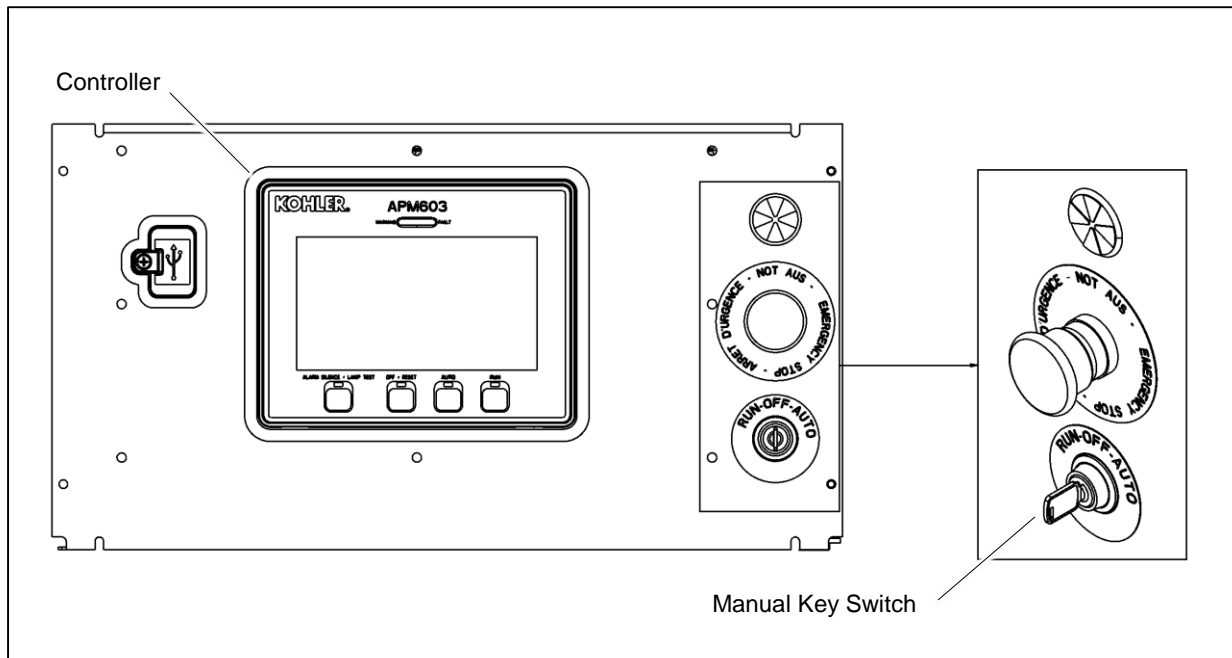


Figure 81 Manual Key Switch Location

### Optional Key Switch

A three-position key switch is available. The key switch allows the controller to be locked in standby mode, which may be required by some local codes. See Figure 81 for the key switch location.

The RUN, OFF, and AUTO positions on the key switch operate as described below.

- **RUN**

When the key is moved to the RUN position, the generator set starts and runs until the OFF or AUTO button is pressed or until a fault condition causes the generator set to shut down.

- **OFF**

When the key is placed in the OFF position, the generator set shuts down immediately, without running the engine cooldown cycle. The generator set will not respond to remote start commands when the key is in the OFF position.

- **AUTO**

Moving the key to the AUTO position places the generator set in Standby mode. The generator set will start and run when a remote start signal is received. The key can be removed only when the switch is in AUTO, locking the generator set in standby mode.

### Controller Pushbuttons

When the controller is equipped with the optional key switch, the functions of the pushbuttons on the controller are affected.

- For normal starting and stopping, the key switch overrides the pushbuttons on the controller.
  - When the key is in the RUN position, pressing OFF/RESET on the controller does not stop the generator set.
  - When the key switch is in the OFF position, pressing the RUN button on the controller will not start the generator set. Pressing AUTO + RUN simultaneously will signal the generator set to start.
- To clear a fault condition, press and hold the OFF/RESET button on the controller for 3 seconds. The key switch does not clear faults from the controller.
- The Alarm Silence/Lamp Test button function does not change when a key switch is installed.

## Emergency Stop

The Emergency Stop button overrides the key switch and the controller pushbuttons. Pressing the Emergency stop button will shut down the generator set regardless of the key switch position. To clear the Emergency stop fault from the controller, first reset the switch and then press the OFF/RESET button on the controller for 3 seconds. The key switch cannot be used to clear the E-Stop fault.

## 7.5 Remote Emergency Stop Kit

The emergency stop (E-stop) kit allows immediate shutdown of the generator set from a remote location. If the emergency stop switch is activated, the EMERGENCY STOP lamp lights and the unit shuts down immediately, bypassing the engine cooldown cycle. Before attempting to restart the generator set, reset the emergency stop switch and reset the generator set by pressing and holding the OFF/RESET button for 3 seconds.

Two emergency stop kits are available. See Figure 82 and the following instructions.

### 7.5.1 Remote emergency stop kit.

This switch uses a glass piece that must be replaced after activation.

1. To stop the generator set, pull down on the handle, breaking the glass piece.
2. To reset the emergency stop switch, return the handle to the original position and replace the glass piece with a new one.
3. Press and hold the controller's OFF/RESET button for 3 seconds.

Use the single glass piece located inside the switch for replacement and order additional glass pieces as service parts.

### 7.5.2 Lockable Emergency Stop Switch

This switch can be locked in the activated position to prevent generator set starting. Use a customer-provided locking device inserted into the holes in the shroud to lock the switch until the generator set can be operated safely.

### Operation

Press the red STOP button to shut down the generator set in an emergency.

Using the emergency stop button bypasses the engine cooldown cycle, stopping the engine immediately. The emergency stop LED on the RSA III lights (if equipped) and the unit shuts down. The generator set cannot be restarted until the emergency stop switch(es) is/are reset.

### Lockout/Tagout

The emergency stop button can be locked in the STOP position. Insert a lock through two openings in the yellow shroud to prevent the stop button from being pulled out. See Figure 82. Remove the lock for normal operation.

A lock is not required in order to keep the switch activated. The switch button will stay depressed until it is pulled out by the operator.

### Resetting the Emergency Stop Switch

To reset the E-stop switch, remove the locking device and pull the button out. Reset the controller by pressing and holding the OFF/RESET button for 3 seconds.

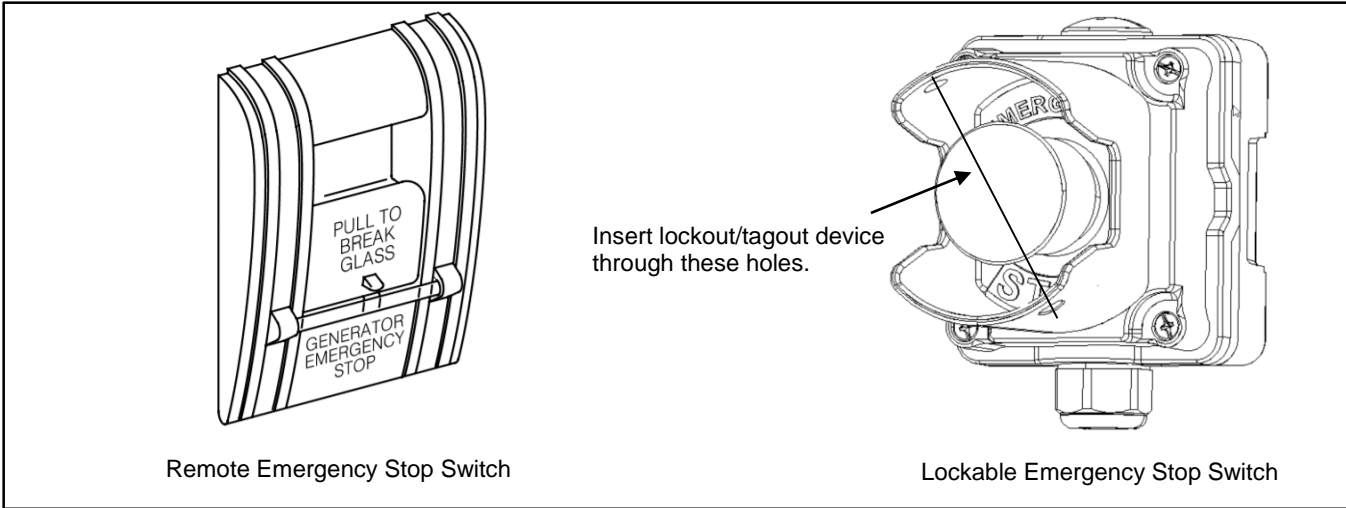


Figure 82 Remote Emergency Stop Switches

## 7.6 Remote Serial Annunciator

The RSA III is an annunciator panel offered in several kit configurations to support Kohler power equipment. See Figure 83. The RSA III is a remote serial annunciator that monitors the status of the generator set and/or ATS from a remote location. The RSA III alerts the operator through visual and audible signals using LED indication and a horn. An alarm silence / lamp test switch is included.

The RSA III meets NFPA 110, Level 1 (2005) applications that require remote controls and alarms be powered by a storage battery such as the engine starting battery. AC adaptor kit GM62466-KP1 is available when NFPA is not required.

The front panel decals include areas that can be used to identify user-selected fault inputs and identify associated power system equipment.

An RSA III annunciator can be used for a single generator set or with a combination of a generator set and automatic transfer switch. In systems using more than a single RSA III, one must be designated as the master device to broadcast to additional RSA III annunciators, designated as slave devices. Up to five RSA III slave devices can be used with an RSA III master device. All RSA III annunciators are factory set as the master device, but can be changed to a slave device using a PC and SiteTech™ software that connects to the RSA III front panel via a universal serial bus (USB) connection.

The RSA II and RSA 1000 can be connected with the RSA III provided that the master remote annunciator is an RSA III.

Refer to TT-1625 Remote Serial Annunciator (RSA III) Kits for operation and installation instructions.

**A personal computer with SiteTech™ software is required** to make the RSA III functional. SiteTech is available to Kohler authorized distributors and dealers. Refer to TP-6701, SiteTech Software Operation Manual, for more information.

The RSA III kits include components for surface mounting or flush mounting.

Figure 84 shows the status of the system ready LED, generator set running LED, communication status LED, common fault LED, common fault output, and horn for each fault or status condition.

If a fault occurs, the RSA III horn activates and the corresponding LED illuminates. The following paragraphs describe specific features of the RSA III.

If the RSA III is used with an Ethernet communication network, order Modbus® Ethernet converter GM41143-KP2 and refer to TT-1405 Converters, Connections, and Controller Setup for Network Communication for system installation.

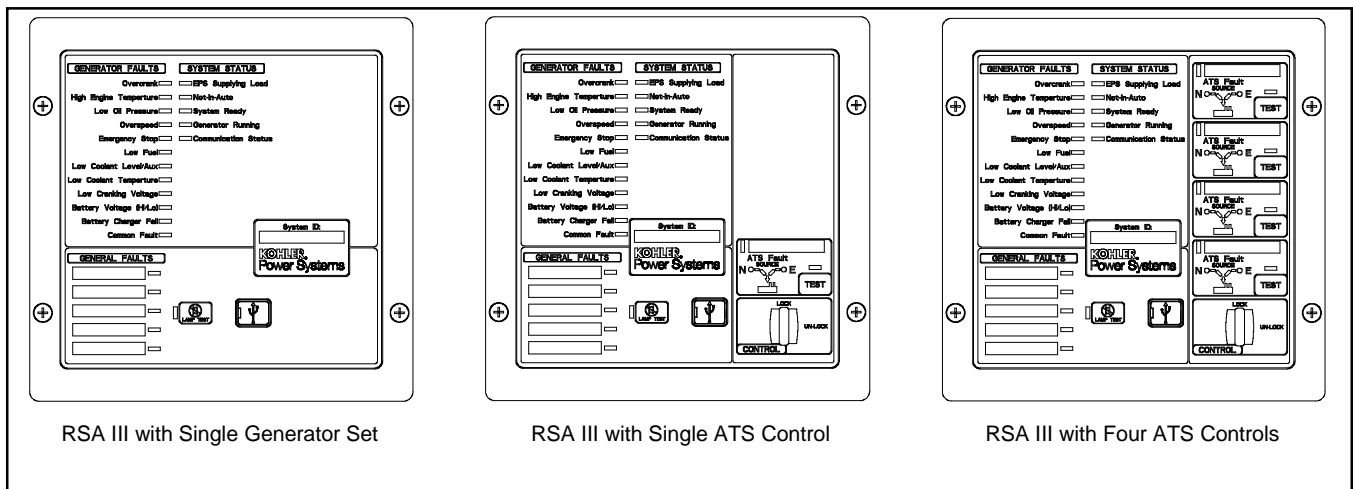


Figure 83 Remote Serial Annunciator (RSIII)

Fault and Status Condition	Fault LED	System Monitoring LEDs and Functions					
		System Ready LED	Generator Running LED	Communications Status LED	Common Fault LED	Common Fault Output	Horn
Overcrank (Shutdown)	Red SF	Red SF	Off	Green	Red SF	On	On
High Engine Temperature (Warning)	Yellow SF	Red SF	Green	Green	Yellow SF	On	On
High Engine Temperature (Shutdown)	Red SF	Red SF	Off	Green	Red SF	On	On
Low Oil Pressure (Warning)	Yellow SF	Red SF	Green	Green	Yellow SF	On	On
Low Oil Pressure (Shutdown)	Red SF	Red SF	Off	Green	Red SF	On	On
Overspeed (Shutdown)	Red SF	Red SF	Off	Green	Red SF	On	On
Emergency Stop	Red SF	Red SF	Off	Green	Red SF	On	On
Low Coolant Level/Aux (Shutdown)	Red SF	Red SF	Off	Green	Red SF	On	On
Low Coolant Temperature	Yellow SF	Red SF	Green or Off	Green	Yellow SF	On	On
Low Fuel (Level or Pressure)	Yellow SF	Red SF	Green or Off	Green	Yellow SF	On	On
Low Cranking Voltage	Yellow SF	Red SF	Off	Green	Yellow SF	On	On
Battery Voltage (Hi)	Yellow	Red SF	Green or Off	Green	Yellow SF	On	On
Battery Voltage (Lo)	Yellow SF	Red SF	Green or Off	Green	Yellow SF	On	On
Battery Charger Fail	Yellow SF	Red SF	Green or Off	Green	Yellow SF	On	On
Common Fault (Warning)	Yellow SF	Green	Green or Off	Green	Yellow SF	On	Off
Common Fault (Shutdown)	Red SF	Green	Green or Off	Green	Red SF	On	On
User-Defined Digital Input 1 (Warning)	Yellow SF	Green	Green or Off	Green	Off	Off	Off
User-Defined Digital Input 1 (Shutdown)	Red FF	Green	Green or Off	Green	Off	On	On
User-Defined Digital Input 2 (Warning)	Yellow SF	Green	Green or Off	Green	Off	Off	Off
User-Defined Digital Input 2 (Shutdown)	Red FF	Green	Green or Off	Green	Off	On	On
User-Defined Digital Input 3 (Warning)	Yellow SF	Green	Green or Off	Green	Off	Off	Off
User-Defined Digital Input 3 (Shutdown)	Red FF	Green	Green or Off	Green	Off	On	On
User-Defined Digital Input 4 (Warning)	Yellow SF	Green	Green or Off	Green	Off	Off	Off
User-Defined Digital Input 4 (Shutdown)	Red FF	Green	Green or Off	Green	Off	On	On
User-Defined Digital Input 5 (Warning)	Yellow SF	Green	Green or Off	Green	Off	Off	Off
User-Defined Digital Input 5 (Shutdown)	Red FF	Green	Green or Off	Green	Off	On	On
ATS Position N (RSA III with ATS only)	Green	Green	Green or Off	Green	Off	Off	Off
ATS Position E (RSA III with ATS only)	Red	Red SF	Green or Off	Green	Off	Off	Off
ATS Available N (RSA III with ATS only)	Green	Green	Green or Off	Green	Off	Off	Off
ATS Available E (RSA III with ATS only)	Red	Red SF	Green or Off	Green	Off	Off	Off
ATS Test (RSA III with ATS only, Test initiated at ATS)	Yellow	Green	Green or Off	Green	Off	Off	On
ATS Test (RSA III with ATS only, Test initiated at RSA)	Green	Green	Green or Off	Green	Off	Off	On
ATS Fault (RSA III with ATS only, No fault)	Green	Green	Green or Off	Green	Off	Off	On
ATS Fault (RSA III with ATS only, With fault)	Red FF	Red SF	Green or Off	Green	Off	Off	On
EPS Supplying Load	Green	Green	Green or Off	Green	Off	Off	Off
Not-In-Auto	Red FF	Red SF	Off	Green	Yellow SF	On	On
Communication Status (Loss - Master)	Red FF	Off	Off	Red FF	Off	On	On
Communication Status (Loss - Slave)	Red SF	Off	Off	Red SF	Off	On	On

**Note:** SF = Slow Flash (once per second), FF = Fast Flash (five times per second)

Figure 84 RSA III System Monitoring LEDs and Functions

## **7.7 Shunt Trip Line Circuit Breaker**

A shunt-trip line circuit breaker provides a 12- or 24-DC volt solenoid within the line circuit breaker case that can energize the trip mechanism. This feature allows the circuit breaker to be tripped by a customer-selected fault or event such as alternator overload, overspeed, overvoltage, or defined common fault. The shunt-trip kit is factory-installed and connected to the circuit breaker. The output or event can be assigned using Kohler SiteTech software. SiteTech software is available to Kohler-authorized distributors and dealers.



## Appendix A. Abbreviations

A, amp	ampere	blk. htr.	block heater	DAC	digital to analog converter
ABDC	after bottom dead center	BMEP	brake mean effective pressure	dB	decibel
AC	alternating current	bps	bits per second	dB(A)	decibel (A weighted)
A/D	analog to digital	br.	Brass	DC	direct current
ADC	advanced digital control; analog to digital converter	BTDC	before top dead center	DCR	direct current resistance
adj.	adjust, adjustment	Btu	British thermal unit	DEF	diesel exhaust fluid
ADV	advertising dimensional drawing	Btu/min.	British thermal units per minute	deg., °	degree
AGM	absorbent glass mat	C	Celsius, centigrade	dept.	department
Ah	amp-hour	cal.	Calorie	dia.	Diameter
AHWT	anticipatory high water temperature	CAN	controller area network	DI/EO	dual inlet/end outlet
AISI	American Iron and Steel Institute	CARB	California Air Resources Board	DIN	Deutsches Institut fur Normung e. V. (also Deutsche Industrie Normenausschuss)
ALOP	anticipatory low oil pressure	CAT5	Category 5 (network cable)	DIP	dual inline package
alt.	alternator	CB	circuit breaker	DPDT	double-pole, double-throw
Al	aluminum	CC	crank cycle	DPST	double-pole, single-throw
ANSI	American National Standards Institute (formerly American Standards Association, ASA)	cc	cubic centimeter	DS	disconnect switch
AO	anticipatory only	CCA	cold cranking amps	DVR	digital voltage regulator
APDC	Air Pollution Control District	ccw.	Counterclockwise	E <sup>2</sup> PROM, EEPROM	electrically-erasable programmable read-only memory
API	American Petroleum Institute	CEC	Canadian Electrical Code	E, emer.	emergency (power source)
approx.	approximate, approximately	cert.	certificate, certification, certified	EATS	Exhaust Aftertreatment System
APU	Auxiliary Power Unit	cfh	cubic feet per hour	ECM	electronic control module, engine control module
AQMD	Air Quality Management District	cfm	cubic feet per minute	EDI	electronic data interchange
AR	as required, as requested	CG	center of gravity	EFR	emergency frequency relay
AS	as supplied, as stated, as suggested	CID	cubic inch displacement	e.g.	for example (exempli gratia)
ASE	American Society of Engineers	CL	centerline	EG	electronic governor
ASME	American Society of Mechanical Engineers	cm	centimeter	EGSA	Electrical Generating Systems Association
assy.	Assembly	CMOS	complementary metal oxide substrate (semiconductor)	EIA	Electronic Industries Association
ASTM	American Society for Testing Materials	com	communications (port)	EI/EO	end inlet/end outlet
ATDC	after top dead center	coml	commercial	EMI	electromagnetic interference
ATS	automatic transfer switch	Coml/Rec	Commercial/Recreational	emiss.	Emission
auto.	Automatic	conn.	Connection	eng.	Engine
aux.	auxiliary	cont.	continued	EPA	Environmental Protection Agency
avg.	average	CPVC	chlorinated polyvinyl chloride	EPS	emergency power system
AVR	automatic voltage regulator	crit.	Critical	ER	emergency relay
AWG	American Wire Gauge	CRM	Common Rail Manifold	ES	engineering special, engineered special
AWM	appliance wiring material	CSA	Canadian Standards Association		
bat.	Battery	CT	current transformer	ESD	electrostatic discharge
BBDC	before bottom dead center	Cu	copper	est.	estimated
BC	battery charger, battery charging	cUL	Canadian Underwriter's Laboratories	E-Stop	emergency stop
BCA	battery charging alternator	cu. in.	cubic inch	etc.	et cetera (and so forth)
BCI	Battery Council International	cw.	Clockwise	exh.	exhaust
BDC	before dead center	CWC	city water-cooled	ext.	external
BHP	brake horsepower	cyl.	Cylinder	F	Fahrenheit, female
blk.	black (paint color), block (engine)	D/A	digital to analog	FDS	Fluid Dosing System



FHM	flat head machine (screw)	in.	inch	Lpm	liters per minute
fl. oz.	fluid ounce	in. H <sub>2</sub> O	inches of water	LOP	low oil pressure
flex.	flexible	in. Hg	inches of mercury	LP	liquefied petroleum
freq.	frequency	in. Lb.	inch pounds	LPG	liquefied petroleum gas
FS	full scale	Inc.	incorporated	LS	left side
ft.	foot, feet	ind.	Industrial	L <sub>wa</sub>	sound power level, A weighted
ft. lb.	foot pounds (torque)	int.	internal	LWL	low water level
ft./min.	feet per minute	int./ext.	internal/external	LWT	low water temperature
ftp	file transfer protocol	I/O	input/output	m	meter, milli (1/1000)
g	gram	IP	internet protocol	M	mega (10 <sup>6</sup> when used with SI units), male
ga.	gauge (meters, wire size)	ISO	International Organization for Standardization	m <sup>3</sup>	cubic meter
gal.	gallon	J	joule	m <sup>3</sup> /hr.	cubic meters per hour
gen.	generator	JIS	Japanese Industry Standard	m <sup>3</sup> /min.	cubic meters per minute
genset	generator set	k	kilo (1000)	mA	milliampere
GFI	ground fault interrupter	K	kelvin	man.	manual
GND, ⊕	ground	kA	kiloampere	max.	maximum
gov.	governor	KB	kilobyte (2 <sup>10</sup> bytes)	MB	megabyte (2 <sup>20</sup> bytes)
gph	gallons per hour	KBus	Kohler communication protocol	MCCB	molded-case circuit breaker
gpm	gallons per minute	kg	kilogram	MCM	one thousand circular mils
gr.	grade, gross	kg/cm <sup>2</sup>	kilograms per square centimeter	meggar	megohmmeter
GRD	equipment ground	kgm	kilogram-meter	MHz	megahertz
gr. wt.	gross weight	kg/m <sup>3</sup>	kilograms per cubic meter	mi.	mile
H x W x D	height by width by depth	kHz	kilohertz	mil	one one-thousandth of an inch
HC	hex cap	kJ	kilojoule	min.	minimum, minute
HCHT	high cylinder head temperature	km	kilometer	misc.	miscellaneous
HD	heavy duty	kOhm, kΩ	kilo-ohm	MJ	megajoule
HET	high exhaust temp., high engine temp.	kPa	kilopascal	mJ	millijoule
hex	hexagon	kph	kilometers per hour	mm	millimeter
Hg	mercury (element)	kV	kilovolt	mOhm, mΩ	milliohm
HH	hex head	kVA	kilovolt ampere	MOhm, MΩ	megohm
HHC	hex head cap	kVAR	kilovolt ampere reactive	MOV	metal oxide varistor
HP	horsepower	kW	kilowatt	MPa	megapascal
hr.	hour	kWh	kilowatt-hour	mpg	miles per gallon
HS	heat shrink	kWm	kilowatt mechanical	mph	miles per hour
hsg.	Housing	kWth	kilowatt-thermal	MS	military standard
HVAC	heating, ventilation, and air conditioning	L	liter	ms	millisecond
HWT	high water temperature	LAN	local area network	m/sec.	meters per second
Hz	hertz (cycles per second)	L x W x H	length by width by height	mtg.	mounting
IBC	International Building Code	lb.	pound, pounds	MTU	Motoren-und Turbinen-Union
IC	integrated circuit	lbm/ft <sup>3</sup>	pounds mass per cubic feet	MW	megawatt
ID	inside diameter, identification	LCB	line circuit breaker	mW	milliwatt
IEC	International Electrotechnical Commission	LCD	liquid crystal display	μF	microfarad
IEEE	Institute of Electrical and Electronics Engineers	LED	light emitting diode	μF	microfarad
IMS	improved motor starting	Lph	liters per hour		

N, norm.	normal (power source)	PMG	permanent magnet generator	SCR	silicon controlled rectifier (electrical), selective catalytic reduction (exhaust emissions)
NA	not available, not applicable	pot	potentiometer, potential	s, sec.	second
nat. gas	natural gas	ppm	parts per million	SI	<i>Systeme international d'unites</i> , International System of Units
NBS	National Bureau of Standards	PROM	programmable read-only memory	SI/EO	side in/end out
NC	normally closed	psi	pounds per square inch	sil.	Silencer
NEC	National Electrical Code	psig	pounds per square inch gauge	SMTP	simple mail transfer protocol
NEMA	National Electrical Manufacturers Association	pt.	pint	SN	serial number
NiCd	nickel cadmium	PTC	positive temperature coefficient	SNMP	simple network management protocol
NFPA	National Fire Protection Association	PTO	power takeoff	SPDT	single-pole, double-throw
Nm	newton meter	PVC	polyvinyl chloride	SPST	single-pole, single-throw
NO	normally open	PVC	polyvinyl chloride	spec	specification
no., nos.	number, numbers	PWM	pulse width modulated, pulse width modulation	specs	specification(s)
NPS	National Pipe, Straight	qt.	quart, quarts	sq.	square
NPSC	National Pipe, Straight-coupling	qty.	quantity	sq. cm	square centimeter
NPT	National Standard taper pipe thread per general use	R	replacement (emergency) power source	sq. in.	square inch
NPTF	National Pipe, Taper-Fine	rad.	radiator, radius	SMS	short message service
NR	not required, normal relay	RAM	random access memory	SS	stainless steel
Ns	nanosecond	RDO	relay driver output	std.	standard
OC	overcrank	ref.	reference	stl.	Steel
OD	outside diameter	rem.	Remote	tach.	Tachometer
OEM	original equipment manufacturer	Res/Co ml	Residential/Commercial	TB	terminal block
OF	overfrequency	RFI	radio frequency interference	TCP	transmission control protocol
opt.	option, optional	RH	round head	TD	time delay
OS	oversize, overspeed	RHM	round head machine (screw)	TDC	top dead center
OSHA	Occupational Safety and Health Administration	rly.	Relay	TDEC	time delay engine cooldown
OSHPD	Office of Statewide Health Planning and Development (California)	rms	root mean square	TDEN	time delay emergency to normal
OV	overvoltage	rnd.	Round	TDES	time delay engine start
oz.	ounce	RO	read only	TDNE	time delay normal to emergency
p., pp.	page, pages	ROM	read only memory	TDOE	time delay off to emergency
PC	personal computer	rot.	rotate, rotating	TDON	time delay off to normal
PCB	printed circuit board	rpm	revolutions per minute	temp.	temperature
pF	picofarad	RS	right side	term.	Terminal
PF	power factor	RTDs	resistance temperature detectors	THD	total harmonic distortion
ph., ø	phase	RTU	remote terminal unit	TIF	telephone influence factor
PHC	Phillips® head Crimptiter (screw)	RTV	room temperature vulcanization	tol.	Tolerance
PHH	Phillips® hex head (screw)	RW	read/write	turbo.	Turbocharger
PHM	pan head machine (screw)	SAE	Society of Automotive Engineers	typ.	typical (same in multiple locations)
PLC	programmable logic control	scfm	standard cubic feet per minute	UF	underfrequency

UHF	ultrahigh frequency
UIF	user interface
UL	Underwriter's Laboratories, Inc.
UNC	unified coarse thread (was NC)
UNF	unified fine thread (was NF)
univ.	universal
URL	uniform resource locator (web address)
US	undersize, underspeed
UV	ultraviolet, undervoltage
V	volt
VAC	volts alternating current
VAR	voltampere reactive
VDC	volts direct current
VFD	vacuum fluorescent display
VGA	video graphics adapter
VHF	very high frequency
W	watt
WCR	withstand and closing rating
w/	with
WO	write only
w/o	without
wt.	weight
xfmr	transformer

## Appendix B. Controller Displays from the Engine ECM

The controller display showing engine information is dependent upon the engine manufacturer and the corresponding Engine Control Module (ECM). The following list indicates the engine displays that are available by the engine manufacturer. This information is subject to change by the engine manufacturer.

Some engines do not have an ECM and in some cases the ECM information is not available as a controller display. In these situations, critical information like oil pressure and coolant temperature are displayed by the controller using independent engine sensors not used by the ECM.

<b>Controller Displays as Provided by the Engine ECM (availability subject to change by the engine manufacturer)</b>		
<b>Display</b>	<b>John Deere (JDEC)</b>	<b>Volvo</b>
Ambient temperature		X
Air intake pressure		X
Air intake temperature		X
Barometric pressure		X
Charge air pressure		
Charge air temperature	X	
Coolant level		
Coolant pressure		
Coolant temperature	X	X
Crankcase pressure		
ECM battery voltage		X
ECM fault codes	X	
ECM serial number		
ECM run time hours		X
Engine model number	X	
Engine serial number	X	
Engine speed	X	X
Fuel pressure		X
Fuel rate	X	X
Fuel temperature	X	
Intake manifold pressure		X
Intake manifold Temperature		X
Intercooler Temperature		X
Mechanical Engine Load		X
Oil level		
Oil pressure	X	X
Oil temperature		X
Trip fuel		

## Appendix C. Alternator Protection

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The controller has built-in thermal protection for the alternator. This feature functions similarly to a thermal circuit breaker. When the output current exceeds the nominal rating for a short period of time the condition causes the fault shutdown. The amount of time at which current is over the rating is inversely related to the amount of current above the nominal rating. In other words, the higher the current, the shorter the acceptable time.

The current and time limits are defined by actual test data and are maintained in the personality parameter file. Although the equation for detecting a fault is proprietary, some of the important limits are shown below for informational purposes.

<b>Rated Current</b>	<b>Time Delay</b>
200%	40 seconds
300%	10 seconds
425%	5 seconds
950%	1 second













**TP-7100 2/21b**

*Original Instructions (English)*

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