# Operation

Industrial Generator Set



Models:

## Gaseous-Fueled Generator Sets

Controller:

## APM603

rehlko

TP-7165 2/26c

⚠ **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

## 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 generator set 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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| | |
| | |

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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**

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

**⚠ WARNING**

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

**⚠ CAUTION**

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

| **⚠ WARNING** | |
|---|---|
|  | **Accidental starting.**<br>**Can cause severe injury or death.**<br>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. |

**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.

## Battery

| **⚠ WARNING** | |
|---|---|
|  | **Explosion.**<br>**Can cause severe injury or death.**<br>**Relays in the battery charger cause arcs or sparks.**<br>Locate the battery in a well-ventilated area. Isolate the battery charger from explosive fumes. |

## Engine Backfire/Flash Fire

| ⚠ WARNING | **Risk of fire.**<br>**Can cause severe injury or death.**<br>Do not smoke or permit flames or sparks near fuels or the fuel system. |
|---|---|
|  | |

**Servicing the fuel system. A flash fire can cause severe injury or death.** Do not smoke or permit flames or sparks near the carburetor, fuel line, fuel filter, fuel pump, or other potential sources of spilled fuels or fuel vapors. Catch fuels in an approved container when removing the fuel line or carburetor.

**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

| ⚠ WARNING | **Carbon monoxide.**<br>**Can cause severe nausea, fainting, or death.**<br>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

| ⚠ WARNING | **Explosive fuel vapors.**<br>**Can cause severe injury or death.**<br>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.

**Explosive fuel vapors can cause severe injury or death.** Take additional precautions when using the following fuels:

**Propane (LPG)**—Adequate ventilation is mandatory. Because propane is heavier than air, install propane gas detectors low in a room. Inspect the detectors per the manufacturer's instructions.

**Natural Gas**—Adequate ventilation is mandatory. Because natural gas rises, install natural gas detectors high in a room. Inspect the detectors per the manufacturer's instructions.

**Gas fuel leaks. Explosive fuel vapors can cause severe injury or death.** Fuel leakage can cause an explosion. Check the LPG vapor or natural gas fuel system for leakage by using a soap and water solution with the fuel system test pressurized to 6–8 ounces per square inch (10–14 inches water column). Do not use a soap solution containing either ammonia or chlorine because both prevent bubble formation. A successful test depends on the ability of the solution to bubble.

## Hazardous Noise

| ⚠ CAUTION | **Hazardous noise.**<br>**Can cause hearing loss.**<br>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

| | |
|---|---|
| **DANGER**<br> | **Hazardous voltage.**<br>**Will cause severe injury or death.**<br>Disconnect all power sources before opening the enclosure. |

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

**Short circuits. Hazardous voltage/current will cause severe injury or death.** Short circuits can cause bodily injury and/or equipment damage. Do not contact electrical connections with tools or jewelry while making adjustments or repairs. Remove all jewelry before servicing the equipment.

**Welding on the generator set. Can cause severe electrical equipment damage.** Before welding on the generator set perform the following steps: (1) Remove the battery cables, negative (–) lead first. (2) Disconnect all engine electronic control module (ECM) connectors. (3) Disconnect all generator set controller and voltage regulator circuit board connectors. (4) Disconnect the engine battery-charging alternator connections. (5) Attach the weld ground connection close to the weld location.

## Hot Parts

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

This manual provides operation instructions for gaseous-fueled generator sets 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. Generator set installation and commissioning must be performed by appropriately skilled and suitably trained personnel.

**Note:**
The controller screens shown in illustrations throughout this document are examples. Some parameters shown in the illustrations may not apply to your model or application.

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

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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 |
| Controller Commissioning and Setup Manual, APM603 | TP-7131 |
| Generator Set Maintenance Manual, Powered by Doosan Engines | TP-7167 |
| Generator Set Maintenance Manual, Powered by Rehlko Gaseous Engines | TP-7173 |
| Generator Set/Controller Wiring Diagram Manual | TP-6832 |
| Communication Protocol Operation Manual, APM603 | TP-7151 |
| SiteTech™ Software Manual | TP-6701 |
| Controller Service Manual, APM603 | TP-7149 |
| Controller Service Replacement, APM603 | TT-1779 |
| 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 Rehlko 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. Rehlko SiteTech software is available only to Rehlko -trained and authorized distributors and dealers. Contact your local distributor/dealer for assistance.

# Service Assistance

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

- Visit the company website at powersystems.rehlko.com.
- Look at the labels and decals on your 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.

**Headquarters Europe, Middle East, Africa (EMEA)**

EMEA Headquarters
Netherlands B.V.
Kristallaan 1
4761 ZC Zevenbergen
The Netherlands
Phone: (31) 168 331630
Fax: (31) 168 331631

**Asia Pacific**

Asia Pacific Headquarters
Singapore, Republic of Singapore
Phone: (65) 6264-6422
Fax: (65) 6264-6455

**China**

North China Regional Office, Beijing
Phone: (86) 10 6518 7950
(86) 10 6518 7951
(86) 10 6518 7952
Fax: (86) 10 6518 7955

East China Regional Office, Shanghai
Phone: (86) 21 6288 0500
Fax: (86) 21 6288 0550

**India, Bangladesh, Sri Lanka**

India Regional Office
Bangalore, India
Phone: (91) 80 3366208
(91) 80 3366231
Fax: (91) 80 3315972

**Japan, Korea**

North Asia Regional Office
Tokyo, Japan
Phone: (813) 3440-4515
Fax: (813) 3440-2727

## 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<br>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.

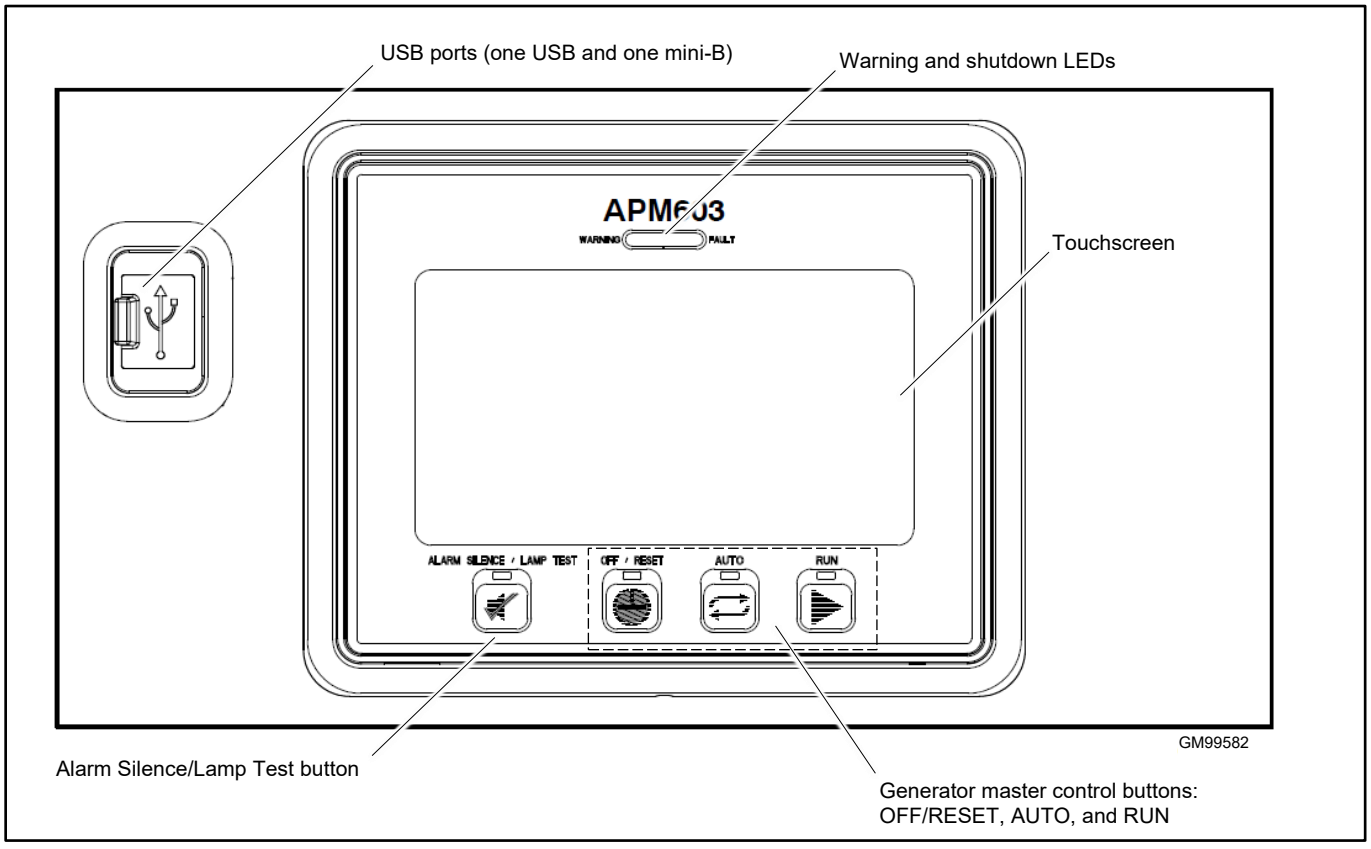


Figure 2 APM603 Controller

**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 the Inputs and Outputs section 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 the Operation section.

**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.<br>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 the Operation section.

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

**Note:**
The screens shown in illustrations throughout this document are examples. Some parameters shown in the illustrations may not apply to your model or application.

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.

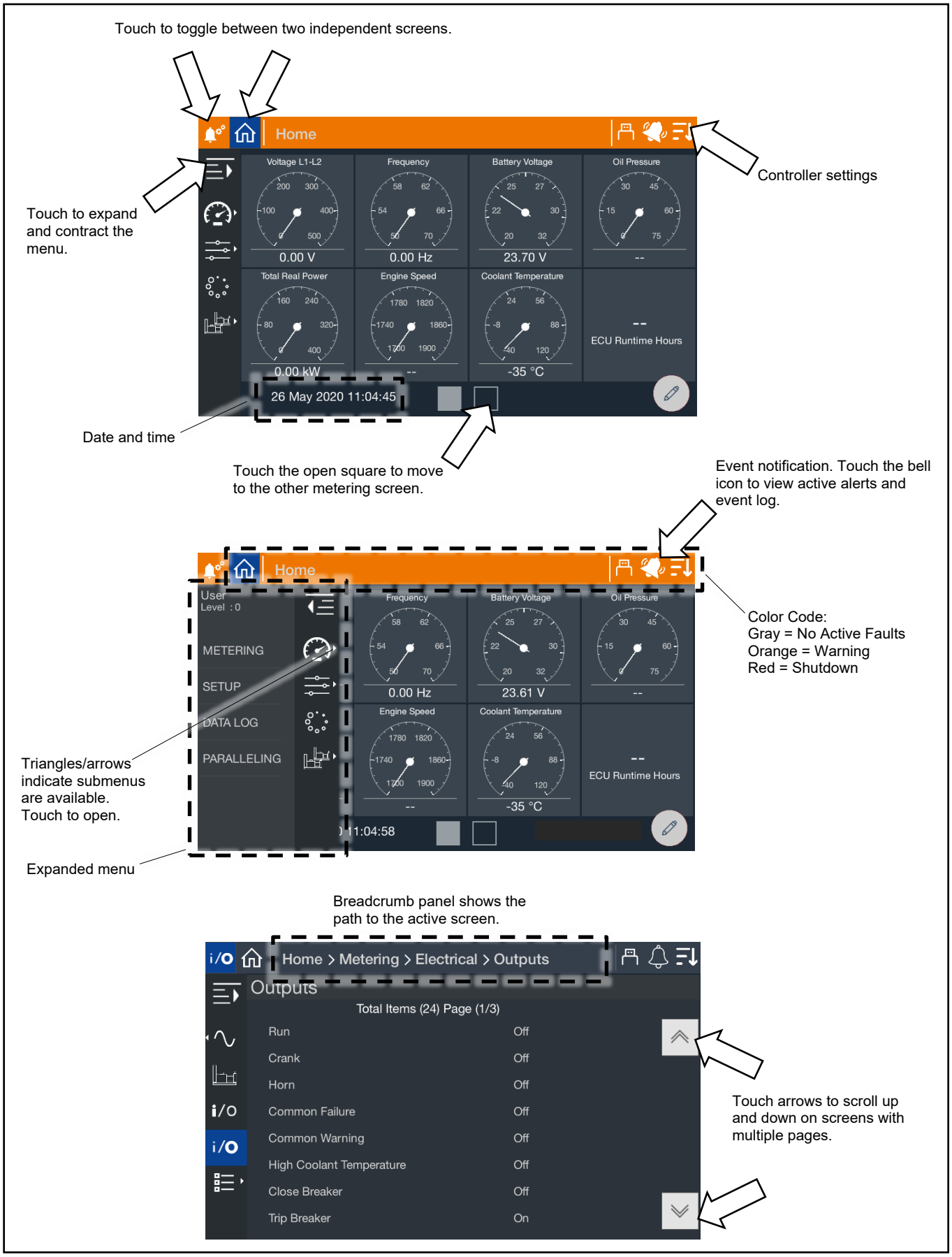


Figure 4 Screen Features and Functions

## 1.4 Run Relay

The run relay is provided as standard equipment with the APM603 controller. The run relay 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 wiring diagrams for connections.

## 1.5 Inputs and Outputs

The controller is equipped with the standard, dedicated inputs and outputs shown in Figure 5 and Figure 6. These onboard inputs and outputs are factory set and cannot be adjusted.

| Inputs | Input Type |
|---|---|
| Remote Engine Start | Two-Wire Input |
| Auxiliary Fault (Shutdown) | Digital Input |
| Auxiliary Warning | |
| Battery Charger Fault | |
| Breaker Closed | |
| Breaker Tripped | |
| Excitation Overvoltage | |
| Fuel Type | |
| Ground Fault Relay | |
| Key Switch Auto | |
| Key Switch Run | |
| Low Fuel Pressure | |
| Emergency Stop, Local | |
| Emergency Stop, Remote | |
| Speed Bias | Analog Voltage Input, Scalable up to +/- 10 VDC |
| Voltage Bias | |

Figure 5 Standard Dedicated User Inputs

| Outputs | Output Type |
|---|---|
| Run | Relay Driver Output |
| Common Failure | |
| Common Warning | |
| Crank | |
| High Coolant Temperature | |
| Horn | |
| Close Breaker * | |
| Trip Breaker/Shunt Trip * | |
| * Only with remote-mounted electrically operated circuit breakers. | |

Figure 6 Standard Dedicated User Outputs

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

## 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.

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

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

| |
|---|
| **Air Cleaner.** Check for a clean and installed air cleaner element to prevent unfiltered air from entering engine. |
| **Air Inlets.** Check for clean and unobstructed air inlets. |
| **Battery.** Check for tight battery connections. Consult the battery manufacturer's instructions regarding battery care and maintenance. |
| **Coolant Level.** Check the coolant level according to the cooling system maintenance information.<br>**Note:**<br>**Block Heater Damage.**<br>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. |
| **Drive Belts.** 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. |
| **Enclosure Doors, if equipped.** 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. |
| **Exhaust System.** Check for exhaust leaks and blockages. Check the silencer and piping condition and check for tight exhaust system connections.<br><br>Inspect the exhaust system components (exhaust manifold, exhaust line, flexible exhaust, clamps, silencer, and outlet pipe) for cracks, leaks, and corrosion.<br><br>Check for corroded or broken metal parts and replace them as needed.<br><br>Check for loose, corroded, or missing clamps and hangers. Tighten or replace the exhaust clamps and/or hangers as needed.<br><br>Check that the exhaust outlet is unobstructed.<br><br>Visually inspect for exhaust leaks (*blowby*). Check for carbon or soot residue on exhaust components. Carbon and soot residue indicates an exhaust leak. Seal leaks as needed. |
| **Lamp Test.** Press the lamp-test button to verify all controller LEDs are operational. |
| **Oil Level.** Check the oil level. Maintain the oil level at or near, not over, the full mark on the dipstick. |
| **Operating Area.** 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. |
| **Radiator.** 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. |
| **Visual Inspection.** 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. |

## 2.2 Generator Set Operation

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

### 2.2.1 Starting and Stopping Functions

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.<br>Press and HOLD the OFF/RESET button for 3 seconds to reset an active fault (shutdown).<br>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 7 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 Rehlko distributor or dealer can make cyclic cranking adjustments using SiteTech™ software.

#### 2.2.1.1 Starting and Stopping Functions, Parallel Operation

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 | 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.<br>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. |
| RUN | Press the RUN button to start the generator set. No other generator sets in the system will start. |
| AUTO | Press AUTO to place the generator set into automatic (standby) mode. The generator set will respond to remote start and remote stop signals.<br>The generator set will start and run when a start signal is received via a remote start, local auto-start, or communications-based start.<br>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.<br>If Generator Management is on, the generator set may shut down after a period of time.<br>When the start signal is removed, the generator set will shut down with the appropriate engine cooldown. |
| AUTO-RUN | Press AUTO and RUN together for a system start signal.<br>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. |
| AUTO-OFF | Press AUTO and OFF together to remove a system start signal, if AUTO-RUN is active.<br>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.<br>**Note:**<br>Pressing AUTO and OFF together stops the generator sets only if there are no other system start signals present. |

### 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 or activate the Remote Reset digital input, if configured.
4. Acknowledge all shutdown events on the controller User Interface.
5. After resetting all faults using the controller reset procedure, press the generator set RUN button, or press the AUTO button and activate the remote start signal, to restart the generator set.

   **Note:**
   The generator set will not crank until the reset procedure is completed.

## 2.3 Maintenance Mode

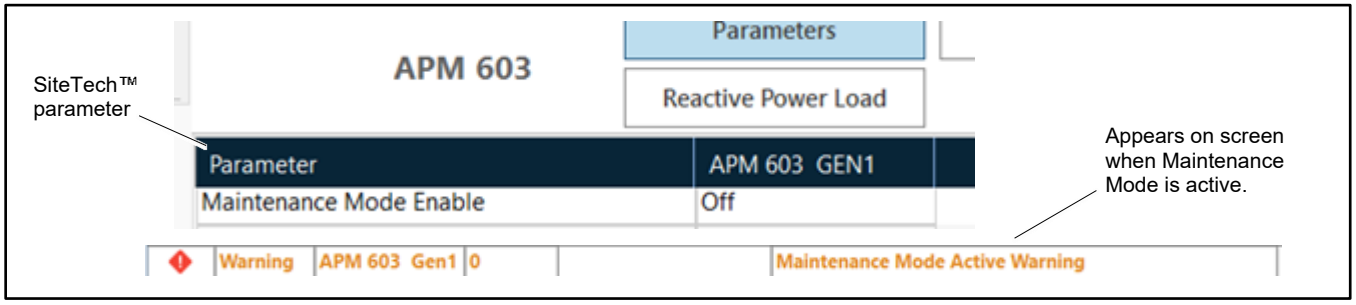


Figure 8 SiteTech™ Parameters and Onscreen Warning

For maintenance or service procedures that must be performed while the generator set is operating, ***Maintenance Mode***, when engaged, lowers the overcurrent threshold and provides extra protection in dangerous situations. The overcurrent level is adjustable from 0-150% of rated current. The user can set the parameter low enough to protect and high enough not to trip under normal circumstances. Note that factory setting for overcurrent is typically 10% of rated current.

Maintenance mode does not alter breaker trip curves. Trip speed is dependent on the shunt trip speed of the breaker making the trip speed constant on all overcurrent settings on the controller. The controller reaction takes place 30 ms after detecting that the current exceeds the specified threshold.

An Arc flash study and selective coordination of the system is recommended to determine that maintenance mode settings will reduce incident energy exposure to levels that can be mitigated by the required personal protective equipment. The resulting study will determine maximum allowable arc current and thus dictate the overcurrent setting in maintenance mode.

Maintenance mode requires:

- Four-input, fifteen-output module (15-600 kW generator sets) or the digital I/O module (700-4000 kW generator sets)
- Shunt trip kit
- Physical switch to operate maintenance mode
- Controller firmware version 3.9

- Controller configuration version 3.9 with Mitsubishi engines; version 3.8 with all other engines [John Deere, Volvo, Doosan, and Rehlko (KG, KDI, KD series)]
- Output status indicator or status light (optional)

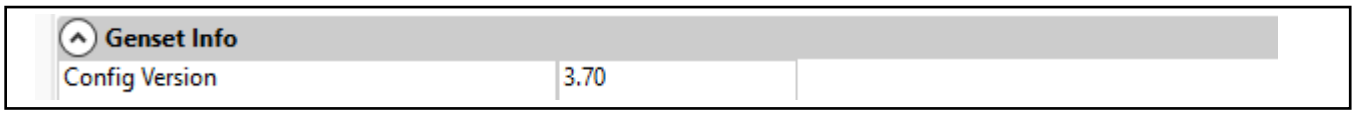


Figure 9 Config Version in SiteTech™

***Maintenance Mode Enable*** parameter must be enabled by an authorized service technician. The service technician must also specify the maintenance mode trip level threshold. When maintenance mode is enabled and the digital input circuit is open, indicating a currently active feature, the controller monitors the designated closed-circuit input. The monitored circuit is typically connected to a physical switch that opens the circuit and activates maintenance mode. When activated, an on-screen prompt (Maintenance Mode Active Warning) appears on the APM603 controller.

## 2.4 Emergency Battle Mode

| NOTICE |
| --- |
| **Emergency Battle Mode. Damage is not covered under warranty.**<br>Emergency battle mode can cause severe or permanent damage to the generator set by overriding shutdown faults and warnings. Be aware of the risks to the generator set before enabling emergency battle mode. |

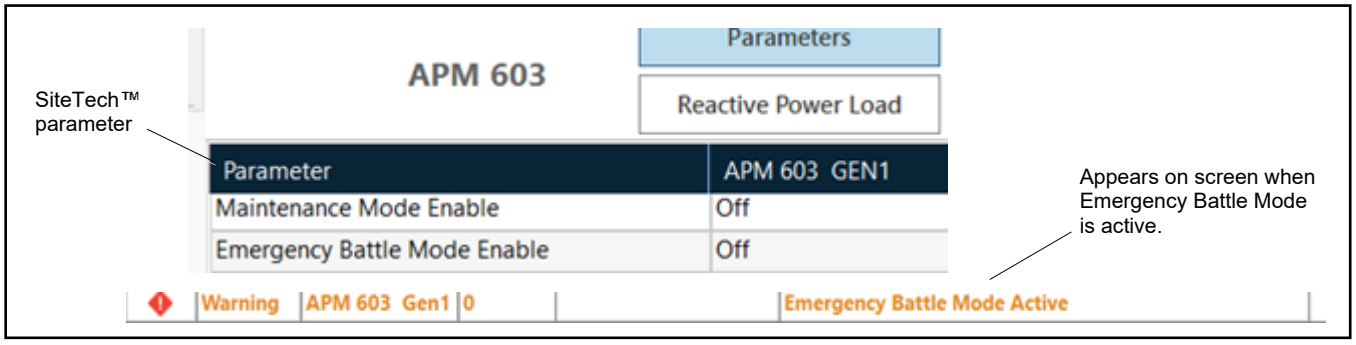


Figure 10 SiteTech™ Parameters and Onscreen Warning

Note that any damage to the generator set resulting from being placed in Emergency Battle Mode is not covered by warranty.

When uninterrupted power is essential for critical emergency operation, ***Emergency Battle Mode*** overrides most shutdowns and warnings except for emergency stop, overspeed, maintenance mode, and shutdown faults from the ECU. This operation allows the generator set to function when continuous power is more important than the potential damage to the generator set.

Emergency battle mode requires:

- Four-input, fifteen-output module (15-600 kW generator sets) or the digital I/O module (700-4000 kW generator sets)
- Controller firmware version 3.9
- Controller configuration version 3.9 (with Mitsubishi engines); 3.8 [with all other models, John Deere, Volvo, Doosan, and Rehlko engines (KG, KDI, KD series)]
- Output status indicator or status light (optional)

**Note:** Use SiteTech™ to verify the configuration version under the Genset Info menu.

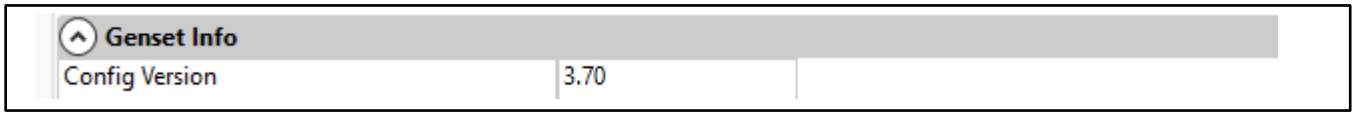


Figure 11 Config Version in SiteTech™

***Emergency Battle Mode Enable*** parameter must be enabled by an authorized service technician. When emergency battle mode is enabled, the controller monitors the designated closed-circuit input. The monitored circuit is typically connected to

essential equipment that needs emergency battle mode support from the generator set and activates emergency battle mode by opening the input. When activated, an on-screen prompt (Emergency Battle Mode Active Warning) appears on the APM603 controller.

While in Battle Mode, the engine ECU determines if a shutdown override request is implemented or ignored. As a result, a generator set in emergency battle mode may still shut down in certain instances depending on the specific engine ECU.

## 2.5 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. The heater helps to prevent moisture and frost buildup on the alternator components.
- **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.

## 2.6 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 30% 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 the Controller Operation section. 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.

## 2.7 Dual Fuel System

Some applications use natural gas as the primary fuel and LP gas as the emergency fuel when natural gas is not available. The automatic changeover dual fuel system allows the system to switch to LP fuel automatically if the natural gas supply is not available.

The dual fuel reset box includes:

- An indicator light that turns on when the system is using LP fuel.
- A reset switch that allows manual return to natural gas, if available.

Once on LP, the fuel system will switch back to natural gas when:

- The LP fuel supply runs out.
- The generator set stops and restarts.
- The reset switch on the dual fuel box is used.

**Procedure to Reset to Natural Gas**

To reset the fuel to natural gas using the reset box, turn the reset switch clockwise and hold it briefly until the changeover occurs. The indicator light turns off when the system has changed back to natural gas.

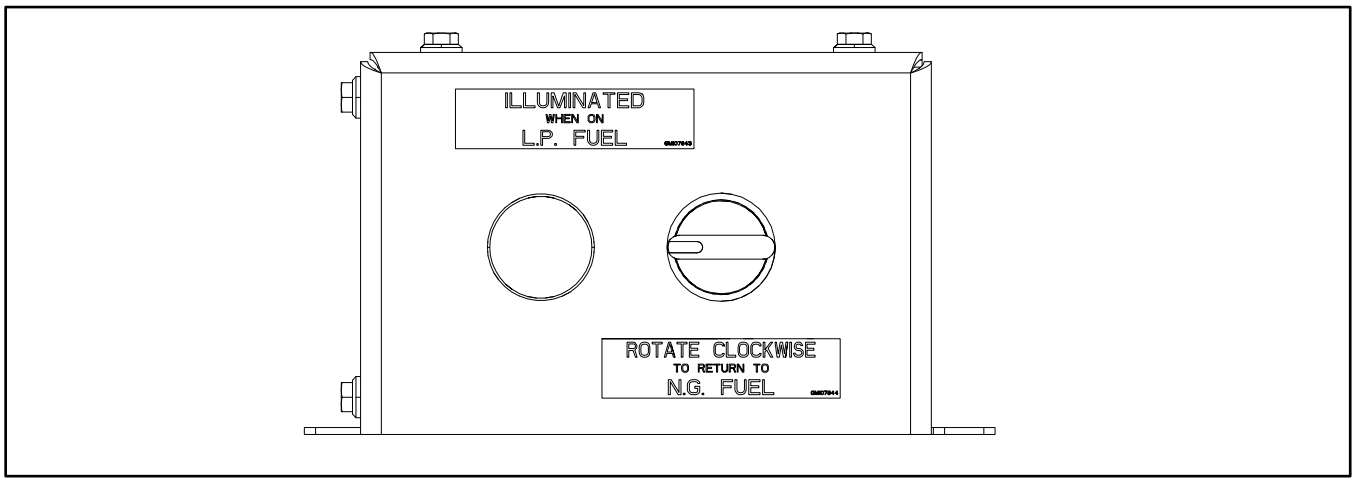


Figure 12 Dual Fuel Reset Box

## 2.8 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.

### 2.8.1 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 the Notifications section 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.

### 2.8.2 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 the Notifications section 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 Resetting the Controller section for information to reset a system shutdown.

### 2.8.3 Fault, Notice, and Status Displays

New warning or shutdown messages appear in a banner across the top of the screen. See Figure 13. Touch ACKNOWLEDGE ALL to close the banner. Touch VIEW ACTIVE ALERTS or the Bell icon to see a list of all active events.

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.

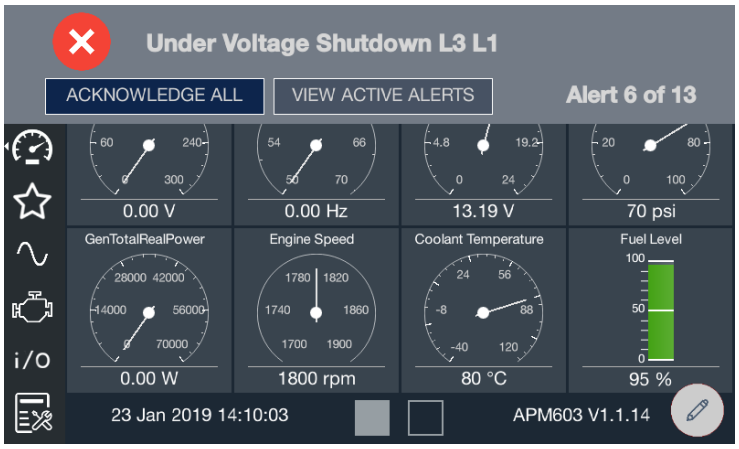


Figure 13 Fault Message Banner

### 2.8.4 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 15 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 Rehlko 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 Rehlko distributor or dealer for service. Do not start the generator set until the condition has been corrected.

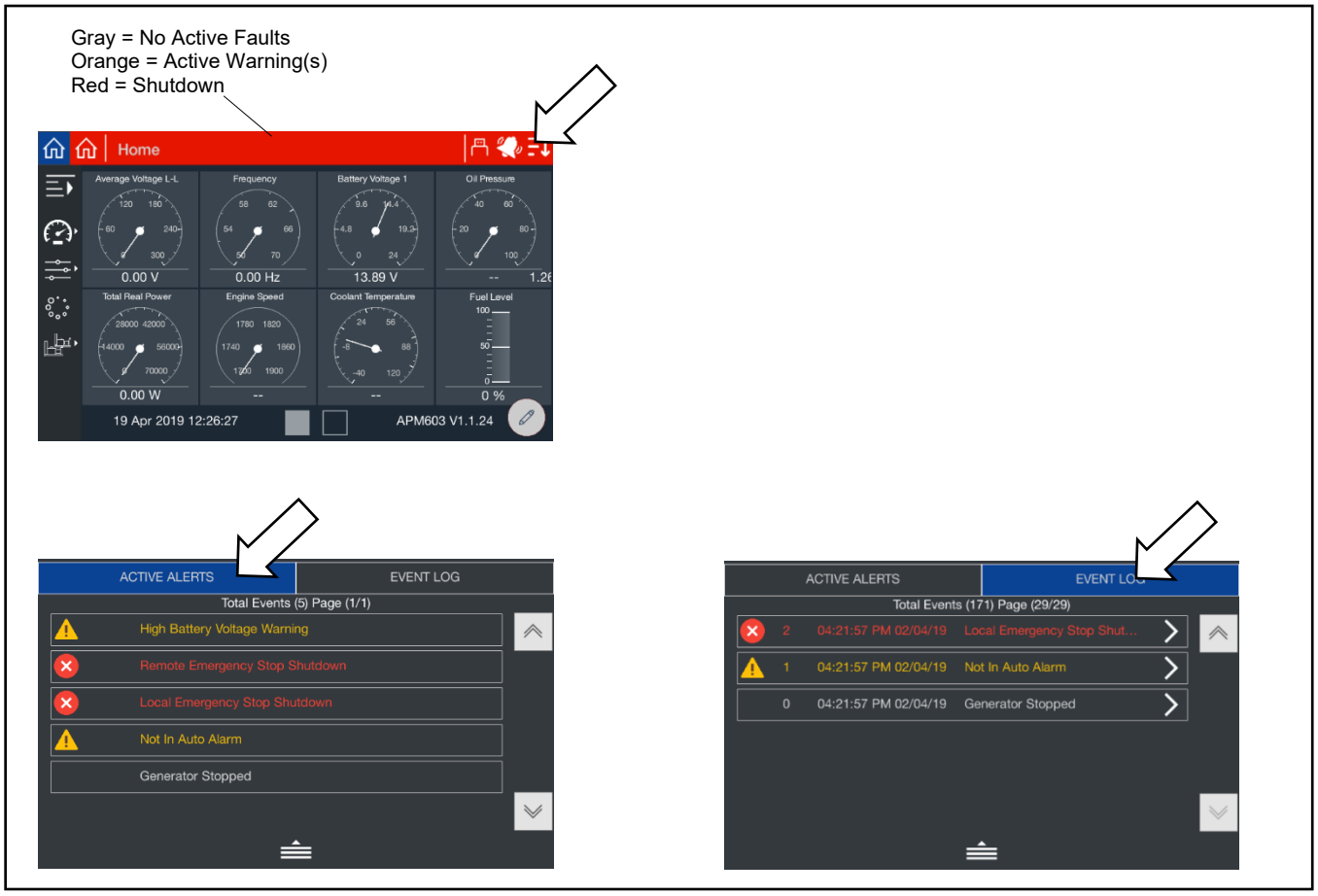


Figure 14 Notifications (Active Alerts and Event Log)

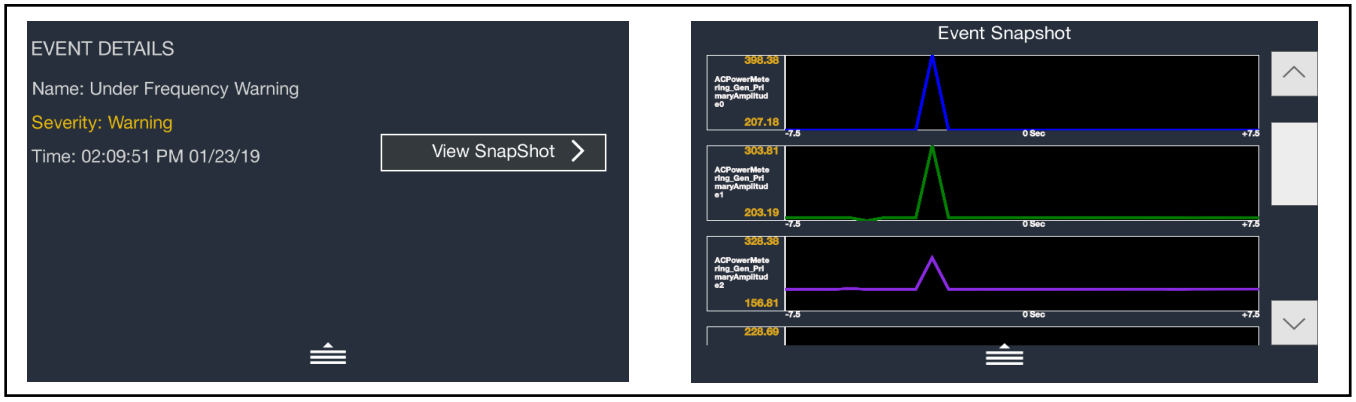


Figure 15 Event Details and Snapshot

**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. See the Event Configuration section for a list of events.

## 2.9 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 the Emergency Stop section 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.

## 2.10 APM603 Logging On and Access Levels

### Access Levels

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 16. The current access level is shown in the upper left corner of the screen when the navigation menu is expanded as shown in Figure 17. The default access level is User.

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 additional selected settings. |
| Technician (2) | Provided to Rehlko trained and authorized distributors and dealers | Includes all Operator level functions plus allows trained and authorized Rehlko distributors or dealers to adjust additional controller settings. |
| Factory (4) | Confidential | Some parameters can only be set at the factory. |

Figure 16 Access Levels

### Logging On to the Controller

Log onto the controller using the Operator or Technician password as described in the procedure below. Refer to Figure 17 for illustrated steps to log on.

### Procedure to Log On to the APM603 Controller

1. Touch or click on the settings symbol in the upper right corner of the screen. See Figure 17. The symbol has three lines and a down arrow.
2. Touch or click on Switch Account.
3. Touch or click on the level that you want to use, Operator or Technician.
4. In the number keypad that appears, touch or click on the numbers for the password. Make sure that a ? symbol appears in the box at the top of the screen as you press each number. Then touch the green check mark.
5. The screen briefly displays a message indicating the level logged into.
6. Touch or click on the arrow symbol at the bottom of the screen.
7. The default session time is 60 minutes. To change the session time, touch or click on Controller Session Login Time Out. Enter the session time in minutes and touch the green check mark.
8. Touch or click on the arrow symbol at the bottom of the screen to close the Session Timeout window. Repeat to close the settings window.
9. The access level is displayed near the upper left corner of the screen when the navigation pane is expanded, as shown.

The numbers below correspond to the steps in the Procedure to Log On to the APM603 Controller.

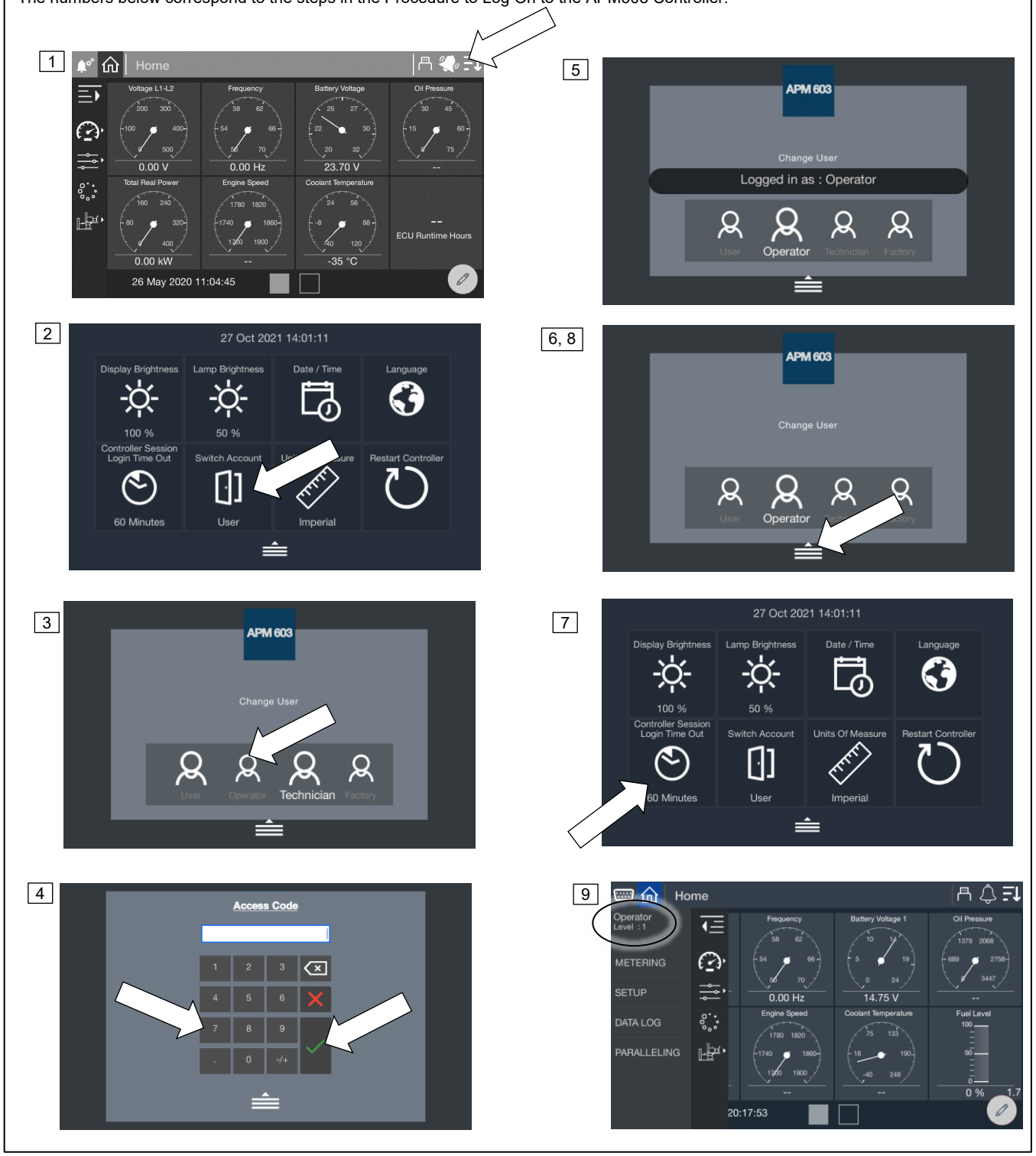


Figure 17 Logging On to the APM603 Controller

The APM603 is equipped with a 7-inch touchscreen display. Use your finger, the blunt end of a pen, or a stylus to navigate through the controller menus as described in the procedures in this manual. As an alternative, a mouse can be used to navigate through the menus. See instructions to connect and use a mouse below.

## 2.11 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.

## 2.12 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.

## 2.13 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.
- Switch Account – 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.
- Units of Measure – Imperial or Metric
- Restart Controller

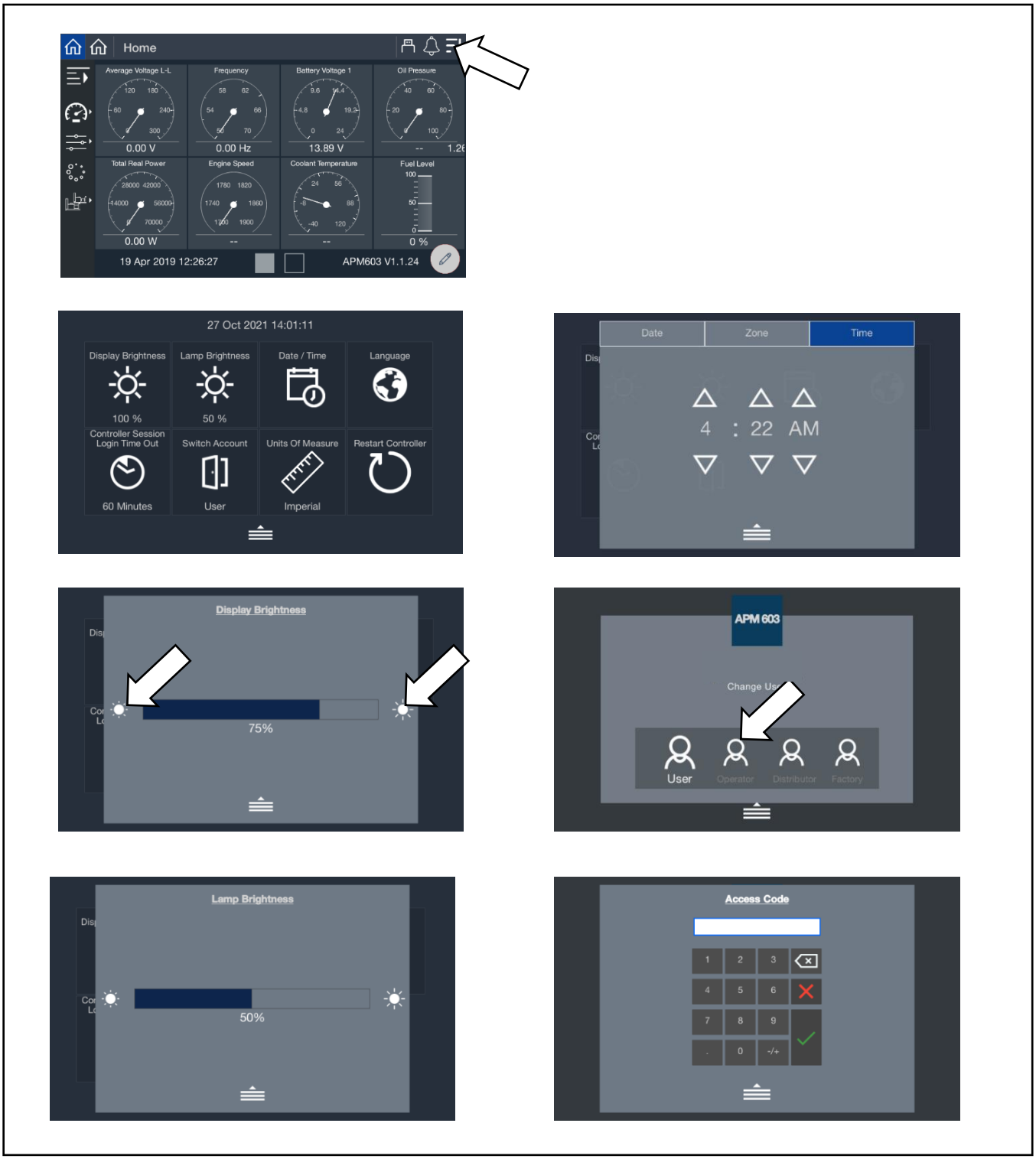


Figure 18 Controller Settings and Access Levels

## 2.14 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 the Controller Features section 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.

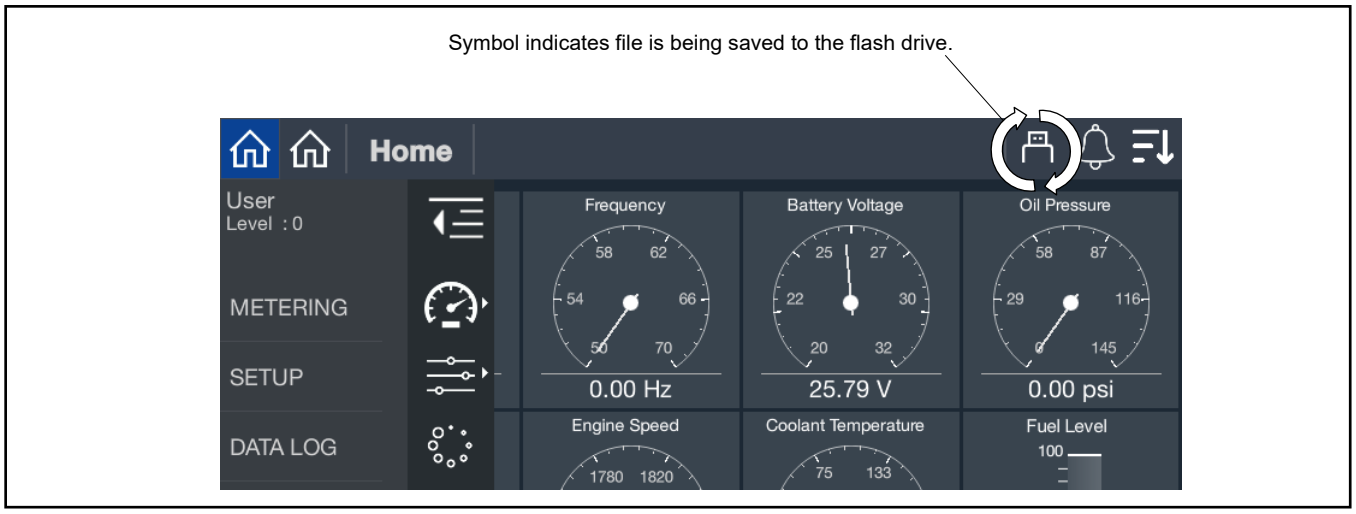


Figure 19 Saving a Screen Shot File

## 2.15 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

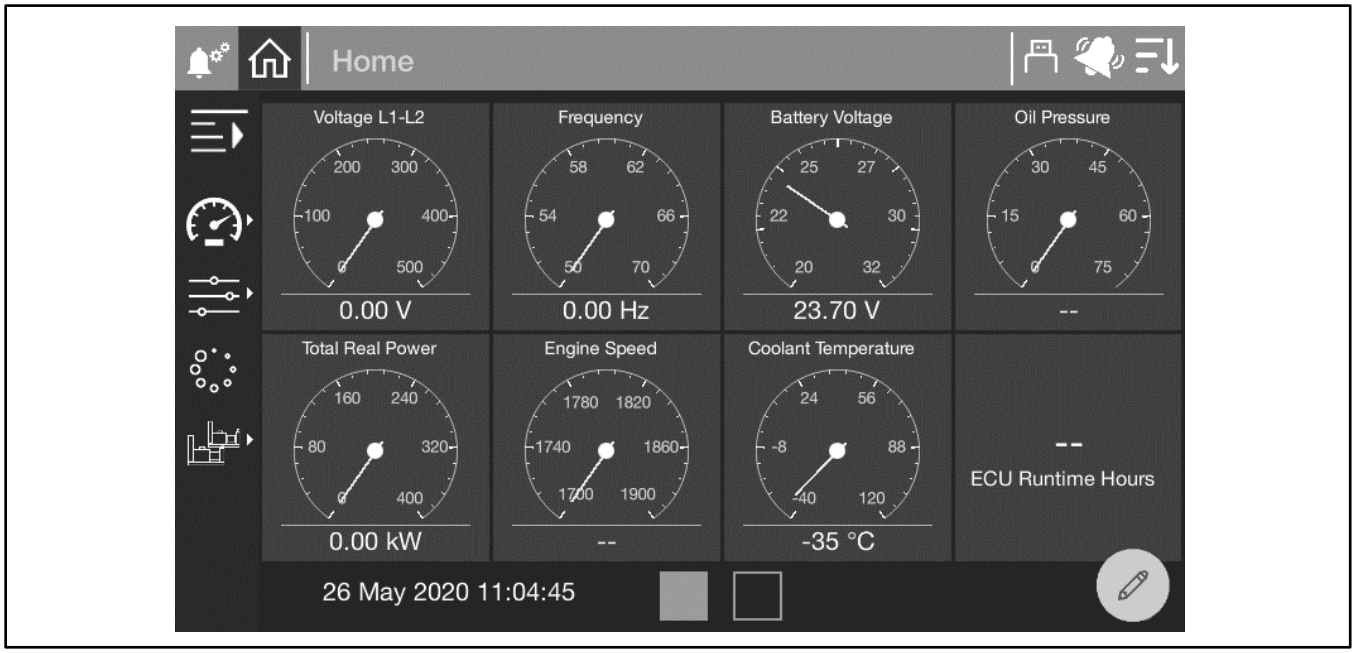


Figure 20 Metering Menu, Expanded

### 3.1.1 Home

At startup, the controller displays the home screen shown in Figure 21. 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 21 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 |
|---|
| Voltage L1 – L2 |
| Frequency |
| Battery Voltage |
| Oil Pressure |
| Total Real Power |
| Engine Speed |
| Coolant Temperature |
| ECU Runtime Hours |
| Voltage L1-N |
| Voltage L2-N |
| Voltage L3-N |
| Total Power Factor |
| Current L1 |
| Current L2 |
| Current L3 |
| Runtime Hours |

Figure 22 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 23 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 23 Removing Gauges from the Home Screen

**Procedure to Add New Gauges to the Home Screen**

Refer to Figure 24 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.

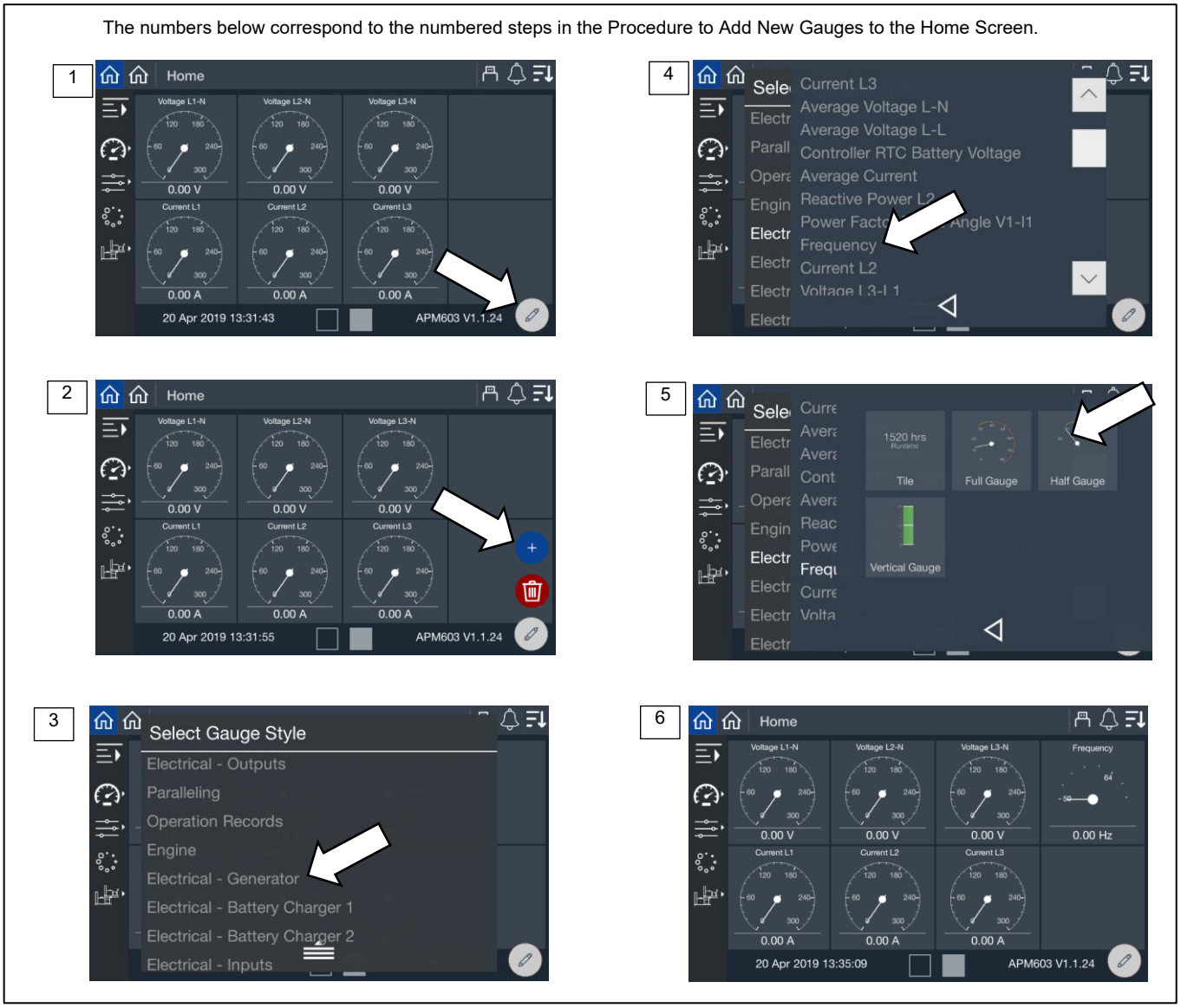


Figure 24 Adding Gauges to the Home Screen

### 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.

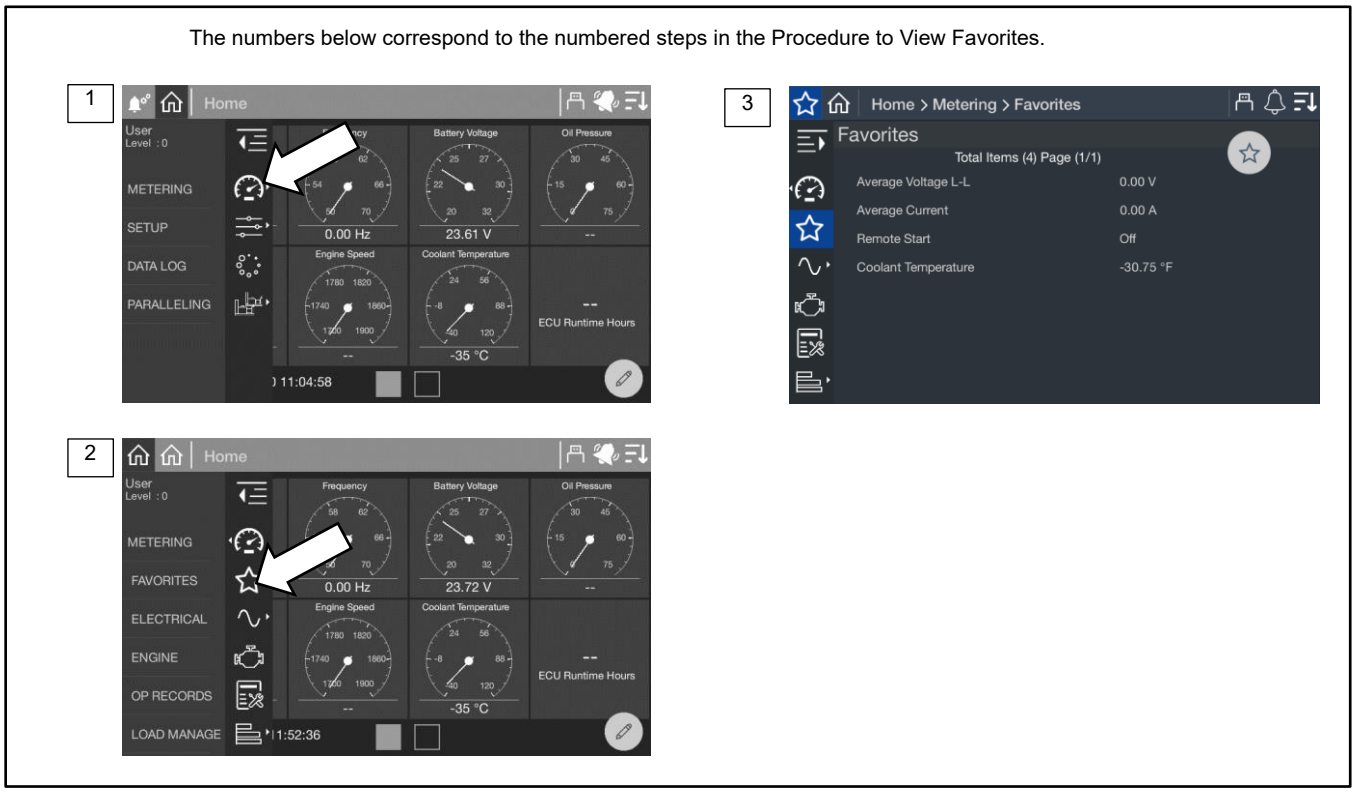


Figure 25 Metering, Favorites

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 26 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 25.

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.

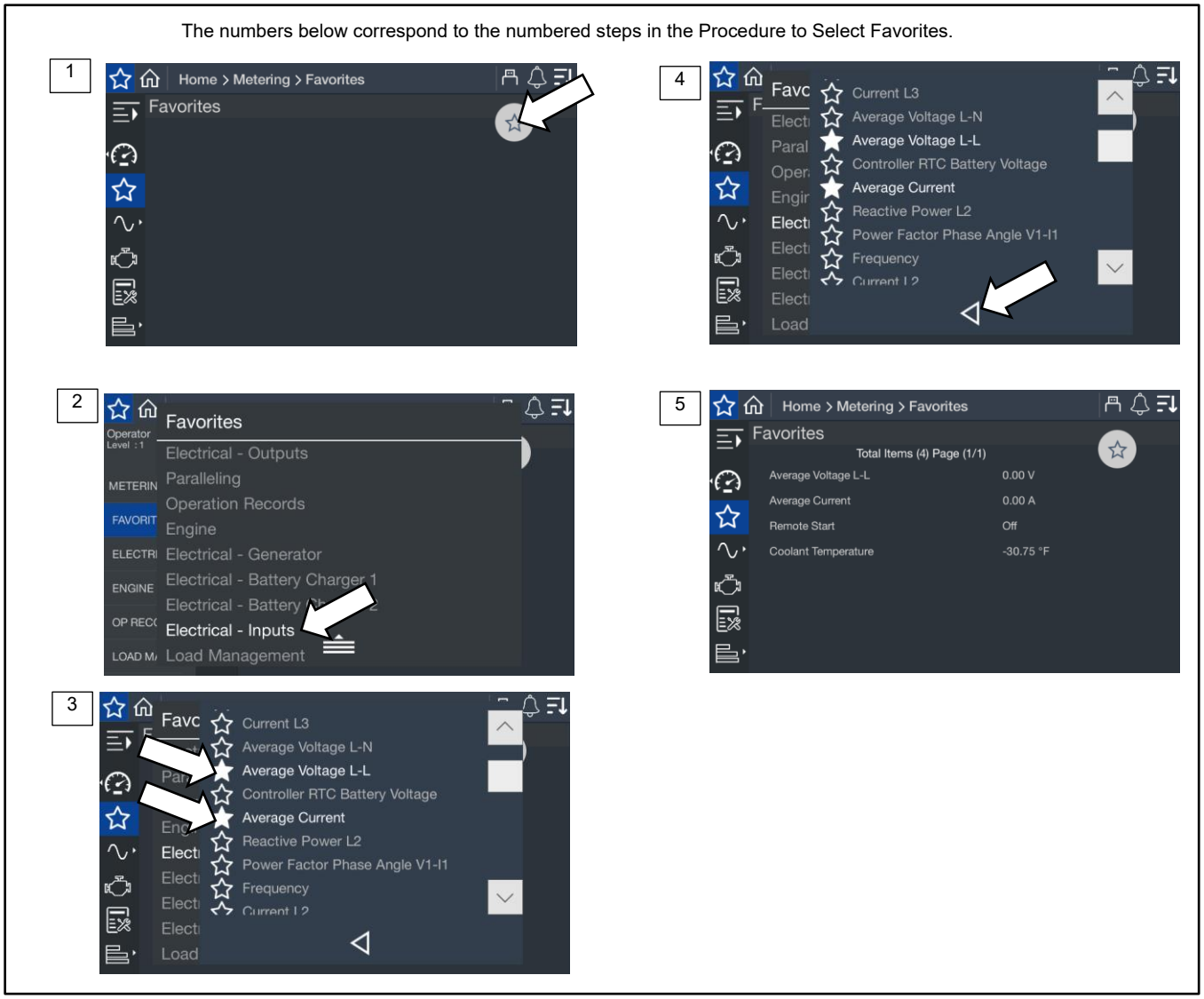


Figure 26 Selecting Favorites

## 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 28. 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.

The numbers below correspond to the numbered steps in the Procedure to View Generator Electrical Metering Screens.




Figure 27 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 |
| 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 |

Figure 28 Generator Metering Data

### 3.2.1 Input Metering

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

The standard, dedicated inputs are listed in Section 1Figure 6. 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 Rehlko SiteTech™ software are required to assign input functions to the inputs on the I/O modules. SiteTech is available to Rehlko 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.

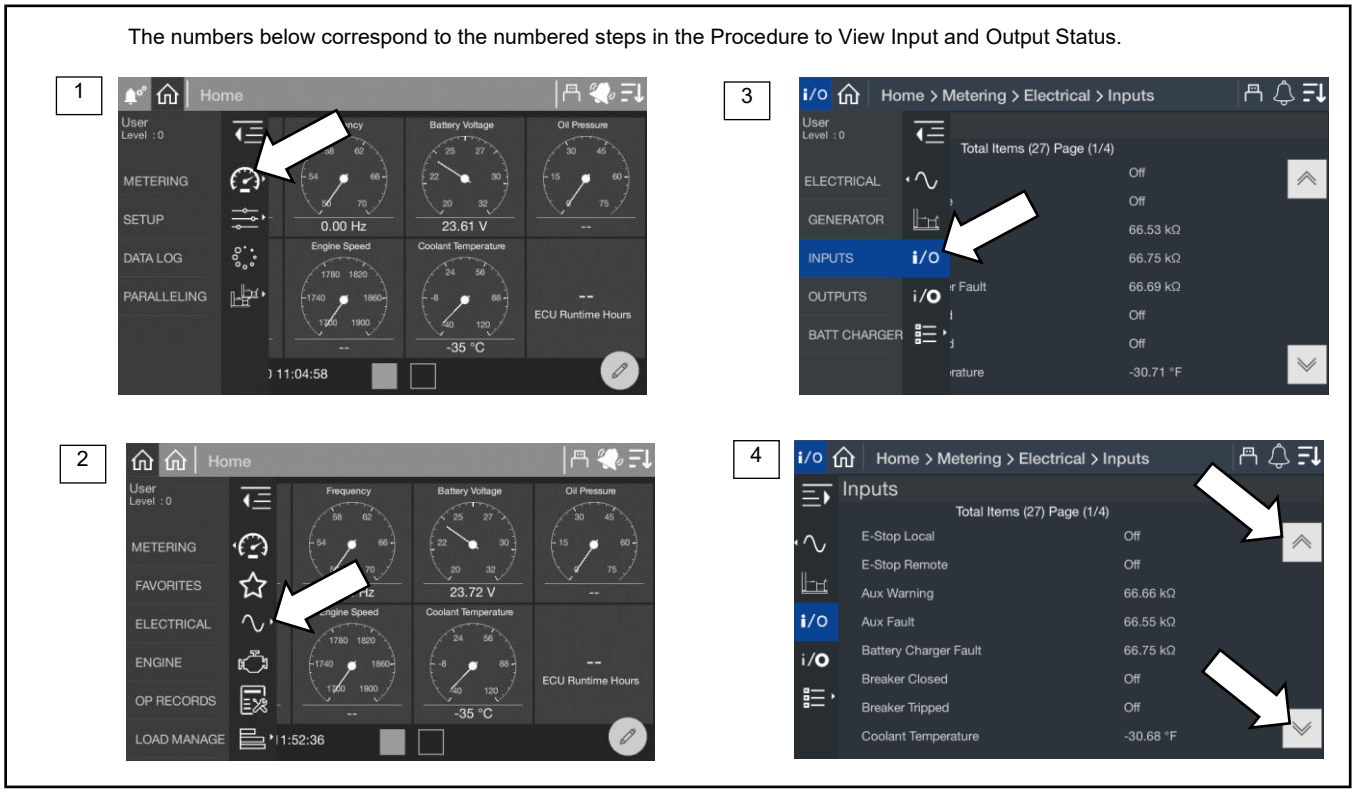


Figure 29 Inputs Metering Screen

| Parameter | Units |
|---|---|
| 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 Type | NG/LP |
| Low Fuel Pressure 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 | |
| I/O Module Digital Input 1 | On/Off |
| I/O Module Digital Input 2 | On/Off |
| I/O Module Digital Input 3 | On/Off |
| I/O Module Digital Input 4 | On/Off |

Figure 30 Inputs Included in the Inputs Metering Screen

### 3.2.2 Output Metering

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

The standard, dedicated outputs are listed in the Controller Specifications and Features section . 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 Rehlko SiteTech™ software are required to assign output functions to the programmable outputs on the I/O module. SiteTech is available to Rehlko 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.

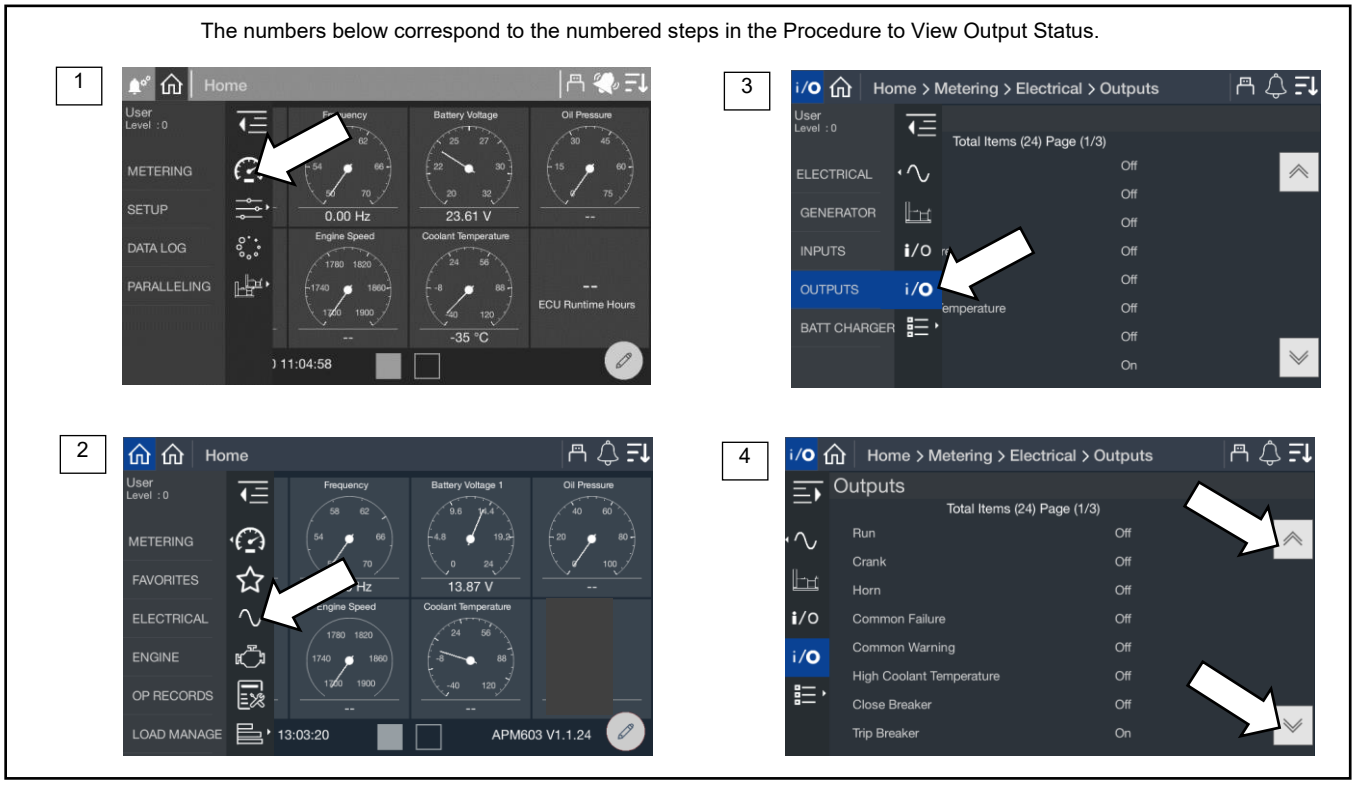


Figure 31 Outputs Metering Screen

| Output | | |
|---|---|---|
| Run | | RDO1 |
| Crank (For John Deere Units) | | RDO2 |
| ECU Wakeup (For Volvo Units) | | |
| Horn | | RDO3 |
| Common Failure | | RDO4 |
| Common Warning | | RDO5 |
| High Coolant Temperature | | 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 32 Outputs Displayed in the Outputs Metering Screen

### 3.2.3 Battery Charger

View the status for battery charger 1 and 2 as shown in Figure 33.

**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.

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

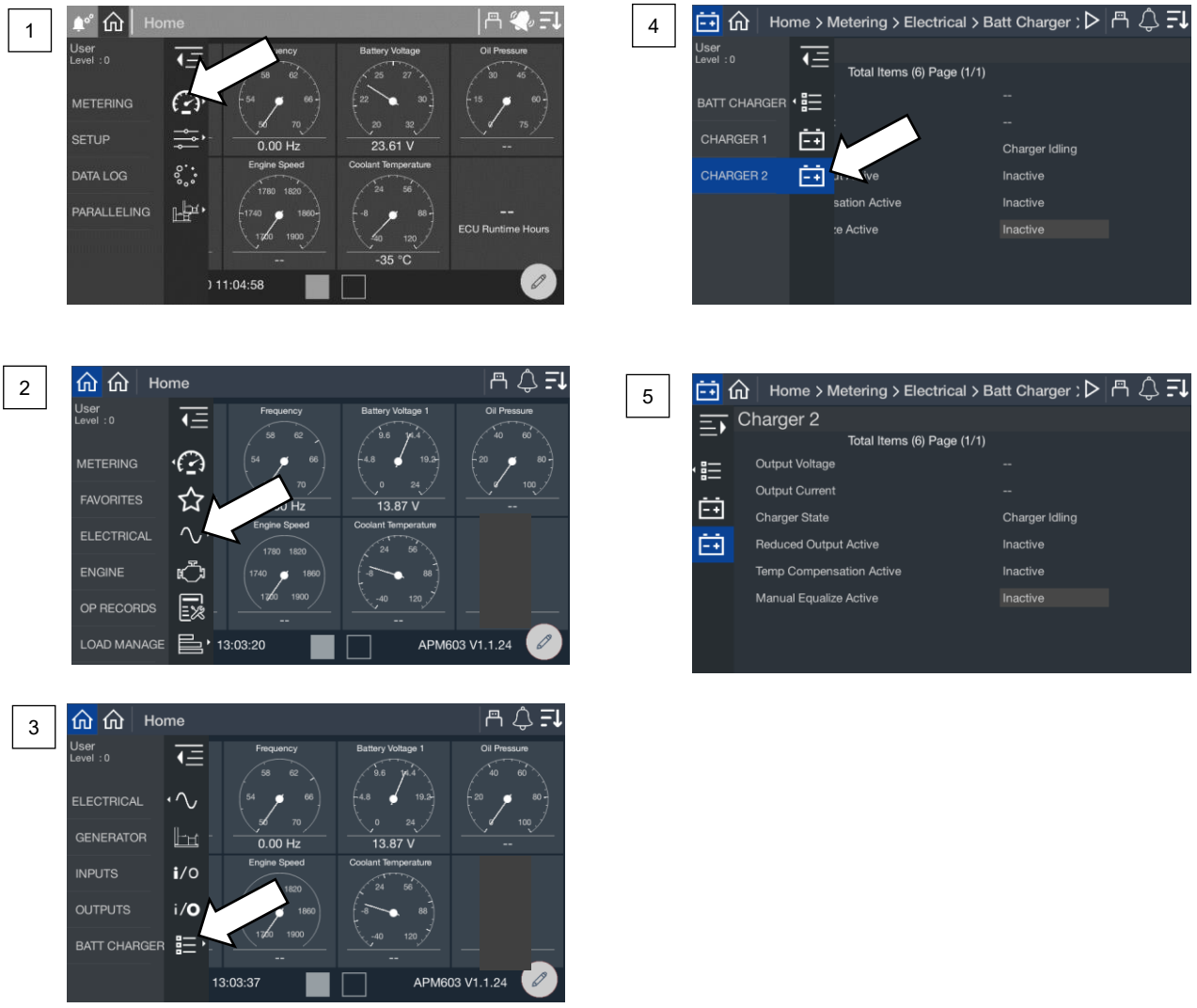


Figure 33 Battery Charger Metering Screens

The parameters listed in Figure 34 are available for each charger.

| Parameter | Units |
|---|---|
| Output Voltage | V |
| Output Current | A |
| Charger State | |
| Reduced Output Active | Active/Inactive |
| Temp Compensation Active | Active/Inactive |
| Manual Equalize Active | Active/Inactive |

Figure 34 Battery Charger Metering Parameters

## 3.3 Engine

The Engine Metering screen displays the engine data shown in Figure 36.

**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 35 Metering, Engine

| Item | Units |
|---|---|
| Engine Speed | RPM |
| Oil Pressure | kPa |
| Oil Temperature | Degrees C |
| Coolant Temperature | kPa Degrees C |
| Intercooler Temperature | Degrees C |
| Ambient Temperature | Degrees C |
| ECU Runtime Hours | Hours |
| Intake Manifold Pressure | kPa |
| Intake Manifold Temperature | Degrees C |
| Fuel Pressure | kPa |
| Engine Percent Load | % |

Figure 36 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 38.

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.

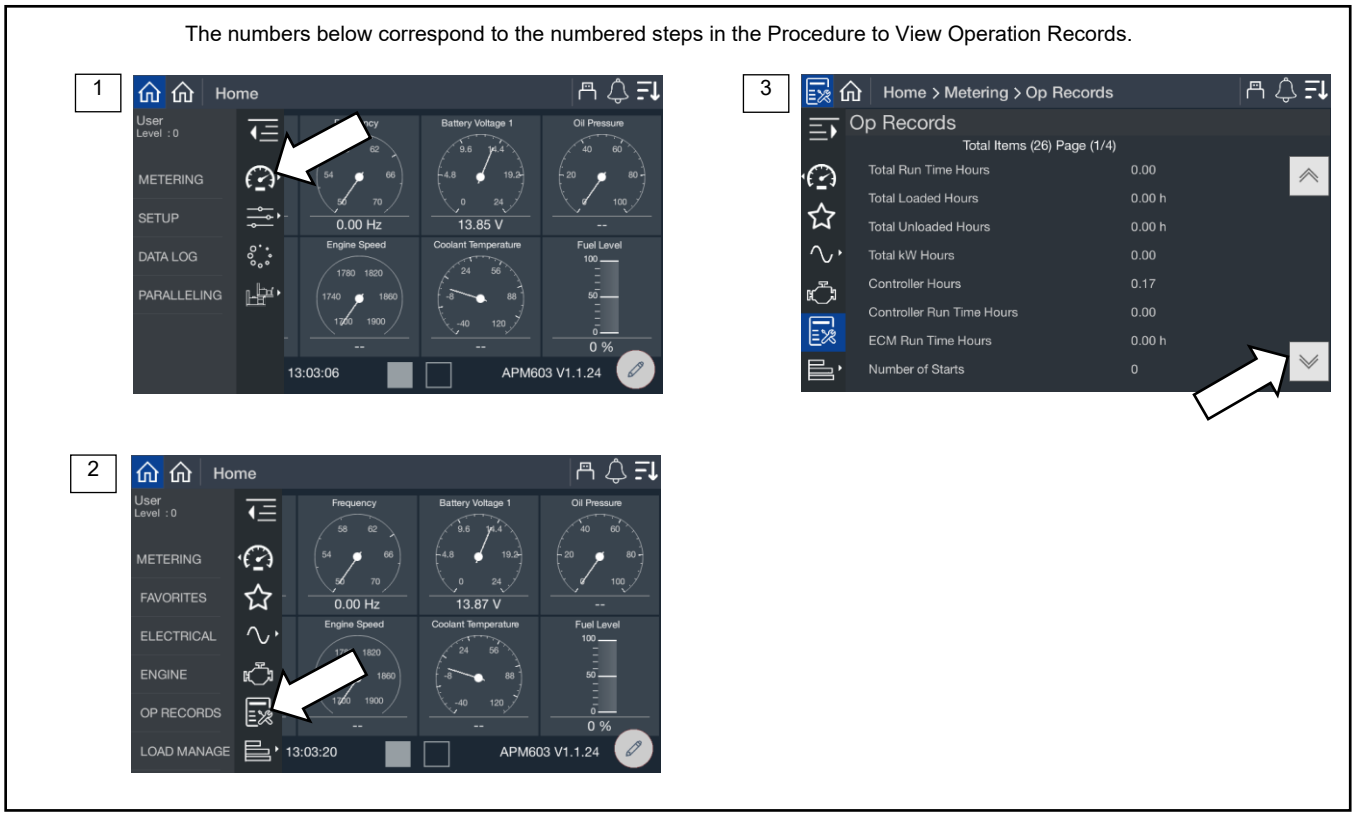


Figure 37 Metering Screen, Operation (Op) Records

| Parameter | Units |
|---|---|
| Total Run Time Hours | Hours |
| Total Loaded Hours | Hours |
| Total Unloaded Hours | Hours |
| Total kW Hours | kWh |
| 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 |
| Reset Maintenance Records | Yes/No * |
| * The Technician password is required to reset maintenance records. | |

Figure 38 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 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 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, adding the load again 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.

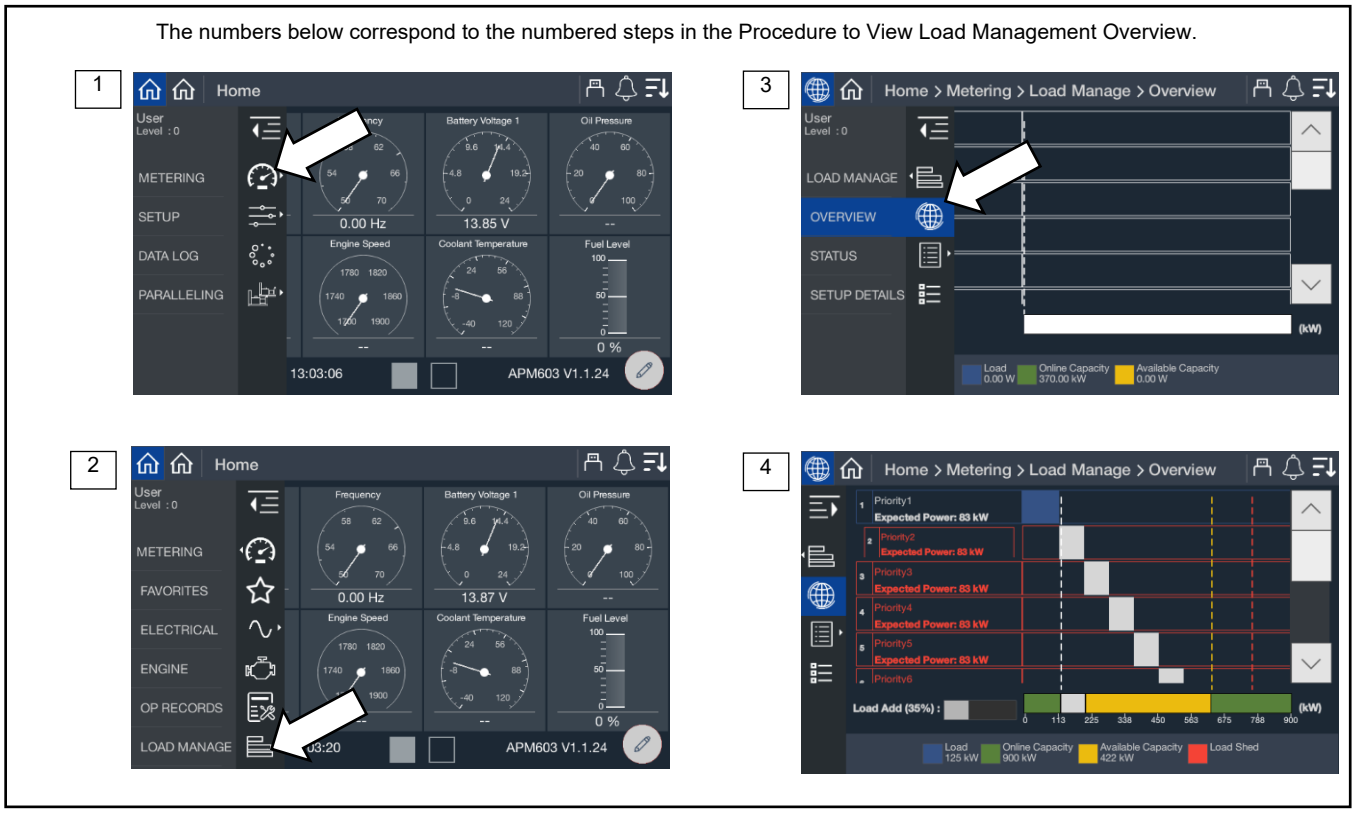


Figure 39 Metering Screens, Load Management Overview

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 Rehlko 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 40 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 41 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.

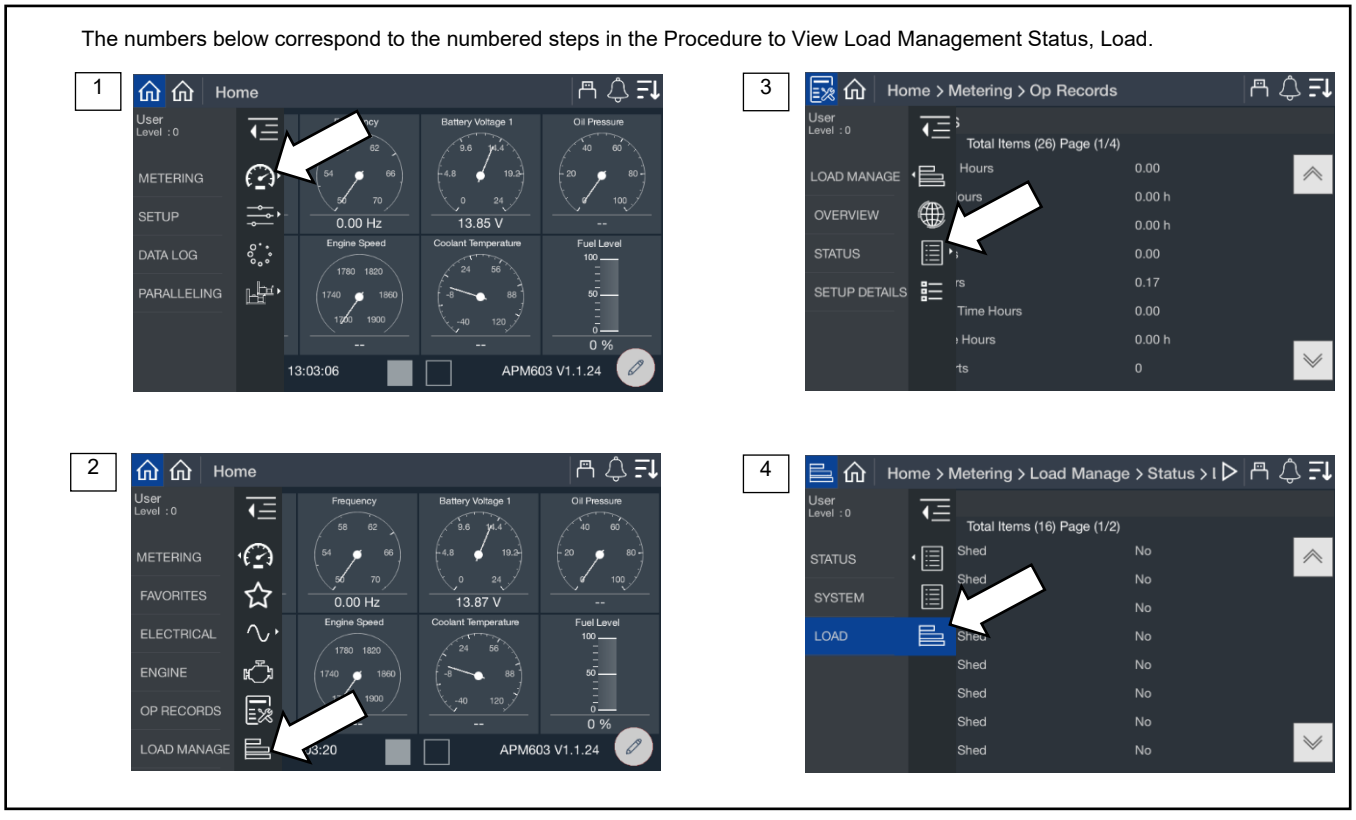


Figure 42 Load Management Status, Load

| Parameter | Units |
|---|---|
| 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 43 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.

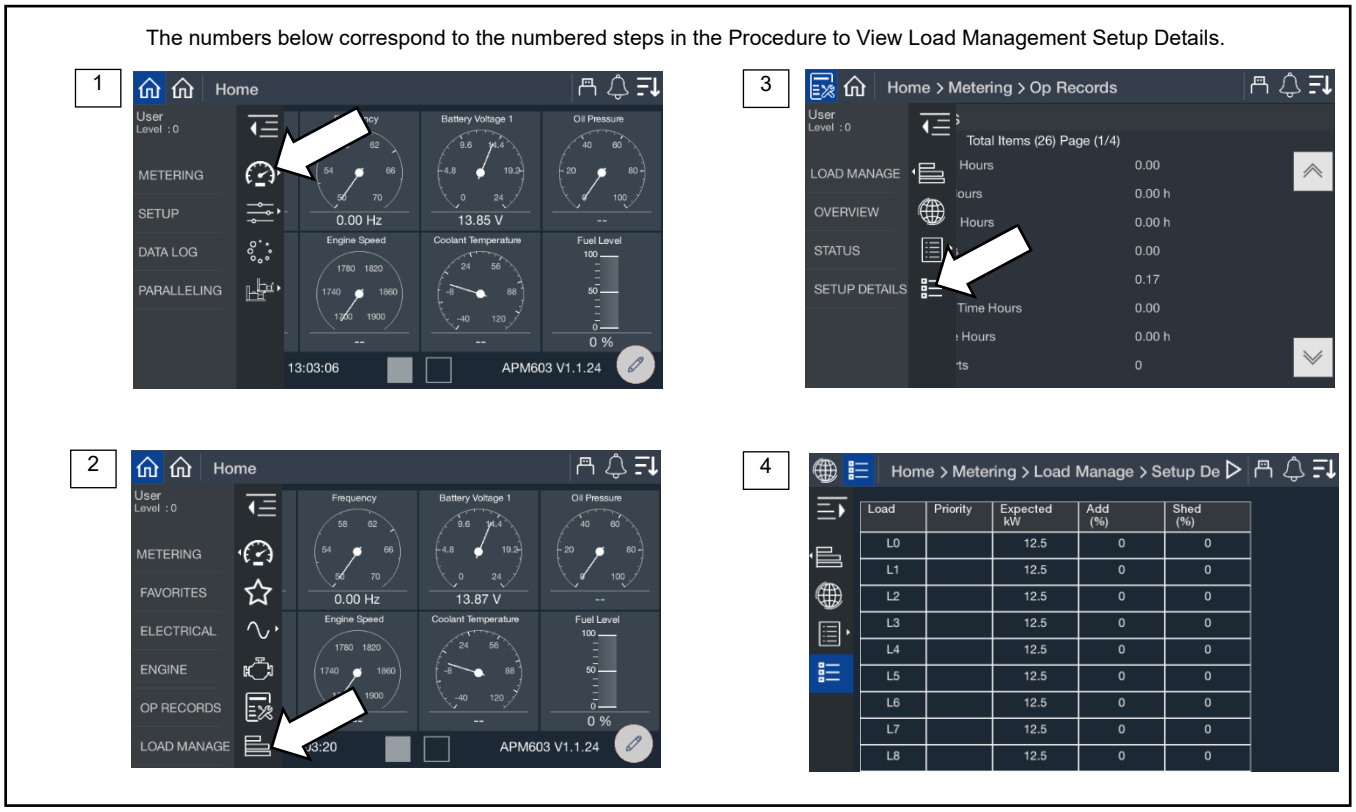


Figure 44 Metering, Load Management, Setup Details

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 Rehlko 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 45 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 Rehlko 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 47.

**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.

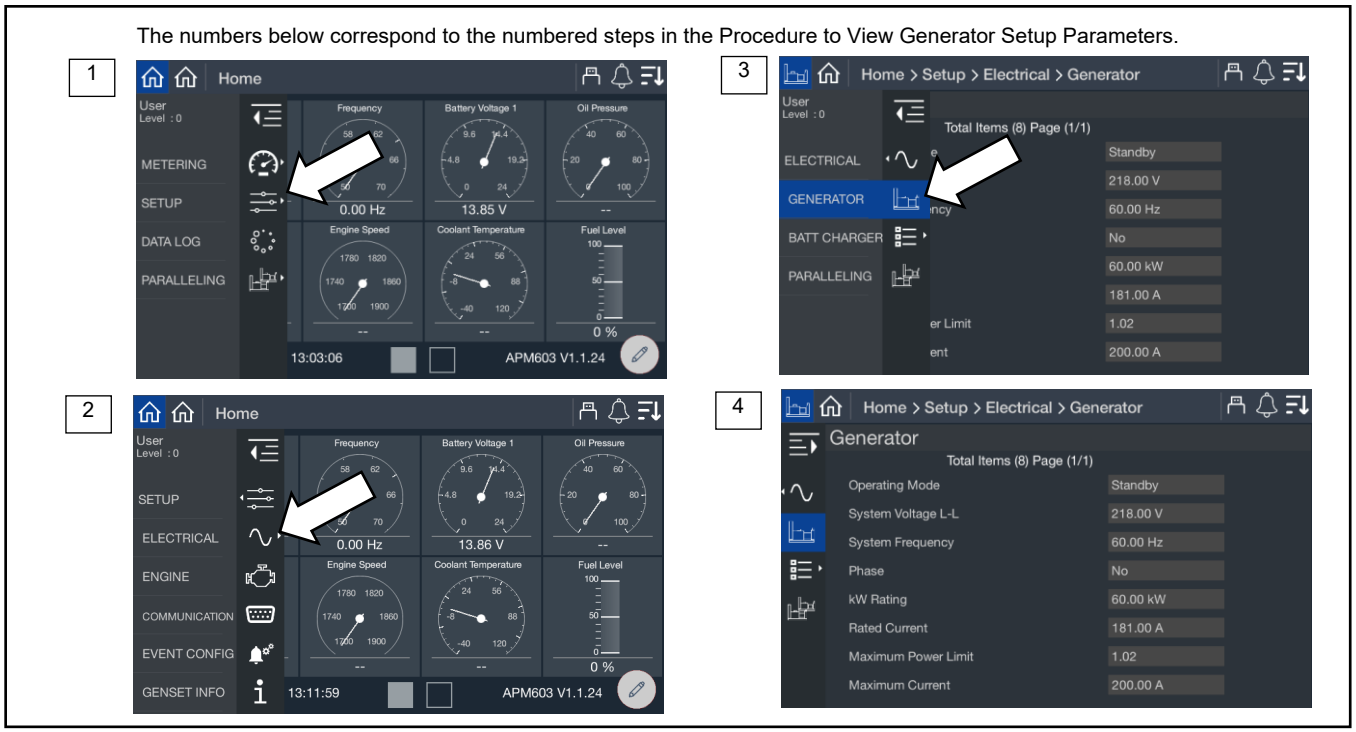


Figure 46 Generator Setup Screen

| 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 47 Generator Settings, Electrical Setup

### 4.2.2 Battery Charger Setup

View the settings for one or two battery chargers as shown in Figure 49.

**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 48 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 49 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.

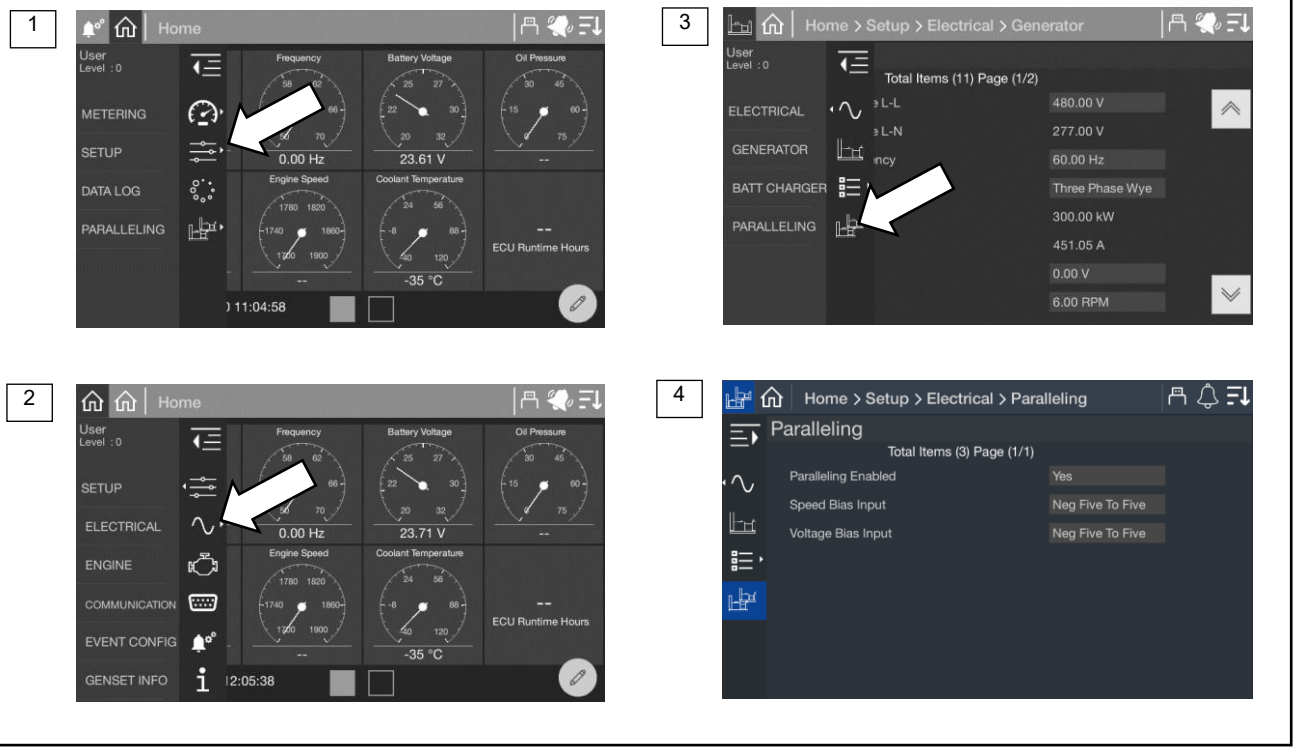


Figure 50 Paralleling Setup Screen

| Parameter | Units | Write Access Level |
|---|---|---|
| Paralleling Enabled | Yes/No | Technician |
| Speed Bias Input | Off<br>0 to 5<br>Neg (-) 5 to 5<br>0 to 10<br>Neg (-)10 to 10 | Operator |
| Voltage Bias Input | | Operator |

Figure 51 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.

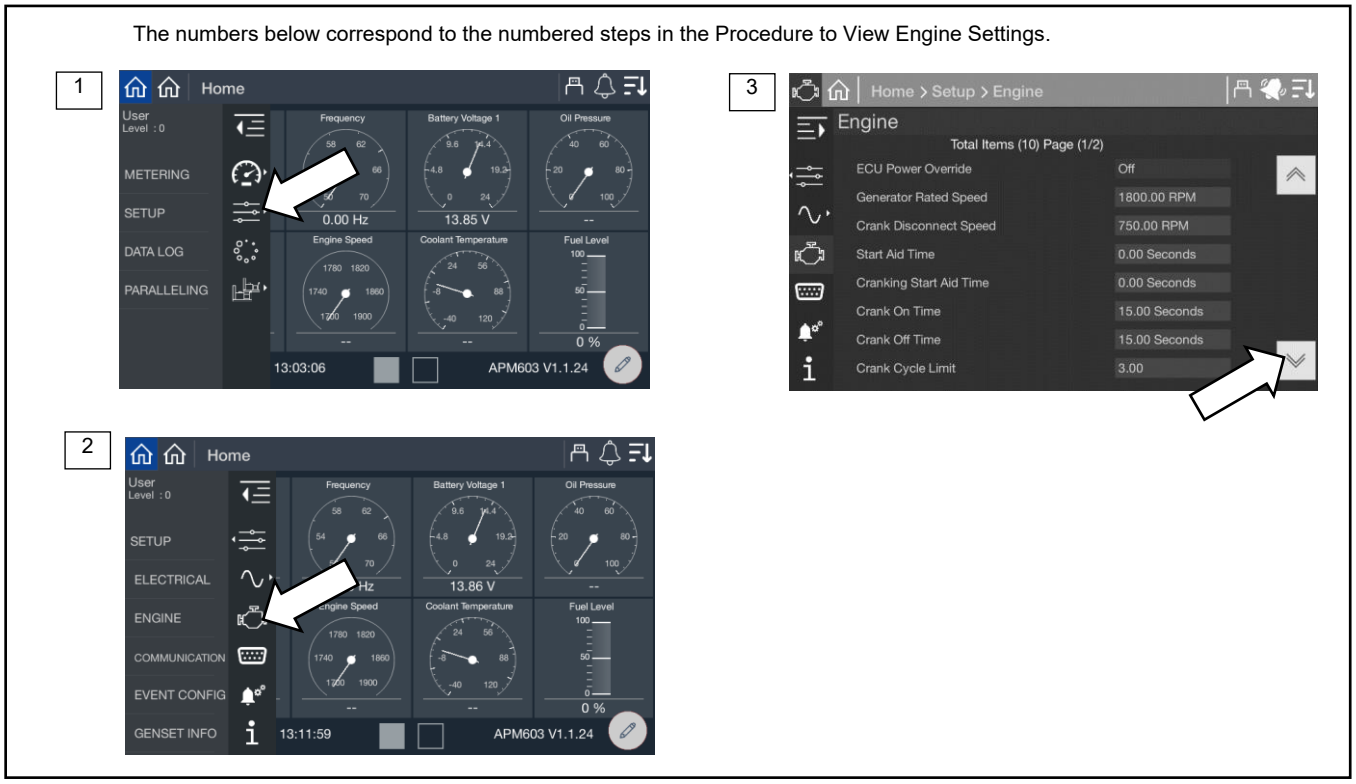


Figure 52 Setup Screen, Engine

| 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 53 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.

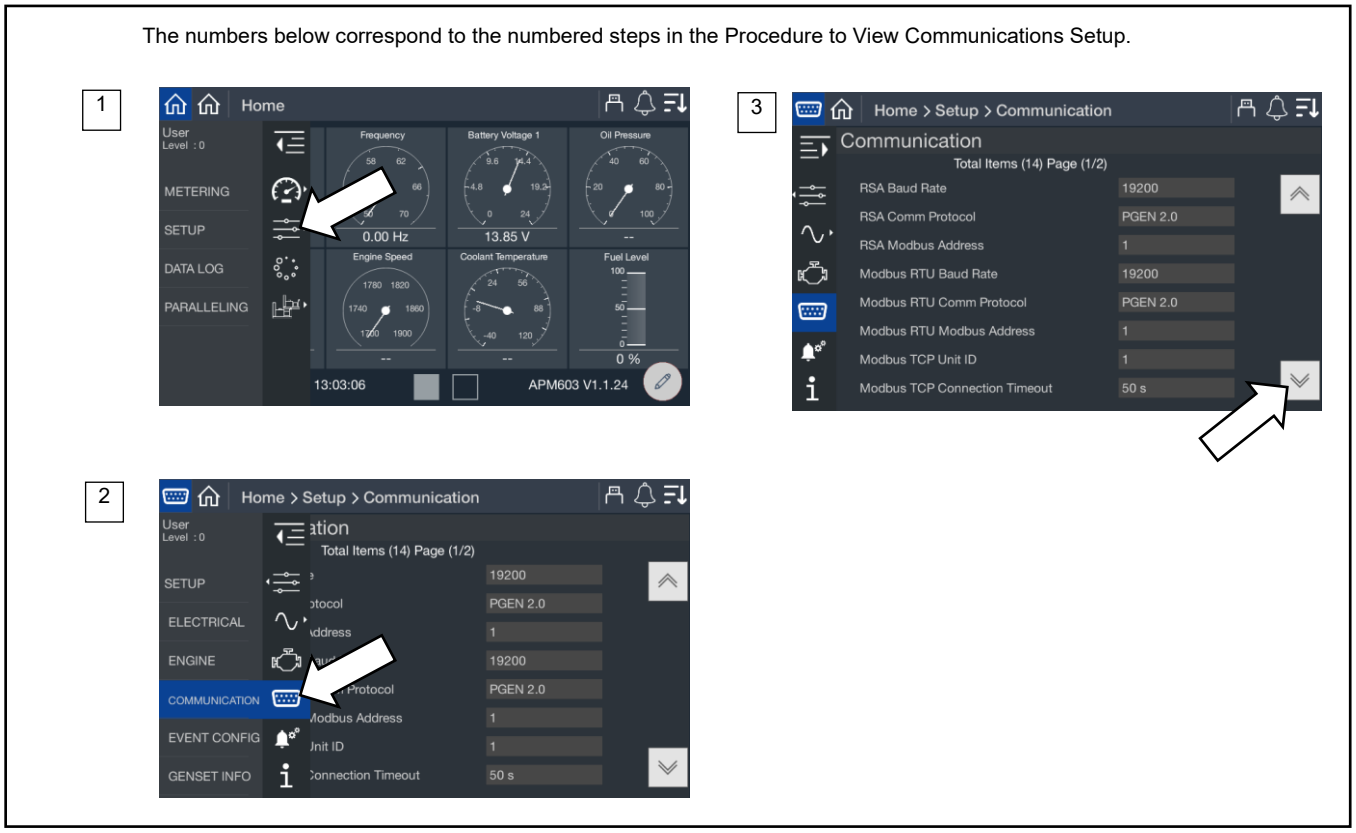


Figure 54 Setup, Communication, Modbus

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 Rehlko 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 55 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.

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

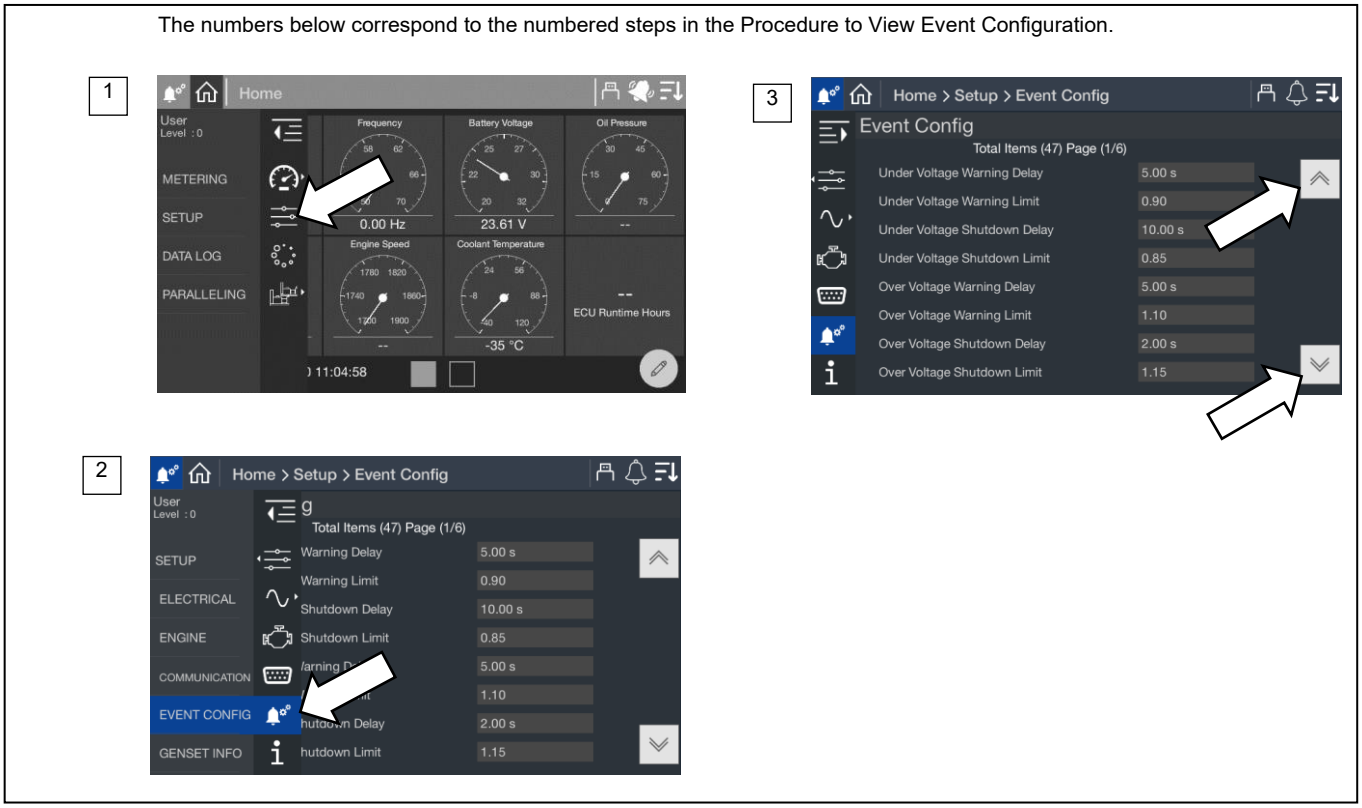


Figure 56 Setup, Event Config

| Event | Units | Access |
|---|---|---|
| Under Voltage Warning Delay | Seconds | Operator |
| Under Voltage Warning Limit | % | Operator |
| Under Voltage Shutdown Delay | Seconds | Operator |
| Under Voltage Shutdown Limit | % | Operator |
| Over Voltage Warning Delay | Seconds | Operator |
| Over Voltage Warning Limit | % | Operator |
| Over Voltage Shutdown Delay | Seconds | Operator |
| Over Voltage Shutdown Limit | % | Operator |
| Under Frequency Warning Delay | Seconds | Operator |
| Under Frequency Warning Limit | % | Operator |
| Under Frequency Shutdown Delay | Seconds | Operator |
| Under Frequency Shutdown Limit | % | Operator |
| Over Frequency Warning Delay | Seconds | Operator |
| Over Frequency Warning Limit | % | Operator |
| Over Frequency Shutdown Delay | Seconds | Operator |
| Over Frequency Shutdown Limit | % | Operator |
| Over Power Warning Delay | Seconds | Operator |
| Over Power Warning Limit | % | Operator |
| Over Power Shutdown Delay | Seconds | Operator |
| Over Power Shutdown Limit | % | Operator |
| Over Current Warning Delay | Seconds | Operator |
| Over Current Warning Limit | % | Operator |
| Over Current Shutdown Delay | Seconds | Operator |
| Over Current Shutdown Limit | % | Operator |
| AC Signal Recovery Time | Seconds | Operator |
| Over Speed Shutdown Delay | Seconds | Factory |
| Over Speed Shutdown Limit | % | Factory |
| Low Battery Voltage Warning Delay | Seconds | Operator |
| Low Battery Voltage Warning Limit | % | Operator |
| High Battery Voltage Warning Delay | Seconds | Operator |
| High Battery Voltage Warning Limit | % | Operator |
| Weak Cranking Battery Delay | Seconds | Operator |
| Weak Cranking Battery Limit | % | Operator |
| Battery Voltage Event Recovery Delay | Seconds | Operator |
| EPS Supplying Load Delay | Seconds | Operator |
| EPS Supplying Load On Limit | % | Operator |
| EPS Supplying Load Off Limit | % | Operator |
| Low Fuel Pressure Warning Limit | % | Operator |
| Maximum Power Warning Delay | Seconds | Operator |
| Battery Charger 1 Enable | Yes/No | Operator |
| Battery Charger 2 Enable | Yes/No | Operator |

Figure 57 Status and Event Configuration

**Note:**
Percent (%) indicates a value relative to nominal. For example, a limit of 90% for the Under Voltage Warning means the limit is the nominal voltage times 0.9. For a 480 volt system, this is 480 x 0.9 = 432 volts. A limit of 110% is 1.10 times the nominal value.

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.

**Maximum Power Warning Delay** indicates the time delay, in seconds, after the maximum power level is reached until a maximum power warning is triggered. The maximum power level is factory-set and shown in Setup>Electrical>Generator.

**EPS Supplying Load On Limit and Off Limit** define the % of load the generator must be suppling to be considered supplying load.

**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 ECU. 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.

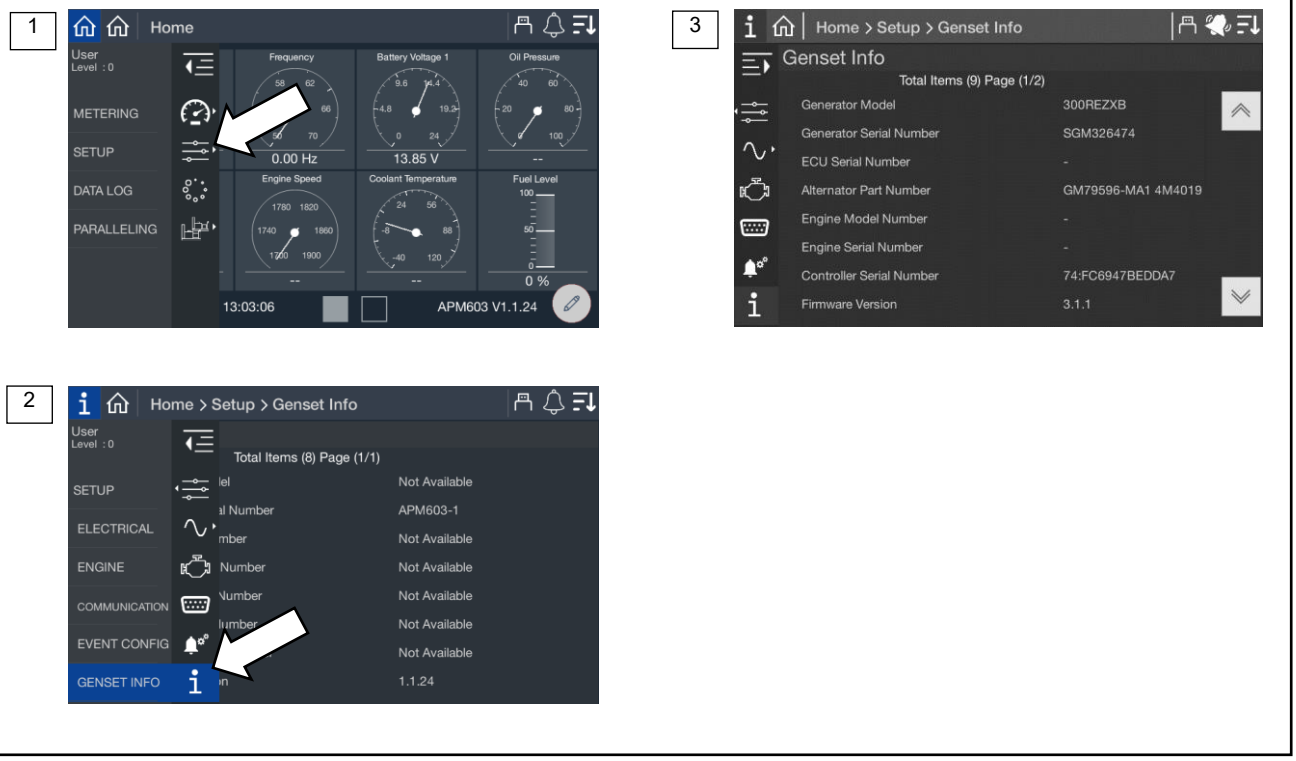


Figure 58 Genset Info Screen

| Information |
|---|
| Generator Model |
| Generator Serial Number |
| ECU Serial Number |
| Alternator Part Number |
| Engine Model Number |
| Engine Serial Number |
| Controller Serial Number |
| Firmware Version |

Figure 59 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 60 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.

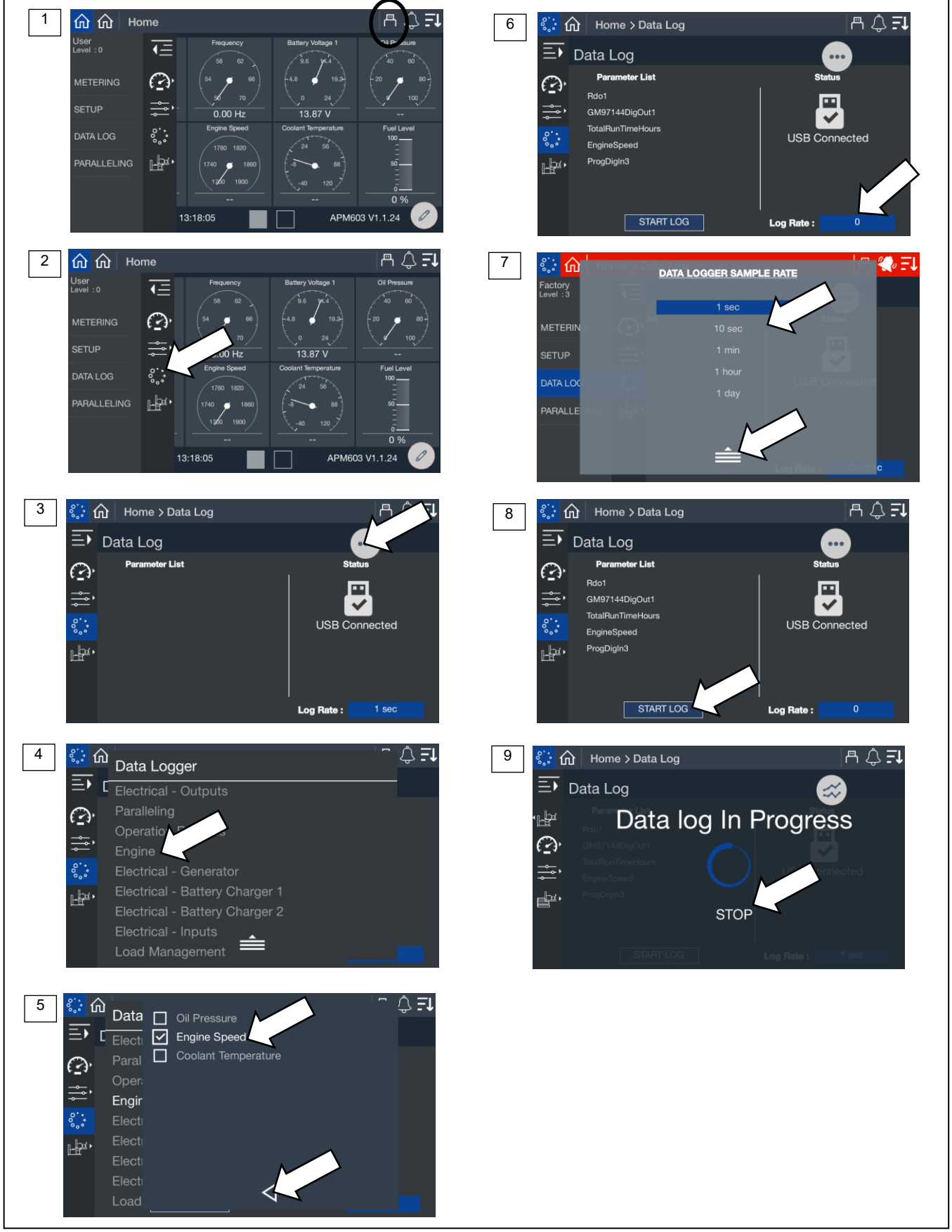


Figure 60 Data Logging

## 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.

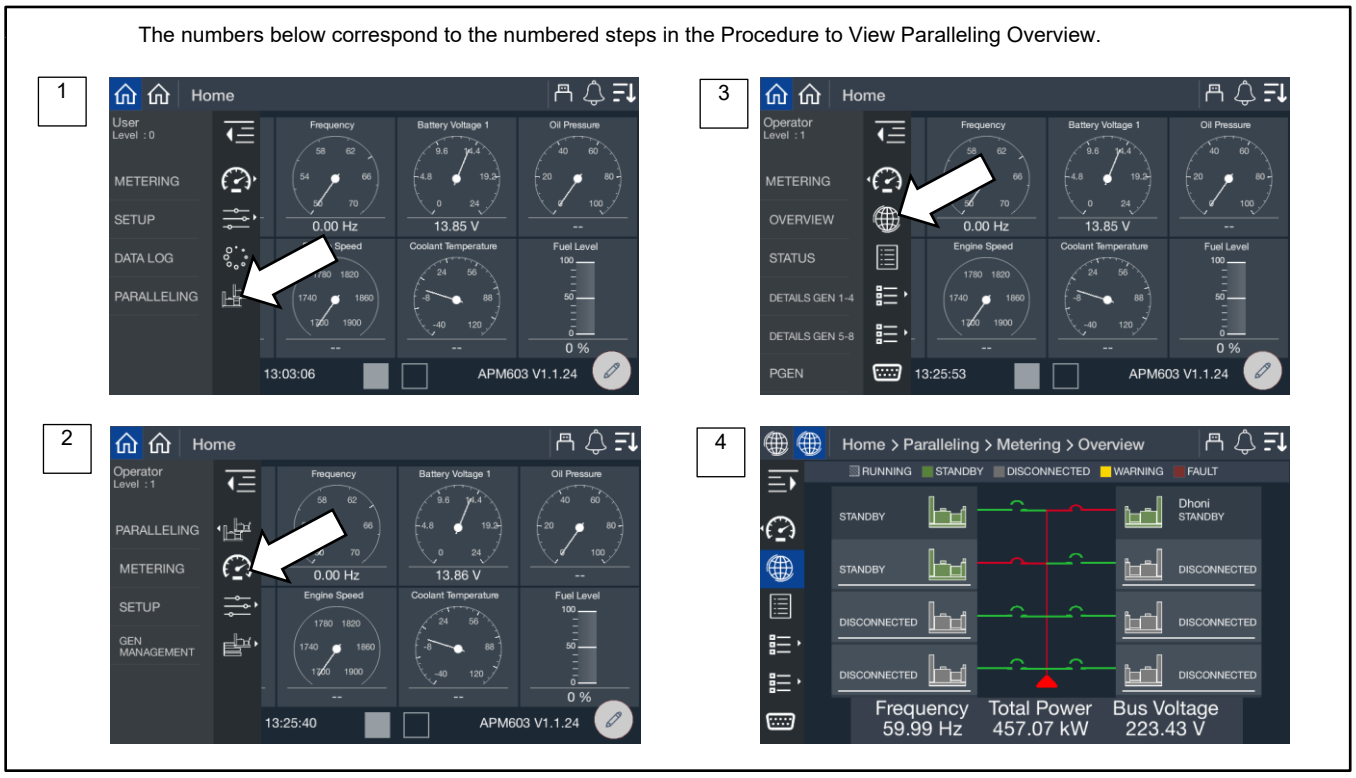


Figure 61 Paralleling, Metering, Overview Screen

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 Rehlko 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 62 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 63 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.

The numbers in the list below correspond to the numbered steps in the Procedure to View Paralleling System Generator Metering.

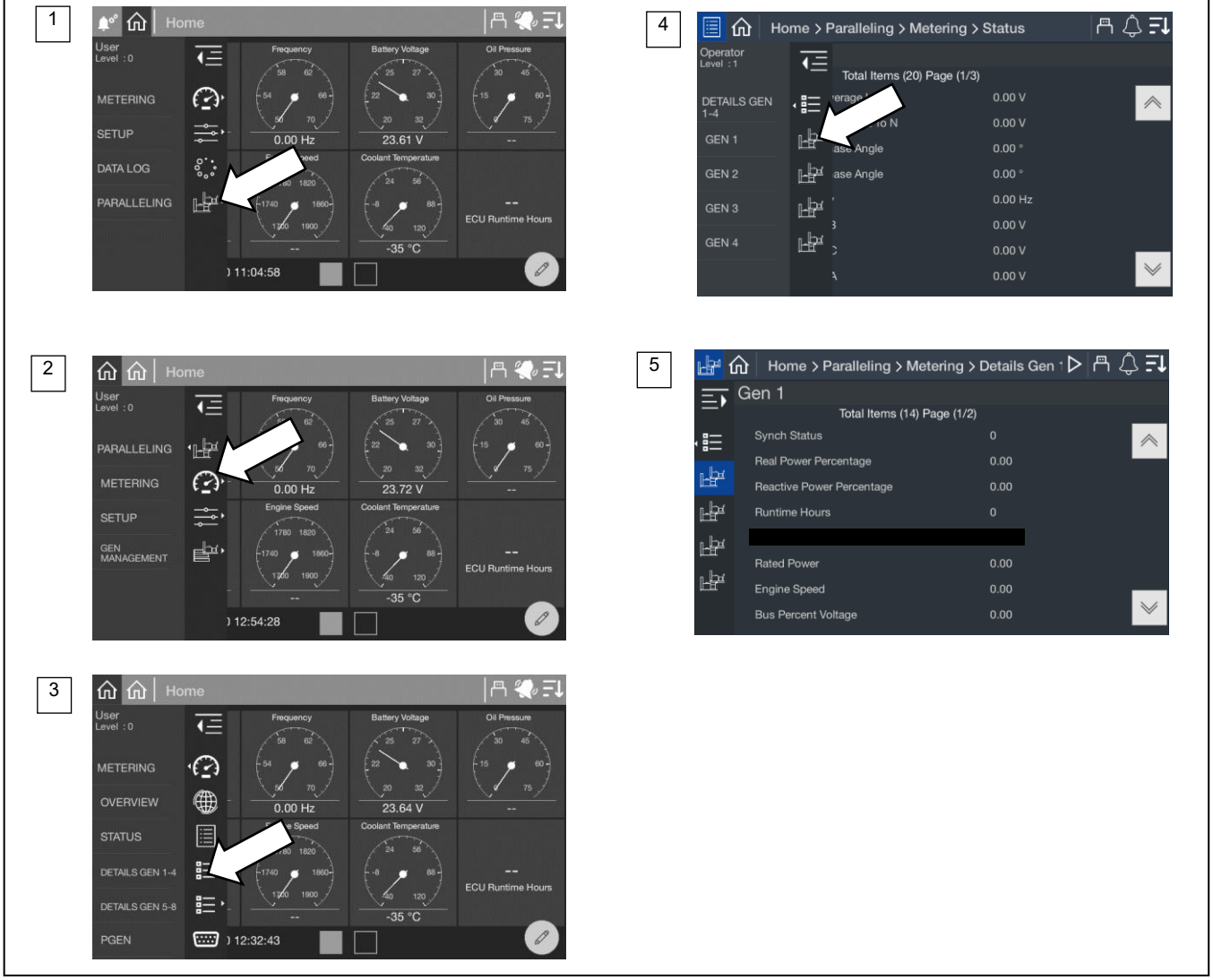


Figure 64 Paralleling, Metering, Details

| Parameter | Units |
|---|---|
| Synch Status | |
| Real Power Percentage | % |
| Reactive Power Percentage | % |
| Run Time Hours | Hours |
| 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 65 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.

**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 66 Paralleling, Metering, PGEN

| PGEN Metering Parameters |
|---|
| Connected Nodes |
| Disconnected Nodes |
| Scheduler ID |

Figure 67 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.

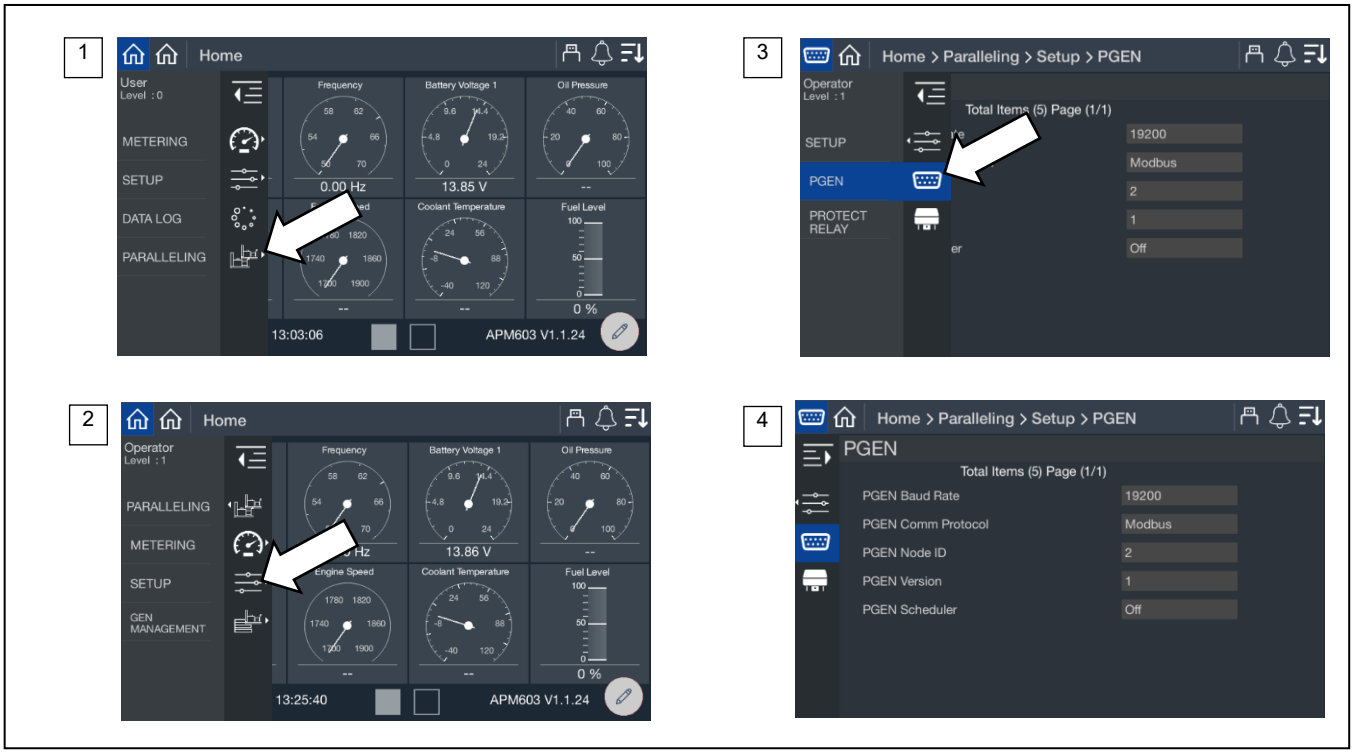


Figure 68 Paralleling, Setup, PGEN Screens

| 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 69 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 70 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 71 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—generator management failures will result in additional generator sets running any time the system receives a start signal (this unit or others).

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.

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.

**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 72 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. See the Gen Management Modes section for a description of generator priority changes in runtime mode.

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 demand 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.

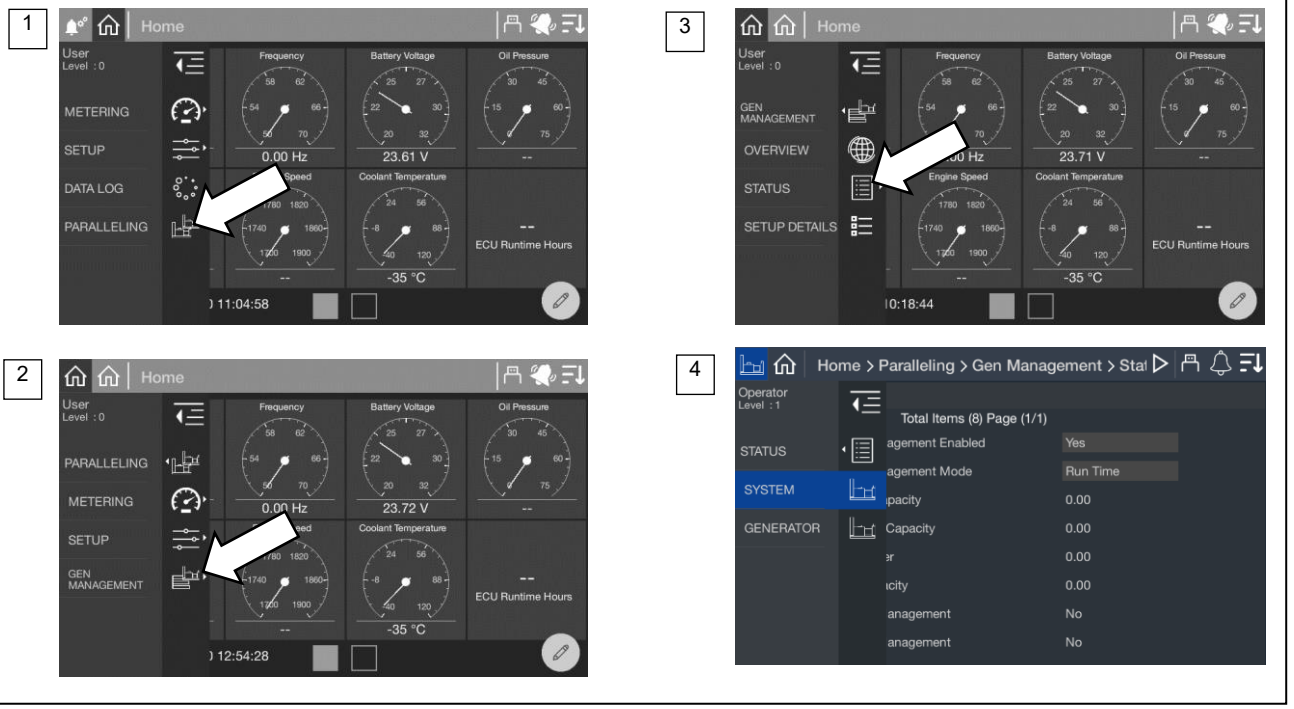


Figure 73 Paralleling Screens, Generator Management Status

| 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 74 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.

Runtime mode is recommended for gas-powered generator sets.

**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.** Fuel level mode applies to diesel generators with fuel level sensors. Fuel level mode is not recommended for gas-powered generator sets.

### 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.

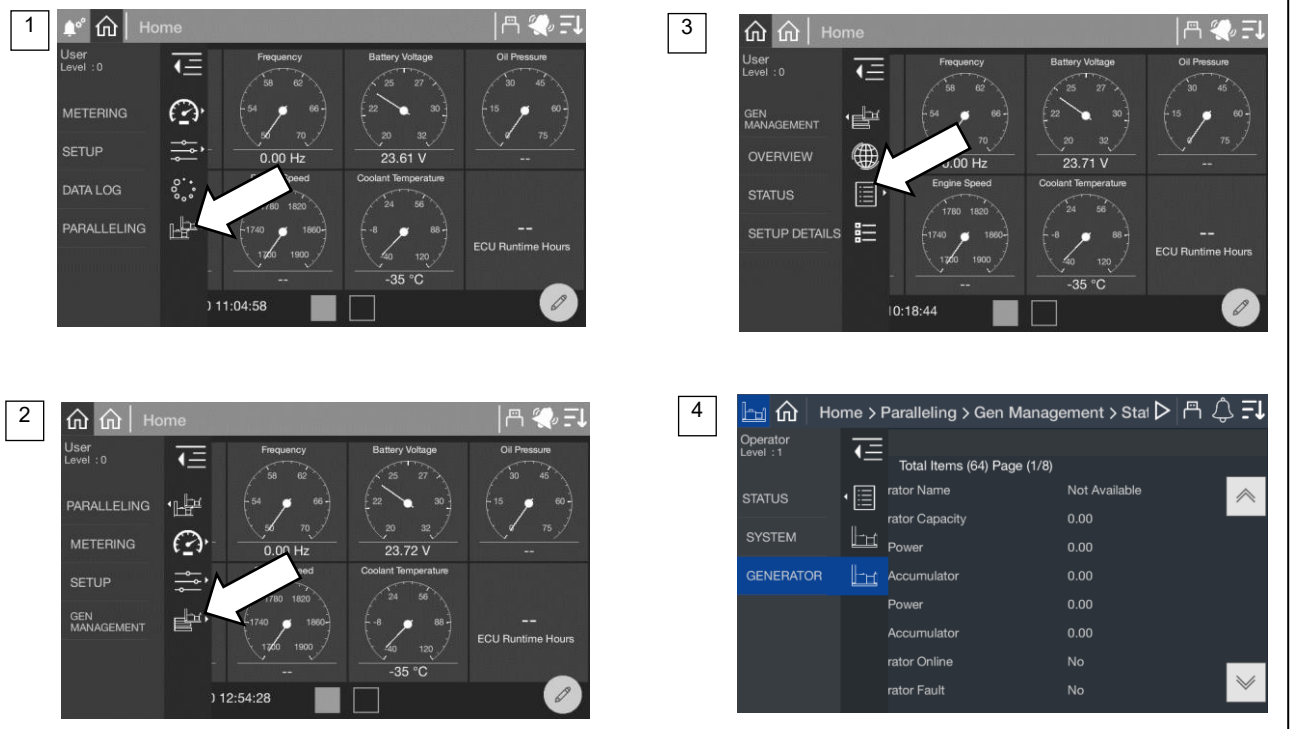


Figure 75 Paralleling, Gen Management, Status, Generator

| 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 76 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 Rehlko 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 77 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.

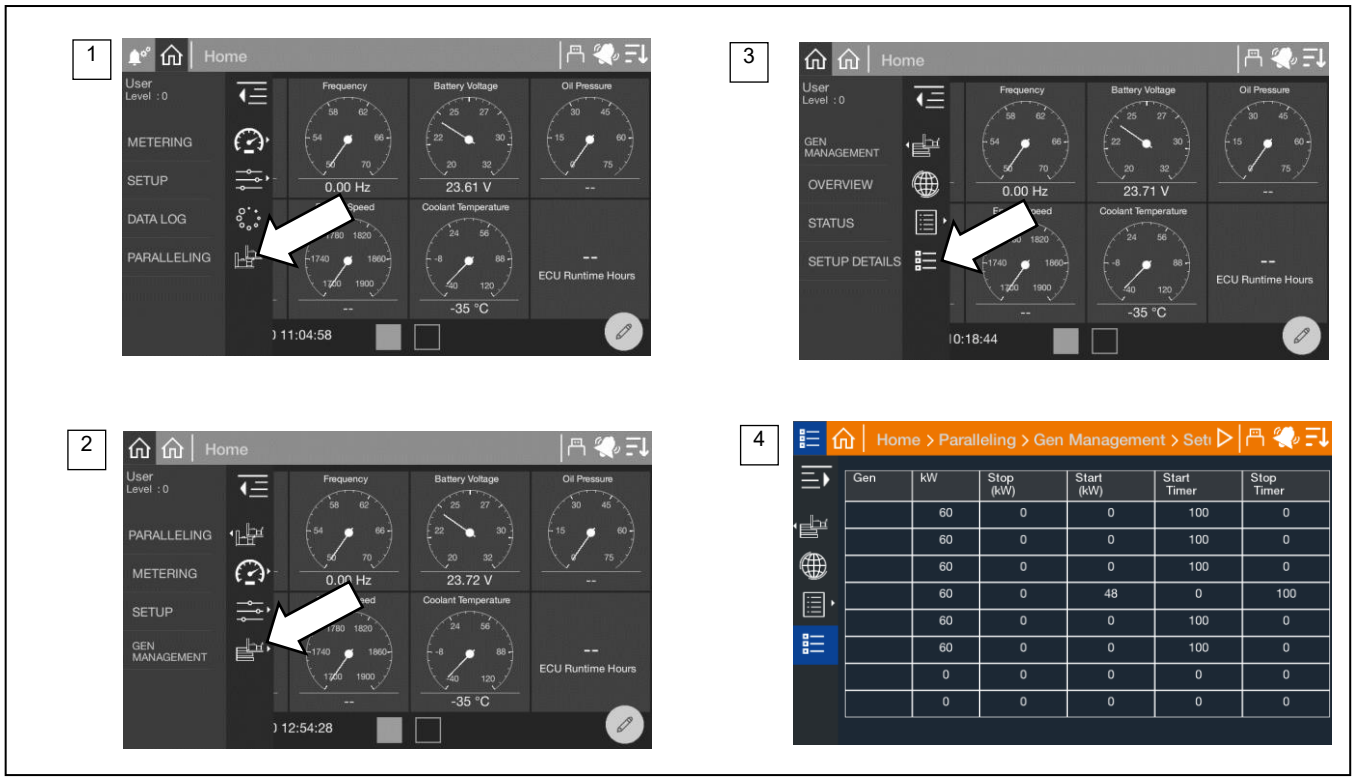


Figure 77 Paralleling Screens, Gen Management Setup Details

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 78 for the SiteTech Group.

| GenManagement Setting | |
|---|---|
| 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 78 Generator Management Settings Adjustable in SiteTech

| Trouble Symptoms | | | | | | | | | | | | | | Probable Causes | Recommended Actions | Section or Publication Reference* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Does not crank | Cranks but does not start | Starts hard | No or low output voltage | Stops suddenly | Lacks power | Overheats | Low oil pressure | High fuel consumption | Excessive or abnormal noise | Displays error message/locks up | Exercise run time and/or event records inoperative | | | | | |
| | | | | | | | | | | | | **Controller** | | | | |
| x | x | | | | | | | | | | | | | Controller circuit board(s) inoperative | Replace the controller. | Gen. S/M |
| x | x | | | | | | | | | | | | | Controller circuit board(s) wiring fault. | Check the wiring. | W/D |
| | | | | x | | | | | | | | | | Controller fault. | Troubleshoot the controller.† | Gen. S/M |
| x | x | | | | | | | | | | | | | Controller fuse blown | Check for continuity across fuse. If fuse is blown, troubleshoot the controller wiring and replace circuit board. | Specifications and Features, W/D |
| x | | | | | | | | | | | | | | Controller master control buttons inoperative | Replace the controller master control button circuit board. | -- |
| x | | | | | | | | | | | | | | Controller master control button in the OFF/RESET mode. | Press the controller master control RUN or AUTO button. | Operations |
| x | | | | | | | | | | | | | | Engine start circuit open. | Press the controller master control RUN button to test the generator set. Troubleshoot the auto start circuit and the time delays. | Operations, W/D, Gen. S/M |
| | | | x | x | | | | | | | | | | Voltage regulation inoperative | Replace the junction box sensing fuses. If the fuse blows again, troubleshoot the controller. | W/D, Gen. S/M |
| | | | | | | | | | | x | | | | Low battery voltage. | Charge or replace the engine starting battery.. | Gen M/M |

* ATS—Automatic Transfer Switch; Eng.—Engine; Gen.—Generator Set; Alt.—Alternator; I/M—Installation Manual; O/M—Operation Manual; S/M—Service Manual; S/S—Spec Sheet; O/S/M—Operation/Service Manual; W/D—Wiring Diagram; M/M—Maintenance Manual

† Have an authorized service distributor/dealer perform this service.

| Trouble Symptoms | | | | | | | | | | | | Probable Causes | Recommended Actions | Section or Publication Reference* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Does not crank | Cranks but does not start | Starts hard | No or low output voltage | Stops suddenly | Lacks power | Overheats | Low oil pressure | High fuel consumption | Excessive or abnormal noise | Displays error message/locks up | Exercise run time and/or event records inoperative | | | |
| **Alternator** | | | | | | | | | | | | | | |
| | | | x | | | | | | | | | AC output circuit breaker open. | Reset the breaker and check for AC voltage at the generator set side of the circuit breaker. | -- |
| x | | | | | | | | | | | | Transfer switch test switch in the OFF position. | Move the transfer switch test switch to the AUTO position. | ATS O/M |
| | | | | | | | | | | | | Transfer switch fails to transfer load | Move the ATS test switch to the AUTO position. Troubleshoot the transfer circuit and time delays. | ATS O/M, S/M |
| | | | x | | | | | | | | | Wiring, terminals, or pin in the exciter field open. | Check for continuity. | Gen. S/M, W/D |
| | | | x | | | | | | | | | Main field (rotor) inoperative (open or grounded). | Test and/or replace the rotor.† | Gen. S/M |
| | | | x | | | | | | | | | Stator inoperative (open or grounded). | Test and/or replace the rotor.† | Gen. S/M |
| | | | | | | | | | x | | | Vibration excessive. | Tighten loose components. † | -- |
| | | | x | x | | | | | | | | Voltage regulator settings incorrect. | Adjust the voltage regulator. | Voltage Regulator Adjustments, SiteTech O/M |
| **Electrical System (DC Circuits)** | | | | | | | | | | | | | | |
| x | x | | | | | | | | | | | Battery connections loose, corroded, or incorrect. | Verify that the battery connections are correct, clean, and tight. | Scheduled Maintenance |
| x | x | | | | | | | | | | | Battery weak or dead. | Recharge or replace the battery. The spec sheet provides recommended battery CCA rating. | Scheduled Maintenance, S/S |
| x | x | | | | | | | | | | | Starter/starter solenoid inoperative. | Replace the starter or starter solenoid. | Eng. S/M |
| x | | | | x | | | | | | | | Engine harness connector(s) not locked tight. | Disconnect the engine harness connector(s) then reconnect it to the controller. | W/D |
| | | | | x | | | | | | | | Fault shutdown. | Reset the fault switches and troubleshoot the controller. | Operations |

* ATS—Automatic Transfer Switch; Eng.—Engine; Gen.—Generator Set; Alt.—Alternator; I/M—Installation Manual; O/M—Operation Manual; S/M—Service Manual; S/S—Spec Sheet; O/S/M—Operation/Service Manual; W/D—Wiring Diagram

† Have an authorized service distributor/dealer perform this service.

| Trouble Symptoms | | | | | | | | | | | | Probable Causes | Recommended Actions | Section or Publication Reference* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Does not crank | Cranks but does not start | Starts hard | No or low output voltage | Stops suddenly | Lacks power | Overheats | Low oil pressure | High fuel consumption | Excessive or abnormal noise | Displays error message/locks up | Exercise run time and/or event records inoperative | | | |
| **Engine** | | | | | | | | | | | | | | |
| | x | x | | | x | | | x | | | | Air cleaner clogged. | Clean or replace the filter element. | Eng. O/M |
| | x | x | | | | x | | x | x | | | Compression weak. | Check the compression. † | Eng. S/M |
| | | | x | | x | x | | x | x | | | Engine overload. | Reduce the electrical load. See the generator set installation manual for wattage specifications. | S/S |
| | | | | | | | | | x | | | Exhaust system leak. | Inspect the exhaust system. Replace the inoperative exhaust system components. † | I/M |
| | | | | | | | | | x | | | Exhaust system not securely installed | Inspect the exhaust system. Tighten the loose exhaust system components. † | I/M |
| | | x | x | | x | | | x | | | | Governor inoperative. | Adjust the governor. † | Eng. S/M |
| | | | | | x | | | | x | | | Valve clearance incorrect. | Adjust the valves. † | Eng. S/M |
| | | | | | | | | | x | | | Vibration excessive. | Tighten all loose hardware. | -- |
| | x | x | | | x | | | | | | | Ignition system inoperative (gas models only) | Check the ignition system (spark plugs, spark plug wires, etc.). | Eng. O/M, Eng. S/M |
| x | x | | | x | | | | | | x | x | Engine ECM and/or sensors. | Troubleshoot the engine ECM and/or sensors. | Eng. O/M, Eng. S/M |

* ATS—Automatic Transfer Switch; Eng.—Engine; Gen.—Generator Set; Alt.—Alternator; I/M—Installation Manual; O/M—Operation Manual; S/M—Service Manual; S/S—Spec Sheet; O/S/M—Operation/Service Manual; W/D—Wiring Diagram

† Have an authorized service distributor/dealer perform this service.

| Trouble Symptoms | | | | | | | | | | | | Probable Causes | Recommended Actions | Section or Publication Reference* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Does not crank | Cranks but does not start | Starts hard | No or low output voltage | Stops suddenly | Lacks power | Overheats | Low oil pressure | High fuel consumption | Excessive or abnormal noise | Displays error message/locks up | Exercise run time and/or event records inoperative | | | |
| **Cooling System** | | | | | | | | | | | | | | |
| | | | | | | x | | x | | | | Air openings clogged. | Clean the air openings. | - |
| | | | | | | x | | | | | | Coolant level low. | Restore the coolant to normal operating level. | Scheduled Maintenance |
| | | | | | | x | | | | | | Cooling water pump inoperative. | Tighten or replace the belt. 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. | Scheduled Maintenance, Eng. O/M |
| | | | | x | | | | | | | | Low coolant level shutdown, if equipped. | Restore the coolant to normal operating level. | Scheduled Maintenance |
| | | | | | | x | | | | | | Thermostat inoperative. | Replace the thermostat. | Eng. S/M |
| **Fuel System** | | | | | | | | | | | | | | |
| | x | | | x | | | | | | | | Fuel tank empty (LPG) or fuel valve shut off. | Add fuel and move the fuel valve to the ON position. | - |
| | x | x | | x | x | | | | | | | Fuel filter restriction. | Clean or replace the fuel filter. † | Eng. O/M |
| | x | | | | | | | | | | | Fuel solenoid inoperative | Troubleshoot the fuel solenoid. † | Eng. S/M |
| | x | | | | x | | | | | | | Fuel pressure insufficient | Check the fuel supply and valves. † | S/S, Gen. O/M |

* ATS—Automatic Transfer Switch; Eng.—Engine; Gen.—Generator Set; Alt.—Alternator; I/M—Installation Manual; O/M—Operation Manual; S/M—Service Manual; S/S—Spec Sheet; O/S/M—Operation/Service Manual; W/D—Wiring Diagram

† Have an authorized service distributor/dealer perform this service.

| Trouble Symptoms | | | | | | | | | | | | Probable Causes | Recommended Actions | Section or Publication Reference* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Does not crank | Cranks but does not start | Starts hard | No or low output voltage | Stops suddenly | Lacks power | Overheats | Low oil pressure | High fuel consumption | Excessive or abnormal noise | Displays error message/locks up | Exercise run time and/or event records inoperative | | | |
| **Lube System** | | | | | | | | | | | | | | |
| | x | x | | | | | x | | x | | | Crankcase oil type incorrect for ambient temperature | Change the oil. Use oil with a viscosity suitable for the operating climate. | Eng. O/M |
| | | | | | | x | x | | x | | | Oil level low | Restore the oil level. Inspect the generator set for oil leaks. | Eng. S/M |
| | | | | x | | | | | | | | Low oil pressure shutdown | Check the oil level. | Eng. O/M |

* ATS—Automatic Transfer Switch; Eng.—Engine; Gen.—Generator Set; Alt.—Alternator; I/M—Installation Manual; O/M—Operation Manual; S/M—Service Manual; S/S—Spec Sheet; O/S/M—Operation/Service Manual; W/D—Wiring Diagram

† Have an authorized service distributor/dealer perform this service.

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 79. Obtain the most current accessory information from your local authorized service distributor/dealer.

| Kit Description |
|---|
| Battery Chargers, 6 Amp and 10 Amp |
| Electrically Operated Circuit Breakers (EOBs) * |
| Failure Relay |
| Four Input/Fifteen Output Module |
| Manual Key Switch |
| Remote Emergency Stop |
| Remote Serial Annunciator |
| Shunt Trip Line Circuit Breaker |
| * EOBs for paralleling applications. See the Commissioning manual for connection and operation information. |

Figure 79 Optional Accessories

Some accessories are available as factory-installed kits only. Others are available as loose kits for installation in the field by a Rehlko 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.

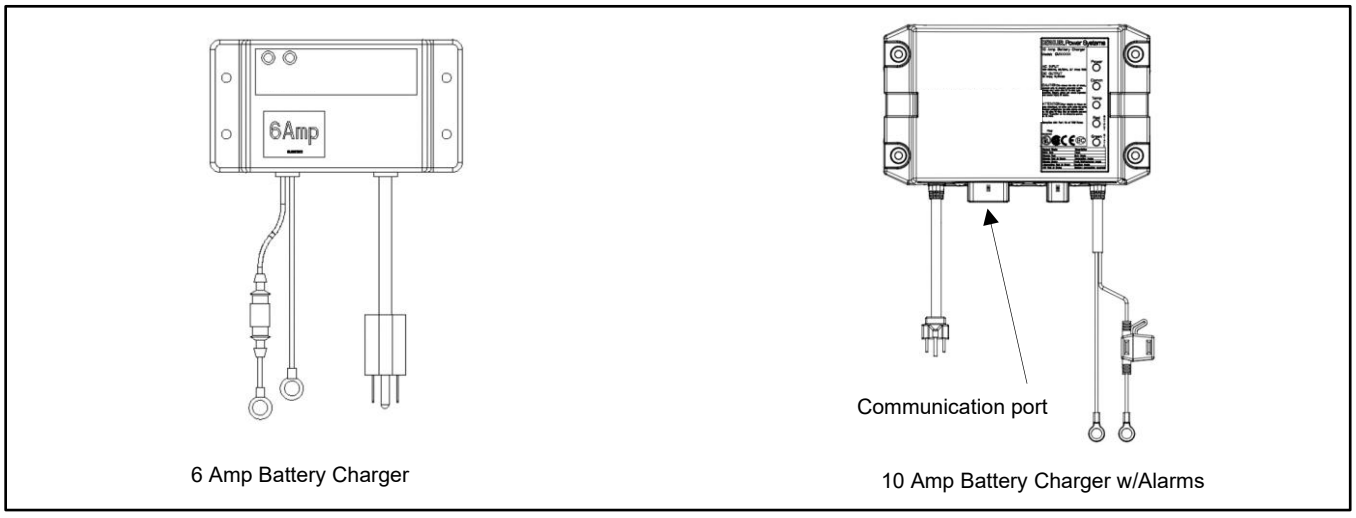


Figure 80 Battery Chargers

## 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 81 are factory-assigned to the common fault relay output. A Rehlko authorized distributor or dealer can change the events assigned to the common fault relay using a personal computer and Rehlko 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 Pressure Warning |
| Low Oil Pressure Shutdown |
| Over Crank Shutdown |
| Over Current L1 Shutdown |
| Over Frequency Shutdown |
| Over Power Shutdown |
| Over Speed Shutdown |
| Over Voltage Shutdown Line-Line |
| Over Voltage Shutdown Line-Neutral |
| Protective Relay Shutdown Reverse VAR |
| Protective Relay Shutdown Reverse Power |
| Protective Relay Shutdown Over Current |
| Protective Relay Shutdown Over Power |
| Remote Emergency Stop Shutdown |
| Reverse Power Shutdown |
| UL Over Power Shutdown |
| Under Frequency Shutdown |
| Under Voltage Shutdown Line-Line |
| Under Voltage Shutdown Line-Neutral |

Figure 81 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 Rehlko SiteTech™ software are required for assigning the inputs and outputs. Contact a Rehlko 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 82. 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<br>10 amps @ 28 VDC (max.)<br>0.01 amp @ 28 VDC (min.) |
| K15 Common Fault Relay Contact | 500 mA @ 125 VAC<br>2 amps @ 30 VDC |

Figure 82 Output Contact Specifications

## 7.4 Manual Key Switch

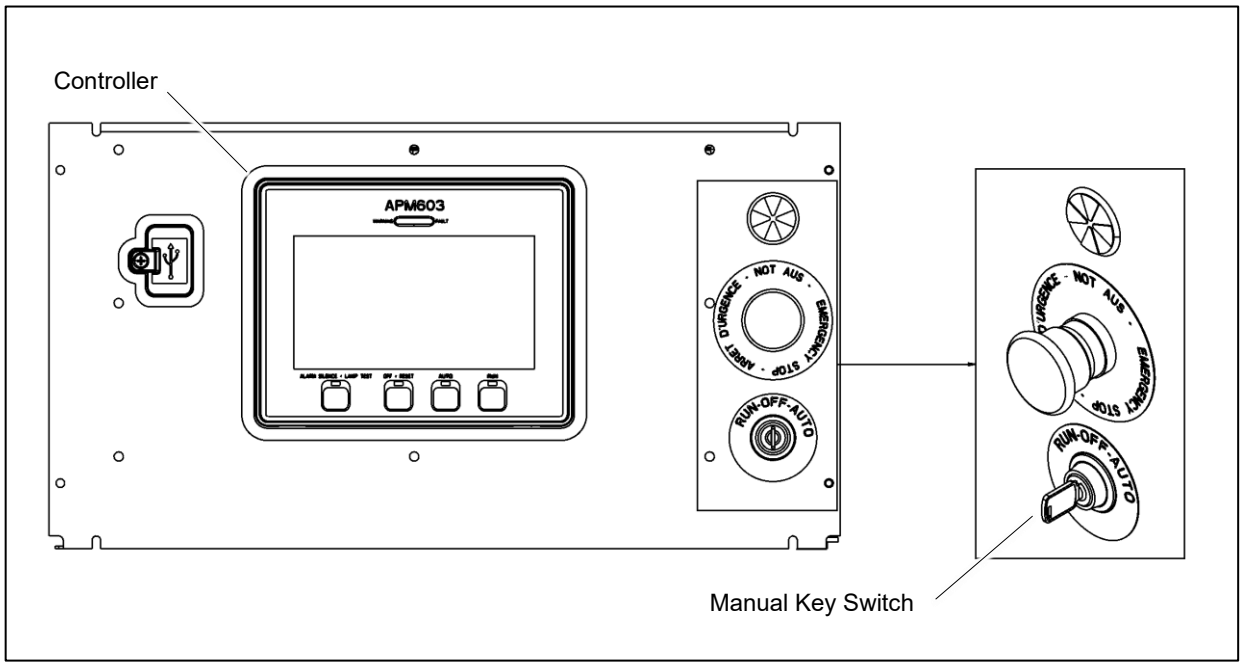


Figure 83 Manual Key Switch Location

**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 83 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 84 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 84. 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.

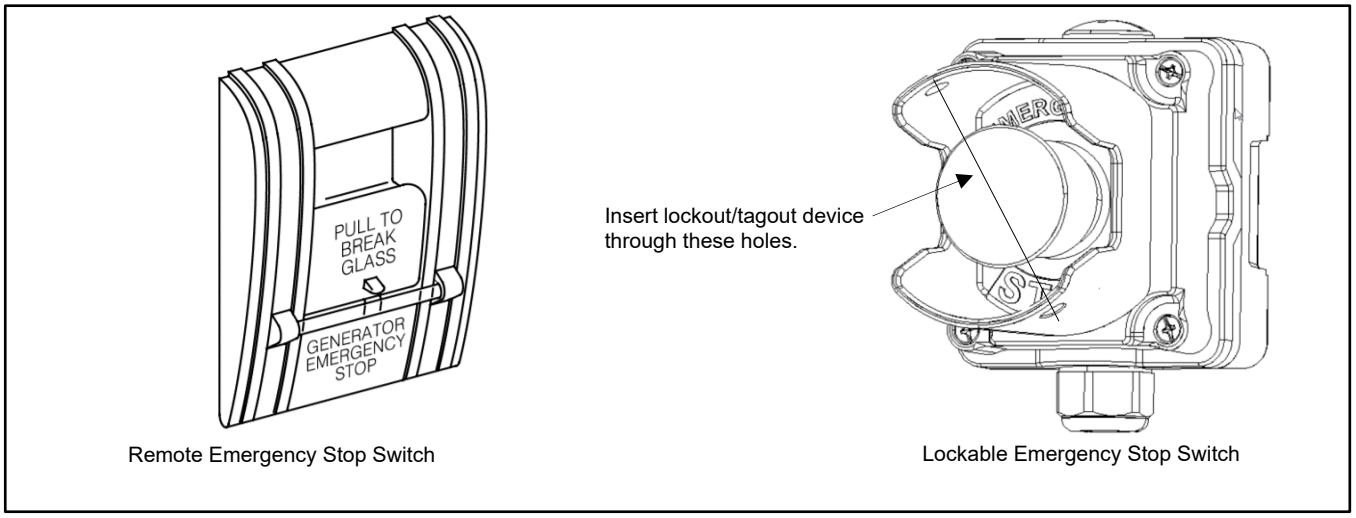


Figure 84 Remote Emergency Stop Switches

## 7.6 Remote Serial Annunciator

The RSA III is an annunciator panel offered in several kit configurations to support Rehlko equipment. See Figure 85. 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 SiteTech1 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 Rehlko 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 86 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[1] Ethernet converter GM41143-KP2 and refer to TT-1405 Converters, Connections, and Controller Setup for Network Communication for system installation.




RSA III with Single Generator Set

RSA III with Single ATS Control

RSA III with Four ATS Controls

Figure 85 Remote Serial Annunciator (RSAIII)

| 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 86 RSA III System Monitoring LEDs and Functions with the APM603 Controller

## 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 Rehlko SiteTech software. SiteTech software is available to Rehlko-authorized distributors and dealers.

| | | | | | |
|---|---|---|---|---|---|
| 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 | E2PROM, 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. $H_2O$ | 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 | $L_{wa}$ | 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 ($10^6$ when used with SI units), male |
| ga. | gauge (meters, wire size) | ISO | International Organization for Standardization | $m^3$ | cubic meter |
| gal. | gallon | J | joule | $m^3$/hr. | cubic meters per hour |
| gen. | generator | JIS | Japanese Industry Standard | $m^3$/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 ($2^{10}$ bytes) | MB | megabyte ($2^{20}$ bytes) |
| gph | gallons per hour | KBus | Communication protocol | MCCB | molded-case circuit breaker |
| gpm | gallons per minute | kg | kilogram | MCM | one thousand circular mils |
| gr. | grade, gross | $kg/cm^2$ | kilograms per square centimeter | meggar | megohmmeter |
| GRD | equipment ground | kgm | kilogram-meter | MHz | megahertz |
| gr. wt. | gross weight | $kg/m^3$ | 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 | $lbm/ft^3$ | 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 | *Systeme international d'unites*, 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/Coml | 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 PSI/Doosan and Rehlko Gas (KG) engine data is displayed on the generator set controller.

| Parameter |
|---|
| Ambient temperature * |
| Coolant temperature |
| ECU runtime hours |
| Intake manifold pressure |
| Intake manifold temperature |
| Intercooler temperature |
| Engine speed |
| Fuel pressure |
| Mechanical engine load * |
| Oil pressure |
| Oil temperature |
| * PSI/Doosan engines only |

# Appendix C. Alternator Protection

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.

| Rated Current | Time Delay |
|---|---|
| 200% | 40 seconds |
| 300% | 10 seconds |
| 425% | 5 seconds |
| 950% | 1 second |

# Appendix D. Operating Hour Service Log

Use the log below to keep a cumulative record of operating hours on your generator set and the dates required services were performed. Enter hours to the nearest quarter hour.

| | Operating Hours | | Service Record | |
|---|---|---|---|---|
| Date Run | Hours Run | Total Hours | Service Date | Service |
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| | Operating Hours | | Service Record | |
|---|---|---|---|---|
| Date Run | Hours Run | Total Hours | Service Date | Service |
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| | | | |

**TP-7165 2/26c**

*Original Instructions (English)*

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