Operation

Mobile Generator Sets



Models:

35-175REOZT

Controller:
Decision-Maker® 3500

rehlko

TP-6895 2/26g

⚠ **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

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

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

For more information go to www.P65warnings.ca.gov/diesel

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: _____

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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Notes

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.** **Can cause severe injury or death.** 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	
	**Sulfuric acid in batteries.** **Can cause severe injury or death.** Wear protective goggles and clothing. Battery acid may cause blindness and burn skin.

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

Battery electrolyte is a diluted sulfuric acid. Battery acid can cause severe injury or death. Battery acid can cause blindness and burn skin. Always wear splashproof safety goggles, rubber gloves, and boots when servicing the battery. Do not open a sealed battery or mutilate the battery case. If battery acid splashes in the eyes or on the skin, immediately flush the affected area for 15 minutes with large quantities of clean water. Seek immediate medical aid in the case of eye contact. Never add acid to a battery after placing the battery in service, as this may result in hazardous spattering of battery acid.

Battery acid cleanup. Battery acid can cause severe injury or death. Battery acid is electrically conductive and corrosive. Add 500 g (1 lb.) of bicarbonate of soda (baking soda) to a container with 4 L (1 gal.) of water and mix the neutralizing solution. Pour the neutralizing solution on the spilled battery acid and continue to add the neutralizing solution to the spilled battery acid until all evidence of a chemical reaction (foaming) has ceased. Flush the resulting liquid with water and dry the area.

Battery gases. Explosion can cause severe injury or death. Battery gases can cause an explosion. Do not smoke or permit flames or sparks to occur near a battery at any time, particularly when it is charging. Do not dispose of a battery in a fire. To prevent burns and sparks that could cause an explosion, avoid touching the battery terminals with tools or other metal objects. Remove all jewelry before servicing the equipment. Discharge static electricity from your body before touching batteries by first touching a grounded metal surface away from the battery. To avoid sparks, do not disturb the battery charger connections while the battery is charging. Always turn the battery charger off before disconnecting the battery connections. Ventilate the compartments containing batteries to prevent accumulation of explosive gases.

Battery gases. Explosion can cause severe injury or death. Incorrect use of the equalize charge state may lead to hazardous situations. Equalization is ONLY applicable for flooded lead acid (FLA) type batteries and will damage gel, absorbed glass mat (AGM), or nickel-cadmium (NiCad) type batteries. In the controller menu or SiteTech™ settings, verify that the battery topology is set correctly for the battery type used. Do not smoke or permit flames, sparks, or other sources of ignition to occur near a battery at any time.

Battery short circuits. Explosion can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Disconnect the battery before generator set installation or maintenance. Remove all jewelry before servicing the equipment. Use tools with insulated handles. Remove the negative (–) lead first when disconnecting the battery. Reconnect the negative (–) lead last when reconnecting the battery. Never connect the negative (–) battery cable to the positive (+) connection terminal of the starter solenoid. Do not test the battery condition by shorting the terminals together.

Engine Backfire/Flash Fire

WARNING	
	**Risk of fire.** **Can cause severe injury or death.** 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.

Servicing the air cleaner. A sudden backfire can cause severe injury or death. Do not operate the generator set with the air cleaner removed.

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.** **Can cause severe nausea, fainting, or death.** 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.** **Can cause severe injury or death.** 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.

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

Draining the fuel system. Explosive fuel vapors can cause severe injury or death. Spilled fuel can cause an explosion. Use a container to catch fuel when draining the fuel system. Wipe up spilled fuel after draining the system.

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.

LPG liquid withdrawal fuel leaks. Explosive fuel vapors can cause severe injury or death. Fuel leakage can cause an explosion. Check the LPG liquid withdrawal fuel system for leakage by using a soap and water solution with the fuel system test pressurized to at least 90 psi (621 kPa). 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.** **Can cause hearing loss.** 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 	**Hazardous voltage.** **Will cause severe injury or death.** Disconnect all power sources before opening the enclosure.

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

WARNING 	**Hazardous voltage. Backfeed to the utility system.** **Can cause property damage, severe injury, or death.** If the generator set is used for standby power, install an automatic transfer switch to prevent inadvertent interconnection of standby and normal sources of supply.

Grounding electrical equipment. Hazardous voltage will cause severe injury or death. Electrocution is possible whenever electricity is present. Ensure you comply with all applicable codes and standards. Electrically ground the generator set, transfer switch, and related equipment and electrical circuits. Turn off the main circuit breakers of all power sources before servicing the equipment. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

High voltage test. Hazardous voltage will cause severe injury or death. Follow the instructions of the test equipment manufacturer when performing high-voltage tests on the rotor or stator. An improper test procedure can damage equipment or lead to generator set failure.

Installing the battery charger. Hazardous voltage will cause severe injury or death. An ungrounded battery charger may cause electrical shock. Connect the battery charger enclosure to the ground of a permanent wiring system. As an alternative, install an equipment grounding conductor with circuit conductors and connect it to the equipment grounding terminal or the lead on the battery charger. Install the battery charger as prescribed in the equipment manual. Install the battery charger in compliance with local codes and ordinances.

Connecting the battery and the battery charger. Hazardous voltage will cause severe injury or death. Reconnect the battery correctly, positive to positive and negative to negative, to avoid electrical shock and damage to the battery charger and battery(ies). Have a qualified electrician install the battery(ies).

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.

Engine block heater. Hazardous voltage will cause severe injury or death. The engine block heater can cause electrical shock. Remove the engine block heater plug from the electrical outlet before working on the block heater electrical connections.

Electrical backfeed to the utility. Hazardous backfeed voltage can cause severe injury or death. Install a transfer switch in standby power installations to prevent the connection of standby and other sources of power. Electrical backfeed into a utility electrical system can cause severe injury or death to utility personnel working on power lines.

Testing live electrical circuits. Hazardous voltage or current will cause severe injury or death. Have trained and qualified personnel take diagnostic measurements of live circuits. Use adequately rated test equipment with electrically insulated probes and follow the instructions of the test equipment manufacturer when performing voltage tests. Observe the following precautions when performing voltage tests: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Do not touch the enclosure or components inside the enclosure. (4) Be prepared for the system to operate automatically. *(600 volts and under)*

Servicing the generator set when it is operating. Exposed moving parts will cause severe injury or death. Keep hands, feet, hair, clothing, and test leads away from the belts and pulleys when the generator set is running. Replace guards, screens, and covers before operating the generator set.

Heavy Equipment

WARNING 	**Unbalanced weight.** **Improper lifting can cause severe injury or death and equipment damage.** Do not use lifting eyes. Lift the generator set using lifting bars inserted through the lifting holes on the skid.

Hot Parts

WARNING 	**Hot coolant and steam.** **Can cause severe injury or death.** Before removing the pressure cap, stop the generator set and allow it to cool. Then loosen the pressure cap to relieve pressure. Fill system before starting unit.

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

Servicing the alternator. Hot parts can cause severe injury or death. Avoid touching the alternator field or exciter armature. When shorted, the alternator field and exciter armature become hot enough to cause severe burns.

Servicing the exhaust system. Hot parts can cause severe injury or death. Do not touch hot engine parts. The engine and exhaust system components become extremely hot during operation.

Notice

NOTICE
This generator set has been rewired from its nameplate voltage to:
246242

NOTICE

Voltage reconnection. Affix a notice to the generator set after reconnecting the set to a voltage different from the voltage on the nameplate. Order voltage reconnection decal 246242 from an authorized service distributor/dealer.

NOTICE

Parallel Operation. This product includes features intended to support operation in parallel with the utility grid, but these features have not been evaluated for compliance with specific utility interconnection protection standards or requirements.

NOTICE

Canadian installations only. For standby service connect the output of the generator set to a suitably rated transfer switch in accordance with Canadian Electrical Code, Part 1.

Notes

This manual provides operation instructions for 35-175REOZT4 mobile generator sets. Use this manual for information about generator set trailers, electrical connection requirements at the jobsite, and operation of related equipment found on mobile units.

To determine the generator set controller software version, go to the Overview menu.

Wiring diagrams are available separately. Refer to the engine operation manual for generator set engine 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 to 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 communication and software information not provided in this manual. Figure 1 lists the available literature part numbers.

Note:
The trailer manufacturer may include additional literature not shown in Figure 1.

Several engine manufacturers provide engines with electronic controls. These 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 respective Parts Catalog.

	35REOZT4	45REOZT4	55REOZT4	90REOZT4	120REOZT4	145REOZT4	175REOZT4
Generator set controller	Decision-Maker® 3500						
Trailer/generator set spec sheet	G5-412	G5-413	G5-414	G5-416	G5-417	G5-418	G5-419
Engine operation manual	TP-6915		TP-6979	TP-6985		TP-6998	
Wiring diagram manual	TP-6913						
Alternator service manual	TP-6878		TP-6783				
Controller service manual	TP-6929						
SiteTech™ Software Manual	TP-6701						
Mobile paralleling box spec sheet	G6-148						
Mobile paralleling box instruction sheet	TT-1672						
6-Amp battery charger spec sheet	G6-60						
6-Amp battery charger instruction sheet	TT-1341						

Figure 1 Other 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

Several instances in this manual make reference to SiteTech™ software which is required for programming the Decision-Maker® 3500 controller if the factory default settings are not appropriate for the application. SiteTech™ software is also needed for updating the controller application code. Contact your local distributor/dealer for assistance.

Requires SiteTech™ software version 4.1 or higher to upgrade the controller firmware.

Tech Tools

Note:
Tech Tools is for Rehlko authorized personnel only.

Access Tech Tools to find the following topics:

- **Software** used by generator set controllers including updates and documentation references.
- **Network Communications** provides basics to terms, protocols, standards, wiring, configurations, and model.
- **Engine Electronic Control Module (ECM)** has information about electronic devices provided by the engine manufacturer to manage engine data.

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.

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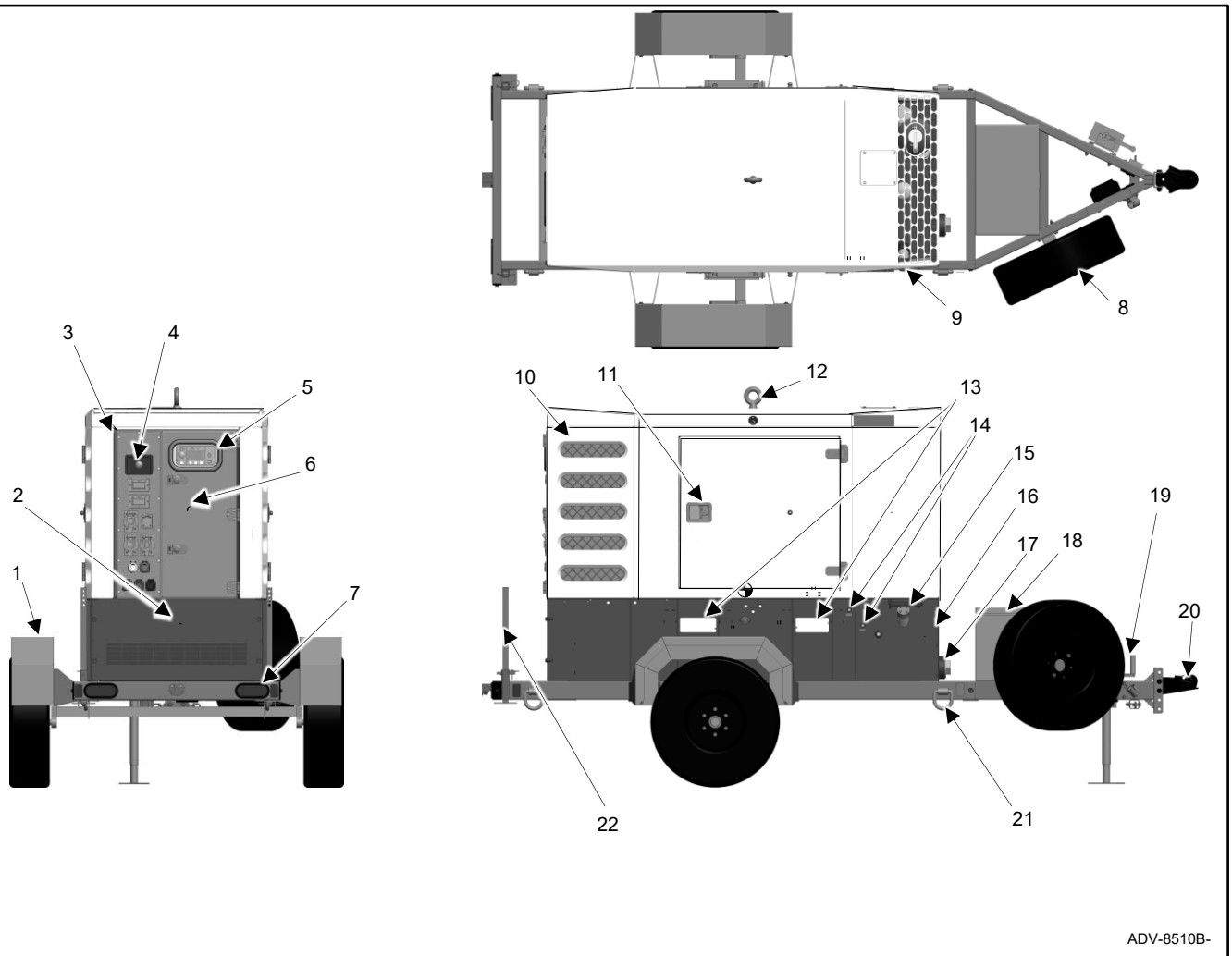
Notes

1.1 Introduction

The views and features section provides illustrations and explanations of various mobile generator set components. Individual model illustrations are shown where differences exist between models.

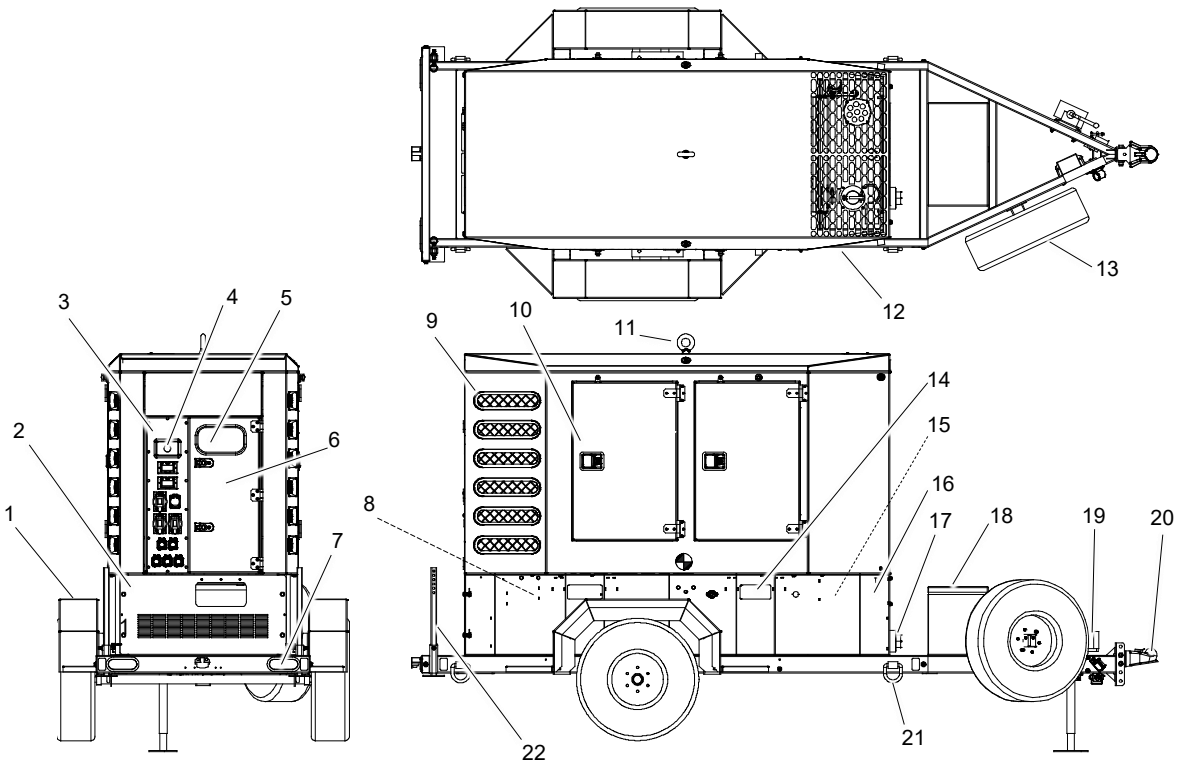
1.2 Illustrations and Major Components

The following illustrations show major components and descriptions. The trailer, generator set, and generator set accessory subsections provide additional information. Use Figure 2, Figure 3, or Figure 4 to identify major generator set trailer components. The illustrations indicate component locations and may not show the component.



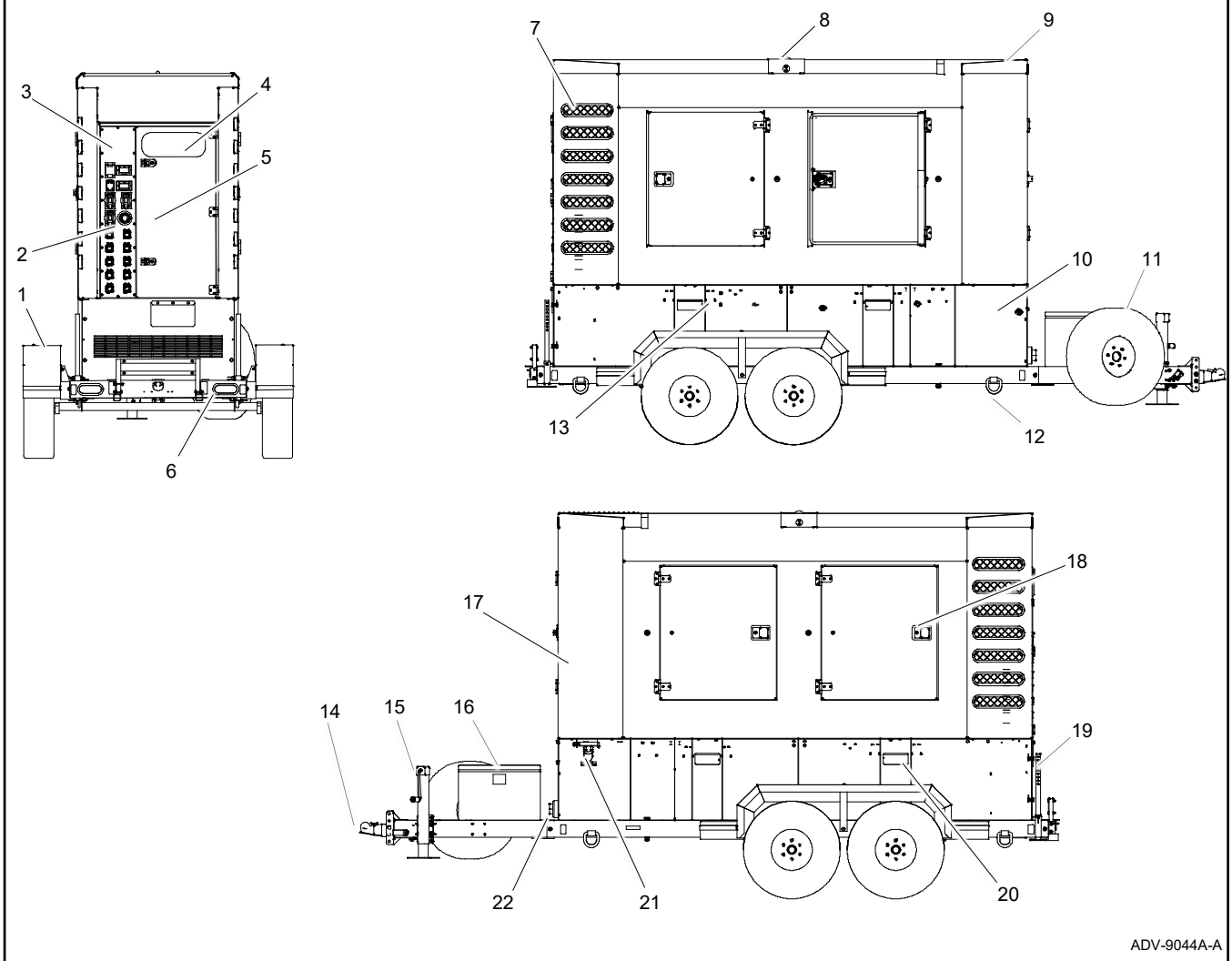
1.	Weight bearing steel fender and standing platform	9.	Discharge plenum	17.	Fuel tank drain
2.	Removable end channel lockable for cable storage	10.	Air intake	18.	Tool box
3.	Customer connection panel	11.	Lockable side door	19.	Tongue jack
4.	Emergency stop (E-stop) switch	12.	Generator set/trailer lifting eye	20.	Trailer hitch
5.	Decision-Maker® 3500 controller	13.	Fork lift pockets	21.	Tie downs (qty. 4)
6.	Lockable rear door with viewing window	14.	External fuel supply and return, 3/8 NPT	22.	Rear stabilizer
7.	Trailer taillights	15.	External lockable fuel fill		
8.	Spare tire	16.	Integrated fuel tank		

Figure 2 Trailer and Weather Enclosure Components, 35/45 kVA (standard skid/tank with available options shown)



1. Weight bearing steel fender and standing platform
2. Removable end channel lockable for cable storage
3. Customer connection panel
4. Emergency stop (E-stop) switch
5. Decision-Maker® 3500 controller
6. Lockable rear door with viewing window
7. Trailer taillights
8. External fuel supply and return, 3/8 NPT (Opposite side)
9. Air intake
10. Lockable side door (qty. 4)
11. Generator set/trailer lifting eye
12. Discharge plenum
13. Spare tire
14. Fork lift pockets (qty. 4)
15. External lockable fuel fill (opposite side)
16. Integrated fuel tank
17. Fuel tank drain
18. Tool box
19. Tongue jack
20. Trailer hitch
21. Tie downs (qty. 4)
22. Rear stabilizer

Figure 3 Trailer and Weather Enclosure Components, 55 kVA (standard skid/tank with available options shown)



1.	Weight bearing steel fender and standing platform	9.	Discharge plenum	17.	Lockable Diesel Exhaust Fluid (DEF) tank fill (inside door)
2.	Emergency stop (E-stop) switch	10.	Integrated fuel tank	18.	Lockable side door (qty. 5)
3.	Customer connection panel	11.	Spare tire	19.	Rear stabilizer
4.	Decision-Maker® 3500 controller	12.	Tie downs (qty. 4)	20.	Fork lift pockets (qty. 4)
5.	Lockable rear door with viewing window	13.	External fuel supply and return, 3/8 NPT	21.	External lockable fuel fill
6.	Trailer taillights	14.	Trailer hitch	22.	Fuel tank drain
7.	Air intake	15.	Tongue jack		
8.	Generator set/trailer lifting eye	16.	Tool box		

Figure 4 Trailer and Weather Enclosure Components, 145/175 kVA models shown (90/120 kVA models similar) (standard skid/tank with available options shown)

1.3 Generator Set and Trailer Components

1.3.1 Engine

This manual does not contain specific engine specifications. Refer to the generator set spec sheet and the engine operation manual for engine information.

1.3.2 Alternator

This manual does not contain specific alternator specifications. Refer to the generator set spec sheet for alternator information.

1.3.3 Controller

Refer to the Prestart Checks and Controller Operation section for generator set controller operation information. Refer to the generator set spec sheet for additional controller information. See Figure 5.

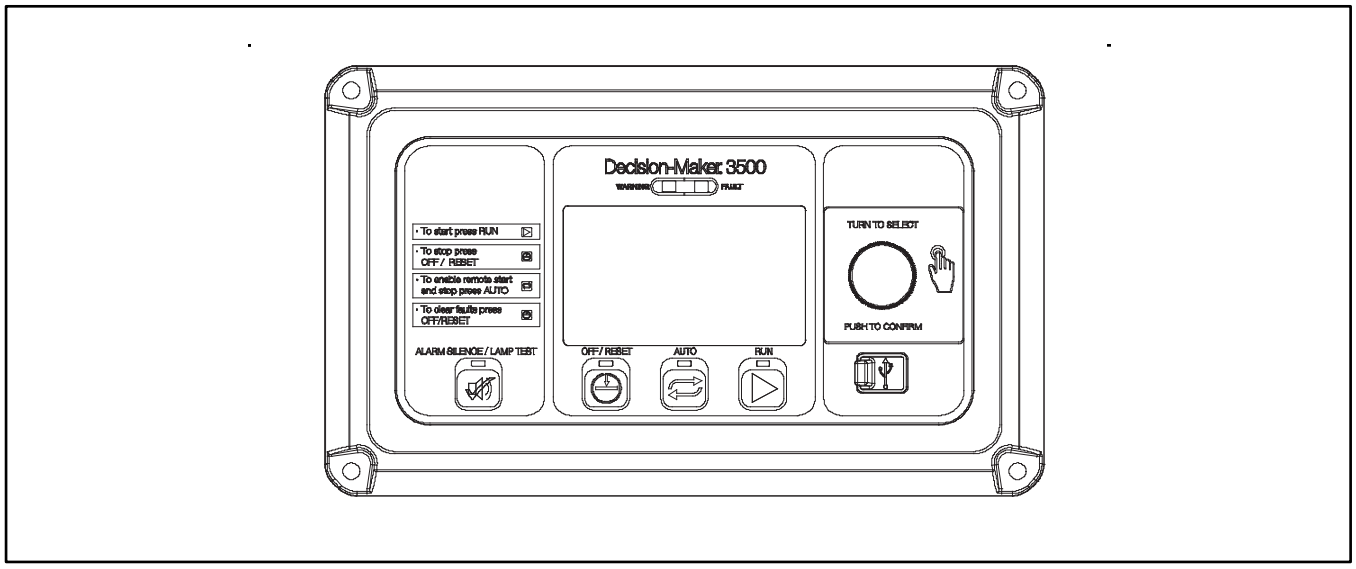


Figure 5 Decision-Maker® 3500 Controller

1.3.4 Trailer

Refer to the Appendix for trailer specifications including tire, wheel, axle, and suspension specifications.

1.3.5 Enclosure

Steel construction, sound-attenuating enclosure with stainless steel hinges and lockable latches on doors. Single-point lifting eye and four-point tie down system.

1.3.6 Fuel Tank and Fuel System

The fuel tank includes the fuel level gauge, fuel fill with lockable cap, and normal/emergency relief vents. The inner tank has a normal relief vent and the outer tank has an emergency relief vent. Refer to the Fuel Valve, Two-Way section for the available two-way fuel valve.

Refer to the Appendix for fuel tank and fuel system specifications.

1.3.7 Customer Connection Panel

Refer to the Electrical Connections and Requirements section for illustrations and features of the customer connection panel.

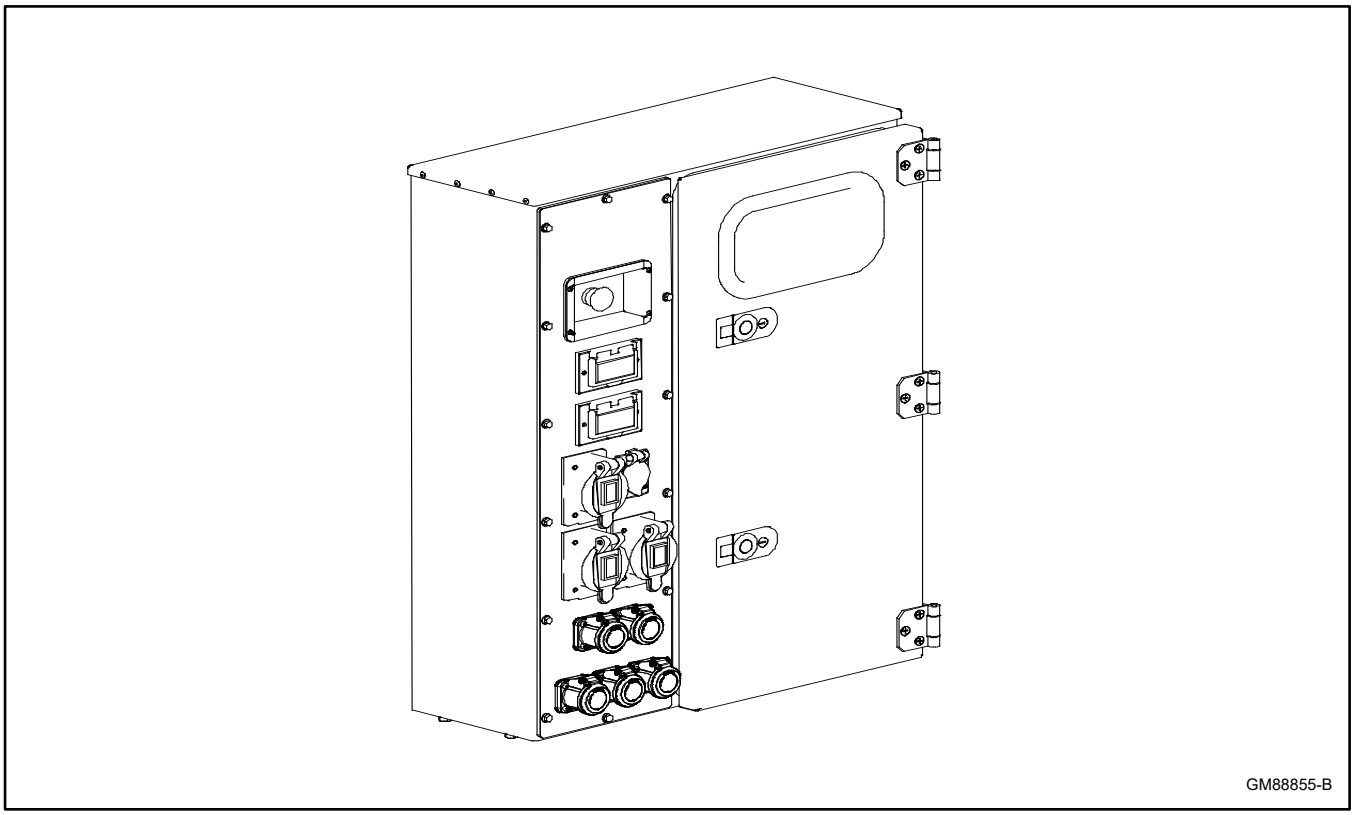


Figure 6 Customer Connection Panel (35/45REOZT4 Shown with Available Options)

1.3.8 Emergency Stop (E-Stop) Switch

The E-stop switch is mounted on the customer connection panel. See Figure 7.

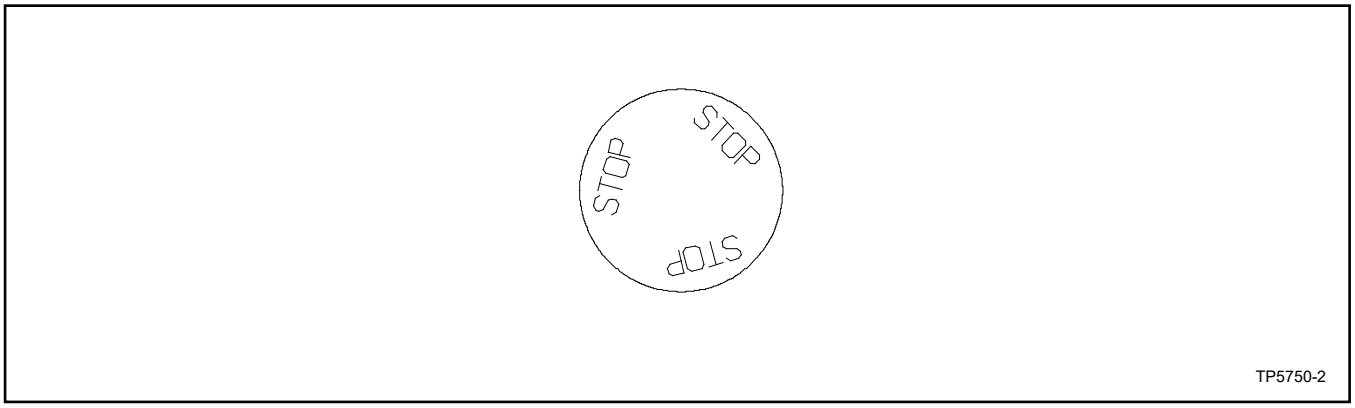


Figure 7 Emergency Stop (E-Stop) Switch

Use the emergency stop switch for emergency shutdowns only. Use the generator set master switch for normal shutdowns.

The unit shuts down and the controller fault lamp lights if an operator activates the emergency stop switch. Reset the generator set emergency stop switch using the following procedure.

1. Investigate the cause of the emergency stop and correct the circuit or wiring problem(s).
2. Reset the emergency stop switch by pulling the knob slightly outward.
3. Press the generator set controller OFF (RESET) switch. The unit is now ready for starting.

1.4 Generator Set Accessories

1.4.1 Battery(ies)

Generator sets with 12-volt engine electrical systems use a single 12-volt, lead-acid battery. Generator sets with 24-volt engine electrical systems contain two batteries. The generator set spec sheet provides battery capacity recommendations.

1.4.2 Battery Charger

The float/equalize battery charger is designed to both recharge your battery and extend the battery's life in applications where it is stored for long periods of time. The float/equalize battery charger is a 3-stage electronic battery charger. Rainproof, lightweight, silent, and completely automatic. Unlike automotive trickle battery chargers, the float/equalize battery charger will not boil off the electrolyte in properly installed and maintained batteries. When the battery charger is attached to the battery and plugged into a standard 120 volt/60 Hz AC outlet, the red and green LEDs let you know the unit is recharging and maintaining your battery.

The float/equalize battery charger is designed to be used as an on-board battery charger for lead acid batteries (flooded cell or AGM types) and gel-cell type batteries.

For 24 VDC engine electrical systems, use two battery chargers. Connect one battery charger to each battery.

1.4.3 Battery Heater

The battery wrap heater is optional on selected models and part of the cold weather package. The battery wrap heater keeps the battery above freezing temperatures making starting easier and is connected to shore power through the customer connection panel.

1.4.4 Dry Contact, 15-Relay

The fifteen-relay dry contact kit provides normally open and normally closed contacts in a form C configuration to activate warning devices and other user-provided accessories allowing remote monitoring of the generator set. Connect any controller fault output to the dry contact kit. Typically, lamps, audible alarms, or other devices signal the fault conditions. See the Electrical Connections and Requirements section for more information.

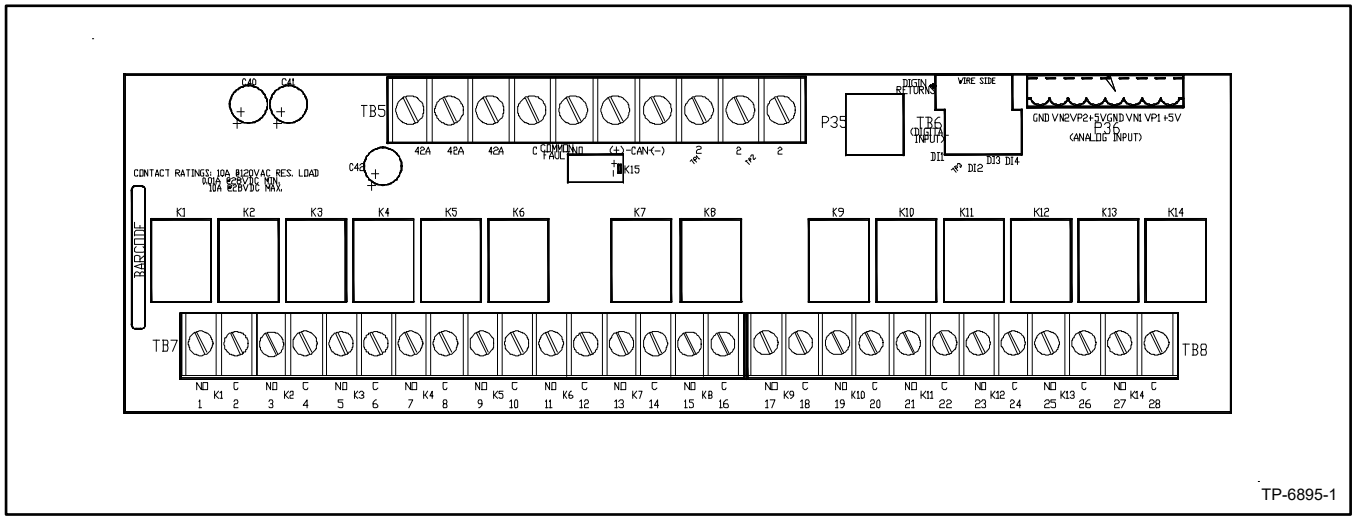


Figure 8 15-Relay Dry Contact

1.4.5 Engine Block Heater

The engine block heater is optional on selected models and part of the cold weather package. The engine block heater heats the engine coolant, making starting easier and warmup quicker. The thermostat automatically turns off the heater when coolant temperature reaches the set point. See Figure 9.

Model	Voltage	Wattage	Turn On	Turn Off
35/45REOZT4	120	700	16°C (60°F)	27°C (80°F)
55REOZT4	120	1000		
90/120REOZT4	120	1500	27°C (80°F)	38°C (100°F)
145/175REOZT4	120	1800		

Figure 9 Block Heater Wattage

1.4.6 Field Draggable Skid/Fuel Tank/Enclosure

Heavy-duty field skid and fuel tank includes heavy gauge steel skid with integrated drains and pull bars. The heavy gauge enclosure has rugged hinges, latches, and door stops.

1.4.7 Fuel Valve, Two-Way

Fuel valve allows the switching of the diesel fuel supply between the subbase fuel tank and an external user-supplied fuel tank. See Figure 10. Refer to the Diesel Fuel Systems section for more information.

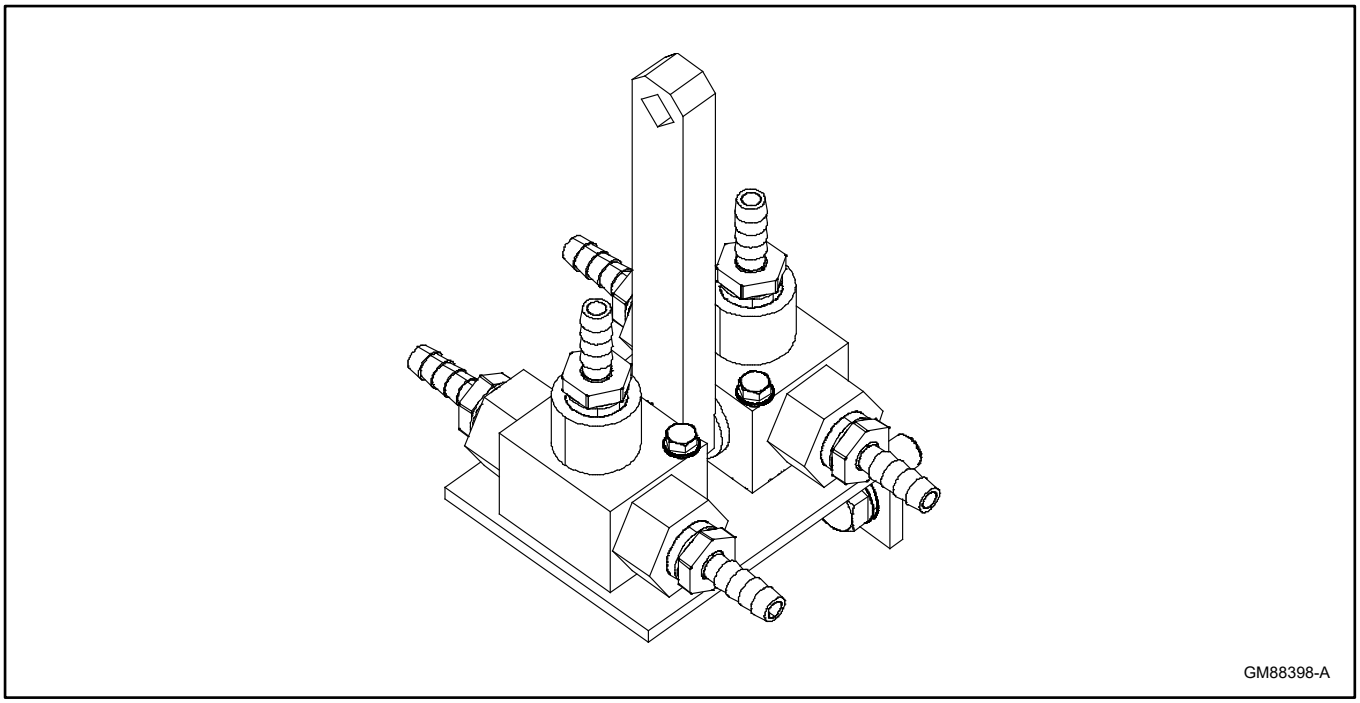


Figure 10 Two-Way Fuel Valve

1.4.8 Mobile Paralleling Box

The mobile paralleling box allows connection of two generator sets to one distribution box. The paralleling box provides contactors to connect to and disconnect from the bus, eliminating the need for motorized breakers for each generator set. Up to four paralleling boxes and eight generator sets can be connected to one distribution bus.

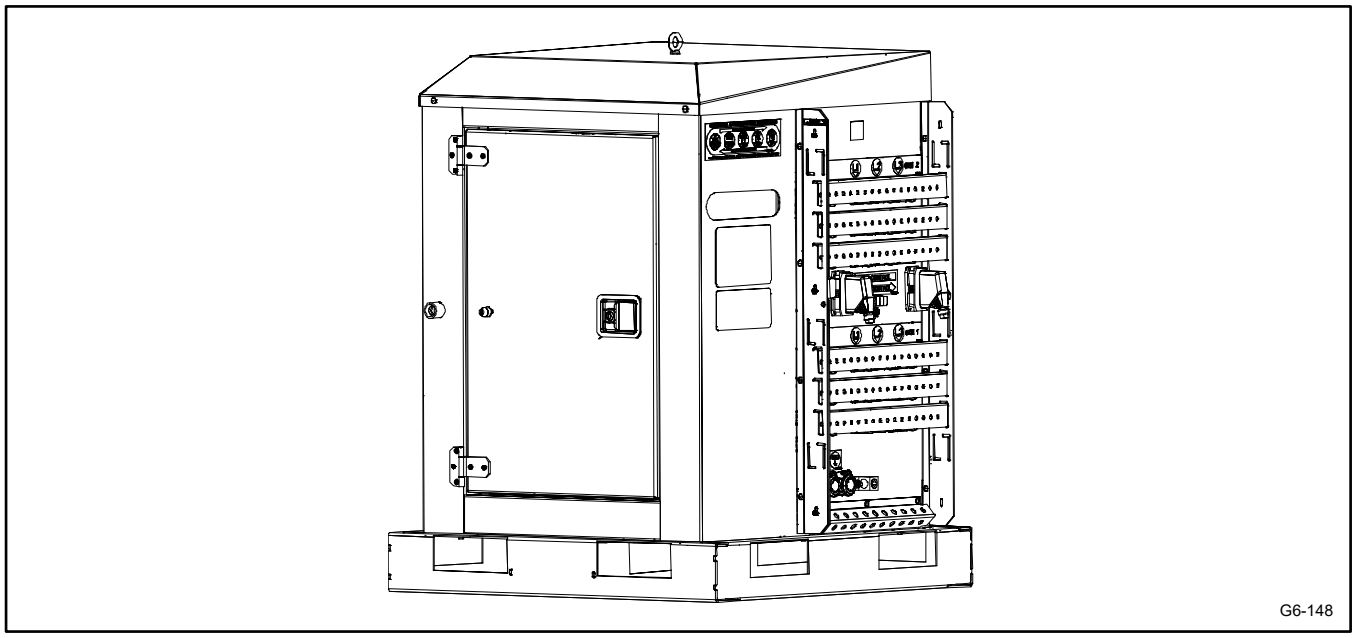


Figure 11 Mobile Paralleling Box

1.4.9 Trailer Related Items

The hydraulic jack, wheel lug nut wrench, and fire extinguisher (stored in the tool box) are part of the available trailer package.

Towable units are available with a lockable spare tire.

A cable box is available on selected models for storing user-supplied cables.

1.4.10 Voltage Selector Switch

Some generator sets include a selector switch providing the ability to change between high wye, low wye, and single phase voltages. See Figure 12 for the different configurations. Move the selector switch to the desired position before starting the generator set and *do not switch voltage while the generator set is running*.

All loads connected to the load lugs (or camlocks) must match the selected voltage of the switch.

Refer to the Electrical Connections and Requirements section for features and operation of the voltage selector switches.

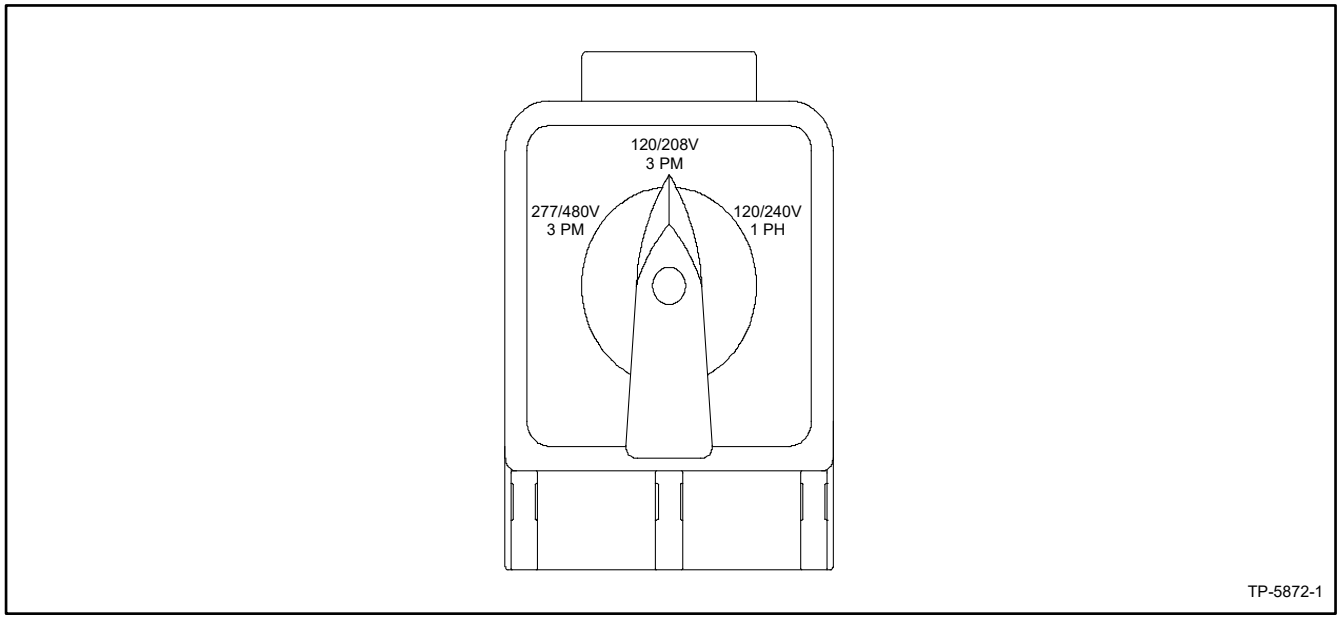


Figure 12 Voltage Selector Switch

1.4.11 Wheel Chock Blocks

Wheel chocks are available to help stabilize the unit and prevent the trailer from rolling on inclined surfaces.

Notes

2.1 Introduction

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

2.2 Controller Specifications

Decision-Maker® 3500	
Power source with circuit protection	12- or 24-volt DC
Power drain	400 milliamps at 12V 200 milliamps at 24V
Humidity range	5-95%
Operating temperature	-40° to 70°C (-40° to 158°F)
Storage temperature	-40° to 85°C (-40° to 185°F)

Note:
Have setup and adjustments of the Decision-Maker® 3500 controller performed only by an authorized Rehlko distributor. The setup and adjustments are password protected.

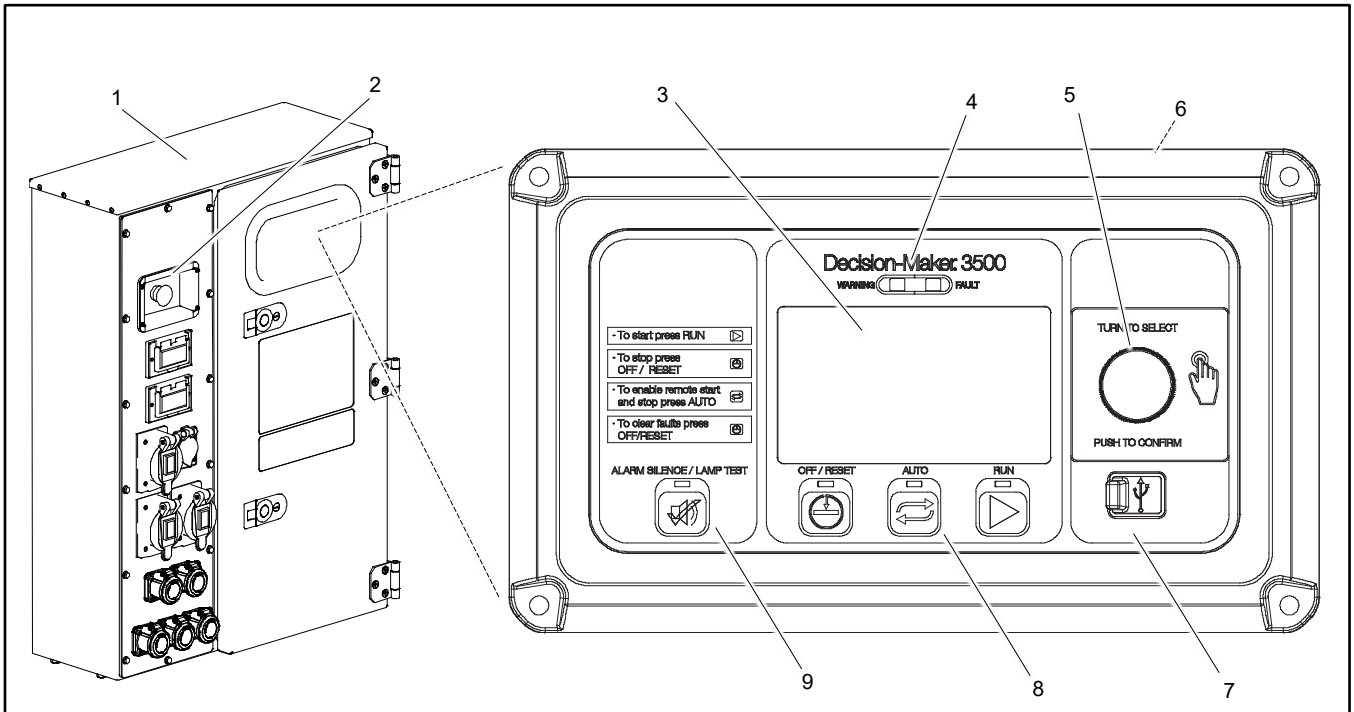
2.3 Controller Features

The controller features include the annunciator lamp, graphical display and pushbutton/rotary selector dial, switches and controls, and terminal blocks. See Figure 13 for an illustration of the controller front panel. The following paragraphs detail the features by general topics. The controller provides:

- The backlit LCD (liquid crystal display) for monitoring the generator set functions and output values
- Master control buttons with status lights
- Fault lamp
- Pushbutton/rotary selector dial to navigate the generator set displays
- Alarm horn and alarm silence switch/light
- Mini USB connector for PC setup using SiteTech™ software

The controller features, accessories, and menu displays depend upon the engine electronic control module (ECM) setup and features. Controller features apply to generator set models with ECM and non-ECM engines unless otherwise noted.

Note:
Measurements display in metric or English units. Use the Controller Configuration menu to change the measurement display.



1. Customer connection panel
2. Emergency stop switch (located on the customer connection panel)
3. Graphical display
4. Annunciator warning and shutdown lamps
5. Pushbutton/rotary selector dial
6. Alarm horn (behind panel)
7. Mini USB connection
8. Generator set master control, OFF/RESET-AUTO-RUN buttons with lamps
9. Alarm silence button with lamp (press and hold for 3 seconds for lamp test)

Figure 13 Customer Connection Panel and Decision-Maker® 3500 Controller

Note:
Press the pushbutton/rotary selector dial to turn on the controller lights and display. The backlight turns off 60 minutes after the last entry when in the AUTO mode.

Note:
After about 15 minutes of no user input (pushbutton/rotary selector dial or buttons), the menu is reset to the top of the main menus and auto-paging activates for the Overview submenus.

2.3.1 Switches and Controls

Note:
US/Metric Display is selectable in the Controller Configuration Menu section.

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.

Note:
Additional alarm silencing options are shown in the Controller Configuration Menu section.

Restore alarm horn switches at all locations including those on remote annunciator kits after correcting the fault shutdown to avoid reactivating the alarm horn. See the Controller Resetting section for resetting the controller.

Emergency Stop (located on the customer connection panel). The operator-activated pushbutton immediately shuts down the generator set in emergency situations. Reset the emergency stop switch after shutdown by pulling the emergency stop switch outward. *Use the emergency stop switch for emergency shutdowns only.* Use the master control switch OFF/RESET button for normal shutdowns.

Generator Set Master Control (OFF/RESET-AUTO-RUN). These buttons reset the controller fault lamps and start/stop the generator set. Additional information in shown in the Prestart Checks and Controller Operation section.

Lamp Test. Press and hold the Alarm Silence/Lamp Test button to test the controller indicator lamps, alarm horn, and digital display.

Pushbutton/Rotary Selector Dial. This control provides access to the menus for monitoring. Press the selector dial to activate the graphical display and to select choices shown on the display. Rotate the dial to navigate through the menus.

The pushbutton/rotary selector dial has several features and functions:

- Momentarily press the dial to activate the graphical display if dark.
- Rotate the dial to navigate through the main menus—turn counterclockwise to go forward (down) and clockwise to go back (up). The menus wrap to the beginning.
- Press the dial at a given main menu to access the submenus within the selected main menu.
- When in the submenu, rotate the dial to navigate through the submenu—counterclockwise to go forward (down) and clockwise to go back (up). The menus wrap to the beginning.
- Momentarily press the dial when in the submenu to make a user selection choice (if available) or to go back to the respective main menu.
- To return to the previous menu, rotate the dial (counterclockwise or clockwise) until the back arrow appears in the upper left corner and press the dial. See Figure 14.

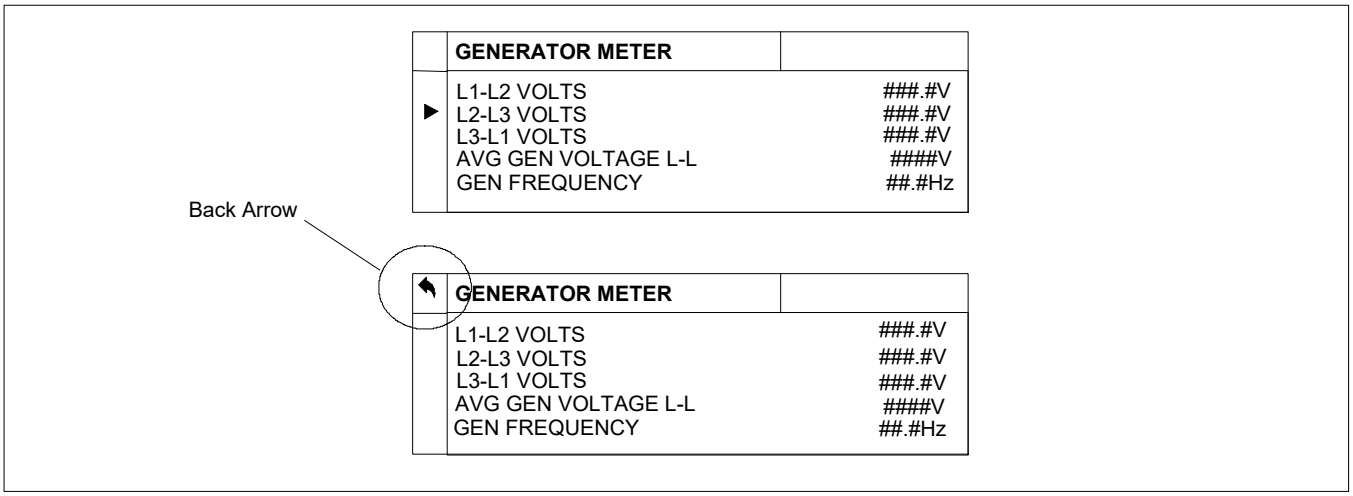


Figure 14 Back Arrow Location

- After about 15 minutes of no user input (pushbutton/rotary selector dial or buttons), the menu resets to the top of the main menus and auto-paging activates for the Overview submenus.

2.3.2 Annunciator Lamps

The controller has a single annunciator fault lamp providing visual generator set status. In addition, each button has a lamp. See Figure 15.

Lamp/Button	Lamp Color
Alarm (Fault) Lamp	Yellow (Warning) or Red (Shutdown)
Off/Reset Button	Blue
Auto Button	Blue (System Ready)
Run Button	Blue
Alarm Silence Button	Orange

Figure 15 Annunciator Lamps

System Status Lamps (Master Control Switches)

The lamp illuminates on the master control switch AUTO (automatic start) button indicating the system senses no faults and the unit is ready to start by remote command.

The lamp illuminates on the master control switch OFF/RESET button indicating the generator set is stopped.

The lamp illuminates on the master control switch RUN button indicating the generator set is cranking or running from a local command.

Only one of the three master control switch lamps will illuminate at any given time.

Alarm Silence Lamp. Orange lamp illuminates indicating the alarm horn was silenced.

Alarm Fault Lamp. Yellow lamp illuminates indicating a warning condition or red lamp illuminates indicating a shutdown condition. See the System Fault Warning Lamp with Digital Displays section and the System Fault Shutdown Lamp with Digital Displays section for system fault conditions.

System Warning Fault Lamp. Yellow lamp identifies an existing fault condition that does not shut down the generator set. A continuing system warning fault condition may cause a system shutdown. Correct all system warnings as soon as practical.

See the System Fault Warning Lamp with Digital Displays section for definitions of the items listed.

System Shutdown Fault Lamp. Red lamp indicates that the generator set has shut down because of a fault condition. The unit will not start without resetting the controller, see the Controller Resetting procedure section.

See the System Fault Shutdown Lamp with Digital Displays section for definitions of the items listed.

2.3.3 Graphical Display

Press the pushbutton/rotary selector dial to turn on the controller lamps and display. The backlight turns off 10 minutes after the last entry when in the AUTO mode.

The generator set must be running for some displays to indicate values. If the generator set is not running some values will display zero or N/A (not available).

The 5-line, 35 character per line backlit heated display provides generator set and engine data, system status, and fault information. See the Customer Connection Panel and Decision-Maker® 3500 Controller figure. The graphical display shows abbreviations in some instances.

Note:
US/Metric Unit Display is selectable in the Controller Configuration menu.

Note:
After about 5 minutes (10 minutes with firmware) of no user input (pushbutton/rotary selector dial or buttons), the menu resets to the top of the main menus and auto-paging activates for the Overview submenus.

The main menus are listed below. Within each main menu are multiple submenus with descriptions following.

- Metering (See the Metering Menu section)
- Generator Information (See the Generator Information Menu section)
- Controller Configuration (See the Controller Configuration Menu section)
- I/O Setup (See the I/O Setup Menu section)
- Active Events (See the System Fault Warning Lamp with Digital Displays section, the System Fault Shutdown Lamp with Digital Displays section and the Fault, Notice, and Status Displays section)

2.4 Metering Menu

2.4.1 Generator Metering Submenu

- **Volts** displays the alternator output AC voltages. The display shows all line-to-line and line-to-neutral voltage combinations for three-phase or single-phase configurations. The display also shows the average line-to-line and line-to-neutral voltages.

  Note:
  The average line-to-neutral is not listed for the delta connection.
- **Current** displays the alternator output AC amps. The display shows each line (L1-L2-L3) of three-phase models or L1-L2 current for single-phase models. The display also shows the average current.
- **Frequency (Hz)** displays the frequency (Hz) of alternator output voltage.
- **Power kW** displays the total and the individual L1, L2, and L3 alternator output as actual output values.
- **Power Factor** displays the total and individual line power factor values.
- **% Rated kW** displays alternator output as a percentage of the entered rated value.
- **Reactive Power kVAR** displays the total and individual L1, L2, and L3 kVAR.
- **Apparent Power kVA** displays the total and individual L1, L2, and L3 kVA.
- **% Rated kVA** displays alternator kVA as a percentage of the entered rated value.
- **Phase Rotation** displays the actual generator rotation.

2.4.2 Engine Metering Submenu

Note:
Not all of these engine metering submenus may apply.

- **Engine Speed (Tachometer)** displays the engine speed (RPM) at which the engine is presently running.
- **Oil Pressure** displays the engine oil pressure.
- **Coolant Temperature** displays the engine coolant temperature.
- **Fuel Rate** displays the calculated fuel consumption rate based on fuel injector outputs (if available from ECM).
- **Gen Battery Voltage** displays the DC voltage of the generator set starting battery(ies) as measured by the controller.
- **ECM Battery Voltage** displays the DC voltage of the engine starting battery(ies) as reported from the ECM.
- **Oil Temperature** displays the engine oil temperature.
- **Coolant Pressure** displays for the engine coolant pressure.
- **Fuel Pressure** displays the fuel line pressure at the generator set inlet for gas-powered models.
- **Fuel Temperature** displays the fuel supply temperature.
- **Fuel Used Last Run** displays the accumulated amount of fuel used since last reset (if available from ECM).
- **Crankcase Pressure** displays the engine crankcase pressure.
- **Intake Air Pressure** displays the engine intake manifold air pressure if available.
- **Intake Air Temperature** displays the engine intake manifold air temperature if available.

2.4.3 Overview Submenu

Generator Status:

- **Average Volts Line-to-Line**. For three-phase configurations the average line-to-line voltage of L1, L2, and L3 is displayed. Single-phase configurations show the L1-L2 voltage.
- **Average Current** value displays as the average for three-phase configurations or the current value for L1-L2 with single-phase configurations.
- **Frequency (Hz)** value displays for the output AC voltage.

Engine Status:

- **Coolant Temperature** displays the engine coolant temperature.
- **Oil Pressure** displays the engine oil pressure.
- **Battery Voltage** displays the DC voltage of the engine starting battery(ies).

System Status:

- **Fuel Pressure** displays fuel injection pressure.
- **Total Power** displays the generator set operating power rating in kW.
- **Engine Run Time** displays the total run time hours.

Charger Status:

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

Battery gases. Explosion can cause severe injury or death. Incorrect use of the equalize charge state may lead to hazardous situations. Equalization is ONLY applicable for flooded lead acid (FLA) type batteries and will damage gel, absorbed glass mat (AGM), or nickel-cadmium (NiCad) type batteries. In the controller menu or SiteTech™ settings, verify that the battery topology is set correctly for the battery type used. Do not smoke or permit flames, sparks, or other sources of ignition to occur near a battery at any time.

Battery charger menus are available on Decision-Maker® 3500 Controllers with controller firmware version 1.25.4 and higher.

Battery Charger 1 and 2 menus provide battery charger information and metering. Use this menu to view the charger output metering and charger states.

Note:
Incorrect charger output system voltage may cause irreversible damage to the battery and abnormal out gassing. Ensure that the battery charger parameters match the battery manufacturer's specifications before using. In the controller user interface settings, verify that the battery topology and system voltage is set correctly for the battery type that is used.

Note:
The battery charger menus are designed to work with charger GM87448. Unless connected to charger GM87448 through CAN communication, the battery charger menus, although visible, have no effect on the battery charger.

2.4.4 Paralleling Metering Submenu

Note:
The paralleling metering is only valid if the generator set controller is controlling a motor-operated circuit breaker.

- **Connected to Bus** displays if the generator set is connected to the paralleling bus (the output breaker or contactor is closed).
- **Avg Bus Voltage L-L** displays the average of the three-phase line-to-line voltage measured by the paralleling bus sensing.
- **Avg Gen Voltage L-L** displays the average of the three-phase line-to-line voltage of the generator set output.
- **Bus Frequency** displays the cycle frequency of the paralleling bus.
- **Gen Frequency** displays the cycle frequency of the generator set.
- **Bus Total Power** displays the real power provided by all the generator sets in the paralleling system.
- **Bus % of Rated kW** displays the ratio between the Bus Total Power and the Bus Total Capacity (found in the Generator Management screen) expressed as a percentage.
- **Bus % of Rated kVAR** displays the ratio between the reactive load on all generator sets in the paralleling system and the bus reactive capacity (the sum of 3/4 of the rated kW of all connected generator sets) expressed as a percentage.

2.5 Generator Information Menu

2.5.1 Generator Information Submenu

- **Total Run Time** displays the total run time hours.
- **Hours Loaded** displays the total loaded hours.
- **Hours Unloaded** displays the total unloaded hours.
- **kW Hours** displays the total kW hours.
- **Operating Hours** displays the total operating hours.
- **Total Number of Starts** displays the total number of times that the engine was started via the generator set controller.
- **Last Maintenance** displays the date on the controller system clock when the last maintenance was performed.
- **Operating Hours Since Maintenance** displays the total number of hours of operation since the last maintenance date.
- **Starts Since Maintenance** displays the total number of generator set startup events since the last maintenance date.
- **Engine Hours Since Maintenance** displays the total engine hours since last maintenance.
- **Loaded Since Maintenance** displays the total loaded hour since last maintenance.
- **Unloaded Since Maintenance** displays the unloaded hours since last maintenance.
- **kW Hours Since Maintenance** displays the total kW hours since last maintenance.
- **Reset Maintenance Records**: displays a Yes/No choice for the user to select.
- **Last Start** displays the date when the generator set last operated.
- **Last Run Length** displays the length of time that the engine ran the last time it was started via the generator set controller.
- **Controller Serial No**. displays the controller serial number.
- **Software Version** displays the software version number. Use the version number to determine if an upgrade is needed and/or when troubleshooting the controller.
- **ECM Serial No**. displays the ECM serial number.
- **Genset Model No.** displays the generator set model number. Only adjustable from SiteTech™.
- **Genset Spec No**. displays the generator set specification number. Only adjustable from SiteTech™.
- **Genset Serial No**. displays the generator set serial number. Only adjustable from SiteTech™.
- **Alternator Part No**. displays the alternator part number. Only adjustable from SiteTech™.
- **Engine Part No**. displays the engine part number. Only adjustable from SiteTech™.
- **Engine Model No**. displays the engine model number. Only adjustable from SiteTech™.
- **Engine Serial No**. displays the engine serial number. Only adjustable from SiteTech™.

2.5.2 Event History Submenu

Generator Event History:

This menu allows the user to review up to 1000 entries of generator set system events including shutdown faults, warning faults, notices, and status events with date and time stamp. See NO TAG Controller Fault Diagnostics for a list of the items that appear on the Generator Event History.

Engine Event Log:

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

- **SPN (Suspect Parameter Number)** is a four-digit code that represents an engine component.
- **FMI (Failure Mode Indicator)** is a two-digit code that represents the type of fault that occurred (i.e. short circuit, out of range).
- **Occurrence Count** is a count of how many times a fault has occurred.

2.5.3 Configuration Submenu

Generator Configuration

The values in this menu are user-entered for the generator set configuration and are NOT measured values of the generator set.

Note:
Have setup and adjustments of the Decision-Maker® 3500 controller performed only by an authorized Rehlko distributor. The setup and adjustments are password protected.

- **Operating Mode** displays the programmer- entered generator set application configuration as Standby or Prime.
- **Application Type** displays the programmer- entered generator set application type as None, Marine, Mobile, Standby or Prime.
- **System Voltage** displays the programmer- entered L1-L2-L3 output voltage for three-phase or the L1-L2 output voltage for single-phase.
- **System Frequency** displays the programmer- entered L1-L2-L3 output voltage frequency for three-phase or the L1-L2 output voltage frequency for single-phase.
- **System Phase** displays the programmer-entered configuration as Single Phase, Single Phase Dogleg, Three Phase Wye, or Three Phase Delta.
- **Rated Engine Speed** displays the programmer- entered engine speed in RPM.
- **Adjusted Engine RPM** displays the target engine speed setting.
- **kW Rating** displays the programmer-entered kW value for the generator set.
- **kVA Rating** displays the programmer-entered kVA value for the generator set.
- **Rated Current** displays the programmer-entered current value for the generator set.
- **Battery Voltage** displays the programmer-entered battery voltage.
- **Engine Start Delay** displays the time delay before the generator set starts while the master switch is in AUTO or RUN positions.
- **Starting Aid Delay** displays the engine starting aid activation time.
- **Crank On Delay** displays the time allocated for generator set crank on in seconds.
- **Crank Pause Delay** displays the time allocated for generator set crank pause in seconds.
- **Engine Warmed Up** displays the temperature when the engine is warmed up enough to be loaded.

- **Engine Cooled Down** displays the temperature below which the engine cooldown can be overridden. See Cooldown Override below.
- **Cooldown Delay** displays the time delay for engine cooldown while the master switch is in the AUTO or RUN positions and not in the idle mode.
- **Cooldown Override** allows the user to select the Cooldown Temperature Override Mode. If set to ON, the engine will stop immediately if the coolant temperature is below the engine cooled threshold, but will run for the duration of the cooldown cycle otherwise. If set to OFF, the engine will always complete the cooldown cycle.
- **Fuel Type** displays the programmer-entered fuel type as NG (Natural Gas), LP (Liquefied Petroleum), Gasoline, Diesel, or Unknown.
- **Crank Cycles Limit** displays the programmer-entered crank cycle.
- **Enable NFPA** Defaults allows the user to Enable or Disable the NFPA defaults.
- **Enable Emergency Battlemode** allows the user to turn On/Off the emergency battlemode feature.

  Note:
  Conditional for certain units.

Protection Configuration

Note:
The time delays are user adjustable using SiteTech™. Have setup and adjustments of the Decision-Maker® 3500 controller performed only by an authorized Rehlko distributor. The setup and adjustments are password protected.

- **Overvoltage** displays the percentage of the system voltage that the generator set voltage must exceed for an overvoltage condition to be indicated.
- **Overvoltage Delay** displays the time that the generator set voltage must be in an overvoltage condition before a fault is indicated.
- **Undervoltage** displays the percentage of the system voltage that the generator set voltage must drop below for an undervoltage condition to be indicated.
- **Undervoltage Delay** displays the time that the generator set voltage must be in an undervoltage condition before a fault is indicated.
- **Overfrequency** displays the percentage of the system frequency that the generator set frequency must exceed for an overfrequency condition to be indicated.
- **Underfrequency** displays the percentage of the system frequency that the generator set frequency must drop below for an under frequency condition to be indicated.
- **Overspeed** displays 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.

2.5.4 Voltage Regulation Submenu

Note:
Have setup and adjustments of the Decision-Maker® 3500 controller performed only by an authorized Rehlko distributor. The setup and adjustments are password protected.

The Decision-Maker® 3500 controller has a built-in voltage regulation function. This means that no external voltage regulator is necessary. The voltage regulation of the controller uses Root Mean Square (RMS) sensing for fast response to changes in indicated and regulated voltages resulting in excellent regulation accuracy.

The descriptions of the voltage regulator adjustments and features follow.

Voltage Adjust. The voltage adjust allows the user to enter the desired generator set output level. The voltage regulator controls the average of the three output phase voltages to this target in a three phase configuration, and L1/L2 voltage to this target in a single phase configuration.

Submenus display the individual line-to-line voltages and the individual phase voltages. These voltages are for reference only and are relevant in unbalanced load conditions. The voltage adjust setpoint can be changed to accommodate an important phase in an unbalanced system.

Target Voltage. The voltage that the Decision-Maker® 3500 controller is trying to achieve including droop and paralleling bias.

Volts/Hz. The excitation control system includes an under-frequency unloading feature. This is sometimes referred to as Volts-per-Hertz or V/Hz. When the frequency drops below a certain value, the output voltage is reduced to decrease engine load, allowing the engine speed to recover more quickly. The output voltage reduction is based on the frequency.

Volts per Hz Settings. The amount of voltage reduction can be adjusted to achieve the desired transient response of the engine and alternator system. The V/Hz function will use the following parameter settings:

- V/Hz Setpoint (Hz)
- V/Hz Slope (%/Hz)
- V/Hz reduction limit (fixed at 50% of rated voltage)

Volts per Hz Adjustment. The V/Hz settings can be changed using SiteTech™ setup program or at the front panel and are password protected. The setup program will read current settings to determine a similar function when making changes to alternator connections, system voltages or operating frequency.

Volts/Hz Setpoint. This adjustment affects the voltage droop (volts per Hz) when load is applied and underfrequency occurs. The volts/Hz setpoint setting defines the threshold below which the underfrequency unloading is active. Any frequency below the setpoint causes the voltage to drop thus reducing the load allowing the engine speed to recover according to the volts/Hz slope setting.

Engine speed recovery depends upon characteristics such as engine make, fuel type, load types, and operating conditions. The volts/Hz setpoint setting is set at the factory to match the engine speed recovery characteristics for the application.

Volts/Hz Slope. This setting determines how much the voltage drops during an underfrequency condition. The Volts/Hz Slope setting is set at the factory. Typically, applying a large electrical load causes a dip in engine speed and frequency. The voltage regulator reduces voltage, allowing engine speed recovery. The volts-per-Hz setting determines the degree of unloading that occurs for each 1 Hz decrease in frequency.

Voltage Droop at 100% kVAR (Reactive Droop). Reactive droop compensation provides reactive current flow adjustment in the generator set when connected in paralleling applications. Reactive droop reduces excitation levels with increasing reactive power current. A reduced excitation level reduces generator set reactive power or generated VARs, improving reactive load sharing.

Enter the parameter as a percentage of system voltage when full-rated load with 0.8 power factor is applied. Any loads less than full load cause the voltage to drop by the ratio of reactive volt-amps (VARs) to rated VARs.

Voltage Gain Adjust. Regulator gain refers to the gain of the control system. Generally, the higher the gain the faster the system responds to changes and the lower the gain, the more stable the system.

If the voltage is slow to recover when loads are applied or removed, increase the regulator gain. If the voltage is unstable, decrease the regulator gain.

The voltage regulator value is reviewable at all times and provides the ability to fine adjust voltage. Changing the system voltage or replacing the controller typically requires a voltage adjustment.

The user can change the individual value or can select *Reset Regulator Defaults?-Yes* to reset to the default value. The *Reset Regulator Defaults* display will only show if editing is enabled.

Start-Up Ramp Rate. Slowly ramps the voltage to its target to minimize voltage overshoot at startup.

2.5.5 Voltage Selector Switch (Menu)

The voltage selector switch menu typically applies to towable models only. This feature allows easy voltage reconnection on models equipped with a voltage selector switch mounted on the generator set junction box. This menu provides settings that may be viewed or adjusted relating to system voltage, frequency, and phase.

Present Position. The setting indicates the voltage configuration currently set in the controller. The position number corresponds to a number identifying the voltage, frequency, and phase selected by the end user. Each position is explained further in the following menu items shown as Pos. 1, Pos. 2, and Pos. 3.

System Voltage L-L. Indicates the system line-to-line voltage as setup to correspond to the voltage selector switch.

System Frequency. Indicates the system frequency as setup to correspond to the voltage selector switch.

System Phase. Indicates the system phase as setup to correspond the voltage selector switch.

kW Rating. Indicates the system kW rating as setup to correspond to the generator set's rating based on the voltage, frequency, and phase selection. Some voltage connections cause the kW rating to change. This setting affects the trip point of select warnings and shutdowns.

Max Positions. Indicates the number of positions of the voltage selector switch mounted on the junction box. This value is either 2 for (277/480 V, 3 Ph. or 120/208 V, 3 Ph.) or 3 for (277/480 V, 3 Ph.; 120/208 V, 3 Ph.; or120/240 V, 1 Ph.) voltages.

Note:
Some 4-position voltage selector switch generator sets are available as engineered specials for (277/480 V, 3 Ph.; 120/208 V, 3 Ph.; 120/240 V, 3 Ph. delta; or 120/240 V, 1 Ph.) voltages.

Pos. 1 Volts. Factory set at 277/480 volts.

Pos. 1 Frequency. Factory set at 60 Hz.

Pos. 1 Phase. Factory set at Three Phase Wye.

Pos. 2 Volts. Factory set at 120/208 volts.

Pos. 2 Frequency. Factory set at 60 Hz.

Pos. 2 Phase. Factory set at Three Phase Wye.

Pos. 3 Volts. Factory set at 120/240 volts with 3-position switch only.

Pos. 3 Frequency. Factory set at 60 Hz. with 3-position switch only.

Pos. 3 Phase. Factory set Single Phase Dogleg with 3-position switch only.

2.5.6 Paralleling Operation

Note:
Have paralleling setup performed by appropriately skilled and suitably trained maintenance personnel familiar with generator set parallel commissioning, operation, service, and troubleshooting.

The Decision-Maker® 3500 controller is a paralleling controller and provides varying degrees of paralleling functionality.

While the Decision-Maker® 3500 controller can also be used with external switchgear controlling the speed, voltage and paralleling breaker/contactor, the Parallel Operation menu is used to configure settings for parallel operation where the controller is communicating on a network with other controllers and provides integral paralleling functionality.

Paralleling Setup

The Paralleling Setup menu is intended to configure the basic settings for the parallel operation of the controller. Most of the settings in this menu are configured during commissioning and do not require user adjustment. There are a few settings that may be viewed or adjusted after commissioning is complete.

Volts-Hz OK Delay. The time that the voltage and frequency must remain within the acceptable window before the controller considers them to be stable. The voltage window requires the output voltage of the generator set to be within the **Voltage OK Pickup** of the system voltage, the frequency window requires the operating frequency of the generator set to be within the **Frequency OK Pickup** of the system frequency. This delay may need to be increased if the first generator set to close to the bus has not yet reached rated operating parameters or if the speed/voltage is in an overshoot condition when the generator set comes online.

First On Delay. The time that the system will wait before closing the first generator set to the bus. This delay should be set as low as possible, but can be extended to ensure that a different generator set will be the first to close. One generator set in the system should have the first on delay set to a low number to minimize the delay before the generator set can supply power to the load.

kW Ramp Rate. The generator set will load and unload against the other generator sets at this rate. The default rate (5%/sec) requires 20 sec to accept 100% load. Increasing the ramp rate will allow the generator set to disconnect more quickly from the bus when signal to stop by generator management, but may result in variations in the output voltage or frequency of the generator set system. The ramp rate can be decreased if there is noticeable fluctuation in the voltage or frequency when a generator set is loading or unloading.

Trims Enable. The trims are the mechanism that the paralleling system uses to keep the output voltage and frequency near the rated values when the generator set system is operating. The trims default is enabled on all generator sets, but they can be disabled on some generator sets in the system to improve load sharing. The trims should be enabled on at least one generator set in the paralleling system or the voltage and frequency may drift significantly during the operation of the system.

Load Enable. The generator set will unload and trip the circuit breaker/contactor when this setting is set to OFF. This can be used to force a generator set to soft-unload and shut down for service. To keep the breaker/contactor from reclosing, the Sync Mode in Auto can be set to OFF (see Sync Mode In Auto below). A generator set is not considered for generator management when Load Enable is set to OFF. This parameter should always be returned to ON after the generator set has been stopped for service, as it will keep the generator set from sharing load or stopping for generator management if it is set to OFF.

Stand Alone Mode. This will tell the controller that it is a paralleling controller, even if it does not see another generator set on the communication lines. This may be required if all other generator set controllers are removed from service for a period of time in which the battery power to this controller will be cycled (the controller remembers that it is in a paralleling system until power is cycled). If the controller sees another controller on the PGEN communication network, this parameter will not change the operation of the system in any way.

Sync Mode In Auto. This should be set to Active before leaving the site when commissioning or can be used to keep the controller from closing the paralleling breaker/contactor to complete a test or to take a generator set out of service. Setting the Sync Mode to OFF will disable the synchronizer, the paralleling breaker/contactor will not close with the synchronizer disabled. To remove a generator set from service manually, set the Sync Mode in Auto to OFF, wait for any additional generator sets to start, and set the Load Enable to OFF. When the breaker/contactor trips, stop the generator set by pressing the OFF button, then set the Sync Mode back to Active and the Load Enable back to ON.

Note:
Pressing the OFF button will also disconnect the generator set from the paralleling bus, but it will not give the other generator sets any opportunity to negotiate an arrangement to support the load. Even if there are enough generator sets online to support

the load, the voltage and frequency may dip when the other running generator sets are required to pick up the load formerly supported by this generator set.

Sync Mode In Run. The default setting for this parameter is Check. In Check mode, the controller will close the paralleling breaker/contactor to a dead bus (no other generator sets supplying the load) but will hold synchronism with the bus without closing the paralleling breaker/contactor if it is already supplied by another generator set. This allows operational verification of the synchronizer, but does not allow the generator set to supply the load. If the generator set system is to be operated with the engine control switch in Run, the Sync Mode in Run may need to be set to Active.

Note:
System Start (AUTO-RUN) is the preferred method of operating a generator set system. RUN is intended for testing or verification only.

Note:
Sync Mode in Auto and Sync Mode in Run can also be found on the Synchronizing Setup screen.

Synchronizing Setup

This screen is primarily used to configure the synchronizer. There is a lot of metering information that can be accessed on this screen, but the parameters should be adjusted only during commissioning.

Volts-Hz OK. The voltage and frequency have been within the acceptable window for the Volts-Hz OK Delay.

In Sync. The frequency, voltage and phase rotation of the generator set have matched that of the bus and the generator set and bus have been in phase for the duration of the dwell timer. This value is only updated when the controller is synchronizing (Synch Mode=Active, Passive or Check, breaker/contactor is open, generator set is running).

Voltage Matched. The difference between the generator set voltage and the bus voltage is within the acceptable window. This value is only updated when the controller is synchronizing (Synch Mode=Active, Passive or Check, breaker/contactor is open, generator set is running).

AVG Bus Voltage L-L. The average voltage of the paralleling bus.

AVG Gen Voltage L-L. The average voltage of this generator set.

Voltage Bias. The amount that the controller is attempting to adjust the output voltage (100% bias= +10% on the output voltage, -100%= -10% on the output voltage). The controller adjusts the Voltage Bias to match the generator set voltage to the bus voltage.

Frequency Matched. The difference between the generator set frequency and the bus frequency is within the acceptable window. This value is only updated when the controller is synchronizing (Synch Mode=Active, Passive or Check, breaker/contactor is open, generator set is running).

Bus Frequency. The operating frequency of the paralleling bus.

Gen Frequency. The operating frequency of this generator set.

Speed Bias. The amount that the controller is attempting to adjust the output frequency of the generator set (100% bias=+5% on the engine speed, -100%=-5% on the engine speed). The controller adjusts the Speed Bias to match frequency and phase with the paralleling bus.

Phase Matched. The phase between the generator set voltage and the bus voltage is within the acceptable window. This value is only updated when the controller is synchronizing (Synch Mode=Active, Passive or Check, breaker/contactor is open, generator set is running).

Phase Difference. The phase angle between the generator set and the bus.

Note:
This value is only accurate if the generator set is running and the bus is energized. The phase angle must be established between two waveforms.

Dwell Time Remaining. The remaining time for the dwell timer in seconds. The generator set is considered to be in Sync when the dwell timer expires. If this value is resetting to the Dwell Time (directly above it), the generator set is not holding synchronism. This value is only updated when the controller is synchronizing (Synch Mode=Active, Passive or Check, breaker/contactor is open, generator set is running).

Sync Time Remaining. The remaining time before the controller issues a Failure to Synchronize warning. The Failure to Synchronize warning will cause the generator management to consider this generator set unreliable and to start another

generator set (if available). If the system commissioning has been performed properly, this warning should only occur if the system is overloaded or if there is a malfunction on this generator set. This value is only populated when the generator set is actively synchronizing (Sync Mode=Active, breaker/contactor is open, generator set is running).

Note:
Dwell Time Remaining and Sync Time Remaining are not supported on all firmware versions. If the controller firmware does not support the time remaining parameters, they will be populated with N/A.

Sharing Setup

Bus % of Rated kW. The ratio of the total load on the bus (sum of the loads on all connected generator sets) to the total bus capacity (sum of all the connected generator set capacities), expressed as a percentage. This value can be monitored to determine system loading (also found on Bus Metering screen, and Generator Management screen).

Gen % of Rated kW. The ratio of the total load on this generator set to its rated capacity, expressed as a percentage. This value can be compared to the Bus % of Rated kW (directly above it) to determine if the system is sharing load properly. The acceptable difference between the generator set and bus is site-dependent. The adjustment of the parameters on this screen (during commissioning) will determine how closely the generator sets share load.

Speed Bias. The amount that the controller is attempting to adjust the output frequency of the generator set (100% bias= +5% on the engine speed, -100= -5% on the engine speed). The controller adjusts the speed bias to share load between the generator sets connected to the paralleling bus.

Bus % of Rated kVAR. The ratio of the total reactive load on the bus (sum of the reactive loads on all connected generator sets) to the total bus reactive capacity (sum of all the connected generator set reactive capacities), expressed as a percentage. This value can be monitored to determine system loading (also found on Bus Metering screen). The Reactive Power rating of the generator set is fixed at 3/4 of the rated kW capacity of the generator set (even in single-phase applications).

Gen % of Rated kVAR. The ratio of the total reactive load on this generator set to its rated reactive capacity, expressed as a percentage. This value can be compared to the Bus % of Rated kVAR (directly above it) to determine if the system is sharing reactive load properly. The acceptable difference between the generator set and bus is site-dependent. The adjustment of the parameters on this screen (during commissioning) will determine how closely the generator sets share reactive load. The Reactive Power rating of the generator set is fixed at 3/4 of the rated kW capacity of the generator set (even in single-phase applications).

Voltage Bias. The amount that the controller is attempting to adjust the output voltage of the generator set (100% bias= +10% on the output voltage, -100%= -10% on the output voltage). The controller adjusts the voltage bias to share reactive load between the generator sets connected to the paralleling bus.

Note:
The metering values in this screen are populated regardless of the state of the generator set system, but the system must be in a sharing mode before it will attempt to match generator set and bus loading.

Protective Relays

The protective relays serve two purposes:

1. To protect the generator set from damage and
2. To protect the loads supplied by the generator set from damage

The protective relays are configured during commissioning and should not be adjusted except by a trained commissioning agent. These settings are often taken into consideration for breaker trip curves, load control settings, and generator management settings. The adjustment without careful consideration of the implications may mask a problem in the system and cause another. Properly-configured protective relays should only trip due to a failure.

Note:
All protective relay events will trip the breaker/contactor, but will not stop the generator set until the Trip to Shutdown Delay has expired. During this time, the protective relay which tripped the breaker/contactor will be listed under the Active Events, the warning LED will be active, and the generator set will remain running. The protective relay can be reset by pressing the AUTO button (note, if the generator set is in Run, the protective relay will have to be cleared by stopping the generator set). Pressing OFF/RESET or removing the remote start signal to the generator set system also clears any active protective relays.

Gen 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 generator sets off in a predetermined order. 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.

The time to stop a generator set (if the load is low enough that the generator set is no longer needed) varies with the degree of 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.

Start Capacity. The percent of generator set rated kW of the running generator sets that the system allows before the accumulator to start this generator set begins filling.

Start Delay. The time to decide to start the generator set at 10% over capacity.

Stop Capacity. The percent of generator set rated kW of the other running generator sets that the system allows before the accumulator to stop this generator set begins filling.

Stop Delay. The time to decide to stop the generator set at 10% available capacity.

Gen Management Modes

The method that generator management uses to determine the starting and stopping order of the available generator sets. All the generator sets in the system must have the same setting for this parameter for the generator management to operate. If this parameter is changed, it will be updated on all the generator sets which are connected to the PGEN network. 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 (all generator sets will run all the time).

- **Run Time.** The generator management start/stop order is determined by the runtime hours on the generator sets. In this mode, the order is determined to ensure that the generator set with the fewest runtime hours is the last to stop. Each subsequent order is assigned to generator sets with increasing runtime hours.

  If a generator set is not running, the system will add the Run Time Threshold to the runtime hours for that generator set before it considers it in the order—this allows the generator sets to avoid starting and stopping continuously. The actual runtime will have to differ by more than the threshold to force the generator set order to switch (the stopped generator set will start, synchronize to the paralleling bus, and begin sharing load—the running generator set will soft-unload, disconnect from the bus, cool down and stop).

  The generator management order is not user adjustable in runtime mode.

  Note:
  If the load on the system requires an additional generator set to start, the generator set with the most runtime hours will always be the first one to stop if the load decreases enough to permit it (the threshold is no longer taken into consideration as soon as the generator set is connected to the paralleling bus).

- **Fuel Level.** The generator management start/stop order of the generator sets is determined by the level of the fuel in the tank which supplies each generator set. In this mode, the order is determined to ensure that the generator set with the most fuel is the last to stop. Each subsequent order is assigned to generator sets with decreasing fuel percentage.

  If a generator set is running, the system will add the Fuel Level Threshold to the measured Fuel Level for that generator set before it considers it in the order. This allows the generator sets to avoid starting and stopping continuously. The actual fuel level will have to differ by more than the threshold to force the generator set order to switch (the stopped generator set will start, synchronize to the paralleling bus, and begin sharing load and the running generator set will soft-unload, disconnect from the bus, cool down and stop).

  The generator management order is not user adjustable in Fuel Level mode.

  Note:
  Fuel Level Order Selection mode requires separate fuel tanks for the generator sets and fuel level senders connected to the controller to operate. Operation of Fuel Level mode without sensors is not defined.

  Note:
  If the load on the system requires an additional generator set to start, the generator set with the lowest fuel level will always be the one to stop (the threshold is no longer taken into consideration as soon as the generator set is connected to the paralleling bus).

Gen Management. Allows permanent disabling of the generator management on this generator set. 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 taking 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 defaults to OFF. It should be enabled on all generator sets in the system if it is desired.

Gen Management Order. Determines the Start/Stop Order of this generator set. Generator sets with a lower order will start before generator sets with a higher order, higher order generator sets stop before lower order generator sets.

If the Generator Management Order for a generator set changes, generator management will start any generator sets which were involved in the order changing process (including automatic re-sort). After the incoming generator sets connect to the paralleling bus, the generator sets with a high enough order to stop will start filling their accumulators to stop.

The generator set order is adjustable in Manual/Fixed Order selection mode. It is only adjustable in Runtime or Fuel level mode if the generator sets have identical runtime or fuel level.

Total Bus Capacity. The total bus capacity is simply the sum of the kW rating of all generator sets that are connected to the paralleling bus (running with paralleling breaker/contactor closed). Generator sets in Baseload, System Control, or Unload mode are not taking into consideration for this capacity.

Bus Total Power. The sum of the power output of all generator sets which are connected to the bus and available for sharing load. Generator sets in Baseload, System Control, or Unload mode are not taking into consideration for this level. The Bus Total Power is compared to the Start kW and Stop kW of the generator set to determine if the generator set should be started, stopped, or remain as-is.

Start kW. The threshold of Bus Total Power above which the Start Accumulator for this generator set will start filling.

Note:
The Accumulator fill rate is higher for larger differences between Bus Total Power and Start kW.

Stop kW. The threshold of Bus Total Power below which the Stop Accumulator for this generator set will start filling.

Note:
The Accumulator fill rate is higher for larger differences between Stop kW and the Bus Total Power.

Preemptive Warnings. A preemptive warning tells the system that a generator set may have a problem in the future. If Generator Management has stopped the generator sets, it will start one of the unused generator sets but keep the running generator set with the preemptive fault online. The following conditions are considered preemptive warnings:

- Low Oil Pressure Warning
- Low Fuel Pressure Warning
- High Coolant Temperature Warning
- Failure to Synchronize Warning
- Water in Fuel Warning
- Fuel Tank Leak Warning
- Loss of Fuel Warning

A preemptive warning disables Generator Management on the unit which has the warning. It will run as long as the start signal is present.

Note:
Most of the preemptive warnings have a shutdown which follows shortly after the warning. The intent of starting another generator set is that it will be able to supply the load when the generator set shuts down on a fault.

Start Accumulator. The Start Accumulator fills from 0% to 100% while the Bus Total Load remains above the Start kW. This generator set will be signaled to start when this accumulator reaches 100%.

Note:
The Start Accumulator will reset to 0% if the Bus Total Power drops below the Start kW for one second.

The Start Accumulator may be filling while the engine is running in cooldown. If it reaches 100% before the cooldown is complete, the generator set will synchronize and close to the bus (it will not have to go through a start sequence).

Stop Accumulator. The Stop Accumulator fills from 0% to 100% while the Bus Total Load remains below the Stop kW. This generator set will be signaled to stop when this accumulator reaches 100%.

Note:
The Stop Accumulator will reset to 0% if the Bus Total Power exceeds the Stop kW for one second.

The generator set may remain running and connected to the paralleling bus for a few seconds after the Stop Accumulator reaches 0%. During this time, the generator set is unloading so that it can trip the circuit breaker/contactor connecting it to the bus with minimal wear on the contacts in the breaker/contactor and minimal disturbance to the voltage and frequency of the system.

Run Time Threshold. The maximum difference in runtime hours that generator set management will accept before it re-sorts the Start/Stop Order of the generator sets to equalize hours (see Gen Management Order earlier in this section). All the generator sets in the system must have the same setting for the Run Time Threshold for the generator management to operate. If this parameter is changed, it will be updated on all the generator sets which are connected to the PGEN network.

Total Run Time. The actual runtime hours of this generator set (to the nearest tenth of an hour). This parameter is also available in the Generator Information screen, but is rounded to the nearest hour.

Fuel Level Threshold. The maximum difference in fuel level that generator management will accept before it re-sorts the Start/Stop Order of the generator sets to equalize fuel level. (See Gen Management Order earlier in this section). All the generator sets in the system must have the same setting for the Fuel Level Threshold for the generator management to operate. If this parameter is changed, it will be updated on all the generator sets which are on any controller connected to the PGEN network.

Fuel Level. The level of the fuel in the tank supplying this generator set. This is available in the engine metering section in SiteTech™, but not elsewhere on the User Interface. If no fuel level sensor is connected, this parameter will display N/A. Do not use Fuel Level as the Generator Management Mode if there is no fuel level sensor connected—the operation of the system is not defined in this case.

Stable Delay. The time between the system entering a valid generator management state and the time that generator management becomes active.

A valid generator management state requires:

- A Start Signal is present (Local start, remote start, or communications start)
- A least one generator set is closed to the paralleling bus
- Generator Management is enabled
- The configuration of vital parameters of the system are identical between all controllers
- No generator sets have recently failed
- Load control has added priorities through the Min Loads Added Threshold
- The generator management order is valid

Once active, generator management will only go inactive if:

- A generator set fails (shuts down with either a fault or user input)
- All generator sets are disconnected from the bus
- The Start Signal is removed
- Generator Management is disabled
- The configuration on any controller on the network is changed by a user
- The order becomes invalid

All the generator sets in the system must have the same setting for the stable delay for the generator management to operate. If this parameter is changed, it will be updated on all the generator sets which are connected to the PGEN network.

Minimum Gens Online. Generator Management will always try to keep this many generator sets online (even if they are not needed). All the generator sets in the system must have the same setting for the Minimum Gens Online for the generator management to operate. If this parameter is changed, it will be updated on all the generator sets which are connected to the PGEN network.

The purpose of this setting is to allow configuration to support large transient loads or potential generator set failure (N+1 redundancy).

Note:
Only 1 and 2 Minimum Gens Online is supported at this time.

Min Loads Added. The Load Shed priority that must be online before generator management will consider stopping a generator set. This is implemented so that generator sets aren't stopped prematurely (before all the available load has been applied to the system). All the generator sets in the system must have the same setting for Min Loads Added for the generator management to operate. If this parameter is changed, it will be updated on all the generator sets which are connected to the PGEN network.

Note:
Min Loads Added should be set up to support the load control outputs which are connected to actual loads. There is no reason to wait for a load control output to add if no load will be added to the system when it does. At the same time, it is important that all load which the paralleling system will have to support be supplied by the system before generator management makes the determination to stop a generator set.

The load control outputs should be capable of shedding enough load that a single generator set can support what remains (this should be handled during commissioning, but is included for consideration as loads grow).

Load Control

Load Control drives 6 outputs (Load Priority 1 Shed through Load Priority 6 Shed) to remove loads from the paralleling bus when the attached generator sets are unable to support them. See the Load Control Description Section following for more information.

The outputs must be tied to programmable outputs in the configuration before they can be used, but they are controlled internally regardless of output configuration or external connection status.

All generator sets on the PGEN network initiate load control at the same time and use the same measured values to determine the Add and Shed timing (Bus % kW and Bus Frequency). If the load control settings are set identically, each load control priority will add at the same time on all generator sets in the paralleling system. This allows Priorities 1 and 2 to be connected to one generator set, while Priorities 3 and 4 can be connected to another generator set.

Note:
Load Control in a paralleling system operates identically to the load control on a single generator set, except that it takes different metered values into consideration.

Load Control Description

The purpose of Load Control is to permit a generator set to support load which may occasionally exceed the rated capacity of the generator set. In paralleling systems, load shed permits the bus to stay at rated voltage and frequency while an additional generator set is synchronizing to it. In single-generator set applications, load control may shed unimportant but highly demanding loads when the generator set is overloaded, preventing a power outage caused by the generator set going offline.

The Load Control in the Decision-Maker® 3500 controller supports 6 load control priorities. These priorities generate internal notices for the shed condition. 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.

Only 4 load control priorities can be configured to the RDO outputs on the controller (2 in paralleling applications) but the optional relay dry contact kit will permit all 6 load control priorities to be accessed and configured to disconnect 6 different loads (each load priority can interrupt several devices).

In paralleling applications, the load shed priorities can be divided between all 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 does not require the optional relay dry contact kit and permits partial load shed 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—this occurs when the start signal is removed.

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

Load Control 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:
The generator management start % should be significantly lower than the Gen Overload Percent so that additional generator sets will come online before a load is shed.

An under frequency event will also shed load—the under frequency threshold is not adjustable from the User Interface.

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

In a standard application (single generator set or generator set controlled by external switchgear) the load control logic uses the Gen % or Rated kW and the Gen Frequency.

In a paralleling application (where the Decision-Maker® 3500 controller is responsible for first-on, synchronizing, load sharing, and generator management) the load control logic uses the Bus % of Rated kW and Bus Frequency. All generator sets use the same start signal, load and frequency values to determine load control timing, hence each controller will shed and add a given load priority at the same time (provided that the load control settings are identical in each controller).

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 may de-activate its Load Control outputs to energize those loads. 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.

Description of User Adjustable Load Control Settings

The Load Control settings are found under GENERATOR INFO->PARALLEL OPERATION->LOAD CONTROL. Load control is active, even if the generator set is not operating in a paralleling application.

Gen % Max Cap. The load level on the generator set (or paralleling bus, in a paralleling application) that the load control will not intentionally exceed. If the load is within 15% of this load level, the load control will not add the next priority until the load decreases (or another generator set starts, synchronizes and closes its paralleling breaker/contactor, in a paralleling application).

Gen Overload Percent. The load level on the generator set (or paralleling bus, in a paralleling application) above which the load Control will start to consider shedding loads. Loads will shed more quickly if the generator set is heavily overloaded, more slowly if the generator set is barely overloaded. If the load drops below the Gen Overload Percent before a load priority is shed, the accumulator for shedding load is reset.

Note:
Additional load control settings are provided in SiteTech™, but they are configured during commissioning and should not require adjustment after commissioning is complete. Have setup and adjustments of the Decision-Maker® 3500 controller performed only by an authorized Rehlko distributor.

2.5.7 Emissions Information

Note:
Have emission information setup performed by appropriately skilled and suitably trained maintenance personnel familiar with generator set operation and service.

The controller provides emissions related information on selected generator sets. This information is intended to provide the service technician data for maintaining functionality and compliance with federal and local emissions requirements.

The Emissions Info menu further provides the user a means to prevent active regeneration or request stationary regeneration. Most of the settings in this menu do not require user adjustment. If PREVENT ACTIVE REGEN is set to NO, the generator set will automatically perform cleaning as needed. If PREVENT ACTIVE REGEN is set to YES, cleaning will not be allowed. The user may be prompted by the ECM to manually initiate stationary regeneration. Further information is shown under the PREVENT ACTIVE REGEN and REQUEST REGEN headings following.

The PREVENT ACTIVE REGEN and REQUEST REGEN parameters can be adjusted locally by the user at the controller. Changes to the status is password protected. These two functions cannot be changed using the SiteTech™ software.

Note:
Refer to the Stationary Regeneration of the Exhaust System section for procedure options and scenarios.

Emissions

DEF LEVEL. The display provides the monitored Diesel Exhaust Fluid (DEF) level expressed as a percentage (0.0-100.0%). The DEF is injected into the exhaust where it is used in the Selective Catalyst Reduction (SCR). The DEF fluid level must be monitored and maintained by the user, refill the DEF tank as necessary.

EXHST SYSTEM REGEN. The display shows the need for cleaning of the exhaust system as Not Needed (0), Needed Low (1), Needed Moderate (2), Needed High (3), Needed Very High (4), or Needed Service Only (5).

When the status indicates cleaning is Needed High (Level 3), steps should be taken to allow active cleaning or to initiate stationary cleaning. If action is not taken and engine operation continues, derating of the engine output will begin; eventually falling to zero. If stationary regeneration is not initiated by the user, an engine derate will occur. Upon further operation, the engine will be shut down. If the need for regeneration is at Needed Service Only, stationary cleaning is no longer an option and a manual cleaning procedure with brushes, blowers, etc. by a certified technician is required to resolve the fault.

SOOT LEVEL. The display provides the monitored soot level at the Diesel Particulate Filter (DPF) expressed as a percentage (0-250%). This parameter will not be shown if no DPF is included as part of the exhaust system equipment.

ASH LEVEL. The display provides the monitored ash level at the DPF expressed as a percentage (0-250%). This parameter will not be shown if no DPF is included as part of the exhaust system equipment.

EXHST OUT TEMP. The display provides the monitored exhaust outlet temperature expressed as xxxxC/F degrees.

TIME SINCE REGEN. The display provides the engine run time since the last active regeneration expressed as hhhhhhh:mm:ss.

CLEANING STATUS. This display shows the status of the ability of the engine ECM and exhaust system (controls and equipment) to perform active cleaning. There are numerous conditions that can prevent active cleaning from being performed. These are observed and monitored by the engine ECM to determine whether or not it can conduct cleaning.

If it is determined that cleaning cannot be conducted, the engine ECM will report all of the reason(s), as codes, to the generator set controller. The most common reasons for disabling cleaning are captured and displayed in a hierarchical order.

CLEANING STATUS—ENABLED. If there are no conditions that would prevent active cleaning, the display shows ENABLED. This does not imply cleaning is in process, only that there is nothing to prevent such functionality.

CLEANING STATUS—USER SWITCH. If the user has disabled cleaning by setting PREVENT ACTIVE REGEN to YES, the display shows USER SWITCH. This will be the display even if other conditions exist that would prevent cleaning.

CLEANING STATUS—LOW EX TEMP. If the user switch (PREVENT ACTIVE REGEN) is not preventing cleaning, the exhaust temperature will be considered next. If the exhaust temperature is too low, thus preventing active cleaning, the display shows LOW EX TEMP, regardless of other conditions.

CLEANING STATUS—SYSTEM FAULT. The next consideration is the cleaning system (controls and equipment). If there is a fault in the cleaning system, the display shows SYSTEM FAULT.

CLEANING STATUS—UNKNOWN. If the engine ECM is reporting that cleaning is disabled for some other reason, the display shows UNKNOWN.

PREVENT ACTIVE REGEN. The display allows the user to review or change the status of the parameter to prevent or allow active regeneration. Use the generator set controller to change the setting between YES and NO. After each engine start, the parameter will revert to the default value of NO, to allow active cleaning.

The cleaning system is intended to operate autonomously. Since disabling cleaning will cause residue levels to rise in the exhaust system, setting this parameter to YES will decrease the ability of the system to perform as intended. Setting the parameter to YES requires conscious user action with understanding of the implications. This parameter must be changed only by personnel at the generator set who will continuously monitor the system.

Since PREVENT ACTIVE REGEN and REQUEST REGEN cannot be YES at the same time, the Prevent Active Regen parameter changes to NO when the Request Regen parameter is set to YES.

REQUEST REGEN. The display allows the user to request stationary regeneration. This function is only available at the generator set controller. The exhaust system regen status must be at Level 3 or Level 4 in order to request regeneration.

If the regen status gets too high (Level 3), the controller menu will alert the need to perform a stationary regeneration. If the regeneration is not performed and the residue level continues to rise (Level 4), the engine ECM will derate engine output by as much as 50%. If residue levels reach an unacceptable level (Level 5), the engine ECM will initiate an engine shutdown where a manual cleaning process with brushes, blowers, etc. by a certified technician is required to resolve the fault.

For the cleaning process to be initiated the proper interlock conditions must be satisfied, including user acknowledgement or request, disabling alternator excitation, and opening the output circuit breaker/contactor. During cleaning, steps are taken to actively elevate the exhaust temperatures by using hydrocarbon dosing, etc. During stationary regeneration, the generator set system logic will not allow connection to load since alternator excitation is disabled and output voltage will be low.

Use the controller to change the settings between YES and NO.

Stationary Regeneration Stages:

Initiation of Stationary Regeneration. Stationary regeneration or cleaning may be requested in the Run, Cooldown, or Off modes. The request may also be made when running in the special regeneration cooldown mode (stationary regen state) following the cancel or failure of a previous regeneration request.

When stationary regeneration is successfully requested, the following actions will occur:

- The process of stationary cleaning is initiated when the request is seen as active and the generator set is running (RUN mode active) or in cooldown (AUTO mode active). If the request is made while in the OFF mode, it will be necessary to press RUN to transition to running where cleaning will be initiated. If the request is made while running, cleaning will be initiated immediately.
- When stationary regeneration is successfully initiated, the generator set controller allows 5 minutes for the engine ECM to indicate stationary regeneration has started. If this timer expires before indication stationary regeneration is in process, a failure of stationary regeneration will be shown as a status event. Refer to Failure of Stationary Cleaning following for additional information.
- Alternator excitation is disabled during stationary cleaning. This prevents any load being applied to the engine. This will further prevent paralleling routines from closing the generator set circuit breaker.

Stationary Regeneration is Active. When stationary regeneration is successfully initiated, the engine ECM controls the cleaning process. The engine ECM indicates cleaning is active through CAN communications and the high exhaust temperature symbol is displayed.

The generator set controller allows 60 minutes for the engine ECM to indicate stationary regeneration is completed. If this timer expires before indication that stationary regeneration is complete, a failure of stationary regeneration will be shown as a status event. Refer to Failure of Stationary Cleaning following for additional information.

Completion of Stationary Regeneration. Stationary cleaning will continue until the process is aborted, fails to start, fails to complete, or until completion is detected. When stationary regeneration is complete, the generator set controller will transition to the special regeneration cooldown mode if in the Run mode. When stationary regeneration is complete, the generator set controller will transition to the cooldown state if in the Auto mode.

Abort Stationary Regeneration. Stationary cleaning may be cancelled or aborted for several reasons. If any of these reasons or causes occur during the stationary cleaning process, the process will be aborted and generator set operation will proceed as described below:

- If the request parameter is changed to NO from the generator set controller during stationary cleaning, an abort event will occur.
- If the prevent active cleaning parameter is changed to YES at the generator set controller during stationary cleaning, an abort stationary regeneration occurs.
- If the OFF mode button is pressed during stationary cleaning, stationary regeneration will abort and the generator set shuts down with transitioning to the OFF mode.
- If the stationary cleaning was initiated from the RUN mode, pushing the AUTO button is acceptable. However, when the AUTO mode is active, a remote start input causes an abort stationary regeneration.
- If stationary regeneration is aborted, a status event is created.
- If stationary regeneration is aborted when in the AUTO mode, the generator set transitions back to the cooldown state where alternator excitation will resume and output voltage should be present. After the cooldown state is complete, the remote start inputs will be checked and normal operation will resume.
- If stationary regeneration is aborted in the RUN mode, the generator set transitions to a special regeneration cooldown mode (within the stationary regeneration state). This special mode is described in Stationary Cleaning Cooldown Mode following.
- If the stationary regeneration is aborted by means other than setting the request parameter to NO, the request parameter as seen on the generator set controller or SiteTech™ software is changed to NO.

Failure of Stationary Cleaning. Stationary cleaning may be determined as failed for either of two reasons. If cleaning is not seen as active within the specified time of request, the process is declared as failed. If cleaning is not seen as complete within the specified time of starting, the process is declared as failed.

Stationary regeneration may fail if the exhaust temperature does not reach satisfactory levels within the allowed time to initiate cleaning. This may occur in cases where ambient temperature is low and the generator set has not been running for an extended period of time. In this case, multiple attempts to perform regeneration may be required.

If cleaning fails to complete within the 60 minutes of time allowed, inspect and confirm that the regen needed status remains high and the Exhaust System Regeneration remains Needed High or Needed Very High. If these conditions no longer indicate cleaning is required, the regeneration was completely successful.

If the need for regeneration is at Needed Service Only, stationary cleaning is no longer an option and a manual cleaning process with brushes, blowers, etc. by a certified technician is required to resolve the fault.

If stationary cleaning fails the following actions will occur:

- If stationary cleaning fails while in the RUN mode, the generator set controller transitions to a special stationary cleaning cooldown mode (as described in Stationary Cleaning Cooldown Mode) before transitioning to the OFF mode.
- If stationary cleaning fails in the AUTO mode, the generator set controller transitions to the normal cooldown state, alternator excitation resumes, and remote start is monitored. The generator set controller changes to the cooldown state.
- If stationary cleaning fails, a status event is posted to indicate the time of failure.

Stationary Cleaning Cooldown Mode. If the RUN mode is active, stationary cleaning will eventually transition to a special regeneration cooldown mode. The following events occur during the stationary cleaning cooldown model:

- The cooldown mode may be entered by failure, abort, or completion of stationary cleaning while in the RUN mode.
- Alternator excitation remains off and output voltage will be low.
- The GensetState parameter will continue to show Regeneration.
- If the AUTO mode button is pressed during regeneration cooldown, the generator set controller transitions to the cooldown state where alternator excitation and normal operation resume.
- If the REQUEST REGEN parameter is set (YES) during the special regeneration cooldown mode, the generator set controller will re-initiate cleaning by transitioning back to the initial stage of stationary regeneration.
- The cooldown mode continues for 5 minutes. If the cooldown period continues for the full 5 minutes, the generator set controller transitions to the OFF mode.
- If the OFF mode button is pressed during the cooldown period, the generator set shuts down and the controller transitions to the OFF mode.
- The user parameter REQUEST REGEN changes to NO when the special regeneration cooldown mode begins.
- The user may re-initiate cleaning during the special cooldown mode by setting the REQUEST REGEN parameter to YES if all other appropriate conditions are satisfied.

Notifications

The controller will receive messages from the engine ECM. When important emissions related messages are received, they will be indicated on the generator set controller through the use of special symbols for Tier 4 engines. These symbols are shown in Figure 16. When one of these symbols is displayed, refer to the specific engine event codes from the engine ECM and refer to the respective engine operation manual.

High Exhaust Temperature. This symbol indicates the exhaust temperature is high when cleaning is in process and indicates the system is functioning properly.

System Issue. This symbol indicates something is wrong with the exhaust or emissions control system.

Low DEF. This symbol indicates the Diesel Exhaust Fluid (DEF) level is low (steady) or extremely low (flashing) and the DEF tank must be filled.

Cleaning Disabled by User. This symbol indicates cleaning/ regeneration has been disabled by the user setting the PREVENT ACTIVE REGEN parameter.

Cleaning Needed. This symbol indicates exhaust system cleaning is required. A solid symbol indicates a low level need. A flashing symbol indicates a higher level need.

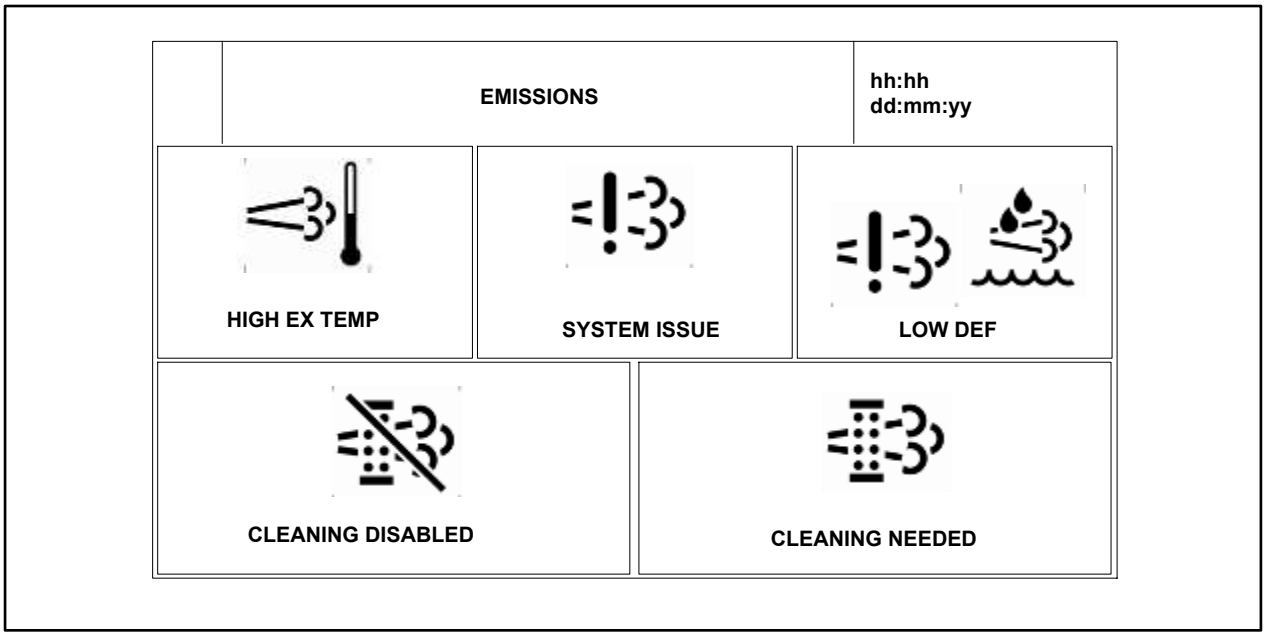


Figure 16 ECM Emissions Symbols

2.6 Controller Configuration Menu

2.6.1 Controller Configuration Submenu

- **Language** displays the user selected language. At this time, English is the only available option.
- **Units** displays the user selected unit of measure as Metric or English.
- **Time Format** displays the user selected time format as 12 hours or 24 hours.
- **Date Format** displays the user selected date format as mm/dd/yyyy or dd/mm/yyyy.
- **Contrast** displays user selected resolution values to improve digital display clarity.
- **Alarm Silence** displays the programmer selected alarm silence method Always or Auto Only using SiteTech™ software. The Always selection activates the alarm horn in any of the OFF/RESET-AUTO-RUN modes. The Auto Only selection activates the alarm horn only when in the Auto mode.

Note:
Press the Alarm Silence/Lamp Test button to silence the alarm horn.

2.6.2 Communication Setup Submenu

Modbus® Communications

The controller communicates using Modbus® as a slave connection with the Modbus® master initiating the communication. The controller seeks the system and alternator 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. See Figure 17. Refer to the List of Related Materials for available Modbus® literature.

Note:
Only one Modbus® master can be connected to the controller. Examples include the remote serial annunciator, monitoring software, and switchgear applications.

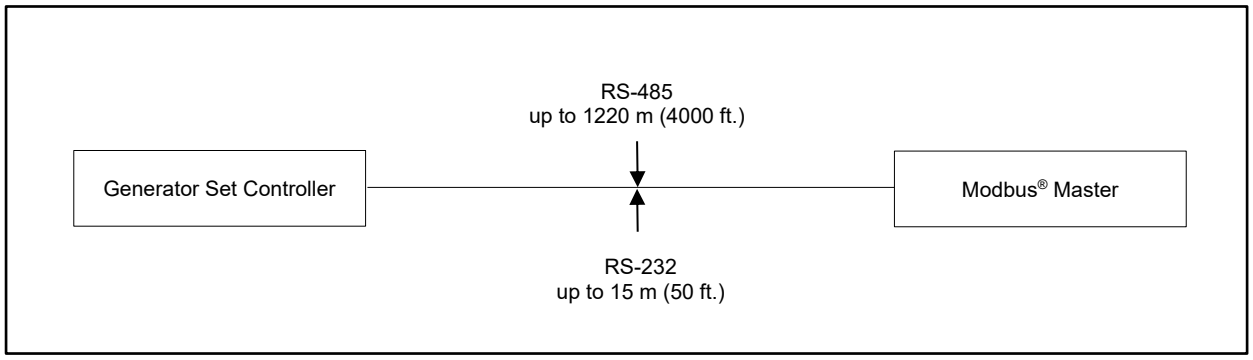


Figure 17 Modbus® Connections

A controller can communicate directly to a Modbus® master or participate in a network of devices. It can also be used to interface a local master to a network of devices.

The Modbus® master polls slave devices for data. Controller devices are slaves. Examples of master devices are a personal computer running monitoring software and the remote serial annunciator. See Figure 18.

SiteTech Group	Parameter	Setting
Modbus	Address	Use a unique network address between 1 and 247 for each unit. Use 1 for a single connection. Do not use 0 (zero).
	Baud rate	9600, 19200, 38400, or 57600. Must match the master PC and all devices in the system.

Figure 18 Decision-Maker® 3500 Communication Parameters

Select the baud rate. Choose the same baud rate for the Modbus® master, modems, and connected devices.

Each generator set controller must have a unique Modbus® address and PGEN node number (1-4).

Note:
The PGEN node number is automatically determined. The number of nodes online should match the number of installed generator sets.

Note:
The PGEN baud rate should not be adjusted except under direction from a factory service representative. Different baud rates between controllers on the network will result in a loss of communication on the network.

Modbus® is a registered trademark of Schneider Electric.

2.6.3 Calibration Submenu

The calibration values are reviewable at all times and provide the calibration of the voltage and current sensing logic. Changing the system voltage or replacing the circuit board requires a calibration adjustment.

Note:
Have calibration adjustments performed by an authorized Rehlko distributor.

To enable calibration, when the line is highlighted, push and hold the pushbutton/rotary selector dial to enable the calibration capability. The user is prompted with a Yes/No prompt for calibration. The display will show the following:

- Gen L1-L0 Volts
- Gen L2-L0 Volts
- Gen L3-L0 Volts
- Gen L1-L2 Volts
- Gen L2-L3 Volts
- Gen L3-L1 Volts
- Gen L1 Current
- Gen L2 Current
- Gen L3 Current
- Bus L1-L2 Volts
- Bus L2-L3 Volts
- Bus L3-L1 Volts
- Reset Gen Volt Meter: (Yes/No)
- Reset Gen Amp Meter: (Yes/No)
- Reset Bus Volt Meter: (Yes/No)
- Reset All Meters: (Yes/No)

The user can change individual values or can select the individual Reset to reset certain values. The Reset selections will only show if calibration is enabled. Refer to the requirements shown with Generator Set Calibration in the Status and Notice Digital Displays section.

2.7 I/O Setup Menu

Note:
Have setup and adjustments of the Decision-Maker® 3500 controller performed only by an authorized Rehlko distributor.

Analog and Digital Input Setup

There are three types of inputs setups:

1. Analog Resistive
2. Analog Differential (used in paralleling applications)
3. Digital

Note:
Analog=a sender, variable-resistant device.
Digital=a switch with contacts.

The I/O Setup Menu displays the setup of digital and analog warning and shutdown inputs. These inputs provide choices for configuring customized auxiliary inputs.

The user must enable the programming mode to edit the display. See the Menu Displays section for changeable settings in this menu.

Descriptions. Descriptions for user inputs (auxiliary analog or auxiliary digital) may be entered using the SiteTech™ software accessory where the user determines the descriptions.

Enabled. This menu indicates whether or not the input is enabled, if the input is not enabled, the controller will ignore this input signal.

Analog inputs have separate warning and shutdown enabled choices.

Inhibit Time Delay. The inhibit time delay is the time period following crank disconnect during which the generator set stabilizes and the controller does not detect the fault or status event. The controller will ignore the input until the inhibit time expires. If the inhibit time is set to zero, the input is monitored at all times, even when the generator set is not running. The inhibit time delay range is from 0 to 60 seconds.

Time Delay (shutdown or warning). The time delay follows the inhibit time delay. The time delay is the time period between when the controller first detects the fault or status event and the controller warning or shutdown lamp illuminates. The delay prevents any nuisance alarms. The time delay range is from 0 to 60 seconds.

Additional Analog Input Entries. The analog input selection typically requires entering four values—low warning, high warning, low shutdown, and high shutdown.

Digital Output and Relay Driver Output Setup

The I/O Setup Menu displays the setup of digital status and fault outputs and relay driver outputs (RDO). These RDO outputs provide choices for configuring customized auxiliary outputs. Additional individual outputs are available for monitoring, diagnostics, and control functions. See Optional Dry Contact Kit following.

The user must enable the programming mode to edit the display. See the Menu Displays section for changeable settings in this menu.

Note:
Changes to the Digital Outputs description requires the use of SiteTech™ software. The digital output can either open or close the circuit to activate.

Optional Dry Contact Kit

Dry contact kits provide an isolated interconnection between the generator set controller and optional devices. Up to fourteen conditions can be specifically identified with this kit.

A relay coil will be energized when the corresponding engine or generator set sensing device or switch monitored by the microprocessor control board is activated.

Each relay provides one set of SPST contacts for field connection of customer supplied indicators or alarms. Contacts are rated for a maximum resistive load of 10A at 120VAC.

2.7.1 Controller Fault Diagnostics

See Figure 19 for an event screen example. Figure 20 provides descriptions of the system events and their types—warning, shutdown, status, and notice.

Warnings show a yellow warning lamp and sound an audible alarm to signal an abnormal condition. A warning does not shut down the unit but requires attention. **Shutdowns** show a red fault shutdown lamp, sound an audible alarm, and stop the generator set. **Statuses** are not indicated by lamps or text messages on the controller interface LCD and do not require user interaction but are part of the event history. **Notices** are used for controlling outputs and notifying the user of the operating status.
Notices are NOT part of the event history.

The default selection time delays and digital outputs are factory set and adjustable. Some data entries require using a PC and SiteTech™ software.

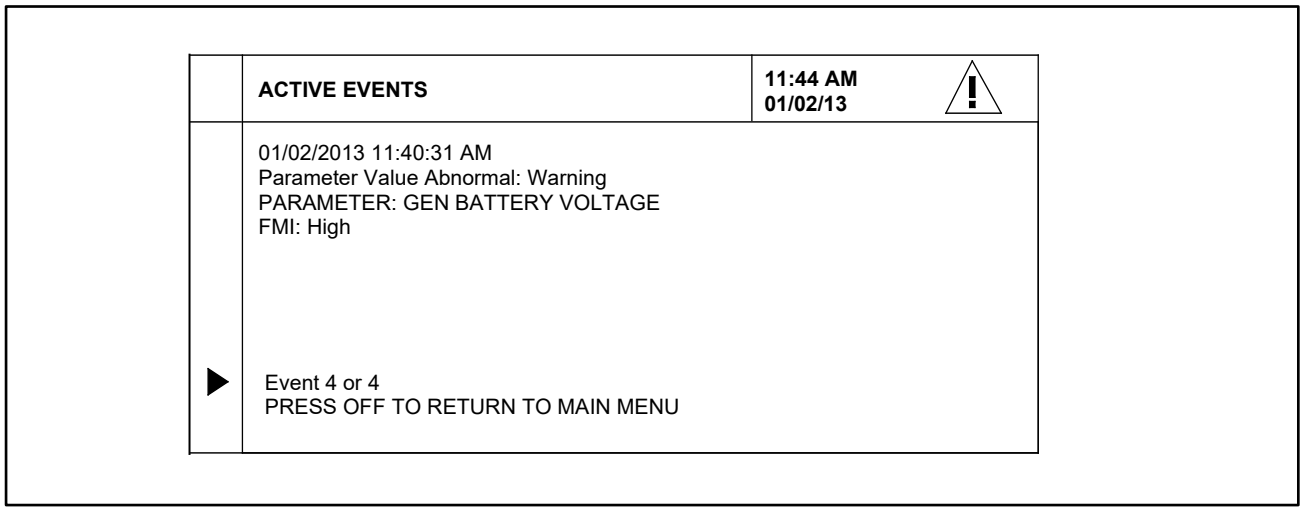


Figure 19 Event Screen Capture (Example)

FMI (Failure Mode Indicator)	Event ID/Parameter at Local Display	Level	Programmed Input	Programmed Output
	Protectives			
Low	Engine Speed	Shutdown		D
High	Engine Speed	Shutdown		D
Shorted High	Engine Oil Pressure *	Warning	AD	D
Shorted High	Engine Oil Pressure *	Shutdown	AD	D
Shorted Low	Engine Oil Pressure *	Shutdown		D
Low	Engine Oil Pressure	Warning	AD	D
Low	Engine Oil Pressure	Shutdown	D	D
Open Circuit	Engine Oil Pressure *	Shutdown		D
Low	Engine Coolant Temperature *	Warning	AD	D
Low	Engine Coolant Temperature *	Shutdown		D
High	Engine Coolant Temperature *	Warning	AD	D
High	Engine Coolant Temperature *	Shutdown	AD	D
Open Circuit	Engine Coolant Temperature *	Shutdown		D
Shorted High (3)	Engine Coolant Temperature *	Shutdown		D
Shorted Low (4)	Engine Coolant Temperature *	Shutdown		D
High	Lube Oil Temperature *	Warning	AD	
High	Lube Oil Temperature *	Shutdown	D	
Low	Engine Coolant Level	Shutdown	D	D
Low	Engine Fuel Level	Warning	AD	D
Low	Engine Fuel Level	Shutdown	D	D
High	Engine Fuel Level	Warning	D	D
Critically High	Engine Fuel Level	Warning	D	D
Low	Fuel Pressure	Warning	AD	D
Low	Fuel Pressure	Shutdown	AD	D
Low	Gen Battery Voltage	Warning		D
High	Gen Battery Voltage	Warning		D
Low	Cranking Voltage	Warning		D
Low	Engine Oil Level	Warning	AD	D
Low	Engine Oil Level	Shutdown	D	D
Low	Generator Voltage L1-L2	Shutdown		D
High	Generator Voltage L1-L2	Shutdown		D
Low	Generator Voltage L2-L3	Shutdown		D
High	Generator Voltage L2-L3	Shutdown		D
Low	Generator Voltage L3-L1	Shutdown		D
High	Generator Voltage L3-L1	Shutdown		D
Low	Avg Gen Voltage L-L	Warning		D
High	Avg Gen Voltage L-L	Warning		D
Low	Generator Frequency	Warning		D
High	Generator Frequency	Warning		D
Low	Generator Frequency	Shutdown		D
High	Generator Frequency	Shutdown		D
Low	Total Power (Generator Total Real Power)	Warning		D
High	Total Power (Generator Total Real Power)	Warning		D
High	Total Power (Generator Total Real Power)	Shutdown		D
Low	Total Reactive Power	Warning		D
High	Avg Current	Warning		D
Low	Maximum Alternator Current	Shutdown		D
High	Intake Air Temperature	Warning		D
High	Intake Air Temperature	Shutdown		D
High	Fuel Temperature	Warning		D
High	Fuel Temperature	Shutdown		D
Low	Coolant Pressure	Warning	AD	D
	AC Sensing Lost	Warning		D

FMI (Failure Mode Indicator)	Event ID/Parameter at Local Display	Level	Programmed Input	Programmed Output
	AC Sensing Lost	Shutdown		D
	Alternator Protection	Shutdown		D
	Auxiliary Input	Warning	AD	D
	Auxiliary Input	Shutdown	D	D
	Battery Charger Fault	Warning	AD	D
	Battery Charger 1 Communication Loss	Warning	AD	D
	Battery Charger 2 Communication Loss	Warning	AD	D
	Battery Charger Identity Conflict	Warning	AD	D
	Battery Charger Parameter Mismatch	Warning	AD	D
	ECM Communication Loss	Shutdown		D
	ECM Model Mismatch	Shutdown		
	Emergency Stop	Shutdown		D
	Fuel Tank Leak	Warning	AD	D
	Fuel Tank Leak	Shutdown	D	D
	Ground Fault Input	Warning	AD	D
	Locked Rotor	Shutdown		D
	Electrical Metering Communication Loss	Shutdown		
	Over Crank	Shutdown		D
	Speed Sensor Fault	Warning		D
	Other Alerts			
	Alarm Horn Silenced	Status		
	Engine Cool Down Active	Notice		D
	Engine Start Aid Active	Notice		D
	Engine Started	Status		
	Engine Stopped	Status		
	Emergency Power System Supplying Load	Notice		D
	Generator Running	Notice		D
	Not In Auto	Warning		D
	Option Board 2A Communication Loss	Notice		
	Option Board 2B Communication Loss	Notice		
	Option Board 2C Communication Loss	Notice		
	Remote Start	Status		
	Load Priority 1 Shed	Notice		D
	Load Priority 2 Shed	Notice		D
	Load Priority 3 Shed	Notice		D
	Load Priority 4 Shed	Notice		D
	Load Priority 5 Shed	Notice		D
	Load Priority 6 Shed	Notice		D
	Cabinet Intrusion Alarm	Warning	D	D
	Reserve Oil Empty	Warning	D	D
	Stopped By Generator Management	Status		D
	Failure To Synchronize	Warning		D
High	Fail To Open Delay	Warning		
High	Fail To Close Delay	Warning		
High	Max Close Attempts	Warning		
Erroneous Data Received	Generator Management (Invalid Generator Management Enabled)	Warning		
High	Trip To Shutdown Delay	Shutdown		
	Run Relay Coil Overload	Shutdown		
	Starter Relay Coil Overload	Shutdown		
High	System Frequency	Warning		
Low	System Frequency	Warning		
High	System Voltage	Warning		
Low	System Voltage	Warning		
Erroneous Data Received	System Phase	Warning		

FMI (Failure Mode Indicator)	Event ID/Parameter at Local Display	Level	Programmed Input	Programmed Output
	ECM Diagnostics			
	Engine Derate Active	Warning		
	Injector Wiring Fault	Warning		
	Run Relay Coil Overload	Warning		
	Sensor Supply Voltage	Warning		
	Speed Sensor Fault	Warning		
	Starter Relay Coil Overload	Warning		
	Water In Fuel	Warning		
	Notices Excluded From Display			
	Common Fault	Notice		D
	Common Warning	Notice		D
	System Ready	Notice		D
	Remote Start Command Issued	Notice		
	Run Button Acknowledged	Notice		
	Contactor	Notice		D
	Close Breaker	Notice		D
	Remove Breaker Trip	Notice		D
	Standalone Operation	Status	D	
	Load Enable	Status	D	
	Baseload Mode	Status	D	
	System Control Mode	Status		
	System Sync Mode	Status		
	Enable Trims	Status		

***** Sensor dependent

Note:
A=Analog, D=Digital

Figure 20 System Events Display Message List

2.7.2 Main Logic Circuit Board

The main logic circuit board provides the connection sockets to connect the controller to the engine/generator, input/output connections, optional I/O module kit, and circuit protection fuses. See Figure 21 for the circuit board connectors.

Note:
The main logic circuit board contains fuses that are either auto-resettable or non-replaceable.

Circuit Board Connections

P1 (35-Pin) Connector for engine/generator wiring harness.

P2 (14-Pin) Connector for sensor input connections and relay driver output connections.

P3 (8-Pin) Connector for generator set output voltage connection and paralleling bus voltage sensing connections.

P4 (Ethernet) Connector for factory use only.

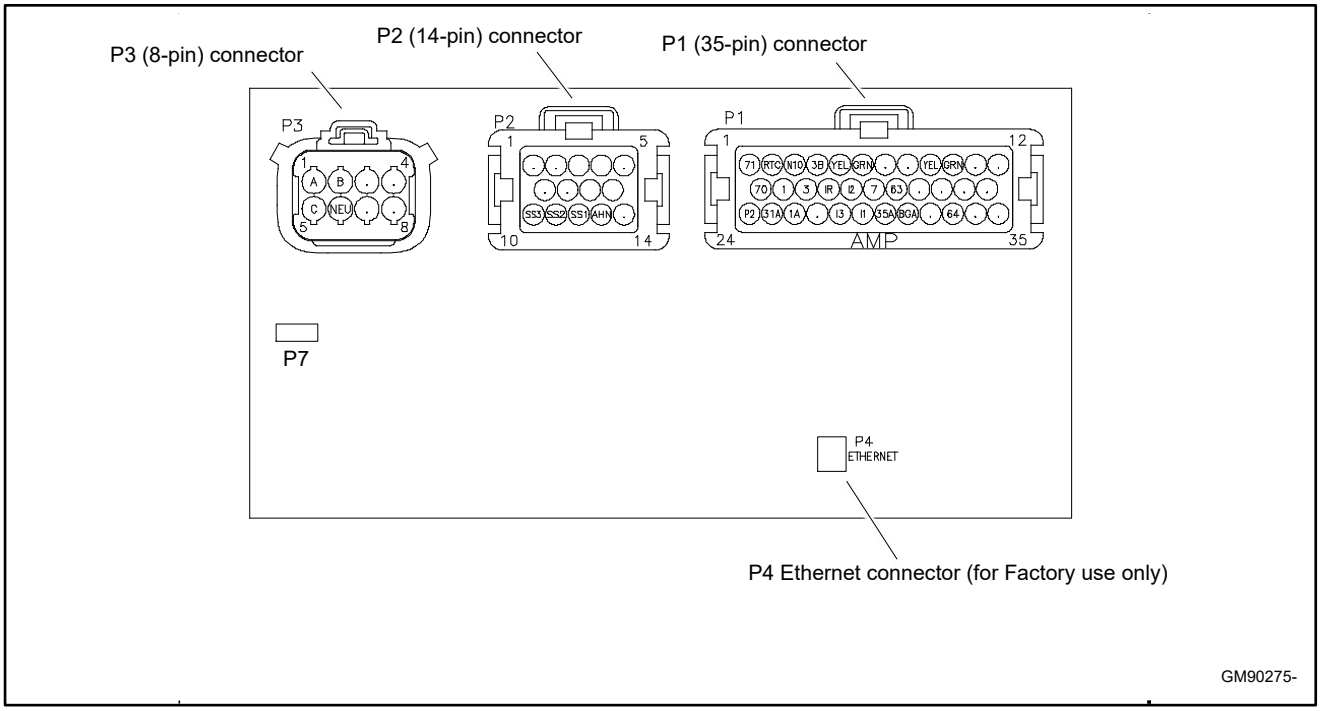


Figure 21 Main Circuit Board Connectors

3.1 Introduction

This section deals with electrical connections and requirements. This section may refer to other literature for procedures and additional information. See the list of related materials in the Introduction of this manual for literature part numbers.

The information in this section is a guideline for licensed electricians and/or qualified technicians. All electrical wiring and connections must comply with state and local codes based on National Electrical Code (NEC) guidelines

WARNING	**Accidental starting.** **Can cause severe injury or death.** 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.

(Decision-Maker® 3000 and 6000 Controllers)

DANGER	**Hazardous voltage.** **Will cause severe injury or death.** Disconnect all power sources before opening the enclosure.
	

WARNING	**Hazardous voltage. Backfeed to the utility system.** **Can cause property damage, severe injury, or death.** If the generator set is used for standby power, install an automatic transfer switch to prevent inadvertent interconnection of standby and normal sources of supply.
	

Grounding electrical equipment. Hazardous voltage will cause severe injury or death. Electrocution is possible whenever electricity is present. Ensure you comply with all applicable codes and standards. Electrically ground the generator set, transfer switch, and related equipment and electrical circuits. Turn off the main circuit breakers of all power sources before servicing the equipment. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

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.

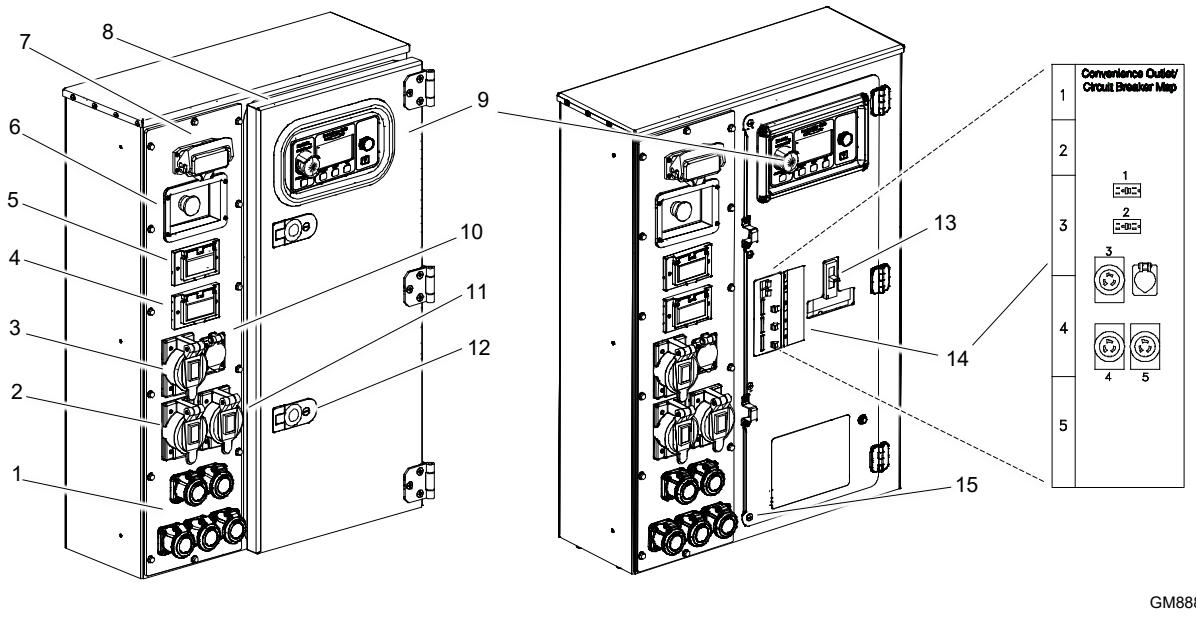
3.2 Customer Connection Panel

Figure 22, Figure 23, Figure 24, and Figure 25 provide customer connection panel specifications and illustrations.

Note:
Some customer connection panel items are available options.

	35/45REOZT4	55REOZT4	90/120REOZT4	145/175REOZT4
See illustration	Figure 23			Figure 24
GFCI duplex receptacles	Two 125 V, 15 A max., NEMA 5-15R			
Duplex circuit breakers	Two 20 Amp, single pole			
Twistlock receptacle	Three 250 V, 50 A max.			
Twistlock circuit breakers	Three 50 A, double pole			
Shore (utility) power connection for battery charger	120 V, 15 A, NEMA 5-15P			120 V, 15 A, NEMA 5-15P
Shore (utility) power connection for block heater				120 V, 20 A, NEMA 5-20P
Load lug connection wire size, qty.	#6-350MCM, one per terminal		#6-350MCM, two per terminal	
Load lug wrench size	5/16 in. hex			
Load lug torque, Nm (ft. lb.)	See lug decal instructions for torque			
Camlocks	Five (one per connection)			Ten (two per connection)
Main circuit breaker, 208-240 V, amps (field adjustable)	150	250	400	600
Main circuit breaker, 480 V, amps (field adjustable)	150	250	400	600
Main circuit breaker, 600 V, amps (field adjustable)	60	60	150	250

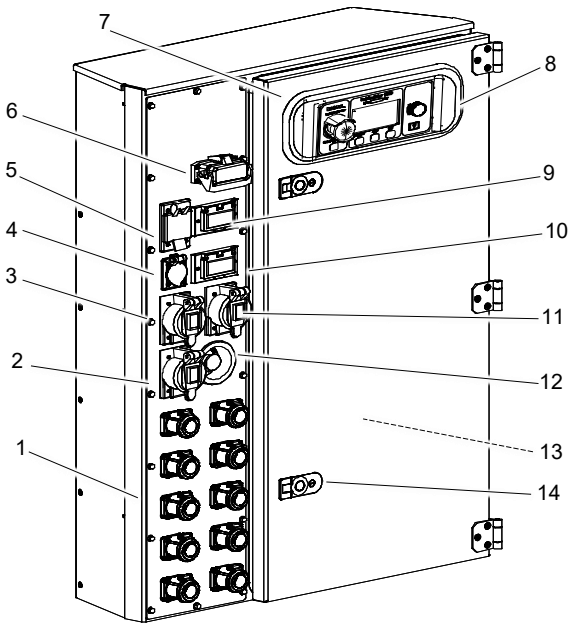
Figure 22 Customer Connection Panel Specifications



1. Color-coded camlocks (qty. 5), 208 V, 3-phase uses black, red, blue, white, and green and 1-phase uses black, red, white, and green
2. Twistlock receptacle, 240 V, 50 amp
3. Twistlock receptacle, 240 V, 50 amp
4. GFCI duplex receptacle, 120 V, 15 amp (or 139 V at high wye voltage selection)
5. GFCI duplex receptacle, 120 V, 15 amp (or 139 V at high wye voltage selection)
6. Emergency stop (E-stop) switch
7. Mobile paralleling box connection (newer models only)
8. Outer cover panel
9. Generator set Decision-Maker®3500 controller
10. Shore power connector, 120 V, 15 amp (for battery charger, battery heater, and engine block heater)
11. Twistlock receptacle, 240 V, 50 amp
12. Lockable latches (qty. 2) for access to inner cover panel
13. Main circuit breaker (main disconnect)
14. Circuit breakers: (1-2) single-pole circuit breaker, 15 amp for each duplex receptacle (3-5) double-pole circuit breaker, 50 amp for each twistlock receptacle
15. Inner cover panel (remove screws to access load lugs when camlocks are not ordered)

Note:
Customer connection panel shown with available options.

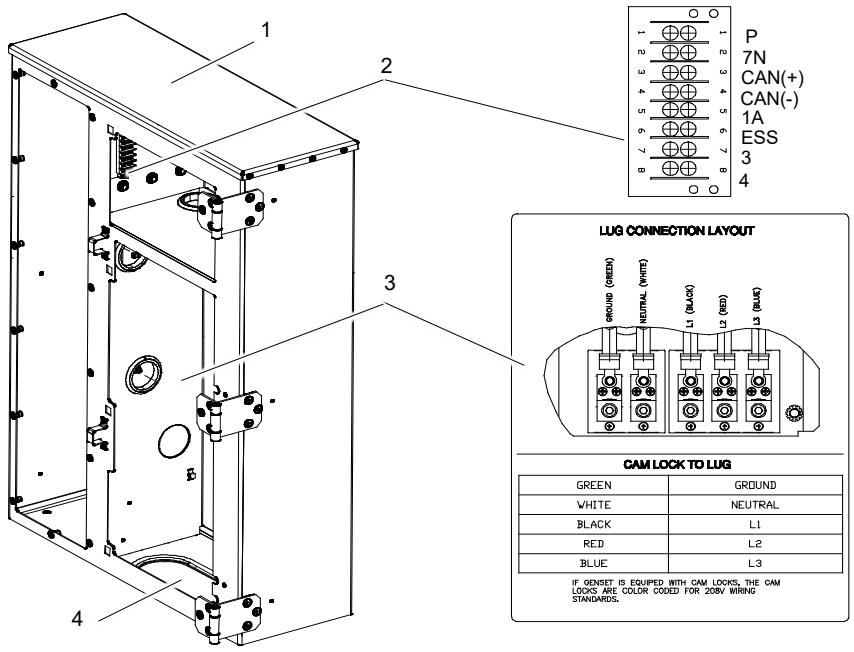
Figure 23 Customer Connection Panel (35-120REOZT4 models shown)



1. Color-coded camlocks (qty. 10), 208 V, 3-phase uses black, red, blue, white, and green and 1-phase uses black, red, white, and green
2. Twistlock receptacle, 240 V, 50 amp
3. Twistlock receptacle, 240 V, 50 amp
4. Shore power connector, 120 V, 15 amp (for battery charger and battery heater)
5. Shore power connector, 120 V, 20 amp (for engine block heater)
6. Mobile paralleling box connection (newer models only)
7. Outer cover panel
8. Generator set Decision-Maker® 3500 controller
9. GFCI duplex receptacle, 120 V, 15 amp (or 139 V at high wye voltage selection)
10. GFCI duplex receptacle, 120 V, 15 amp (or 139 V at high wye voltage selection)
11. Twistlock receptacle, 240 V, 50 amp
12. Emergency stop (E-stop) switch
13. Main circuit breaker (main disconnect) (behind outer cover panel) Circuit breakers: (1-2) single-pole circuit breaker, 15 amp for each duplex receptacle (3-5) double-pole circuit breaker, 50 amp for each twistlock receptacle
14. Lockable latches (qty. 2) for access to inner cover panel

Note:
Customer connection panel shown with available options.

Figure 24 Customer Connection Panel (145/175REOZT4 models shown)



1. Customer connection panel with outer and inner covers removed
2. Terminal strip TB10 (E-stop 1A-ESS and remote start 3-4 connections)
3. Load lugs (qty. 5) (L-R: 3-phase uses ground-green, neutral-white, black-L1, red-L2, blue-L3) (L-R: 1-phase uses ground-green, neutral-white, black-L1, and red-L2)
4. Customer connection panel access for user-supplied cable feed

Figure 25 Customer Connection Panel with Main Load Lugs and TB10 Terminal Strip Connections

The following information pertains to other available electrical connections beyond the main load lugs. This section shows a complete electrical connection list and descriptions that may not apply to all models. Power connections are user-selectable and vary with each situation or application. See Figure 23 for electrical panel illustrations. Each model offers ground fault circuit interruption (GFCI) protection receptacles powered by the generator set.

3.2.1 Shore Power

Use the shore power connector on the customer connection panel to connect to an external power supply to power the generator set battery charger, battery heater, and engine block heater. The power receptacles are located on the back of the junction box.

3.2.2 Main Circuit Breaker

The single 3-pole main circuit breaker (main disconnect) protects the load lugs and camlocks (if equipped). The circuit breaker works with 480-volt (high wye), 208 to 240-volt (low wye), and single-phase voltage circuits. The 600-volt model offer circuit protection using a single 3-pole circuit breaker.

Note:
When changing the position of the voltage selector switch, the output current rating of the generator set changes. The new output current may require adjustment of the trip setting on the main circuit breaker. This setting is indicated by the IR dial on the circuit breaker. The IR dial has indications from 0.4 to 1.0 of the trip plug rating (typically indicated on a plate at the bottom of the breaker trip unit).

3.2.3 Circuit Breaker, GFCI Receptacles

A single-pole circuit breaker protects each GFCI receptacle on the customer connection panel.

3.2.4 Load Lug Assembly

Use the load lug assembly to attach user-supplied load connections and/or distribution boxes when camlocks are not ordered.

3.2.5 GFCI Duplex and Twistlock Receptacles

The customer connection panel provides several duplex and twistlock receptacles for user convenience. These receptacles provide power when the generator set is running. Refer to Figure 26 for output voltages based on voltage connection.

Receptacles	Voltage Connection		
	277/480 V 3 PH	120/208 V 3 PH	120/240 V 1 PH
GFCI Duplex	139 V	120 V	120 V
Twistlock	240 V	208 V	240 V

Figure 26 Receptacle Voltages

Note:
Do not operate standard 120 V equipment on GFCI duplex receptacles when voltage selector switch is in the 480 V position.

3.2.6 Camlocks

One set (larger kW/kVA models have two sets) of five camlocks provides convenient attachment of user-supplied power connections. Camlocks are colored-coded green, white, black, red, and blue for identification and work with single-phase and three-phase voltages. See Figure 27.

	Camlock Colors (Left to Right)				
	Green	White	Black	Red	Blue
	GND	L0	L1	L2	L3
Single-phase	X	X	X	X	
Three-phase	X	X	X	X	X

Figure 27 Camlocks for Single- and Three-Phase Connections

3.2.7 Voltage Selector Switch

The voltage selector switch, located on the generator set junction box, controls the voltage available to the main load lugs or camlocks (if equipped), GFCI receptacles, and 50 amp twist lock connectors. The voltage selector switch is further covered in the Voltage Selection and Load Connection Procedure section.

Note:
Do not move voltage selector switch while the generator set is running.

3.2.8 Mobile Paralleling Box Connection

The mobile paralleling box connection (if equipped) provides the capability of connecting the generator set to an optional mobile paralleling box. The optional paralleling box allows connecting two generator sets to one distribution bus. Refer to TT-1672 instruction for more information.

3.3 Frequency Conversion

These units are offered as 60 Hz models only.

3.4 Voltage Selection and Load Connection Procedure

3.4.1 Introduction

Use the following procedure to match the voltage of the generator set to the load and to connect the required load to the customer connection panel.

Refer to the following procedure and the connection schematics. Follow the safety precautions at the front of this manual and in the procedure text and observe National Electrical Code (NEC) guidelines.

The factory-supplied circuit breaker is sized for maximum generator set output. Have an electrician install secondary circuit protection for other current limit requirements.

NOTICE

Voltage reconnection. Affix a notice to the generator set after reconnecting the set to a voltage different from the voltage on the nameplate. Order voltage reconnection decal 246242 from an authorized service distributor/dealer.

Note:
Equipment damage. Verify that the voltage ratings of the transfer switch, line circuit breakers, and other accessories match the selected line voltage.

WARNING	**Accidental starting.** **Can cause severe injury or death.** 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) Turn the generator set master switch and switchgear engine control switch to the OFF position. (2) Disconnect the power to the battery charger. (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 an automatic transfer switch or a remote start/stop switch.

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) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (–) lead first. Reconnect the negative (–) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

DANGER	**Hazardous voltage. Moving parts.** **Will cause severe injury or death.** 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.

Grounding electrical equipment. Hazardous voltage will cause severe injury or death. Electrocution is possible whenever electricity is present. Ensure you comply with all applicable codes and standards. Electrically ground the generator set, transfer switch, and related equipment and electrical circuits. Turn off the main circuit breakers of all power sources before servicing the equipment. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

3.4.2 Voltage Reconnection Procedure (with Selector Switch)

1. Press the generator set master control OFF/RESET button.
2. Open the main line circuit breaker.
3. Rotate the generator set voltage selector switch to match the desired voltage of the generator set load, see Figure 28. See Figure 29 for voltage choices based on the voltage selection switch position. Generator set voltage selection must match load device voltage.

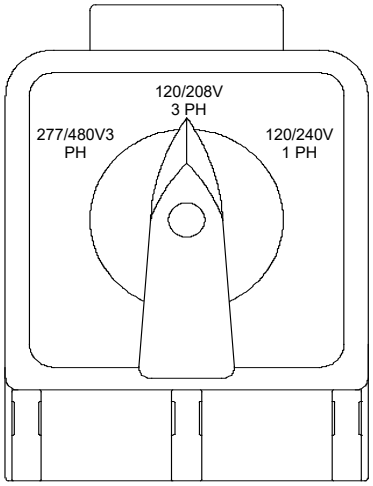


Figure 28 Voltage Selector Switch (mounted on the Generator Set Junction Box)

Voltage Selector Switch Position	60 Hz Voltage	L0-L1 Conn.	L1-L2 Conn.	L1-L3 Conn.	L2-L3 Conn.
High wye	277/480	277	480	480	480
Low wye	120/208	120	208	208	208
Single-phase	120/240	120	240	-	-

Figure 29 Voltage Choices

Lock out voltage selector switch by pressing the lockout button down and placing a padlock (user-supplied) into the opening at the bottom of the voltage selector switch. Have the servicing electrician and/ or rental distributor lock out the voltage selector switch if the unit is accessible to nonqualified personnel such as in rental or other situations with public access. *Do not move the voltage selector switch while generator set is running.*

4. Disconnect the generator set engine starting battery, negative (-) lead first. Disconnect power to the battery charger (if equipped).
5. Make lead connections between the load devices and the load lugs or camlocks (if equipped). See the Electrical Panel section. The user must supply all wiring between the customer connection panel load lugs and load devices. Use wiring of size and type specified in NEC guidelines. Tighten the load lugs using a user-supplied load lug wrench to the torque shown at the load lugs. Protect all wiring and connections from inclement weather and public access.
6. Make a ground connection between the generator set and earth ground according to state and local codes using NEC guidelines.
7. Replace all electrical guards, barriers, covers, and other protective devices on all electrical wiring and connections.
8. Reconnect the battery, negative (-) lead last. Reconnect power to the battery charger (if equipped).
9. Press the generator set master control RUN button to start the generator set. Check the digital display and verify that the settings match the desired voltage/frequency/phase.

   Refer to the Generator Metering Submenu section and the Menu Displays section for more information as needed.

10. Press the generator set master control OFF/RESET button to stop the generator set after completing the voltage adjustments.
11. Adjust the overcurrent trip setting on the main circuit breaker of the generator set to match the rated output current as a percentage of the breaker current plug rating. Refer to the Main Circuit Breaker section for more information.
12. Close the main line circuit breaker.
13. Close any downstream circuit breakers, as needed.

3.4.3 Voltage Reconnection Procedure (without Selector Switch)

Use the following voltage reconnection procedure to change the voltage of 12-lead generator sets.

1. Press the generator set master control OFF/RESET button.
2. Open the main line circuit breaker.
3. Go the Main Menu and turn the selector dial clockwise or counterclockwise to the Generator Info menu. Press the selector dial.
4. Turn the selector dial clockwise or counterclockwise to the Configuration menu. Press the selector dial.

   Refer to the Configuration Submenu, Generator Configuration submenu section and the Menu Displays for more information as needed.
5. Turn the selector dial clockwise or counterclockwise to the Generator Config menu. Press the selector dial. See Figure 30

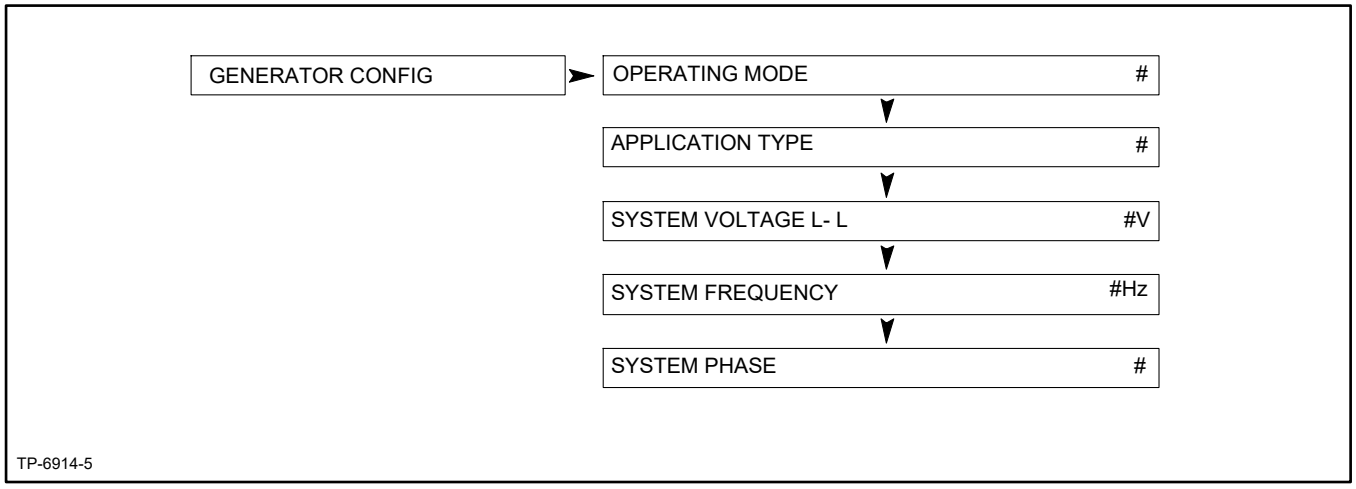


Figure 30 Generator Configuration

6. Turn the selector dial clockwise or counterclockwise to the System Voltage L-L menu and press the selector dial for 10 seconds to enter the edit mode. Use the selector dial to enter the password, then select the System Voltage L-L, and press the selector dial. The entry will be highlighted.
7. Turn the selector dial clockwise or counterclockwise to the desired voltage as needed.
   - 208 V
   - 240 V
   - 480 V
8. Press the selector dial and the entry will no longer be highlighted and the new System Voltage L-L will appear with the desired voltage selection.
9. Turn the selector dial clockwise or counterclockwise to the System Phase menu and press the selector dial. The entry will be highlighted.

10. Turn the selector dial clockwise or counterclockwise to the desired phase as needed.
    - Three Phase
    - Single Phase (4-lead alternator)
    - Single Phase Dog-Leg (12-lead alternator)
11. Press the selector dial and the entry will no longer be highlighted and the new System Frequency will appear with the desired phase selection. System frequency can be adjusted similarly, but is not typically adjustable in the engine ECM due to EPA regulations.
12. Verify that the settings match the desired voltage/frequency/phase.
13. Disconnect the generator set engine starting battery, negative (-) lead first. Disconnect power to the battery charger (if equipped).
14. Use Figure 31 to determine the generator set voltage configuration. Note the original voltage and reconnect as needed. Route leads through current transformers (CTs) and connect them according to the diagram for the desired phase and voltage.

    Note:
    Position current transformers CT1, CT2, and CT3 with the dot or HI side CT marking toward the generator set.
15. Make lead connections between the load devices and the load lugs or camlocks (if equipped). See the Electrical Panel section. The user must supply all wiring between the customer connection panel load lugs and load devices. Use wiring of size and type specified in NEC guidelines. Tighten the load lugs using a user-supplied load lug wrench to the torque shown at the load lugs. Protect all wiring and connections from inclement weather and public access.
16. Make a ground connection between the generator set and earth ground according to state and local codes using NEC guidelines.
17. Replace all electrical guards, barriers, covers, and other protective devices on all electrical wiring and connections.
18. Reconnect the battery, negative lead last. Reconnect power to the battery charger (if equipped).
19. Press the generator set master control RUN button to start the generator set. Check the digital display for correct voltages. Refer to the Generator Metering Submenu section and Menu Displays section for more information as needed.
20. Press the generator set master control OFF/RESET button to stop the generator set after completing the voltage adjustments.
21. Adjust the overcurrent trip setting on the main circuit breaker of the generator set to match the rated output current as a percentage of the breaker current plug rating. Refer to the Main Circuit Breaker section for more information.
22. Close the main line circuit breaker.
23. Close any downstream circuit breakers, as needed.

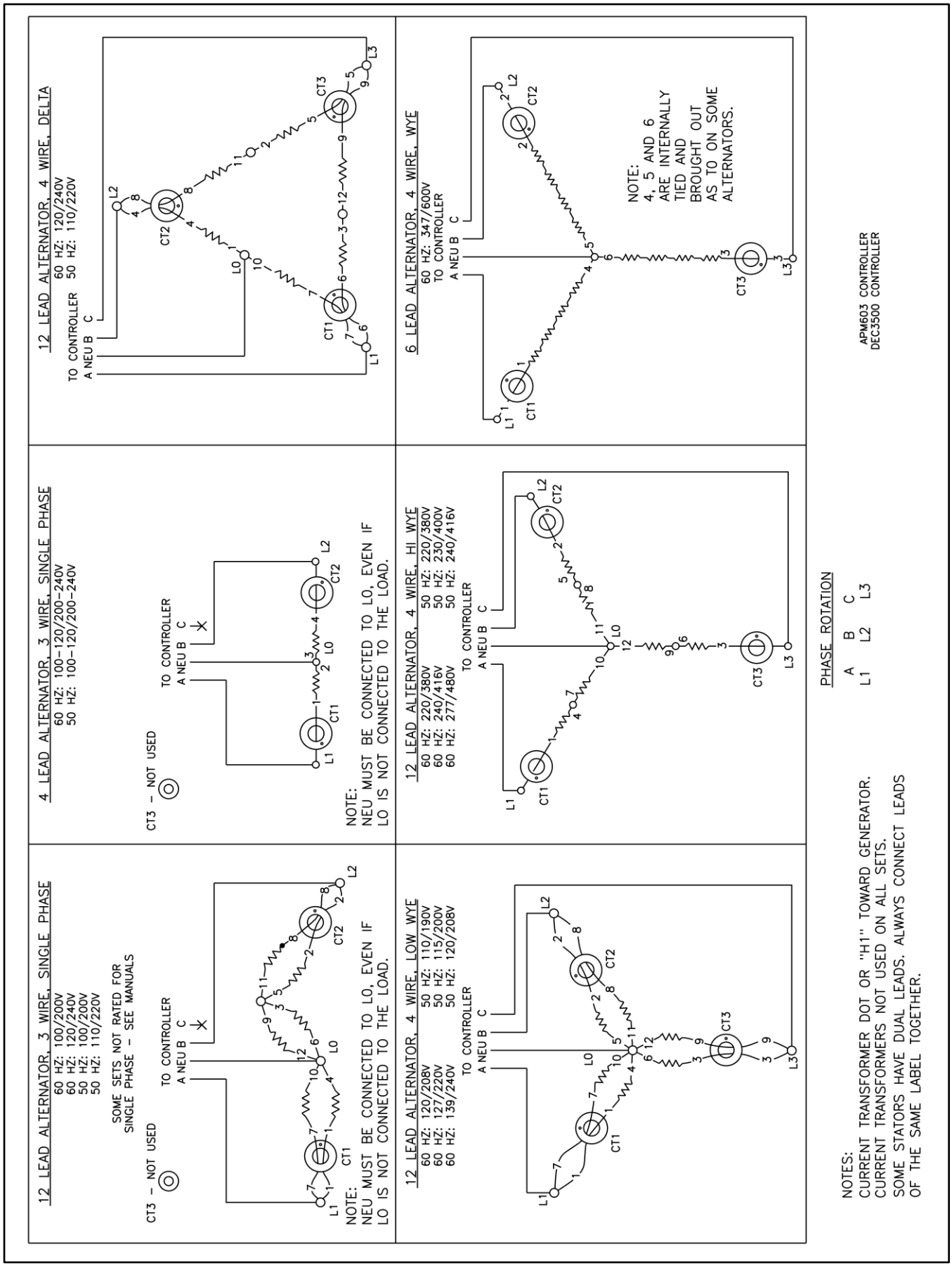


Figure 31 Reconnection Diagram 20-300 kW ADV-5875AC-6

3.5 15-Relay Dry Contact Kit Connections

3.5.1 Introduction

The optional fifteen-relay dry contact kit (Figure 32) provides normally open contacts to activate warning devices and other user-provided accessories allowing remote monitoring of the generator set. Connect any controller fault output to the dry contact kit. Typically, lamps, audible alarms, or other devices signal the fault conditions.

The fifteen-relay dry contact board has four digital inputs and two analog inputs. There are fourteen programmable relay outputs (K1-K14) and one common fault relay output (K15).

When a generator fault condition occurs, the contact kit relay energizes. The relay contact closure corresponds to the controller output being activated.

Check the electrical requirements of the user-supplied accessories prior to installation of the relay dry contact kit. User-supplied accessories require their own electrical source and must not exceed the relay contact ratings.

The normally open (NO) relay contacts (K1 to K14) are rated:

- 10 amps @ 120 VAC
- 10 amps @ 28 VDC (max.)
- amps @ 28 VDC (min.)

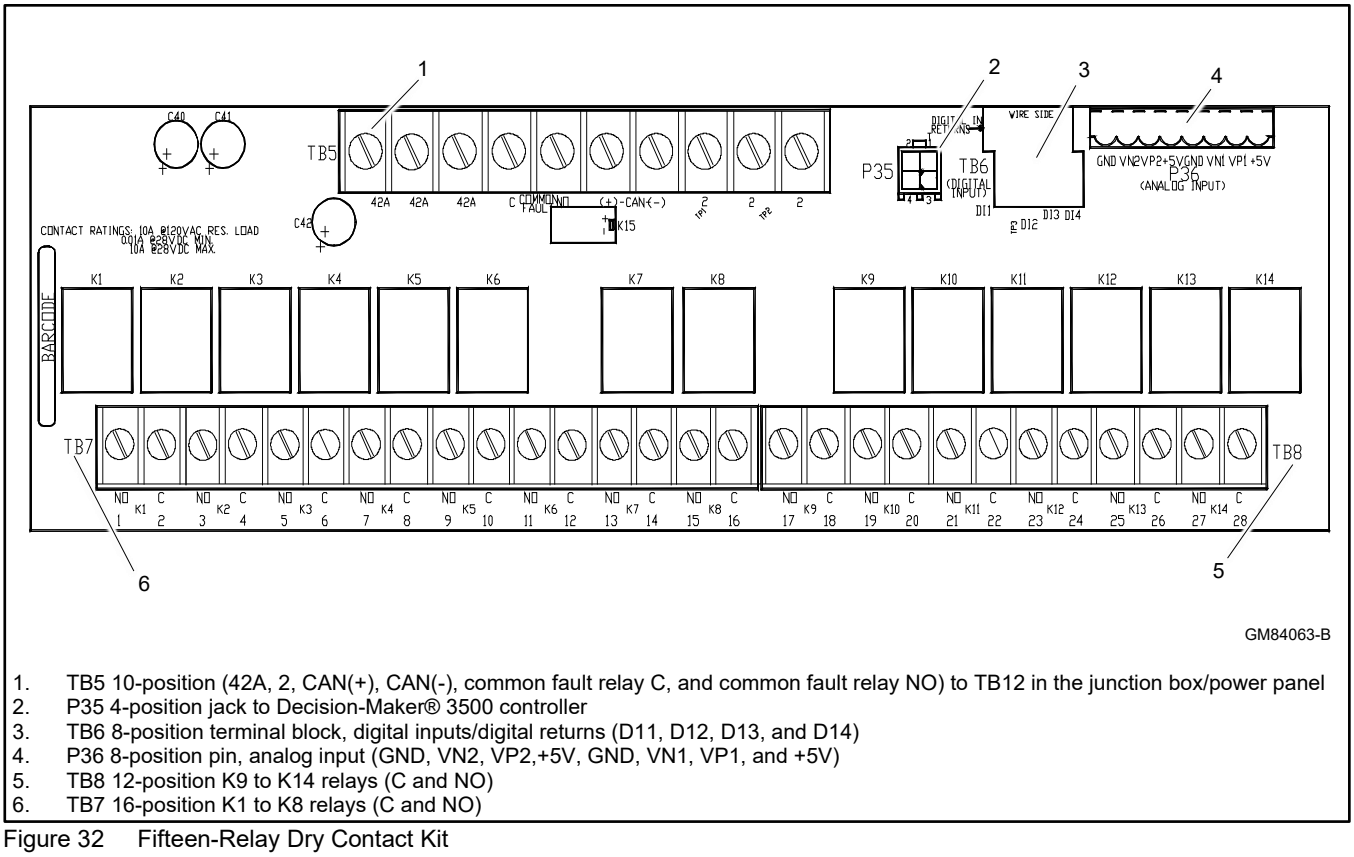
The common fault relay contact (K15) is rated:

- 500 mA @ 125 VAC
- 2 amps @ 30 VDC

Read the entire installation procedure and perform the steps in the order shown.

Observe applicable local and national electrical codes when installing the wiring system.

Observe the following safety precautions while making connections to the kit.



1. TB5 10-position (42A, 2, CAN(+), CAN(-), common fault relay C, and common fault relay NO) to TB12 in the junction box/power panel
2. P35 4-position jack to Decision-Maker® 3500 controller
3. TB6 8-position terminal block, digital inputs/digital returns (D11, D12, D13, and D14)
4. P36 8-position pin, analog input (GND, VN2, VP2,+5V, GND, VN1, VP1, and +5V)
5. TB8 12-position K9 to K14 relays (C and NO)
6. TB7 16-position K1 to K8 relays (C and NO)

Figure 32 Fifteen-Relay Dry Contact Kit

⚠ WARNING	**Accidental starting.** **Can cause severe injury or death.** 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) Turn the generator set master switch and switchgear engine control switch to the OFF position. (2) Disconnect the power to the battery charger. (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 an automatic transfer switch or a remote start/stop switch.

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) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (–) lead first. Reconnect the negative (–) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

⚠ DANGER	**Hazardous voltage. Moving parts.** **Will cause severe injury or death.** 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.

Grounding electrical equipment. Hazardous voltage will cause severe injury or death. Electrocution is possible whenever electricity is present. Ensure you comply with all applicable codes and standards. Electrically ground the generator set, transfer switch, and related equipment and electrical circuits. Turn off the main circuit breakers of all power sources before servicing the equipment. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

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 short circuits. Explosion can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Disconnect the battery before generator set installation or maintenance. Remove all jewelry before servicing the equipment. Use tools with insulated handles. Remove the negative (–) lead first when disconnecting the battery. Reconnect the negative (–) lead last when reconnecting the battery. Never connect the negative (–) battery cable to the positive (+) connection terminal of the starter solenoid. Do not test the battery condition by shorting the terminals together.

Leads 42A and 2 provide power to the relays. Do not use terminals 42A (+) or 2(GND) on the controller connection kit terminal strip to supply voltage to user-supplied accessories. User-supplied DC accessories require separate leads connected directly to the battery for the voltage supply. Attach user-supplied 12/24-volt DC accessories to the battery positive (+) connection at the starter solenoid and to the battery negative (-) connection at the engine ground. The 120 VAC accessories require a user-supplied voltage source.

Note:
A total of one 15-relay dry contact kit may be connected to the Decision-Maker® 3500 controller.

3.5.2 Electrical Connection Procedure

1. Press the generator set master control OFF/RESET button.
2. Disconnect the power to the battery charger, if equipped.
3. Disconnect the generator set engine starting battery(ies), negative (-) lead first.
4. Remove the Decision-Maker™ 3500 controller by removing the screws located at each corner of the panel. See Figure 33 for location of the relay board.
5. See Figure 34 for connections of analog inputs.
6. Select the normally open (NO) contacts of the relay, form A dry contact, depending upon the application. Use a two-wire harness for the NO connections.
7. Supply two lengths of stranded wire to make leads long enough to connect the user- supplied device to the dry contact terminals and power supply. Use color-coded wire for easy identification. Make leads long enough to allow for walls, ductwork, and other obstructions. Use separate conduit for the dry contact wiring.
8. **12/24-Volt DC Devices.** Attach the user-supplied 12/24-volt DC accessories to the starting battery positive (+) connection at the starter solenoid and to the battery negative (-) connection at the engine ground. Otherwise, use a separate 12/24-volt DC supply. Do not use terminals 42A and 2 on the controller connection kit terminal strip to supply the voltage to the relay contacts. Supply separate leads connected directly to the battery for the supply voltage. The circuit must include fuse or circuit breaker protection.

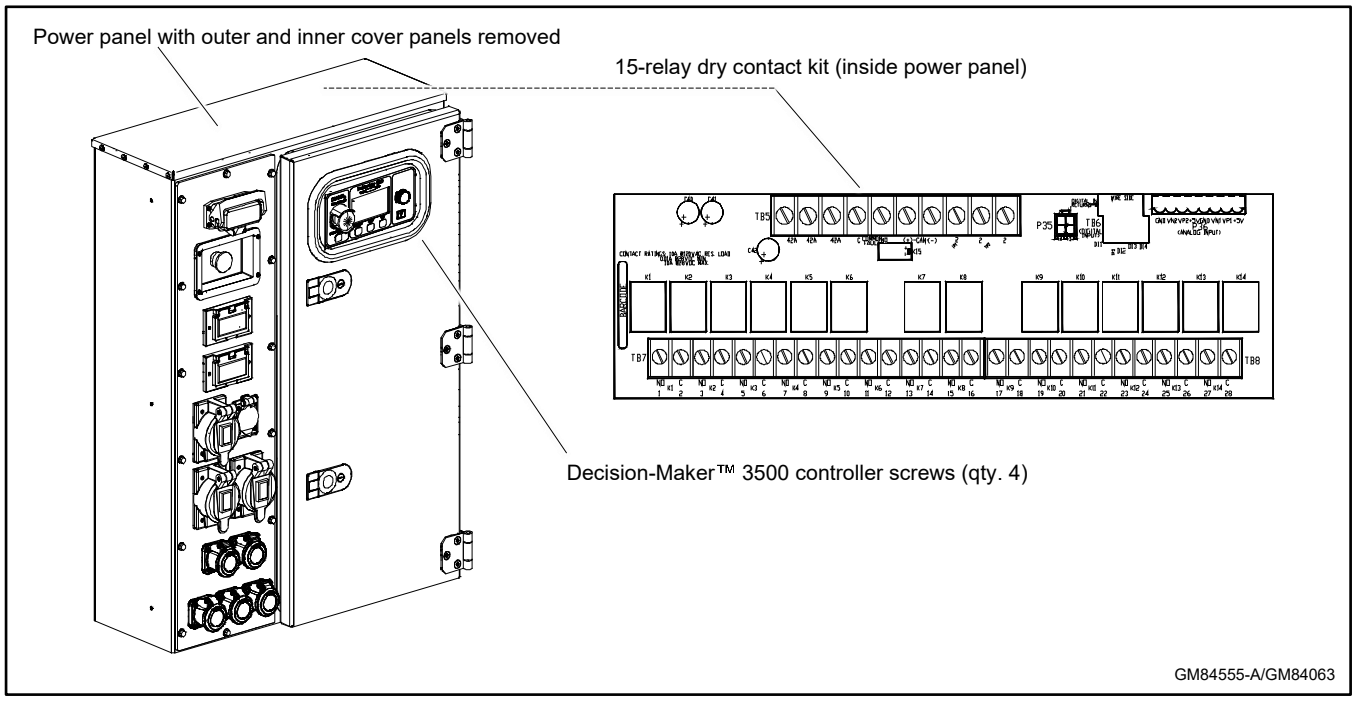


Figure 33 Power Panel with Optional 15-Relay Dry Contact Kit

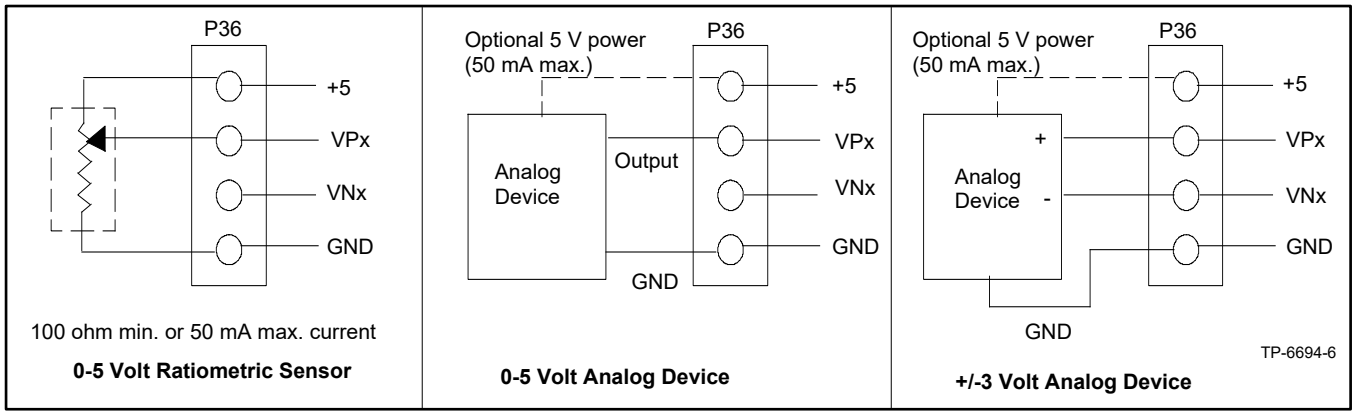


Figure 34 Analog Input Connections P36

9. **120-Volt AC Devices.** Connect the user- supplied accessories to a separate 120-volt AC power supply. The circuit must include fuse or circuit breaker protection.
10. Connect the user-supplied device per the Instructions and/or schematic supplied with the device to a power source and to the dry contact terminals. Cut the user-supplied leads to length, strip lead ends, crimp on spade terminals (not supplied), and connect the leads to the relay contact screw terminals. Route the wiring for the relay dry contacts away from the generator set output leads.
11. Repeat Step 6 for the remaining dry contact relays.
12. Re-install the Decision-Maker™ 3500 controller by replacing four screws.
13. Reconnect the generator set engine starting battery, negative (-) lead last.
14. Reconnect power to the battery charger, if equipped.

3.5.3 Program the Inputs and Outputs using SiteTech™

Use SiteTech™ to assign functions to digital and analog inputs and outputs. Each input and output corresponds to a controller connection. Verify that the settings are appropriate for the connected sensor, switch, or equipment. Do not change factory-set inputs and outputs without verifying the input and output connections.

Refer to Introduction—List of Related Materials for the SiteTech™ Software Operation Manual part number.

SiteTech™ input and output parameters labeled 119-138 are designated for use on the optional 15-relay dry contact board. See Figure 35.

Note:
Inputs and outputs labeled 119-138 will only appear after the initial connection of the optional 15-relay dry contact board.

Note:
See the Fifteen-Relay Dry Contact Kit figure for P36, TB6, TB7, and TB8 locations.

SiteTech I/O Name	Optional Dry Contact Board Connection
Programmable Analog Voltage Input 119	P36 Analog Input VN1/VP1
Programmable Analog Voltage Input 120	P36 Analog Input VN2/VP2
Digital Input 121 Digital Input 122 Digital Input 123 Digital Input 124	TB6
Digital Output 125 Digital Output 126 Digital Output 127 Digital Output 128 Digital Output 129 Digital Output 130 Digital Output 131 Digital Output 132 Digital Output 133 Digital Output 134 Digital Output 135 Digital Output 136 Digital Output 137 Digital Output 138	TB7 and TB8

Figure 35 Optional Inputs and Outputs with Dry Contact Kit

3.5.4 Test Dry Contact Relays

Verify the dry contact relay function by using the following procedure when troubleshooting.

Test Procedure

1. Remove the user-supplied device wiring from the relay dry contact terminals.
2. Test the relay operation by connecting an ohmmeter across the NO and C terminals on the relay terminal strip.
3. Use a jumper wire to ground the selected fault terminal on the controller connection terminal strip. The relay contacts should close and the ohmmeter should display a low resistance reading (continuity).
4. Install the user-supplied device wiring on the relay dry contact output terminals.

3.6 Selecting Trailer Location

Use the following information as a guideline when selecting a trailer location. Be aware of potential detrimental conditions and use common sense when determining a location. Trailer setup and location information does not cover subjects dealing with trailer/generator set security or personnel safety in areas that are open to the public and occupied by children. The contractor, property owner, and/or trailer owner must address these issues.

3.6.1 Surface Stability

Choose a location with a solid, level base and avoid loose gravel, soft dirt, mud, standing water, etc. Avoid steep dropoffs, rough terrain, etc. If the area is subject to heavy rain, evaluate the surrounding area to avoid flooding and/or mud damage.

3.6.2 Adequate Air Flow/Heat Dissipation

Select a location that provides adequate air flow. Avoid locations next to tall buildings that block normal air flow and cause air vacuum pockets. Avoid areas subject to high winds, excessive dust, or other airborne contaminants. High dust areas may accelerate air cleaner maintenance. High temperature conditions affect generator set efficiency. Select a shaded area away from direct sunlight and/or other heat producing equipment when practical.

3.6.3 Combustible Materials

Avoid areas with combustible materials, including building materials as well as natural surroundings. Keep dry field grass, foliage, and combustible landscaping material a safe distance from the exhaust system. DO NOT locate the trailer or operate the generator set in an environment with explosive fumes.

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

3.6.4 Exhaust Gases

Avoid areas next to buildings where exhaust gases may be drawn into the building through doors, windows, vents, fans, and air conditioners.

WARNING	
	**Carbon monoxide.** **Can cause severe nausea, fainting, or death.** 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.

3.6.5 Noise Avoidance and Restrictions

An operating generator set creates a noticeable amount of noise. Promote noise reduction by keeping the exhaust outlet away from areas with heavy pedestrian traffic. Wind direction and proximity to buildings affect noise level. Some residential areas may limit the hours when commercial noise is allowed. Supply hearing protection to workers in direct proximity to an operating generator set.

CAUTION	
	**Hazardous noise.** **Can cause hearing loss.** 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.

Notes

The information in this section is for qualified generator set operating technicians and/or maintenance personnel.

4.1 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.** **Will cause severe injury or death.** Operate the generator set only when all guards and electrical enclosures are in place.
	

Air Cleaner. Prevent unfiltered air from entering engine by cleaning the air cleaner element and ensuring correct installation. Check the air cleaner restriction gauge.

Air Inlets. Check for clean and unobstructed air inlets.

Battery. Check that battery connections are clean of corrosion and that the battery cable clamps are tight. Check the battery electrolyte level if the battery is not the maintenance-free type.

Circuit Breakers. Place the main circuit breakers in the OPEN position prior to starting the generator set. After the generator set is running, then CLOSE the main circuit breakers.

Coolant Level. Check the coolant level according to the cooling system maintenance information.

Note:
Block Heater Damage. 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.

Diesel Exhaust Fluid (DEF) Tank, if equipped. Ensure that there is an adequate DEF supply; keep the DEF tank full. When filling, watch that the DEF tank is not overfilled.

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. Check that the service access doors are closed and secured. Leaving the doors open will create excessive noise and may lead to generator set overheating. Maximum cooling air flow is achieved when the doors are closed.

Check that the enclosure door to the load connection panel is closed and secured. Some units have a microswitch 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.

Inspect the exhaust system components (exhaust manifold, exhaust line, flexible exhaust, clamps, silencer, and outlet pipe) for cracks, leaks, and corrosion.

- Check for corroded or broken metal parts and replace them as needed.
- Check for loose, corroded, or missing clamps and hangers. Tighten or replace the exhaust clamps and/or hangers as needed.
- Check that the exhaust outlet is unobstructed.
- 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.

Fire Extinguisher (optional). Verify that a fully charged fire extinguisher is in place. See illustrations in the Views and Features section for location.

Fuel System. Ensure that there is an adequate fuel supply; keep tanks full. When filling, watch the fuel gauge to determine when the tank is approaching capacity.

Lamp-Test. Press the lamp-test button to verify all controller lamps are operational. Refer to the Switches and Controls section for details.

Oil Level. Keep the engine oil pan level at or near, but not over, the full mark on dipstick. If equipped with an engine oil level regulator, fill the oil makeup system reservoir as needed.

Operating Area. Check for obstructions that could block the flow of cooling air. Keep the area clean. Do not leave rags, tools, or debris on or near the generator set. Check for and remove accumulated fluids in the trailer using the fluid basin drain.

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. In addition, after the unit is started check that the trailer remains level and doesn't exhibit excessive vibration—correct any concerns. This visual inspection should be routinely done while the unit is running.

4.2 Exercising Generator Set

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

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

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

The operator should perform all of the prestart checks before starting the manual exercise procedure. Start the generator set according to the starting procedure in 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. For scheduled exercise periods, refer to the automatic transfer switch (if equipped) literature.

4.2.1 Exhaust System Regeneration Requirements (Models: 90-175REOZT4)

Exhaust system regeneration is required based on three factors:

- Time basis of 50 hours
- Measured accumulation of residue in the exhaust system
- Calculation based on fuel usage, ambient and operating temperatures, etc.

If the exhaust system requires regeneration, the ECM may limit the power output of the engine during regeneration up to 50%. Effective cleaning of the exhaust system will not occur until system temperatures reach acceptable levels. These levels may not be achieved during short exercise periods. As a result, the operator should evaluate the exercise time period and monitor the exhaust system parameters and performance to determine the most efficient means to perform coordinated exercises and regeneration without affecting the availability of the generator set. The regeneration status is displayed on the controller in the Generator Information menu.

4.3 Operation in Cold Weather Climates

Cold weather operation is generally considered ambient temperatures 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 and/or 20 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 respective spec 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 spec sheet for model availability.
- **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.

4.4 Weather and Climate Provisions and Operation Limitations

Operation and use of a generator set in the outdoors or in unsheltered areas require special attention to weather conditions and environmental surroundings. Weather conditions may limit the usability where rain or damp conditions increase the chance of electrocution.

A generator set, like any other electromechanical device, can pose potential dangers to life and limb if improperly maintained or operated. The best way to prevent accidents is to be aware of potential dangers and act safely. This manual and the generator set operation manual contain several types of safety precautions and instructions. Please read and follow the safety precautions and instructions to prevent harm to yourself and others.

Operate the generator set during rain or other inclement weather conditions only if the responsible electrician and/or contractor can secure and protect electrical connections from inclement weather exposure. Keep the trailer doors closed and all electrical boxes closed. Keep unauthorized personnel away from all electrical wiring and devices. The responsible electrician and/or contractor must maintain periodic inspection of the generator set and electrical devices during inclement weather conditions.

If at any time there is a question of generator set operation suitability during inclement weather, shut down the generator set immediately.

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

WARNING	**Hazardous voltage. Backfeed to the utility system.** **Can cause property damage, severe injury, or death.** If the generator set is used for standby power, install an automatic transfer switch to prevent inadvertent interconnection of standby and normal sources of supply.
	

Grounding electrical equipment. Hazardous voltage will cause severe injury or death. Electrocution is possible whenever electricity is present. Ensure you comply with all applicable codes and standards. Electrically ground the generator set, transfer switch, and related equipment and electrical circuits. Turn off the main circuit breakers of all power sources before servicing the equipment. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

Electrical backfeed to the utility. Hazardous backfeed voltage can cause severe injury or death. Install a transfer switch in standby power installations to prevent the connection of standby and other sources of power. Electrical backfeed into a utility electrical system can cause severe injury or death to utility personnel working on power lines.

4.5 Controller Operation

The controller operation includes several types of starting and stopping functions as detailed below. The controller buttons, lamps, and alarm horn functions are summarized in Figure 36.

There are three primary modes of operation, selected by pressing the respective buttons:

- **OFF**
- **RUN**
- **AUTO** (Standby Mode)

When the OFF button is pressed, the generator set is in OFF or goes to OFF and will not start. When the RUN button is pressed, the generator set starts and runs until the OFF or AUTO button is pressed or until a fault is received. When the AUTO button is pressed, the generator set enters the Standby Mode (STANDBY-RUNNING or STANDBY-OFF depending upon the start signal).

- **OFF.** If the generator set was previously running, pressing the OFF button immediately shuts off the generator set, with no engine cooldown. The generator set remains off and will not respond to a remote start signal.
- **RUN—Local Start.** A single generator set starts. No other generator sets in the system will start (or stop).
- **AUTO—Standby or System Ready.** The generator set is waiting for a start signal. The generator set will start and run when a start signal is received via a remote start, local auto-start, or communications- based start.

  All generator sets in the system (connected by PGEN and in Standby Mode by pressing AUTO) will start when any one of the generator sets receives a start signal.

  Any generator set in the system not in AUTO will not start.

  If Generator Management is on, some generator sets may shut down after a period of time.

  With removal of the start signal, all generator sets will shut down with the appropriate engine cooldown.
- **AUTO-RUN** (Press AUTO and RUN together for a system start signal). 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). 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 affect. Generator sets in the system will enter Standby Mode.

  Note:
  Pressing AUTO and OFF together only stops the generator sets if there are no other system start signals present.

Button Mode	Generator Set Status	Fault Lamp	Alarm Horn	Alarm Silence Button	Alarm Horn Lamp	Controller Display
AUTO	Off	—	Off	—	—	Scrolling Overview Menu Only
	On (or Cranking)	—	Off	—	—	
	Running and then Off	Red	On	—	—	Shutdown Message
			Off	Pressed	Yellow	
OFF/RESET	Off	Yellow	On	—	—	Not In Auto Warning
			Off	Pressed	Yellow	
RUN (unit fails to start)	Off (or Cranking)	Yellow	On	—	—	Not in Auto Warning
			Off	Pressed	Yellow	
	Off	Red	On	—	—	Locked Rotor Shutdown (or other shutdown message)
			Off	Pressed	Yellow	
RUN (unit starts)	Off (or Cranking)	Yellow	On	—	—	Not in Auto Warming
	On		Off	Pressed	Yellow	
	Running and then Off	Red	On	—	—	Shutdown Message
			Off	Pressed	Yellow	

Figure 36 Button Function Summary

Start Signal

A start signal includes the following:

- Remote start signal via contacts 3 and 4. An ATS (used during a power outage, exercise period, etc.) or a remote panel take precedence over all other start signals.
- System Start (AUTO-START). Press AUTO and RUN simultaneously to send a start signal.
- Communications-based start message from SiteTech™ or a CAN-based remote panel.

Hardwired contacts (remote start contacts 3 and 4) have priority over all other start signals. If the remote start contacts are activated, the generator sets in the system that are in AUTO will start and run. If the generator sets were already running, they will remain running but the original source of that start signal will be ignored. The contacts now have control.

Note:
The alarm horn sounds and the Not-In-Auto Warning display appears whenever the generator set is not in the AUTO mode.

Note:
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.

Note:
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. Make cyclic cranking adjustments using SiteTech™ software.

Stop Signal

A stop signal includes the following:

- Removal of start signal via contacts 3 and 4. An ATS (used during a power outage, exercise period, etc.) or a remote panel take precedence over all other start signals.
- System Stop (AUTO-OFF). Press AUTO and OFF simultaneously to send a stop signal to cancel the system start.

  Note:
  This will not do anything if the system start is not active or if the system is receiving a start signal from another source. Press AUTO and OFF on any controller in the system.
- Communications-based stop message from SiteTech™ or a CAN-based remote panel.

Engine Cooldown

Cooldown is a state where the generator is running at no load to allow hot engine components time to cool slowly before the engine is stopped. In paralleling applications, this occurs with the circuit breaker open.

When the generator set is running in AUTO mode (AUTO-RUN), an engine cooldown cycle begins when the remote start input is deactivated. Also, if stopping due to a stop signal, a cooldown cycle begins.

If the Cooldown Override is disabled (OFF) in the Generator Configuration Menu, coolant temperature is ignored. The generator will enter cooldown when the start signal is removed, only if the engine control switch is in AUTO. The engine will run for a period of time equal to the Cooldown Delay parameter setting, regardless of the coolant temperature.

If the Cooldown Override is enabled (ON) in the Generator Configuration Menu, coolant temperature will be considered for cooldown. The generator will enter cooldown when the start signal is removed, only if the engine control switch is in AUTO. The engine will run until the coolant temperature is below the Engine Cooled Down parameter setting, or until the Cooldown Delay has expired.

The cooldown cycle lasts for some predetermined amount of time. The cooldown delay is an adjustable parameter. The Engine Cooled Down temperature is not adjustable.

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 5 minutes to ensure adequate engine cooldown.

4.5.1 Emergency Stop

Use the controller emergency stop switch for immediate emergency shutdown.

The emergency stop switch bypasses the time delay engine cooldown and immediately shuts down the generator set.

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

The controller fault lamp lights and the unit shuts down when the local emergency stop switch activates.

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

1. Investigate and correct the cause of the emergency stop.
2. Reset the controller emergency stop switch by pulling the switch dial outward and/or reset the remote emergency stop switch (if equipped).
3. Press the generator set OFF/RESET button.
4. After resetting all faults using the controller reset procedure in the Controller Resetting section (Following System Shutdown or Warning), press the generator set RUN and/or AUTO button to restart the generator set. The generator set will not crank until the reset procedure completes.

4.5.2 System Status Lamps

The (OFF/RESET-AUTO-RUN) buttons indicate the status condition with an integrated lamp at the button.

The lamp illuminates on the AUTO (automatic start) button indicating the system senses no faults and the unit is ready to start by remote command.

The lamp illuminates on the OFF/RESET button indicating the generator set is stopped.

The lamp illuminates on the RUN button indicating the generator set is cranking or running from a local command or is commanded to run from a local command.

Only one of the three button lamps will illuminate at any given time.

4.5.3 System Fault Warning Lamp with Digital Displays

The system FAULT lamp glows yellow and the alarm horn sounds indicating a warning fault but does not shut down the generator set. The fault lamp illuminates yellow and the alarm horn sounds when the fuel tank level on diesel-fueled models approaches empty. This fault requires an optional low fuel level switch for the lamp to function. See the Controller Resetting section for instructions on resetting a system warning.

When the system warning lamp is on and no message displays, rotate the dial to the Active Events menu. Press the dial to view messages. Rotate the dial to view additional messages. Press the OFF button to return to the main menu. When the system warning continues, it may lead to a fault and cause a system shutdown.

Use the Silence Alarm 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. The alarm horn cannot be silenced unless the button is in the AUTO mode. See the Status and Notice Digital Displays section for more information.

AC Sensing Lost (controller in RUN or AUTO and voltage was never present). The fault lamp illuminates yellow and the alarm horn sounds when the controller does not detect the nominal generator set AC output voltage after crank disconnect.

Auxiliary Input. The fault lamp illuminates yellow and the alarm horn sounds when an auxiliary digital or analog input signals the controller. The digital inputs do not function during the first 30 seconds after startup. Use SiteTech™ software to define inputs as shutdowns or warnings.

Average Current High. The fault lamp illuminates yellow and the alarm horn sounds when the generator set encounters excessive load or a downstream fault. The output breaker trips. The available sustained fault current of the generator set can be obtained from the per-unit transient reactance of the generator set and the system voltage and power.

Average Generator Voltage High. The fault lamp illuminates yellow and the alarm horn sounds when the generator set encounters an over voltage condition. This condition can be caused by a loss of sensing wire, a winding failure, voltage regulator failure, etc. The output breaker trips. The generator may continue to produce excessive voltage until it is shut down.

Average Generator Voltage Low. The fault lamp illuminates yellow and the alarm horn sounds when the generator set encounters an under voltage condition. This condition can be caused by a loss of a diode on the rectifier bridge, sensing problem, a winding failure, voltage regulator failure, etc. The output breaker trips. The generator may continue to produce insufficient voltage until it is shut down.

Battery Charger Fault. The fault lamp illuminates yellow and the alarm horn sounds when the battery charger malfunctions. This fault feature requires an optional battery charger with a malfunction output for the lamp to function.

Battery Charger Communication Loss. The warning fault lamp on the controller illuminates yellow and the alarm horn sounds when CAN communication with the battery charger has been lost. Local display shows either bat1CommLoss or bat2CommLoss.

Note:
bat2CommLoss indicates communication loss for battery charger number 2. *bat2CommLoss* is only relevant for generator sets with more than one battery charger.

Battery Charger Identity Conflict. The warning lamp on the controller illuminates yellow and the alarm horn sounds when there is a CAN address communication error. The battery charger has the same CAN address as another generator set component. To correct a CAN address error, verify the address identification in the harness and power cycle the controller. Local display shows *BatIdErr*.

Battery Charger Parameter Mismatch. The warning lamp on controller illuminates yellow and the alarm horn sounds when the battery charger metering is not in range of the specified parameters. Local display shows *ParMisatch.*

Battery Fault. The warning lamp on controller illuminates yellow and the alarm horn sounds when there is an issue with the battery such as a connection problem or a dead battery. When the temperature compensation sensor is connected, whether active or inactive, and the temperature rises above 60°C (140°F) or below -20°C (-4°F), the battery failure warning will also be displayed indicating that the battery is unable to take charge due to temperature. Absorption timeout will also cause a failure since the battery was unable to accept the expected charge in the time frame given which indicates a potential battery issue. Local display shows *Battery Flt.*

Cabinet Intrusion. The fault lamp illuminates yellow and the alarm horn sounds when the door to the unit was opened.

Common Warning. The fault lamp illuminates yellow and the alarm horn sounds when the controller is signaled by a common warning. Use SiteTech™ software to activate the common warning. The common warning comprises all of the warnings under a single alert.

Critically High Fuel Level (diesel-powered models only). The fault lamp illuminates yellow and the alarm horn sounds when the fuel tank level on diesel models approaches full. This fault requires an optional critical high fuel switch and fuel tank for the lamp to function.

DEF Reagent Concentration Low. The fault lamp illuminates yellow and the alarm horn sounds when the fluid in the DEF tank contains a low concentration of DEF reagent.

DEF Reagent Concentration Sensor Obstruction Fault. The fault lamp illuminates yellow and the alarm horn sounds when there is a malfunction in the DEF quality sensor.

DEF Reagent Concentration Invalid. The fault lamp illuminates yellow and the alarm horn sounds when an invalid DEF concentration is detected. If experiencing this fault, check the harness connections between the DEF tank and the engine, and /or replace DEF in the tank.

Reagent Fluid Type Fault. The fault lamp illuminates yellow and the alarm horn sounds when the fluid in the DEF tank is not DEF.

DEF Reagent Concentration High. The fault lamp illuminates yellow and the alarm horn sounds when the fluid in the DEF tank has a high concentration of DEF reagent.

ECM Diagnostics (Multiple Engine Inputs). The fault lamp illuminates yellow and the alarm horn sounds when ECM diagnostics signals the controller. The specific display will be a brief message or fault code that is engine manufacturer dependant. The engine literature provides the fault code description and further information.

Failure to Synchronize. The fault lamp illuminates yellow and the alarm horn sounds when the generator set does not successfully synchronize to the live bus within the time delay as defined in the synchronizing setup menu. The controller will continue attempting to synchronize to the bus after the time delay expires and the warning occurs. Generator Management will start another generator set if this warning occurs.

Fuel Tank Leak. The fault lamp illuminates yellow and the alarm horn sounds when the fuel tank signals a leak of the inner tank. This fault requires an optional fuel tank leak switch for the lamp to function.

Generator Frequency High. The fault lamp illuminates yellow and the alarm horn sounds when the generator has an overfrequency condition. The output breaker trips. This condition can be caused by various mechanical failures (loss of speed signal to ECU, improperly controlled or inadvertent injection of gaseous fuel etc.).

Generator Frequency Low. The fault lamp illuminates yellow and the alarm horn sounds when the generator has an underfrequency condition. The output breaker trips.

Generator Total Real Power High. The fault lamp illuminates yellow and the alarm horn sounds when the generator encounters excessive load or a downstream fault. The output breaker trips.

Generator Total Real Power Low. The fault lamp illuminates yellow and the alarm horn sounds when the generator is no longer producing power (loss of fuel, bearing failure, fuel system failure, ECU problem, or speed bias connection failure on non-ECM engines). The output breaker trips.

Ground Fault Input. The fault lamp illuminates yellow and the alarm horn sounds when a user-supplied ground fault detector signals the controller.

High Battery Voltage. The fault lamp illuminates yellow and the alarm horn sounds when the battery voltage rises above the preset level for more than 10 seconds. Figure 37 shows high battery voltage specifications. The high battery voltage feature monitors the battery and battery charging system in the generator set operating and off modes.

Engine Electrical System Voltage	High Battery Voltage Range	High Battery Voltage Default Setting
12	13.2-16.2	15
24	26.4-32.4	30

Figure 37 High Battery Voltage Specs

High Coolant Temperature. The fault lamp illuminates yellow and the alarm horn sounds when the engine coolant temperature approaches the shutdown range. The high coolant temperature warning does not function during the preset inhibit time delay period after startup.

High Fail To Close Delay. The fault lamp illuminates yellow and the alarm horn sounds when the circuit breaker did not close within the allocated breaker closure time.

High Fail To Open Delay. The fault lamp illuminates yellow and the alarm horn sounds when the circuit breaker did not open as quickly as the controller expected.

High Fuel Level (diesel-powered models only). The fault lamp illuminates yellow and the alarm horn sounds when the fuel tank level on diesel models approaches near full. This fault requires an optional high fuel switch and fuel tank for the lamp to function.

High Genset System Frequency. The fault lamp illuminates yellow and the alarm horn sounds when another generator set in the paralleling system has a lower system frequency than this generator. The local display shows System Frequency, FMI: High.

High Genset System Voltage. The fault lamp illuminates yellow and the alarm horn sounds when another generator set in the paralleling system has a lower system voltage than this generator set. The local display shows System Voltage, FMI: High.

High Intake Air Temperature. The fault lamp illuminates yellow and the alarm horn sounds when the engine intake air temperature approaches the shutdown range.

High Lube Oil Temperature. The fault lamp illuminates yellow and the alarm horn sounds when the engine high oil temperature approaches the shutdown range.

High Max. Close Attempts The fault lamp illuminates yellow and the alarm horn sounds when the circuit breaker did not close, even after the controller attempted to close it as many times as specified by the max. close attempts.

Invalid Generator Management Enabled. The fault lamp illuminates yellow and the alarm horn sounds when the generator management has been disabled because the generator management configuration of this generator set does not match the generator management configuration of another generator set that is connected to the same PGEN network. The local display shows Generator Management.

Invalid Genset Voltage Phase Connection. The fault lamp illuminates yellow and the alarm horn sounds when another generator set in the paralleling system has a different phase connection than this generator set. The local display shows System Phase.

Low Battery Voltage. The fault lamp illuminates yellow and the alarm horn sounds when the battery voltage drops below a preset level for more than 90 seconds.

Engine Electrical System Voltage	Low Battery Voltage Range	Low Battery Voltage Default Setting
12	9.6-12.6	12
24	19.2-25.2	24

Figure 38 Low Battery Voltage Specs

The low battery voltage feature monitors the battery and battery charging system in the generator set operating and off modes. The controller logic inhibits the low battery voltage warning during the crank cycle.

Low Coolant Temperature. The fault lamp illuminates yellow and the alarm horn sounds when the engine coolant temperature is low. The low coolant temperature warning does not function during the preset inhibit time delay period after startup.

Low Cranking Voltage. The fault lamp illuminates yellow and the alarm horn sounds when the battery voltage drops below 60% of the nominal voltage (12 VDC or 24 VDC) for more than 6 seconds during the crank cycle.

Low Engine Oil Level. The fault lamp illuminates yellow and the alarm horn sounds because of low engine oil level. This fault feature requires an optional low engine oil level sensor for the lamp to function.

Low Fuel Level. The fault lamp illuminates yellow and the alarm horn sounds when the fuel tank level on diesel-fueled models approaches empty. This fault requires an optional low fuel level switch for the lamp to function.

Low Fuel Pressure. The fault lamp illuminates yellow and the alarm horn sounds when low fuel pressure occurs. This fault requires an optional low fuel pressure switch for the lamp to function.

Low Genset System Frequency. The fault lamp illuminates yellow and the alarm horn sounds when another generator set in the paralleling system has a higher system frequency than this generator. The local display shows System Frequency, FMI: Low.

Low Genset System Voltage. The fault lamp illuminates yellow and the alarm horn sounds when another generator set in the paralleling system has a higher system voltage than this generator set. The local display shows System Voltage, FMI: Low.

Low Oil Pressure. The fault lamp illuminates yellow and the alarm horn sounds when the engine oil pressure approaches the shutdown range. The low oil pressure warning does not function during first the 30 seconds after startup.

Not in Auto (Generator Master Control Switches). The fault lamp illuminates yellow and the alarm horn sounds when the generator set button is in the RUN or OFF/RESET mode.

Option Board 2X Communication Loss. The fault lamp illuminates yellow and the alarm horn sounds when the communication with option board 2X (A, B, or C) has been lost.

Reserve Oil Empty. The fault lamp illuminates yellow and the alarm horn sounds when the oil makeup kit level has dropped below a threshold.

Speed Sensor Fault. The fault lamp illuminates yellow and the alarm horn sounds when the speed signal is absent for one second while the generator set runs.

Total Reactive Power Low. The fault lamp illuminates yellow and the alarm horn sounds when the generator set has a loss of field condition due to insufficient reactive load production to support real load. The output breaker trips.

4.5.4 System Fault Shutdown Lamp with Digital Displays

The system FAULT lamp glows red, the alarm horn sounds, and the unit shuts down to indicate a fault shutdown under the following conditions. See the Controller Resetting section for information on resetting a system shutdown.

When the system shutdown lamp is on and no message displays, rotate the dial to the Active Events menu. Press the dial to view messages. Rotate the dial to view additional messages. Press the OFF button to return to the main menu.

Use the Alarm Off 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. The alarm horn cannot be silenced unless the button is in the AUTO mode. See the Status and Notice Digital Displays section for more information.

AC Sensing Lost (controller in AUTO and voltage was previously present). The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the controller does not detect the nominal generator set AC output voltage for more than 3 seconds after crank disconnect.

Alternator Protection. The fault lamp illuminates red and the unit shuts down because of an alternator overload or short circuit. See Appendix B, Alternator Protection for more information.

Auxiliary Input (Shutdown). The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when an auxiliary digital or analog inputs signals the controller. The digital inputs do not function during the first 30 seconds after startup. Use SiteTech™ software to define inputs as shutdowns or warnings.

Common Fault. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the controller is signaled by a common fault. Use SiteTech™ software to activate the common fault shutdown. The common fault comprises of any combination of the fault shutdowns under a single alert.

Coolant Temperature Open Circuit. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the engine coolant temperature sender circuit is open.

ECM Communications Loss. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the ECM communication link is disrupted.

ECM Diagnostics (Multiple Engine Inputs). The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when ECM diagnostics signals the controller. The specific display will be a brief message or fault code that is engine manufacturer dependant. The engine literature provides the fault code description and further information.

ECM Model Mismatch. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the controller detects an error with the ECM model.

Electrical Metering Communication Loss. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the metering to the controller communication link is disrupted.

Emergency Stop. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the local or optional remote emergency stop switch activates.

Fuel Tank Leak. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the fuel tank signals a leak of the inner tank. This fault requires an optional fuel tank leak switch for the lamp to function.

Generator Total Real Power High. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the generator set supplies more than 102% of the rated standby output kW (or 112% of the rated prime power output kW) for more than 60 seconds.

High Coolant Temperature. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down because of high engine coolant temperature. The high coolant temperature shutdown does not function during the preset inhibit time delay period after startup.

Note:
The high engine temperature shutdown function and the low coolant level shutdown function are independent. A low coolant level condition may not activate the high engine temperature switch.

High Engine Speed. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down immediately when the governed frequency on 50 and 60 Hz models exceeds the over speed setting.

High Intake Air Temperature. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down because of high intake air temperature. The shutdown occurs 5 seconds after the engine intake air reaches the temperature shutdown range. The engine intake air temperature shutdown does not function during the first 30 seconds after startup.

High Generator Frequency. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the frequency is above the overfrequency setting. See Figure 39.

Overfrequency Setting Range	Time Delay	Overfrequency Default Setting
102%-140% of nominal	10 sec.	110% of nominal

Figure 39 Overfrequency Specs

High Generator Voltage (Each Phase). The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the voltage exceeds the overvoltage setting for the preset time delay period. See Figure 40 for overvoltage specifications.

Note:
Overvoltage can damage sensitive equipment in less than one second. Install separate overvoltage protection on online equipment requiring faster than 2-second shutdown.

Overfrequency Setting Range	Time Delay Range	Overvoltage Default Setting
105%-135% of nominal	2-10 sec.	120% at 2 sec.

Figure 40 Overvoltage Specs

High Lube Oil Temperature. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down because of high engine oil temperature. The shutdown occurs 5 seconds after the engine oil reaches the temperature shutdown range. The high engine oil temperature shutdown does not function during the first 30 seconds after startup.

Locked Rotor (failed to crank). If none of the speed sensing inputs show engine rotation within the preset time delay of initiating engine cranking, the ignition and crank circuits turn off for the preset period and the cycle repeats. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down after the second cycle of the preset period of cranking.

Low Coolant Level. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down because of low coolant level. Shutdown occurs 5 seconds after low coolant level is detected.

Low Engine Oil Level. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down because of low engine oil level. This fault feature requires an optional low engine oil level sensor for the lamp to function.

Low Engine Speed. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down immediately when the governed frequency on 50 and 60 Hz models drops below the under speed setting.

Low Fuel Level (diesel-powered models only). The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the fuel tank level on diesel-fueled models approaches empty. This fault requires an optional low fuel level switch for the lamp to function.

Low Fuel Pressure. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when low fuel pressure occurs. This fault requires an optional low fuel pressure switch for the lamp to function.

Low Generator Frequency. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the frequency drops below the underfrequency setting. See Figure 41 for underfrequency specifications.

Underfreq. Setting Range	Time Delay	Underfrequency Default Setting
80%-95% of nominal	10 sec. (short term) 60 sec. (long term)	90% of nominal

Figure 41 Underfrequency Specs

Low Generator Voltage (Each Phase). The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the voltage drops below the undervoltage setting for the time delay period. See Figure 42 for undervoltage specifications.

Undervoltage Setting Range	Time Delay Range	Undervoltage Default Setting
70%-95% of nominal	5-30 sec.	80% of nominal at 10 sec.

Figure 42 Undervoltage Specs

Low Oil Pressure. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down because of low oil pressure. The shutdown occurs 5 seconds after the low pressure condition is detected. The low oil pressure shutdown does not function during the first the 30 seconds after startup.

Max. Alternator Current Low. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when Alternator Protection Configuration in the personality profile is not correct. If the settings are correct for the application, the controller may need a new or updated personality profile. Consult your local authorized distributor.

Oil Pressure Open Circuit. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the engine oil pressure sender circuit is open for more than 5 seconds.

Overcrank. The fault lamp illuminates red, the alarm horn sounds, and cranking stops when the unit does not start within the defined cranking period. See note at the end of Engine Cooldown in the Controller Operation section for cyclic crank specifications.

Run Relay Coil Overload. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the current draw on the 70 wire from the controller has exceeded 40 amps or has exceeded 10 amps for at least 10 ms.

Starter Relay Coil Overload. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the current draw on the 71 wire from the controller has exceeded 40 amps or has exceeded 10 amps for at least 10 ms.

Trip to Shutdown Delay. The fault lamp illuminates red, the alarm horn sounds, and the unit shuts down when the generator is stopped if the circuit breaker has tripped for a Protective Relay function, and the trip to shutdown time delay has expired. This delay allows mitigation of problem conditions without engine shutdown. If the delay expires, it is presumed no successful action was taken in the allotted time.

4.5.5 Fault, Notice, and Status Displays

Warnings and shutdown faults appear on the digital display under the Active Events menu and become part of the event history. Beyond the warnings and shutdowns there are several events which also appear on the digital display under the Active Events menu. Notice is an alert that is not part of the event history. Status is an event that is only viewable in SiteTech™.

The controller allows a selected number of changes by the user for setting up the controller application which are covered in this section.

Alarm Horn Silence. This notice message indicates whether the alarm horn can be silenced in any button mode (OFF/RESET-AUTO-RUN) or requires the AUTO button be pressed first compliant per NFPA 110. Use SiteTech™ software to change this setting. See the Controller Resetting section for information on resetting the system.

The local display shows *Alarm Silence: Always* when the alarm horn can be silenced with the master control buttons in any position (default setting).

The local display shows *Alarm Silence: Auto Only* when the alarm horn can be silenced only when in the AUTO mode. The correct reset sequence requires pressing the OFF/RESET button, then pressing the AUTO button, and then pressing the ALARM SILENCE button.

Close Breaker. This notice message indicates that the controller is attempting to close the circuit breaker (a close command is being sent to the circuit breaker). This notice only appears in paralleling applications (where the bus sensing is connected to the bus side of the paralleling breaker).

Common Fault. This notice is defined in the System Fault Shutdown Lamp with Digital Displays section.

Common Warning. This notice is defined in the System Fault Warning Lamp with Digital Displays section.

Contactor. This notice message indicates that the controller wants to be connected to the paralleling bus. If a contactor is used for paralleling, this output controls it. This notice only appears in paralleling applications (where the bus sensing is connected to the bus side of the paralleling breaker).

Emergency Power System (EPS) Supplying Load. This notice message indicates when the generator set supplies more than 1% of the rated standby output current.

Engine Cooldown (Delay) Active. This notice message indicates that the delay for engine cooldown is active where the generator set will continue to run after the OFF/RESET button is pressed. The unit will continue to run until the time delay times out.

Engine Load Indication. This notice message indicates that there is a load connected to the generator set.

Engine Start Aid Active. This notice message indicates that the start aid is active and will energize an engine equipped preheat or ether system during the crank cycle. Use SiteTech^{TM} software to set up this feature.

Engine Started (SiteTech™ only). This status indicates that the generator set start circuit is closed allowing the engine to crank and run.

Engine Stopped (SiteTech™ only). This status indicates that the generator set start circuit is open causing the engine to shut down.

Generator Running. This notice indicates that the generator set has started and is running.

Load Priority # Shed. This notice message indicates the digital output for load priority # (1, 2, 3, 4, 5, or 6) shed is active (contacts closed), indicating the 1st, 2nd, 3rd, 4th, 5th, or 6th priority load shed has been activated.

Remote Start (SiteTech™ only). This status indicates that the generator set start circuit was closed from a remote location allowing the engine to crank and run. The remote location is typically a set of contacts on a transfer switch or remote start switch.

Remove Breaker Trip. This notice message indicates that the controller considers the breaker to be safe to close. The breaker may be closed or preparing to close when this notice is displayed. This notice only appears in paralleling applications (where the bus sensing is connected to the bus side of the paralleling breaker).

Run Button Acknowledged. This notice message indicates that the RUN button on the controller has been pushed.

Stationary Regeneration Aborted (SiteTech™ only). This status indicates stationary cleaning was interrupted by one of the following: user cancelled by pressing off, user cancelled by setting cleaning request to NO, or detection of remote start.

Stationary Regeneration Completed (SiteTech™ only). This status indicates a user initiated stationary cleaning of the Tier 4 exhaust system equipment and that the cleaning was performed successfully.

Stationary Regeneration Failed (SiteTech™ only). This status indicates that the stationary cleaning of the Tier 4 exhaust system equipment was initiated but failed to start (as indicated by the ECM) within the allotted time or failed to complete within the allotted time.

Stationary Regeneration Started (SiteTech™ only). The status indicates that the stationary cleaning of the Tier 4 exhaust system equipment was initiated by a user setting the cleaning request parameter to YES.

System Ready. This notice indicates that the generator set is in the AUTO mode and available to start if the start circuit is closed.

4.5.6 Controller Resetting (Following System Shutdown or Warning)

Use the following procedure to restart the generator set after a system shutdown or to clear a warning lamp condition. 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 the OFF/RESET button.
4. Start the generator set by pressing the generator set OFF/RESET button and then press the RUN button.

   When equipped, the remote annunciator alarm horn sounds. Press the ALARM SILENCE/LAMP TEST button to stop the alarm horn. The alarm silenced lamp turns on if the alarm is silenced.
5. Test operate the generator set to verify correction of the shutdown cause by pressing the RUN button.
6. Press the generator set OFF/RESET button to stop the generator set.
7. Press the generator set AUTO button.
8. Silence the controller alarm horn by pressing the ALARM SILENCE button.
9. Reconnect the generator set load via the line circuit breaker or automatic transfer switch.
10. When equipped, the remote annunciator alarm horn sounds. Press the ALARM SILENCE/LAMP TEST button to stop the alarm horn. The alarm silenced lamp turns on if the alarm is silenced.

4.6 Menu Displays

Use the Menu Summary List and Figure 43 to Figure 48 after reading and understanding the features of the pushbutton/rotary selector dial. See the Digital Display section.

The Menu Summary List and Figure 43 to Figure 48 provide a reference to the digital display data. Some digital display data may not be identical to your display due to generator set application differences. The closed bullet items represent main level data and the open bullet items are sub-level data. The Menu Summary List indicates items that are user selectable. Some menu selections are password protected. **See Appendix C Specifications for information on how to access the edit mode requiring a password.** Use SiteTech™ software for changing other programmable information.

Menu Summary List (Legend: ● First level submenu, ○ second level submenu, ◊ third level submenu)

Metering Menu

- **Generator Metering**
  - L1-L2 VOLTS: ###V
  - L2-L3 VOLTS: ###V
  - L3-L1 VOLTS: ###V
  - AVG GEN VOLTAGE L-L: ###V
  - GEN FREQUENCY: ##.#Hz
  - L1-L0 VOLTS: ###V
  - L2-L0 VOLTS: ###V
  - L3-L0 VOLTS: ###V
  - AVG GEN VOLTAGE L-N: ###V
  - GEN FREQUENCY: ##.#Hz
  - L1 CURRENT: ###A
  - L2 CURRENT: ###A
  - L3 CURRENT: ###A
  - AVG CURRENT: ###A
  - GEN FREQUENCY: ##.#Hz
  - L1 POWER: ####W
  - L2 POWER: ####W
  - L3 POWER: ####W
  - TOTAL POWER: ####.#kW
  - GEN % OF RATED kW: ###%
  - L1 REACTIVE POWER: ####VAR
  - L2 REACTIVE POWER: ####VAR
  - L3 REACTIVE POWER: ####VAR
  - TOTAL REACTIVE POWER: ####VAR
  - L1 APPARENT POWER: ####VA
  - L2 APPARENT POWER: ####VA
  - L3 APPARENT POWER: ####VA
  - TOTAL APPARENT PWR: ####VA
  - GEN % OF RATED kVA: ###%
  - L1 PF: #.##
  - L2 PF: #.##
  - L3 PF: #.##
  - TOTAL PF: #.##
  - GEN PHASE ROTATION: ###
- **Engine Metering**
  - ENGINE SPEED: ####RPM
  - ECM BATTERY VOLTAGE: ##.#VDC
  - GEN BATTERY VOLTAGE: ##.#VDC
  - GENSET CONTROLLER TEMP: ###°F
  - OIL PRESSURE: ###PSI
  - OIL TEMPERATURE: ###°F
  - COOLANT TEMPERATURE: ###°F
  - COOLANT PRESSURE: ###PSI
  - FUEL LEVEL: ###%
  - FUEL PRESSURE: ###PSI

Metering Menu (Continued)

  - FUEL TEMPERATURE: ###°F
  - FUEL RATE: ###GAL/h (*shown if available from ECM*)
  - FUEL USED LAST RUN: ###GAL (*shown if available from ECM)*
  - CRANKCASE PRESSURE: ###PSI
  - INTAKE AIR PRESSURE: ###PSI
  - INTAKE AIR TEMP: ###°F
- **Battery X Meter**
  - STATUS: (IDLING/STANDBY/ CHARGING/ BATT FAIL/CHRGR FAIL/ NOT AVAILABLE)
  - OUTPUT VOLTAGE: ##.#VDC
  - OUTPUT CURRENT: ##.#A
  - CHARGER STATE: IDLE/BULK/ ABSORB/FLOAT/EQUAL/ REFRESH/ RECOVER/NA
  - CHARGER TEMP: ###°F
  - REDUCED OUTPUT ACTIVE: YES/NO
  - TEMP COMPENSATION ACTIVE: YES/NO
  - SOFTWARE VER.: XXXXXXXXXXX
- **Overview**
  - GENERATOR STATUS
    - ◊ AVG GEN VOLTAGE L-L: ##V
    - ◊ AVG CURRENT: ###A
    - ◊ GEN FREQUENCY: ##.#Hz
  - ENGINE STATUS
    - ◊ COOLANT TEMPERATURE: ###°F
    - ◊ OIL PRESSURE: ###PSI
    - ◊ GEN BATTERY VOLTAGE: ##.#V
  - SYSTEM STATUS
    - ◊ FUEL PRESSURE: ###PSI
    - ◊ TOTAL POWER: ####kW
    - ◊ TOTAL RUN TIME: #####.#hrs
- **Paralleling Metering**
  - CONNECTED TO BUS: TRUE/FALSE
  - AVG BUS VOLTAGE L-L: ###.#V
  - AVG GEN VOLTAGE L-L: ###.#V
  - BUS FREQUENCY: ##.##Hz
  - GEN FREQUENCY: ##.##Hz
  - BUS TOTAL POWER: #####.#kW
  - BUS % OF RATED kW: ###%
  - BUS % OF RATED kVAR: ###%

Generator Information Menu

- **Generator Information**
  - TOTAL RUN TIME: #####.#hrs
  - HOURS LOADED: #####hrs
  - HOURS UNLOADED: #####hrs
  - kW HOURS: #####kWh
  - OPERATING HOURS: ######hrs
  - TOTAL # OF STARTS: ########
  - LAST MAINTENANCE: ##/##/####
  - OP HRS SINCE MAINT: ####hrs

Generator Information Menu (Continued)

  - STARTS SINCE MAINT: ###
  - ENG HRS SINCE MAINT: ####hrs
  - LOADED SINCE MAINT: ####hrs
  - UNLOADED SINCE MAINT: ####hrs
  - kW HRS SINCE MAINT: ####kWh
  - RESET MAINT RECORDS: YES/NO*
  - LAST START: ##/##/####
  - LAST RUN LENGTH: ####hrs
  - CTRL SERIAL #: XXXXXXXXX
  - SOFTWARE VER.: XXXXXXXXX
  - ECM SERIAL #: XXXXXXXXX
  - GENSET MODEL #: XXXXXXXXX
  - GENSET SPEC. #: XXXXXXXXX
  - GENSET SERIAL #: XXXXXXXXX
  - ALT. PART #: XXXXXXXXX
  - ENGINE PART #: XXXXXXXXX
  - ENGINE MODEL #: XXXXXXXXX
  - ENGINE SERIAL #: XXXXXXXXX
- **Event History**
  - GENERATOR EVENT HISTORY ##/##/#### (Date) ##:##.##XX (Time) DEVICE EVENT: ### STATUS/FAULT/NOTICE/ WARNING EVENT X OF Y
  - ENGINE EVENT LOG SPN: #### FMI: ## OCCURRENCE COUNT: ### EVENT X OF Y
- **Configuration**
  - GENERATOR CONFIGURATION
    - ◊ OPERATING MODE: (STANDBY/PRIME)
    - ◊ APPLICATION TYPE: (NONE/MARINE/ MOBILE/STANDBY/PRIME)
    - ◊ SYSTEM VOLTAGE L-L: ###V*
    - ◊ SYSTEM FREQUENCY: ##.#Hz*
    - ◊ SYSTEM PHASE: (SINGLE/SINGLE DOG/THREE-WYE/THREE-DELTA)*
    - ◊ RATED ENGINE SPEED: ####RPM
    - ◊ ENGINE SPEED ADJUSTMENT: *†
    - ◊ ADJUSTED ENGINE RUN SPEED:####RPM
    - ◊ kW RATING: ####kW
    - ◊ kVA RATING: #####kVA

***** User-Defined (changeable) Menu Displays. Use SiteTech™ software to change other settings including User-Defined Menu Displays.

Generator Information Menu (Continued)

- ◊ RATED CURRENT: ###A
- ◊ BATTERY VOLTAGE: ##VDC*
- ◊ POWER ECM: ON/OFF*
- ◊ ENGINE START DELAY: ##s*
- ◊ STARTING AID DELAY: ##s*
- ◊ CRANK ON DELAY: ##s*
- ◊ CRANK PAUSE DELAY: ##s*
- ◊ ENGINE WARMED UP: ###°F
- ◊ ENGINE COOLED DOWN: ###°F
- ◊ COOLDOWN DELAY: ##s*
- ◊ COOLDOWN OVERRIDE: ON/OFF*
- ◊ FUEL TYPE: (NATURAL GAS/LP/GASOLINE/ DIESEL/ UNKNOWN)*
- ◊ CRANK CYCLES LIMIT:##*
- ◊ NFPA DEFAULTS: ON/OFF*
- ◊ EMERGENCY BATTLEMODE: ON/OFF*

○ PROTECTION CONFIGURATION

- ◊ OVERVOLTAGE: ###%*
- ◊ OVERVOLTAGE: ###.#V
- ◊ OVERVOLTAGE DELAY: ##s*
- ◊ UNDERVOLTAGE: ##%*‡
- ◊ UNDERVOLTAGE: ##.#V
- ◊ UNDERVOLTAGE DELAY: ##s*
- ◊ OVERFREQUENCY: ##%*
- ◊ OVERFREQUENCY: ##.#Hz
- ◊ UNDERFREQUENCY: ##%*
- ◊ UNDERFREQUENCY: ##.#Hz
- ◊ OVERSPEED: ##.#%*
- ◊ OVERSPEED: ##.#Hz
- ◊ OVERSPEED: ####RPM
- ◊ LOW BATTERY VOLTAGE: ###%*
- ◊ LOW BATTERY VOLTAGE: ##.#VDC
- ◊ HIGH BATTERY VOLTAGE: ###%*
- ◊ HIGH BATTERY VOLTAGE: ##.#VDC

○ BATT X BASIC CONFIG

- ◊ BATTERY TOPOLOGY: (DEFAULT/ VRLA/ AGM/GEL/NiCd*
- ◊ CHARGER SYSTEM VOLTAGE: 12VDC/24VDC
- ◊ AUTO EQUALIZE ENABLED: ON/OFF*
- ◊ TEMP COMPENSATION ENABLED: ON/OFF*
- ◊ ABSORPTION TERMINATION: #.##A (+/- 0.05)*

Generator Information Menu (Continued)

- ◊ BULK VOLTAGE: ##.##VDC (+/-0.05)*
- ◊ ABSORPTION VOLTAGE: ##.##VDC (+/-0.05) *
- ◊ FLOAT VOLTAGE: ##.##VDC (+/-0.05)*
- ◊ MANUAL EQUALIZE ACTIVE: YES/NO*
- ◊ CUSTOM PROFILE ENABLED: ON/OFF*
- ◊ TEMP COMPENSATION SLOPE: ##mV/C*
- ◊ EQUALIZE VOLTAGE: ##.##VDC (+/-0.05)*
- ◊ MAX ABSORPTION TIME: ###MIN*
- ◊ MAX BULK TIME: ###MIN*
- ◊ BULK STATE RETURN: ##.##V (+/-0.05)*

• **Voltage Regulation**

- ○ AVG GEN VOLTAGE L-L: ###.#V
- ○ VOLTAGE ADJUST: ###.#V*
- ○ TARGET VOLTAGE: ###.#V
- ○ L1-L2 VOLTS: ###.#V
- ○ L2-L3 VOLTS: ###.#V
- ○ L3-L1 VOLTS: ###.#V
- ○ GEN FREQUENCY: ##.#Hz
- ○ V/Hz SETPOINT: ##.#Hz*
- ○ V/Hz SLOPE: ##%/Hz*
- ○ VOLT DROOP AT 100% kVAR: ##.#%*
- ○ VOLTAGE GAIN ADJUST: ###*
- ○ START UP RAMP RATE: ###.#%/s*
- ○ RESET REG. DEFAULTS:YES/NO*

• **Voltage Selector Switch**

○ VOLT SELECT SWITCH

- ◊ PRESENT POSITION: #
- ◊ SYSTEM VOLTAGE L- L: ### V
- ◊ SYSTEM FREQUENCY: ##.# Hz
- ◊ SYSTEM PHASE: ###
- ◊ kW RATING: ## kW
- ◊ MAX POSITIONS: #
- ◊ POS. 1 VOLTS: ###
- ◊ POS. 1 FREQUENCY: ## Hz
- ◊ POS. 1 PHASE: ###
- ◊ POS. 2 VOLTS: ###
- ◊ POS. 2 FREQUENCY: ## Hz
- ◊ POS. 2 PHASE: ###
- ◊ POS. 3 VOLTS: ###
- ◊ POS. 3 FREQUENCY: ## Hz
- ◊ POS. 3 PHASE: ###

• **Paralleling Operation**

○ PARALLELING SETUP

- ◊ DEAD BUS LEVEL: ##.#%*
- ◊ VOLTAGE OK PICKUP: ##.#%*
- ◊ VOLTAGE OK DROPOUT: ##.#%*
- ◊ FREQUENCY OK PICKUP: ##.#Hz*
- ◊ FREQUENCY OK DROPOUT: ##.#Hz*
- ◊ VOLTS-Hz OK DELAY: ##.#s*
- ◊ FIRST ON DELAY: ##.#s*
- ◊ FAIL TO OPEN DELAY: ##s*
- ◊ FAIL TO CLOSE DELAY: ##s*
- ◊ RECLOSE DELAY: ##.#s*

Generator Information Menu (Continued)

- ◊ MAX CLOSE ATTEMPTS: ###*
- ◊ CB CRNT FAULT LIMIT: ###.#%*
- ◊ CB CRNT FAULT DELAY: ##.#s*
- ◊ CB PHASE FAULT LIMIT: ##.#_ *
- ◊ CB PHASE FAULT DELAY: ##.#s*
- ◊ kW RAMP RATE: ##.#%/s*
- ◊ kW DISCONNECT LEVEL: ##.#%*
- ◊ TRIMS ENABLE: ON/OFF*
- ◊ LOAD ENABLE: ON/OFF*
- ◊ SYSTEM LOAD CONTROL: ON/OFF*
- ◊ SYSTEM SYNC CONTROL: ON/OFF*
- ◊ STAND ALONE MODE: ON/OFF*
- ◊ SYNC MODE IN AUTO: (INVALID/OFF/PASSIVE/ CHECK/ ACTIVE/DEAD FIELD)*
- ◊ SYNC MODE IN RUN: (INVALID/OFF/PASSIVE/ CHECK/ ACTIVE/DEAD FIELD)*

○ SYNCHRONIZING SETUP

- ◊ SYNC MODE IN RUN: (INVALID/OFF/PASSIVE/ CHECK/ ACTIVE/DEAD FIELD)*
- ◊ SYNC MODE IN AUTO: (INVALID/OFF/PASSIVE/ CHECK/ ACTIVE/DEAD FIELD)*
- ◊ CONNECTED TO BUS: TRUE/FALSE
- ◊ VOLTS-Hz OK: TRUE/FALSE
- ◊ IN SYNC: TRUE/FALSE
- ◊ VOLTAGE MATCHED: TRUE/FALSE
- ◊ VOLTAGE MATCH WINDOW: ##.#%*
- ◊ AVG BUS VOLTAGE L-L: ###.#V
- ◊ AVG GEN VOLTAGE L-L: ###.#V
- ◊ VOLTAGE MATCH P GAIN: ##.##*
- ◊ VOLTAGE MATCH I GAIN: ##.##*
- ◊ VOLTAGE MATCH D GAIN: ##.##*
- ◊ VOLTAGE BIAS: ###.##
- ◊ FREQUENCY MATCHED: TRUE/FALSE
- ◊ FREQUENCY WINDOW: #.#Hz*
- ◊ BUS FREQUENCY: ##.##Hz
- ◊ GEN FREQUENCY: ##.##Hz
- ◊ FREQ MATCH P GAIN:##.##*
- ◊ FREQ MATCH I GAIN: ##.##*
- ◊ FREQ MATCH D GAIN:##.##*
- ◊ SPEED BIAS: ###.##
- ◊ PHASE MATCHED: TRUE/FALSE

***** User-Defined (changeable) Menu Displays. Use SiteTech™ software to change other settings including User-Defined Menu Displays.

Generator Information Menu (Continued)

- ◊ PHASE MATCH WINDOW: ##.#°*
- ◊ PHASE DIFFERENCE: ###.#°
- ◊ PHASE MATCH P GAIN: ##.##*
- ◊ PHASE MATCH I GAIN: ##.##*
- ◊ PHASE MATCH D GAIN: ##.##*
- ◊ SPEED BIAS: ###.##
- ◊ DWELL TIME: ##.#s
- ◊ DWELL TIME REMAINING: ##.#s
- ◊ FAIL TO SYNC TIME: ####s*
- ◊ SYNC TIME REMAINING: ####s
- ◊ BUS PHASE ROTATION: DISABLED/A-B-C/C-B-A
- ◊ GEN PHASE ROTATION: DISABLED/A-B-C/C-B-A

○ SHARING SETUP

- ◊ BUS % OF RATED kW: ###.##%
- ◊ GEN % OF RATED kW: ###.##%
- ◊ kW SHARING P GAIN: ##.##*
- ◊ kW SHARING I GAIN: ##.##*
- ◊ kW SHARING D GAIN: ##.##*
- ◊ SPEED BIAS: ###.##
- ◊ SYSTEM FREQUENCY: ##.#Hz
- ◊ GEN FREQUENCY: ##.#Hz
- ◊ FREQ TRIM P GAIN: ##.##*
- ◊ FREQ TRIM I GAIN: ##.##*
- ◊ FREQ TRIM D GAIN: ##.##*
- ◊ SPEED BIAS: ###.##
- ◊ FREQ DROOP AT 100% kW: ##.#%*
- ◊ BUS % OF RATED kVAR: ###.##%
- ◊ GEN % OF RATED kVAR: ###.##%
- ◊ kVAR SHARING P GAIN: ##.##*
- ◊ kVAR SHARING I GAIN: ##.##*
- ◊ kVAR SHARING D GAIN: ##.##*
- ◊ VOLTAGE BIAS: ###.##
- ◊ SYSTEM VOLTAGE L-L: ###.#V
- ◊ AVG GEN VOLTAGE L-L: ###.#V
- ◊ VOLT TRIM P GAIN: ##.##*
- ◊ VOLT TRIM I GAIN: ##.##*
- ◊ VOLT TRIM D GAIN: ##.##*
- ◊ VOLTAGE BIAS: ###.##
- ◊ VOLT DROOP AT 100% kVAR: ##.#%*

○ PROTECTIVE RELAY SETUP

- ◊ OVER POWER TRIP: ###.#%*
- ◊ OVER POWER DELAY: ##.#s*§
- ◊ REVERSE POWER TRIP: ###.#%*
- ◊ REVERSE POWER DELAY: ##.#s*
- ◊ OVER VOLTAGE TRIP: ###.#%*
- ◊ OVER VOLTAGE DELAY: ##.#s*
- ◊ UNDER VOLTAGE TRIP: ###.#%*
- ◊ UNDER VOLTAGE DELAY: ##.#s*
- ◊ OVER FREQ TRIP: ###.#%*
- ◊ OVER FREQ DELAY: ##.#s*
- ◊ UNDER FREQ TRIP: ###.#%*
- ◊ UNDER FREQ DELAY: ##.#s*
- ◊ REVERSE VAR TRIP: ###.#%*
- ◊ REVERSE VAR DELAY: ##.#s*
- ◊ OVER CURRENT TRIP: ###.#%*
- ◊ OVER CURRENT DELAY: ##.#s*
- ◊ TRIP TO SHTDWN DELAY: #####s*

○ GENERATOR MANAGEMENT

- ◊ GEN MANAGEMENT MODE: (INVALID/MANUAL FIXED/RUN TIME/FUEL LEVEL)*
- ◊ GEN MANAGEMENT: ON/OFF*
- ◊ GEN MANAGEMENT ORDER: *#* will revert to previous setting in run time or fuel level mode.*
- ◊ START CAPACITY: ###.#%*
- ◊ START DELAY: ####s*
- ◊ STOP CAPACITY: ###.#%*
- ◊ STOP DELAY: ####s*
- ◊ TOTAL BUS CAPACITY: #####kW
- ◊ BUS TOTAL POWER: #####kW
- ◊ START kW: #####kW
- ◊ STOP kW: #####kW
- ◊ START ACCUMULATOR: #####
- ◊ STOP ACCUMULATOR: #####
- ◊ RUN TIME THRESHOLD: ###.#hrs* *only if in Run Time Management*
- ◊ TOTAL RUN TIME: #######.#hrs
- ◊ FUEL LEVEL THRESHOLD: *##.#%* only if in Fuel Level Management*
- ◊ FUEL LEVEL: ###.#%
- ◊ STABLE DELAY: ####s*
- ◊ MINIMUM GENS ONLINE: ##*
- ◊ MIN LOADS ADDED: ##*
- ◊ STOPPED BY GEN MGMT: TRUE/FALSE

○ LOAD CONTROL

- ◊ GEN MAX % CAP: ###.#%*
- ◊ GEN OVERLOAD %: ###.#%*

- **Emissions Information (selected models only)**

○ EMISSIONS

- ◊ DEF (DIESEL EXHAUST FLUID) LEVEL: ###.#%
- ◊ EXHAUST SYSTEM REGENERATION: NOT NEEDED, NEEDED LOW, NEEDED MODERATE, NEEDED HIGH, NEEDED VERY HIGH, NEEDED SERVICE ONLY
- ◊ SOOT LEVEL: ###%
- ◊ ASH LEVEL: ###%
- ◊ EXHAUST OUTLET TEMPERATURE: ####°F/°C
- ◊ TIME SINCE REGENERATION: #######:##:##
- ◊ CLEANING STATUS: ENABLED, USER SWITCH, LOW EXHAUST TEMP, or SYSTEM FAULT
- ◊ PREVENT ACTIVE REGENERATION: YES/NO (PASSWORD PROTECTED) (DEFAULTS BACK TO NO WHEN REQUEST REGENERATION IS YES)
- ◊ REQUEST REGENERATION: YES/NO

○ NOTIFICATIONS

- ◊ HIGH EXHAUST TEMPERATURE
- ◊ SYSTEM ISSUE
- ◊ LOW DEF (DIESEL EXHAUST FLUID)
- ◊ CLEANING DISABLED BY USER
- ◊ CLEANING NEEDED

Controller Configuration Menu

- **Controller Configuration**
  - ○ LANGUAGE: English*
  - ○ UNITS: Metric/English*
  - ○ TIME FORMAT: Hr 12/Hr 24*
  - ○ DATE FORMAT: Month Date Year/Date Month Year*
  - ○ DATE: ##/##/####*
  - ○ TIME: ##:## XM*
  - ○ CONTRAST: ###*
  - ○ ALARM SILENCE: ALWAYS/AUTO ONLY*
- **Communication Setup**
  - ○ MODBUS BAUD RATE: OFF/9600 b/s/ 19200 b/s/38400 b/s/57600 b/s/ 115200 b/s*
  - ○ MODBUS ADDRESS: ##*
  - ○ PGEN BAUD RATE: OFF/9600 b/s/ 19200 b/s/38400 b/s/57600 b/s/ 115200 b/s
  - ○ PGEN NODE ID: ##
  - ○ PGEN NODES ONLINE: ##
  - ○ PGEN NODES OFFLINE: ##
- **Calibration**

  When the line is highlighted, hold the knob down to enable the calibration capability.
  - ○ GEN L1-L0 VOLTS: ###.#V*
  - ○ GEN L2-L0 VOLTS: ###.#V*
  - ○ GEN L3-L0 VOLTS: ###.#V*
  - ○ GEN L1-L2 VOLTS: ###.#V*

* User-Defined (changeable) Menu Displays. Use SiteTech™ software to change other settings including User-Defined Menu Displays.

Controller Configuration Menu Continued

- GEN L2-L3 VOLTS: ###.#V*
- GEN L3-L1 VOLTS: ###.#V*
- GEN L1 CURRENT: ###.#A*
- GEN L2 CURRENT: ###.#A*
- GEN L3 CURRENT: ###.#A*
- BUS L1-L2 VOLTS: ###.#V*
- BUS L2-L3 VOLTS: ###.#V*
- BUS L3-L1 VOLTS: ###.#V*
- RESET GEN VOLT METER: YES/NO*
- RESET GEN AMP METER: YES/NO*
- RESET BUS VOLT METER: YES/NO*
- RESET ALL METERS: YES/NO*

I/O Menu

- **Resistive Input**

Analog Input 0:1
Analog Input 0:2
Analog Input 0:3
Analog Input 0:4
Analog Input 0:5
Analog Input 0:6

- DESCRIPTION: (*function by default unless modified via SiteTech)*
- MEASUREMENT: ###.#Ohms
- EVENT: *
- INPUT ENABLED: ON/OFF*
- SENSOR TYPE: *[**]
- LOW PROTECTIVE INHIBIT: ##s*
- LOW WARNING: ON/OFF*
- LOW WARNING LIMIT: *
- LOW WARNING DELAY: ##s*
- LOW SHUTDOWN: ON/OFF*
- LOW SHUTDOWN LIMIT: *
- LOW SHUTDOWN DELAY: ##s*
- HIGH PROTECTIVE INHIBIT: ##s*
- HIGH WARNING: ON/OFF*
- HIGH WARNING LIMIT: *
- HIGH WARNING DELAY: ##s*
- HIGH SHUTDOWN: ON/OFF*
- HIGH SHUTDOWN LIMIT: *
- HIGH SHUTDOWN DELAY: ##s*
- I/O BOARD NUMBER: X

- **Digital Input**

Digital Input 0:1
Digital Input 0:2
Digital Input 0:3
Digital Input 0:4
Digital Input 0:5
Digital Input 0:6

- DESCRIPTION: (*function by default unless modified via SiteTech)*
- STATUS: ACTIVE/INACTIVE
- FUNCTION: *
- EVENT: *
- LOGIC: ACTIVE ON/ACTIVE OFF *
- ENABLED: ON/OFF*
- INHIBIT TIME: ##s*

I/O Menu (Continued)

- DELAY TIME: ##s*
- I/O BOARD NUMBER: X

- **Digital Output**

Digital Output 0:1
Digital Output 0:2
Digital Output 0:3
Digital Output 0:4
Digital Output 1:1
(**Note**:
Only displayed if the 15-Relay Dry Contact Kit is installed.)

- DESCRIPTION: *(function by default unless modified via SiteTech)*
- STATUS: ACTIVE/INACTIVE
- FUNCTION: *
- EVENT: *
- LOGIC: ACTIVE ON/ACTIVE OFF*

Active Events Menu

Rotate the dial to view Active Events:
Warnings
Shutdowns
Statuses
Notices

See the System Fault Warning Lamp with Digital Displays, System Fault Shutdown Lamp With Digital Displays, and Fault, Notice, and Status Displays sections for descriptions.

Press the OFF button to return to the main menu.

* User-Defined (changeable) Menu Displays. Use SiteTech™ software to change other settings including User-Defined Menu Displays.

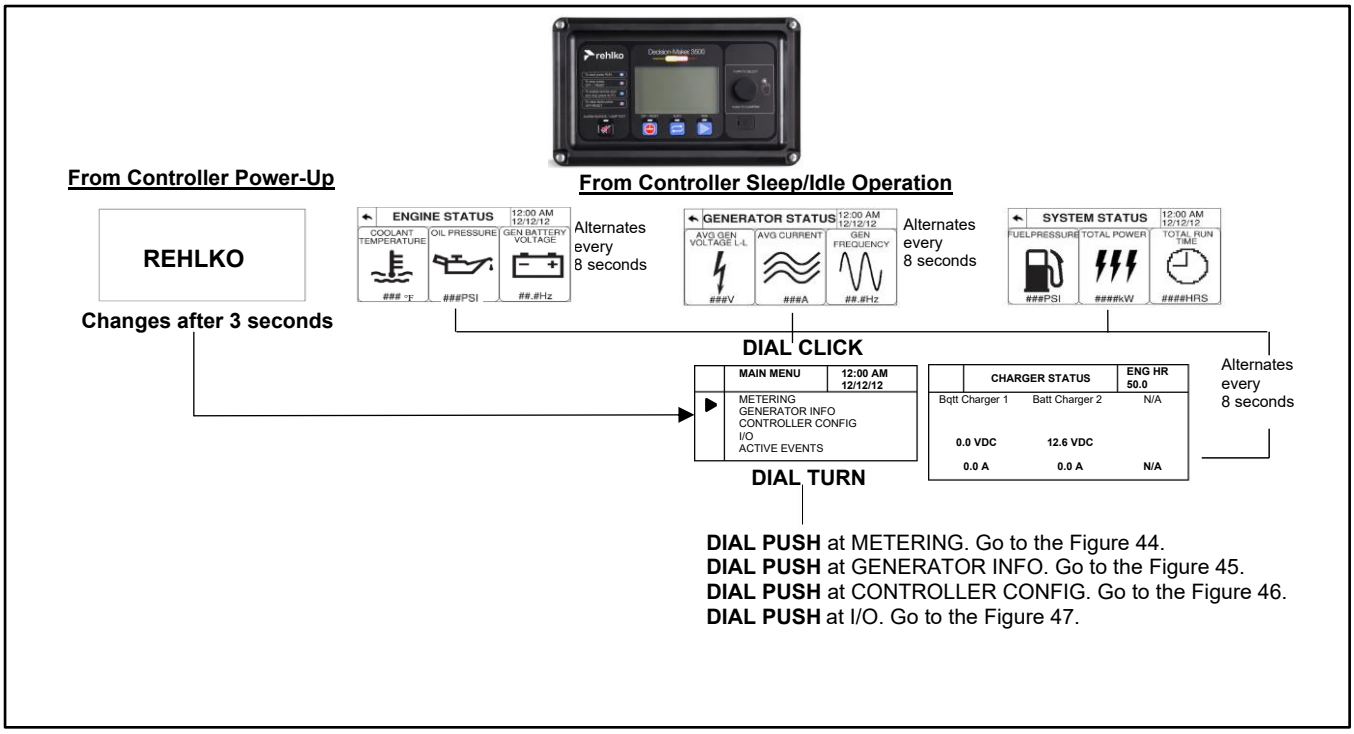


Figure 43 Decision-Maker 3500 Controller Information Menu Structure

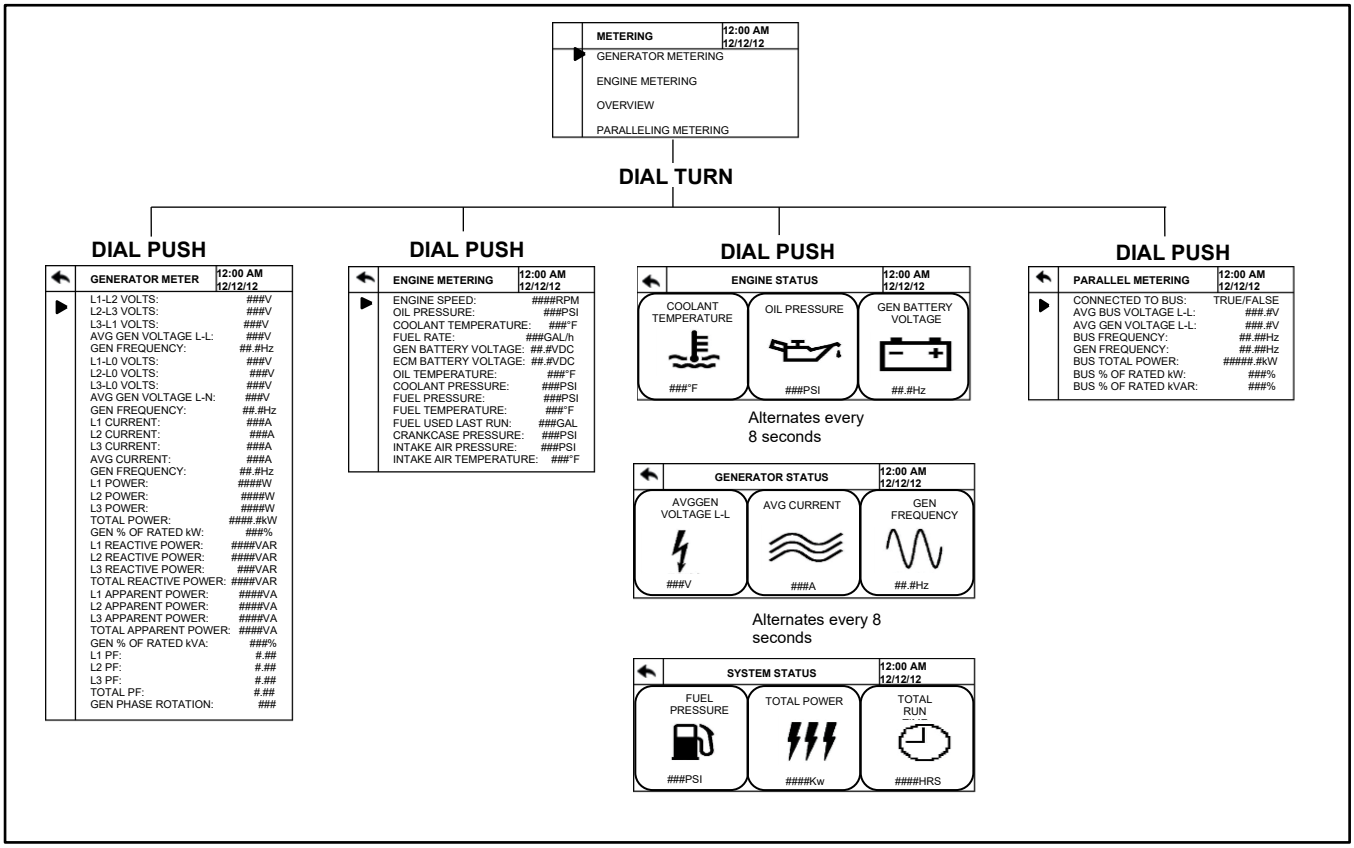


Figure 44 Metering Menu

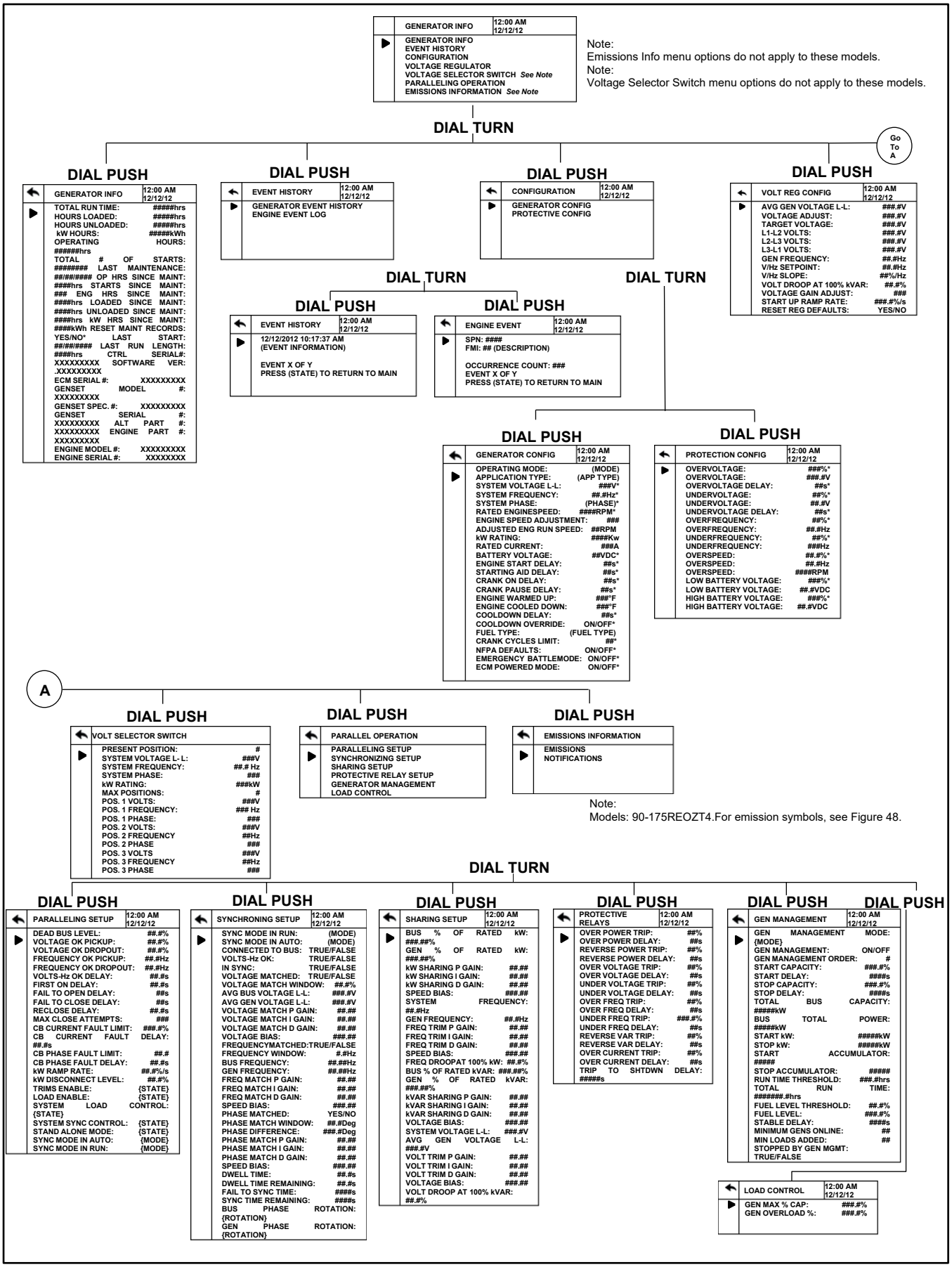


Figure 45 Generator Information Menu

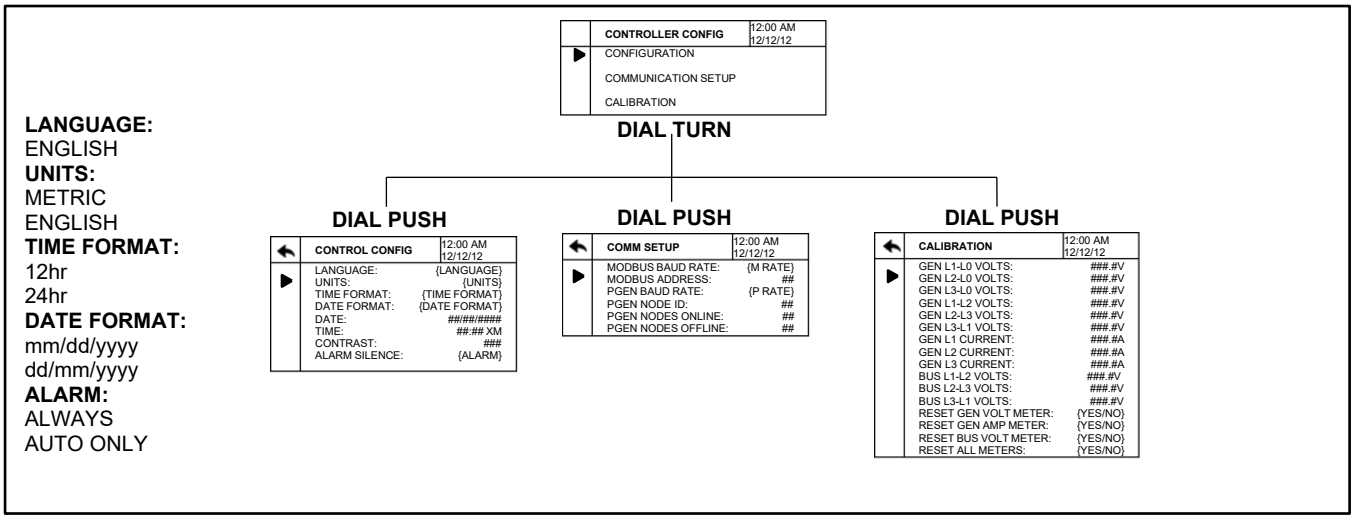


Figure 46 Controller Configuration Menu

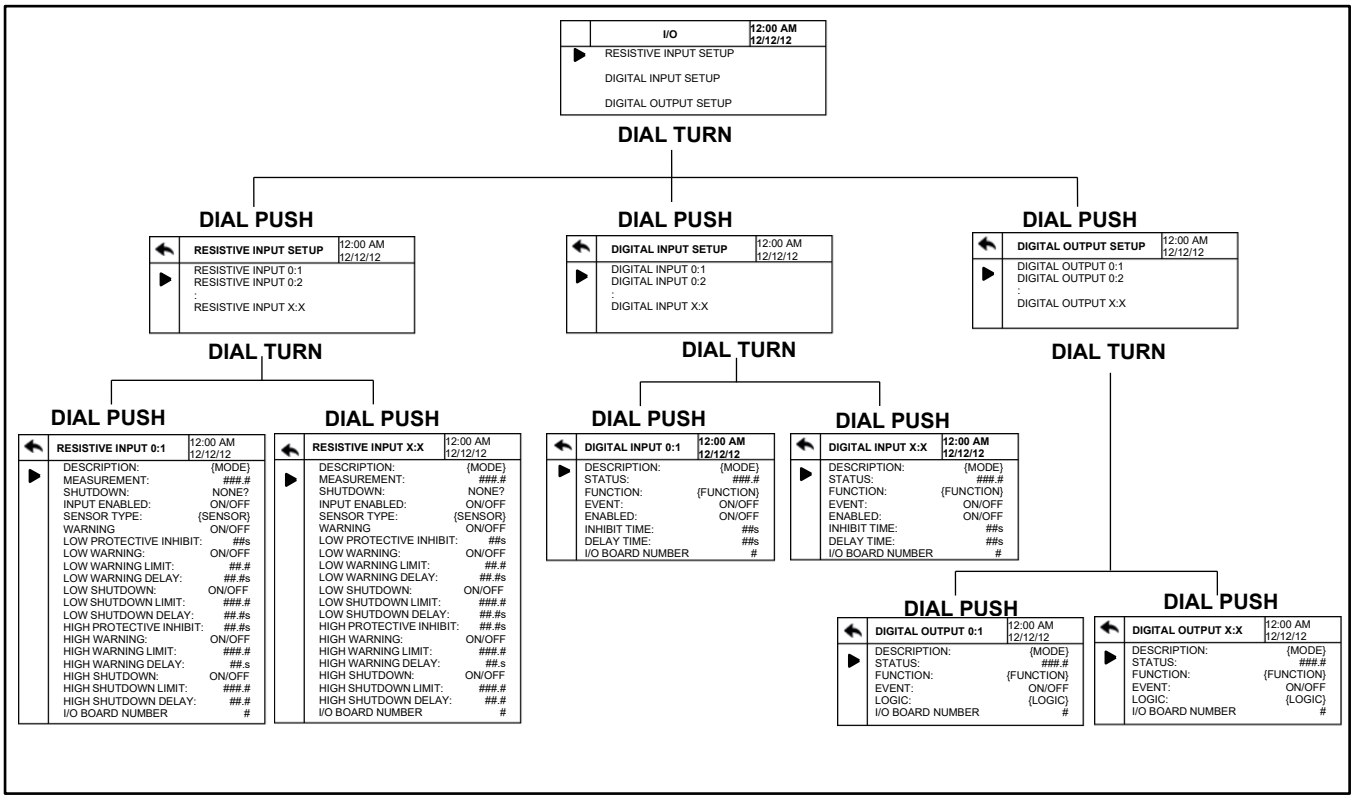


Figure 47 I/O Menu

Indicator	Symbol	Description	Action
DEF Indicator On Steady	Low DEF concentration: 	Auto Cleaning Disabled Indicator On Steady	Fill DEF tank.
	Low DEF level: 		
DEF Indicator Flashing	Low DEF concentration: 	DEF tank has 0% measurable volume and engine performance is reduced. DEF system has lost its prime and engine performance is reduced.	Fill DEF tank.
	Low DEF level: 		
Engine Emissions System Malfunction Indicator On Steady or Flashing		Engine emissions outside of normal operating range. Engine emissions system fault	Contact authorized distributor.
Engine Emissions Temperature Indicator On Steady		Exhaust gas temperature is high. Exhaust cleaning is in process.	Engine can be operated as normal. If operating in an area where high exhaust temperatures may be an issue, inhibit exhaust system cleaning by using the disable feature.
Exhaust System Indicator On Steady or Flashing		Residue level in the exhaust system indicates need for an exhaust system cleaning. After treatment system fault.	Enable auto system cleaning to allow a cleaning cycle or begin stationary cleaning. If system cleaning is performed and indicator still active, contact an authorized distributor.
Auto Cleaning Disabled Indicator On Steady		Auto exhaust system cleaning has been disabled by the user setting.	If possible, enable auto cleaning.

Figure 48 Emission Symbols (Models: 90-175REOZT4)

4.7 Monitoring and Programming Setup

The user programmer can access the controller data with the controller digital display or a personal computer (PC) with optional SiteTech™ software to monitor and/or program. Access the controller system with a PC using a USB cable with a mini USB plug. Refer to the Introduction, List of Related Materials for related software literature.

While this manual focuses on data access through the controller pushbutton/rotary selector dial and display, most data entries require input using a PC for initial setup. The PC entries typically include alpha characters such as digital input descriptions.

4.7.1 PC Communications

Communicate between a PC and the generator set controller logic using USB communication protocol. The PC connections require optional SiteTech™ software. Contact your authorized distributor for assistance.

Local Single Connection

A PC connects to the USB port of the generator set controller using a mini USB connector. See Figure 49.

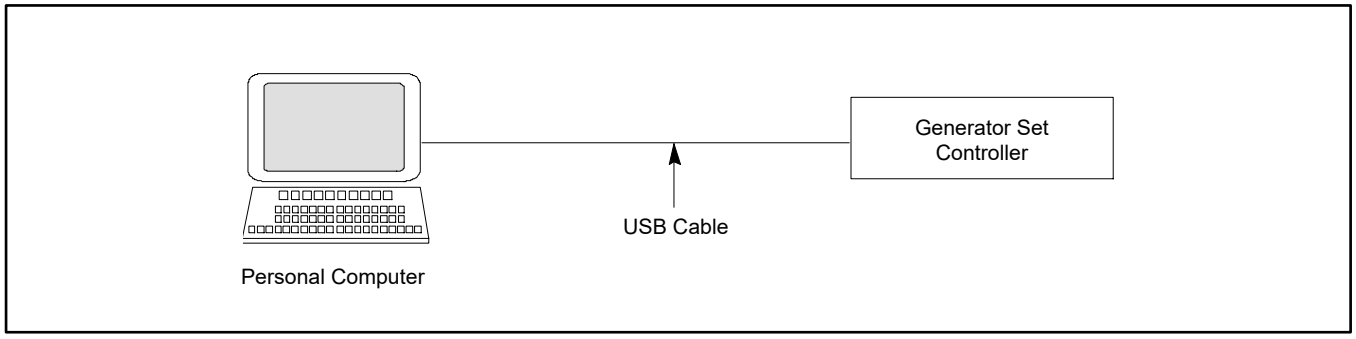
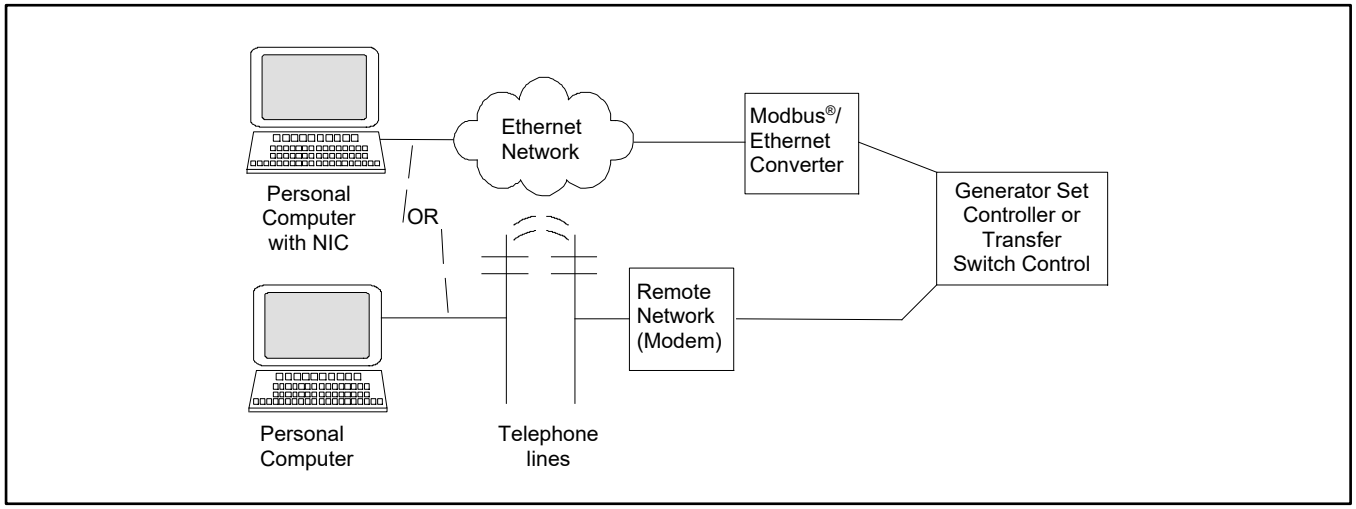


Figure 49 Local Single Connection

Remote Single Connection

A modem connects a PC to a single device. The PC communicates with the device via telephone line or an Ethernet network. See Figure 50.



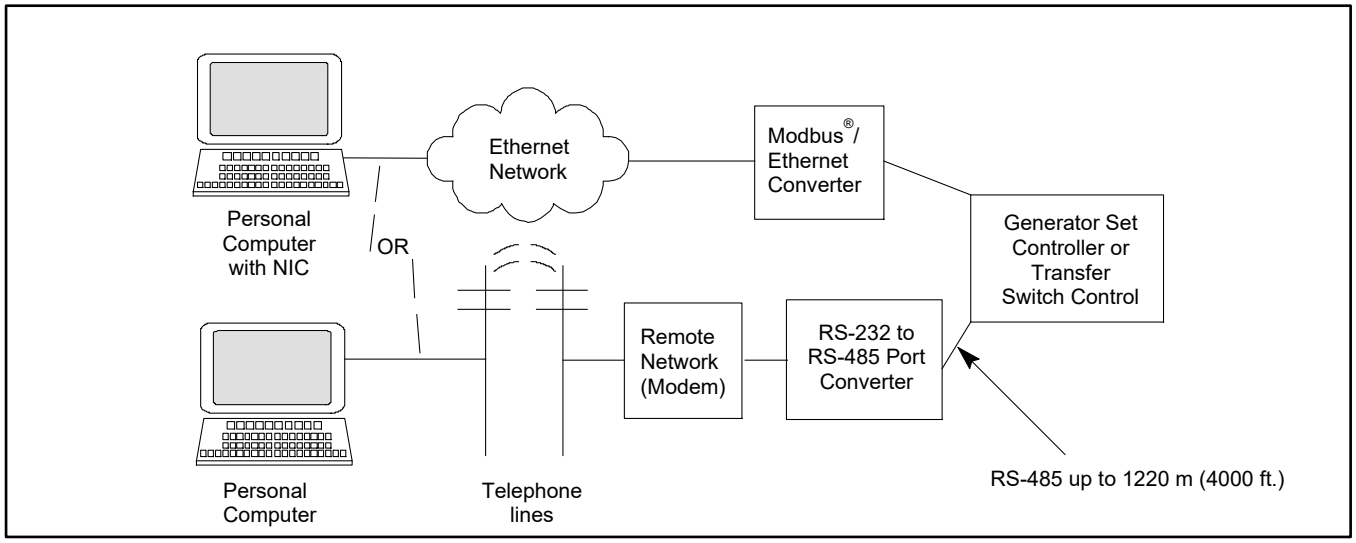


Figure 50 Remote Single Connections

4.7.2 Modbus® Communications

The controller communicates using Modbus® as a slave connection with the Modbus® master initiating the communication. The controller seeks the system and alternator 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. See Figure 51. Refer to the List of Related Materials for available Modbus® literature.

Note:
Only one Modbus® master can be connected to the controller. Examples include the remote serial annunciator and switchgear applications.

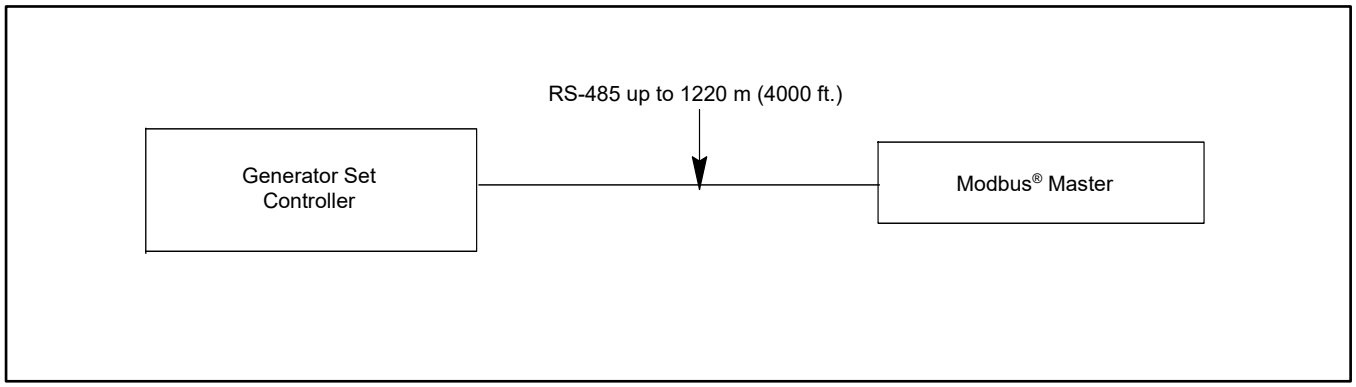


Figure 51 Modbus® Connections

Modbus® is a registered trademark of Schneider Electric.

5.1 Introduction

This section deals with general maintenance of the generator set, trailer, and accessories. This section may refer to other literature for procedures and additional information.

See the list of related materials in the Introduction section of this manual for literature part numbers. Contact an authorized service distributor to obtain service literature.

Rental Units. Contact the leasing distributor for all rental unit service unless the leasing distributor specifically gives other instructions. Follow all requirements per your rental agreement contract.

WARNING	**Accidental starting.** **Can cause severe injury or death.** 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.

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

Servicing the exhaust system. Hot parts can cause severe injury or death. Do not touch hot engine parts. The engine and exhaust system components become extremely hot during operation.

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

Servicing the generator set when it is operating. Exposed moving parts will cause severe injury or death. Keep hands, feet, hair, clothing, and test leads away from the belts and pulleys when the generator set is running. Replace guards, screens, and covers before operating the generator set.

5.1.1 Generator Set Service

The prestart checklist lists generator set main areas that require attention.

Note:
Have maintenance work, including battery service, performed by appropriately skilled and suitably trained maintenance personnel familiar with generator set operation and service.

Some procedures may also require using the generator set service manual or engine service manual.

5.1.2 Engine Service

Perform engine service at the intervals specified in the engine manufacturer's service literature.

5.1.3 Trailer Service

Perform the recommended trailer maintenance as specified in the following service schedule and any other supplied component manuals.

5.2 Service Schedule

System—Component	Action					Interval
	Visually Inspect	Check	Change	Clean	Test	
Fuel System						
Day tank level	X	X				Weekly
Flexible lines and connections	X		R			Weekly
Fuel level switch	X				X	
Main tank supply level		X				
Water in system, remove		•		•		
Filter(s)			•			Quarterly
Fuel piping	X					Yearly
Tank vents and return lines for obstructions		X				
Lubrication System						
Oil level (including oil makeup system if installed)	•	•				Weekly
Crankcase breather	•		•			Quarterly
Change oil			•			First 50 Hrs, Then Every 500 Hrs
Replace filter(s) *			•			
Cooling System						
Block heater operation		X				Weekly
Coolant level	•	•				
Flexible hoses and connectors	X	X				
Water pump(s)	•					
Fan and alternator belts	•	•	R			Monthly
Coolant temperature protection level					•	Six Months
Air ducts, louvers		X		X		Yearly
Radiator exterior				X		
Coolant			•			1500 Hours
Exhaust System						
Drain condensate trap		X				Weekly
Leakage	X	X				
Change DEF dosing unit filter			•			3 years or 4500 hours
Replace in-line DEF filter			•			3 years or 8000 hours
Insulation, fire hazards	X					Quarterly
Flexible connector(s)	X					Six Months
Excessive back pressure					X	Yearly
Hangers and supports	X					
DC Electrical System						
Battery charger operation, charge rate	X					Monthly
Battery electrolyte level		X				
Battery specific gravity, charge state					X	
Recharge after engine start		X				
Remove corrosion, clean and dry battery and rack	X			X		
Clean and tighten battery terminals	X	X				Quarterly
Tighten DC electrical connections		X				Six Months
AC Electrical System						
Controller lamp test	X				R	Weekly
General Inspection	X					
Circuit breakers, fuses†	X	X	R	X	X	Monthly
Wire abrasions where subject to motion	X	X				Quarterly

• **Follow procedures and frequencies indicated in the engine manufacturer's maintenance manual.** If not indicated, follow this service schedule. Some items may not apply to all generator sets.
R Replace as necessary.
X Action
* Service more frequently if operated in dusty areas.
† Do not break manufacturer's seals or internally inspect these devices.

Service Schedule, Continued

System—Component	Action					Interval
	Visually Inspect	Check	Change	Clean	Test	
AC Electrical System, continued						
Safety and alarm operation		X			X	Six Months
Tighten control and power wiring connections		X				Yearly
Transfer switch main contacts †	X			X		Yearly
Wire-cable insulation breakdown	X				X	3 Yrs or 500 Hrs
Engine and Mounting						
General inspection	•					Weekly
Governor operation, lubricate moving parts	•	•				Monthly
Air cleaner service		•	•			Six Months
Injector pump and injector flow rate, pressure, spray pattern		•			•	Yearly
Valve clearance		•				3 Yrs or 500 Hrs
Bolt torque		•			•	
Remote Control System, etc.						
Compartment condition	X			X		Weekly
Remote control					X	Monthly
Run generator set					X	
Alternator						
General inspection	X					Weekly
Rotor and stator	X			X		Yearly
Bearing condition	X	X	R			
Exciter	X	X		X		
Voltage regulator	X	X		X		
Measure and record resistance readings of windings with insulation tester (Megger®, with SCR assembly or rectifier disconnected)					X	
Blow dust out of alternator *	X			X		2 Yrs or 300 Hrs
General Condition of Equipment						
Any condition of vibration, leakage, excessive noise, extreme temperature, or deterioration	X	X		X		Weekly
Ensure that system is set for automatic operation	X					
Interior of equipment room or outdoor weather housing	X			X		
Trailer						
Brakes functionality. Check adjustment at 325/4800 km (200/3000 miles)					X	Each Use
Tire inflation pressure per manufacturer	X	X				Weekly
Wheel lug nut torque (first 80/160 km [50/100 miles])		X				Quarterly or 3000 Miles
Wheel condition—cracks, dents, or distortion	X	X	R			
Tire condition—cuts, wear, bulging, etc.	X	X	R			
Landing gear—inspect and lubricate per manufacturer	X	X	R			
Wheel bearings and cups—inspect for corrosion or wear (repack)	X	X	R	X		Yearly or 12000 Miles
Brake components	X	X	R			Yearly or 12000 Miles
Seals—inspect for leakage.	X	X	R			Yearly or 12000 Miles
Springs—inspect for breakage, wear, loss of arch	X	X	R			
Suspension parts—inspect for bending, loose fasteners, wear	X	X	R			
Hangers—inspect welds	X	X				

- • **Follow procedures and frequencies indicated in the engine manufacturer's maintenance manual.** If not indicated, follow this service schedule. Some items may not apply to all generator sets.
- R Replace as necessary.
- X Action
- * Service more frequently if operated in dusty areas.
- † Do not break manufacturer's seals or internally inspect these devices.

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5.3 Alternator Service

Under normal operating conditions, the alternator does not require regular or scheduled service. When operating the generator set under dusty or dirty conditions, use dry compressed air to blow dust out of the alternator while the generator set is running. Direct the stream of air through openings in the generator set end bracket.

5.4 Alternator Bearing Service

Have an authorized service distributor perform service.

5.4.1 20-300 kW Models

Replace the end bracket bearing every 10,000 hours of operation in prime power applications. Service the bearing more frequently if the annual inspection indicates excessive rotor end play or bearing damage. The sealed end bracket bearing requires no additional lubrication.

5.4.2 Above 300 kW Models with 4M/5M/7M Single-Bearing Alternator

The alternator bearing requires lubrication at intervals specified in the generator set technical manual. Use Chevron SRI or equivalent antifriction, high-quality grease with a lubrication temperature range of -30°C to 175°C (-22°F to 350°F).

5.5 Fuel Systems

WARNING	**Explosive fuel vapors.** **Can cause severe injury or death.** 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.

Draining the fuel system. Explosive fuel vapors can cause severe injury or death. Spilled fuel can cause an explosion. Use a container to catch fuel when draining the fuel system. Wipe up spilled fuel after draining the system.

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

5.5.1 Bleeding Air from Fuel System

Bleed air from the fuel system after fuel system maintenance, such as replacing the fuel filter(s). Use the information provided in the engine operation manual.

5.5.2 Two-Way Fuel Valve

Fuel valve allows the switching of the diesel fuel supply between the subbase fuel tank and an external user-supplied fuel tank. See Figure 52.

Place the fuel valve handle in the DOWN position to connect to the subbase fuel tank. Place the fuel valve handle in the UP position to connect to the user-supplied external fuel tank.

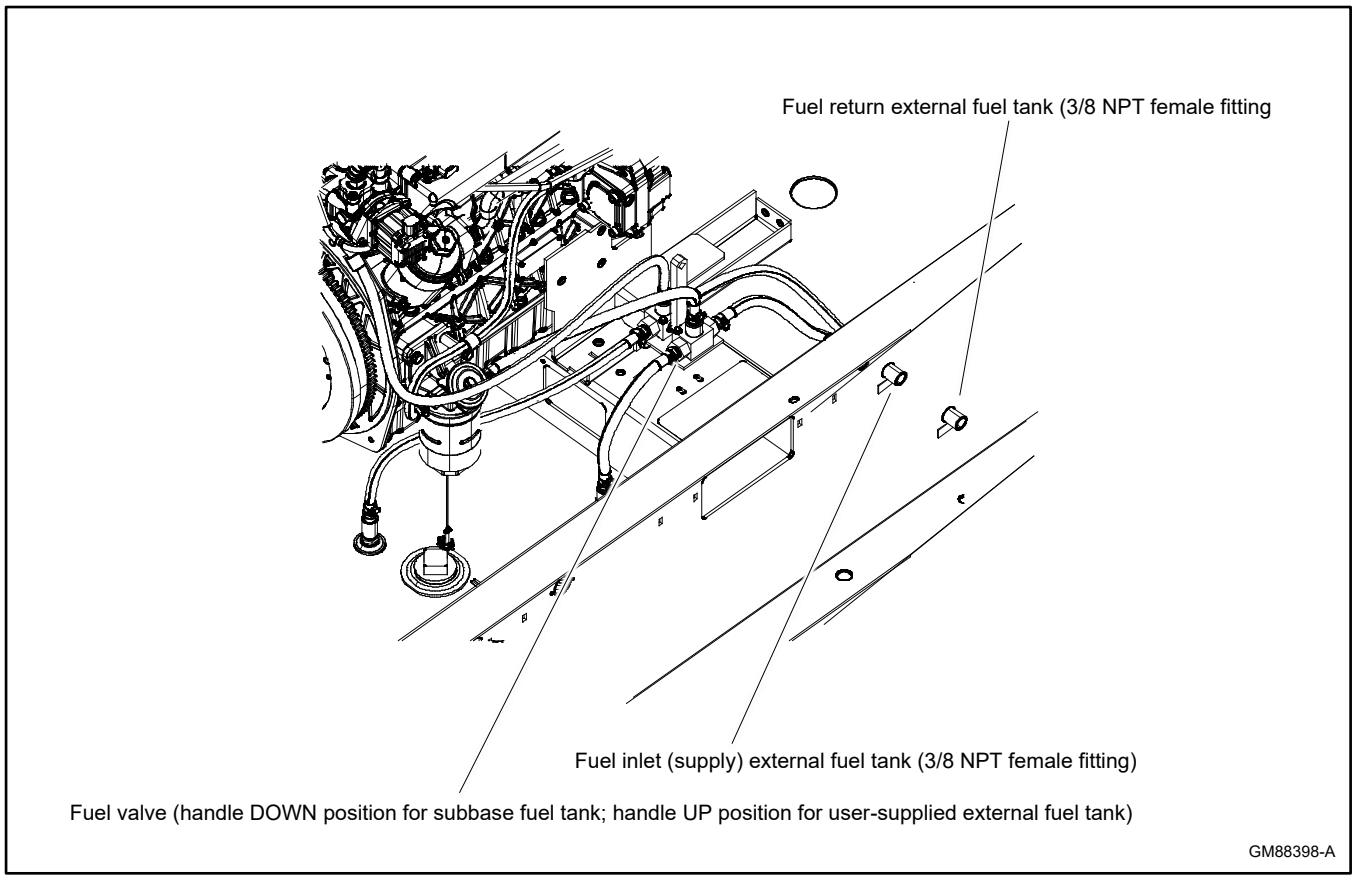


Figure 52 Diesel Fuel Valve

The generator set has pipe plugs installed in the external fuel tank fittings from the factory to prevent contaminants from entering the fuel supply. Remove the pipe plugs prior to installing the external fuel tank connections. Save these pipe plugs for future installation in the external fuel tank fittings on the skid after the external fuel tank is disconnected.

5.6 Air Cleaner Restrictor Indicator

The air cleaner restriction gauge mounted on the air cleaner(s) helps determine the air cleaner change interval.

The air cleaner restriction gauge monitors air flow and continuously displays restriction readings indicated as vacuum (see Figure 53). Increased restriction indicates a clogged air cleaner element.

As maximum allowable restriction is reached, the gauge window turns red indicating the air cleaner element needs replacement. To reset the gauge, push the gauge top down and release.

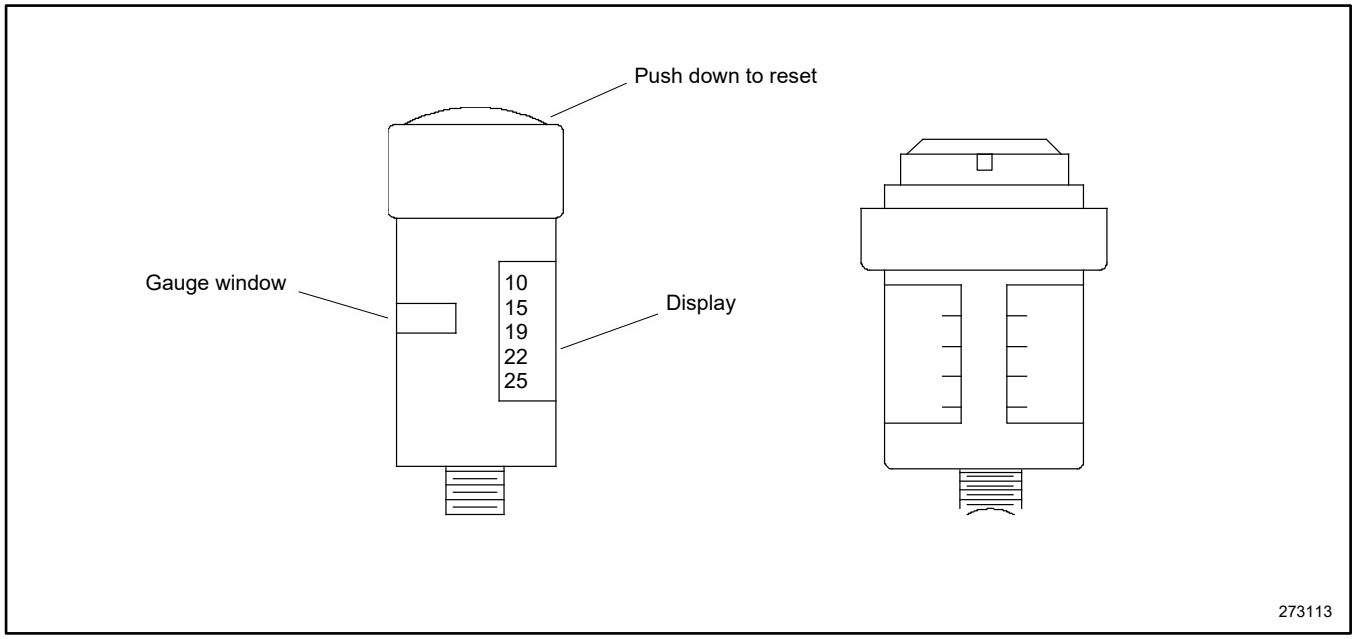


Figure 53 Restriction Indicators (styles vary)

5.7 Cooling System

The cooling system maintenance information applies to radiator-cooled models which have a radiator with a pressure cap and coolant recovery tank.

⚠ WARNING	**Hot coolant and steam.** **Can cause severe injury or death.** Before removing the pressure cap, stop the generator set and allow it to cool. Then loosen the pressure cap to relieve pressure. Fill system before starting unit.
	

Allow the engine to cool. Release pressure from the cooling system before removing the pressure cap. To release pressure, cover the pressure cap with a thick cloth and then slowly turn the cap counterclockwise to the first stop. Remove the cap after pressure has been completely released and the engine has cooled. Check the coolant level at the tank if the generator set has a coolant recovery tank.

Note:
Engine damage. Bleed the air from the cooling system to prevent overheating and subsequent engine damage.

Note:
Block heater damage. 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.

5.7.1 Coolant Level Check

Check the coolant level in the coolant recovery tank (if equipped). Maintain the coolant level between the high and low marks. Check the coolant level at the radiator fill on models without a coolant recovery tank.

Note:
Periodically check the coolant level by removing the pressure cap. Do not rely solely on the level in the coolant recovery tank (if equipped). Add fresh coolant until the level is just below the overflow tube opening of the filler neck.

5.7.2 Cooling System Component Inspection

To prevent generator set shutdown or damage caused by overheating:

- Keep the cooling air inlets clean and unobstructed.
- Inspect the radiator's exterior for obstructions. Remove dirt and foreign material using a soft brush or cloth to avoid damaging the radiator fins.
- Check the hoses and connections for leaks. Replace any cracked, frayed, or spongy hoses.
- Check the condition and tension of the radiator fan and water pump belt(s). Follow the belt tension procedure in this manual and/or the engine operation manual.
- Check the pressure cap seal and replace a cracked or deteriorated cap. Remove dirt and other debris from the pressure cap and filler neck. The pressure cap raises the boiling point of the coolant, enabling higher operating temperatures. Replace a leaking pressure cap with one rated for the same pressure. The pressure cap rating usually appears on the pressure cap.

5.7.3 Procedure to Drain Cooling System

For optimum protection, drain, flush, and refill the cooling system at the intervals listed in the service schedule.

Note:
Dispose of all waste materials (oil, fuel, coolant, filters, and gaskets) in an environmentally safe manner.

1. Deenergize the block heater, if equipped.
2. Remove the pressure cap to allow the entire system to drain and prevent air pockets from restricting coolant flow through the engine block.
3. Open the radiator and/or engine block coolant drain valve(s) and allow the system to drain.
4. If the inside of the radiator has mineral deposits or the used coolant contains dirt or grease, refer to the Procedure to Flush and Clean the Cooling System section. If the cooling system does not have mineral deposits, go to the Procedure to Refill the Cooling System section.

5.7.4 Procedure to Flush and Clean Cooling System

Use the instructions in the engine operation manual when available to flush and clean the cooling system. Otherwise, use the following procedure and the cooling system cleaner manufacturer's instructions.

1. Flush the cooling system with clean water.
2. If the inside of the radiator still has mineral deposits, use a radiator cleaner to remove the remaining deposits following the manufacturer's instructions.
3. Drain, clean, and flush the coolant recovery tank.

5.7.5 Procedure to Refill Cooling System

See the generator set spec sheet for coolant capacity.

Note:
Do not add coolant to a hot engine. Adding coolant to a hot engine can cause the cylinder block or cylinder head to crack. Wait until the engine has cooled.

1. Remove the pressure cap.
2. Close the radiator and/or engine block coolant drain valve(s) and tighten the cooling system hose clamps.
3. Open the air-bleed petcocks, if equipped. Close the air-bleed petcocks when coolant begins to flow from them.
4. Add coolant additives or water pump lubricants according to the engine manufacturer's recommendations in the engine operation manual.
5. Fill the cooling system with the recommended coolant/antifreeze mixture according to the engine manufacturer.
6. With the pressure cap removed, operate the generator set for approx. 5 minutes.
7. Stop the generator set and allow it to cool.
8. Fill the cooling system with the recommended coolant/antifreeze mixture according to the engine manufacturer.
9. Replace the pressure cap.
10. Fill the coolant recovery tank (if equipped) to the low mark.
11. Operate generator set until the thermostat opens when the upper cooling system hose warms.
12. Stop the generator set and allow it to cool.
13. Check and repair any coolant leaks.
14. Remove the pressure cap.
15. Add coolant to bring the coolant level to just below the overflow tube opening of the filler neck.
16. Replace the pressure cap.
17. Maintain the coolant level in the coolant recovery tank (if equipped) between the high and low marks. Check the coolant level at the radiator fill on models without a coolant recovery tank.

    Air pockets often form in the engine water jacket when the coolant system is refilled. Check the coolant level in the coolant recovery tank after each generator set operation and add coolant as necessary until the coolant level stabilizes. Then check the coolant at the interval specified in the service schedule.
18. Reenergize the block heater, if equipped.

5.8 Battery

⚠ WARNING	**Sulfuric acid in batteries.** **Can cause severe injury or death.** Wear protective goggles and clothing. Battery acid may cause blindness and burn skin.
	

Battery electrolyte is a diluted sulfuric acid. Battery acid can cause severe injury or death. Battery acid can cause blindness and burn skin. Always wear splashproof safety goggles, rubber gloves, and boots when servicing the battery. Do not open a sealed battery or mutilate the battery case. If battery acid splashes in the eyes or on the skin, immediately flush the affected area for 15 minutes with large quantities of clean water. Seek immediate medical aid in the case of eye contact. Never add acid to a battery after placing the battery in service, as this may result in hazardous spattering of battery acid.

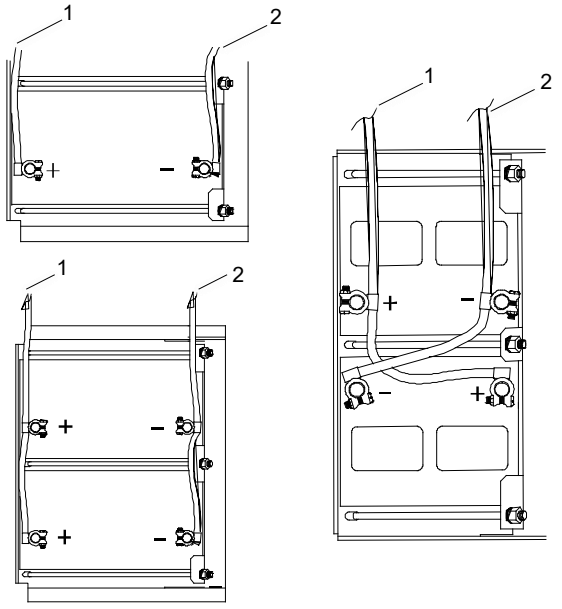
Battery acid cleanup. Battery acid can cause severe injury or death. Battery acid is electrically conductive and corrosive. Add 500 g (1 lb.) of bicarbonate of soda (baking soda) to a container with 4 L (1 gal.) of water and mix the neutralizing solution. Pour the neutralizing solution on the spilled battery acid and continue to add the neutralizing solution to the spilled battery acid until all evidence of a chemical reaction (foaming) has ceased. Flush the resulting liquid with water and dry the area.

Battery gases. Explosion can cause severe injury or death. Battery gases can cause an explosion. Do not smoke or permit flames or sparks to occur near a battery at any time, particularly when it is charging. Do not dispose of a battery in a fire. To prevent burns and sparks that could cause an explosion, avoid touching the battery terminals with tools or other metal objects. Remove all jewelry before servicing the equipment. Discharge static electricity from your body before touching batteries by first touching a grounded metal surface away from the battery. To avoid sparks, do not disturb the battery charger connections while the battery is charging. Always turn the battery charger off before disconnecting the battery connections. Ventilate the compartments containing batteries to prevent accumulation of explosive gases.

Battery gases. Explosion can cause severe injury or death. Incorrect use of the equalize charge state may lead to hazardous situations. Equalization is ONLY applicable for flooded lead acid (FLA) type batteries and will damage gel, absorbed glass mat (AGM), or nickel-cadmium (NiCad) type batteries. In the controller menu or SiteTech™ settings, verify that the battery topology is set correctly for the battery type used. Do not smoke or permit flames, sparks, or other sources of ignition to occur near a battery at any time.

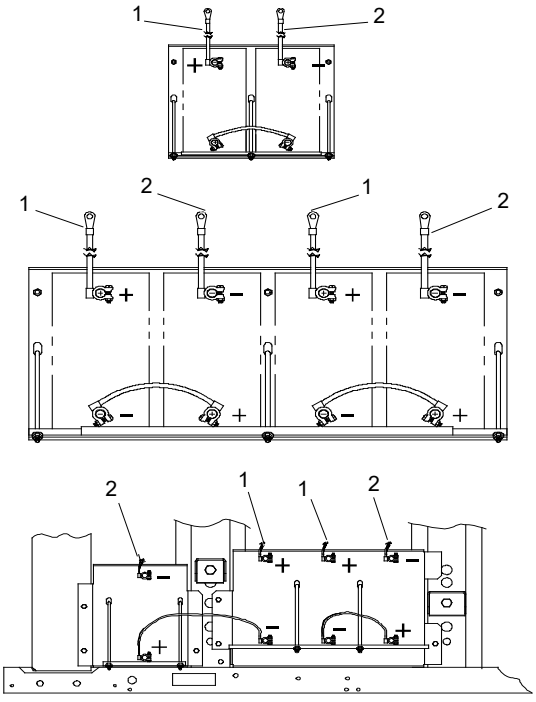
Battery short circuits. Explosion can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Disconnect the battery before generator set installation or maintenance. Remove all jewelry before servicing the equipment. Use tools with insulated handles. Remove the negative (–) lead first when disconnecting the battery. Reconnect the negative (–) lead last when reconnecting the battery. Never connect the negative (–) battery cable to the positive (+) connection terminal of the starter solenoid. Do not test the battery condition by shorting the terminals together.

Refer to this section for general battery information and maintenance. All generator set models use a negative ground with a 12-volt or 24-volt engine electrical system. Consult the generator set nameplate for the engine electrical system voltage. Consult the generator set spec sheet for battery capacity recommendations for replacement purposes. The wiring diagrams provide battery connection information. See Figure 54 and Figure 55 for typical battery connections, including multiple battery configurations.



1. To positive (+) terminal on starter solenoid.
2. To ground (-) terminal on or near starter motor.

Figure 54 12-Volt Engine Electrical System Single Starter Motor Typical Battery Connection



1. To positive (+) terminal on starter solenoid.
2. To ground (-) terminal on or near starter motor.

Figure 55 24-Volt Engine Electrical System Single Starter Motor Typical Battery Connection

5.8.1 Clean Battery

Clean the battery and cables and tighten the battery terminals according to the service schedule recommendations. Clean the battery by wiping it with a damp cloth. Keep the electrical connections dry and tight.

If corrosion exists, disconnect the cables from the battery and remove the corrosion with a wire brush. Clean the battery and cables with a solution of baking soda and water. Do not allow the cleaning solution to enter battery cells. Flush the battery and cables with clean water and wipe the battery with a dry cloth.

After reconnecting the battery cables, coat the terminals with petroleum jelly, silicon grease, or other nonconductive grease.

5.8.2 Electrolyte Level Inspection

Check the electrolyte level and specific gravity of batteries that have filler caps. Maintenance-free batteries do not require electrolyte level checking or specific gravity testing.

Check the electrolyte level at the specified interval. Remove the filler caps and verify that the electrolyte level reaches the bottom of each filler hole. See Figure 56. Refill as necessary with distilled water or clean tap water. Do not add fresh electrolyte. Tighten the filler caps. After adding water during freezing temperatures, run the generator set 20-30 minutes to mix the electrolyte and the water to prevent battery damage from freezing.

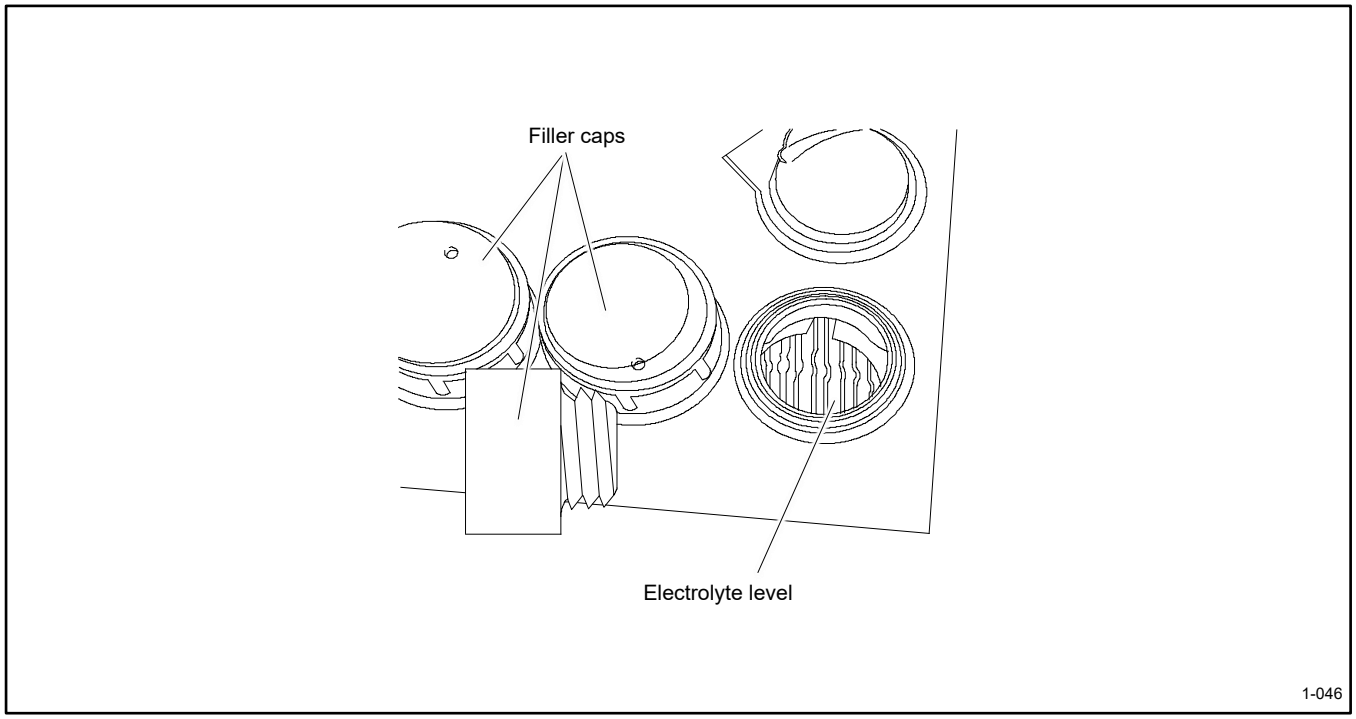


Figure 56 Battery Electrolyte Level Inspection

5.8.3 Specific Gravity Check

Use a battery hydrometer to check the specific gravity of the electrolyte in each battery cell of batteries with filler caps. Holding the hydrometer vertically, read the number on the glass bulb at the top of the electrolyte level or the number adjacent to the pointer. If the hydrometer used does not have a correction table, refer to Figure 57.

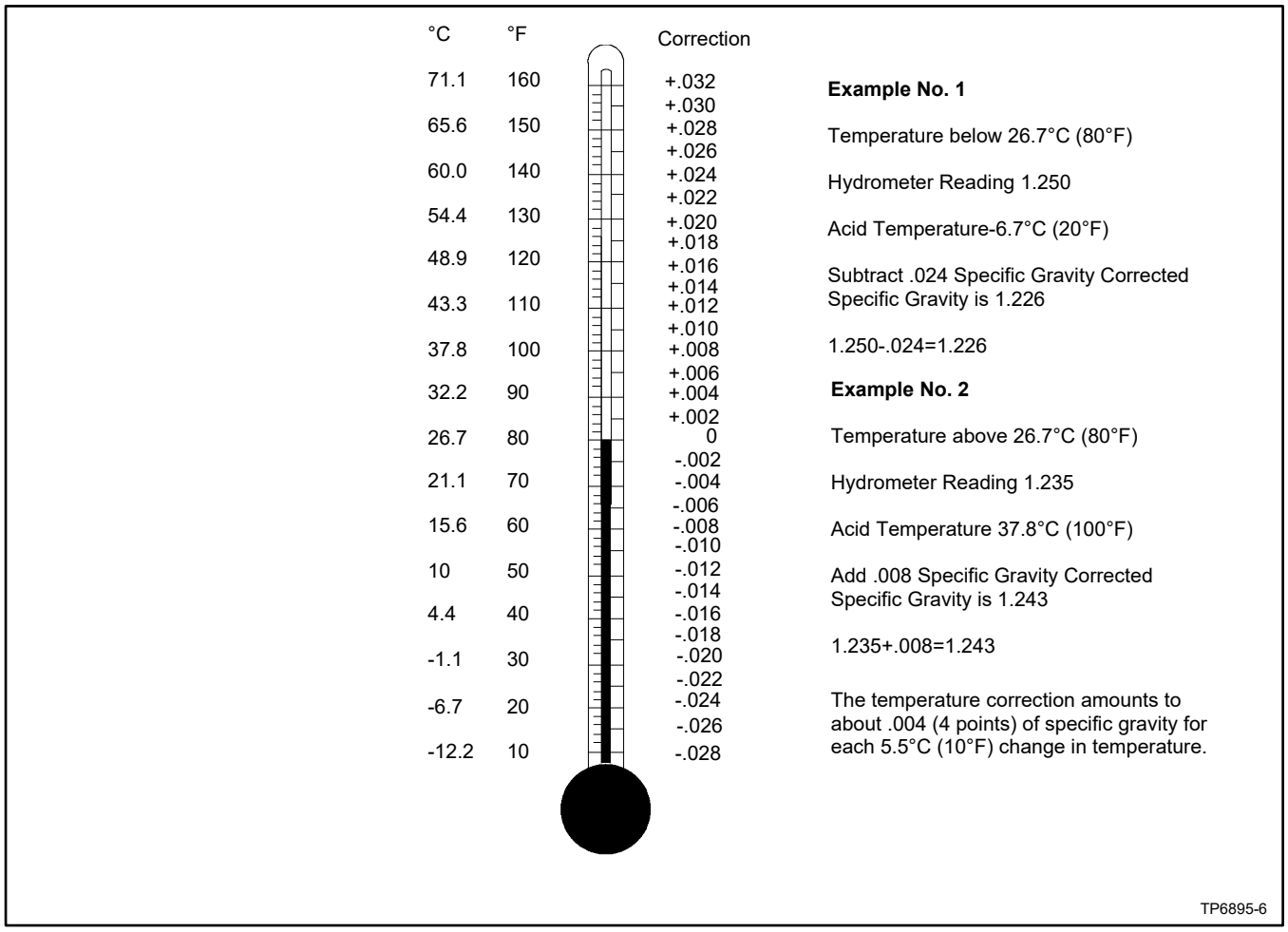


Figure 57 Specific Gravity Temperature Correction

Determine the specific gravity and electrolyte temperature of the battery cells. Locate the temperature in Figure 57 and correct the specific gravity by the amount shown. The battery is fully charged if the specific gravity is 1.260 at an electrolyte temperature of 26.7°C (80°F). Maintain the specific gravities between cells within ±0.01 of each other. Charge the battery if the specific gravity is below 1.215 at an electrolyte temperature of 26.7°C (80°F).

Note:
Some battery testers have four or five beads in a test tube. Draw electrolyte into the tube as with the battery hydrometer described in this section or use the manufacturer's instructions. Use Figure 58 to interpret typical test results.

Number of Floating Beads	Battery Condition
5	Overcharged
4	Fully charged
3	A good charge
1 or 2	A low charge
0	A dead battery

Figure 58 Bead-Type Test Interpretation

5.8.4 Charge Battery

Use a battery charger to maintain a fully charged battery when the generator set is used in a standby application. The engine battery-charging alternator charges the battery while the generator set is running.

Note:
If the generator set is in a temporary prime power application in which the generator set has periods of inactivity, the controller circuitry may drain the battery. If there is no power source for a battery charger, place the controller in the prime power mode, if equipped, or disconnect the battery from the generator set.

5.9 Electric Brake Service

Use the supplied component manual for all required inspection, troubleshooting, and service maintenance.

Never use compressed air to clean brake components as this will cause the dust to become air borne. Some brake components may contain asbestos. Use proper care and equipment when servicing brakes.

5.9.1 Visually Inspect

The trailer must be raised adequately with the wheels off the ground and blocked safely using jack stands. Then remove the respective wheel.

With the drum removed, inspect:

- Drum surface. Replace if there is wear beyond the service limit (wear marks), out-of-round wear, or deep gouging.
- Armature plate (part of drum). Check for a pattern of grooves on the armature surface due to worn magnets. Always replace the magnets if the armature plate is resurfaced or the drum is replaced.
- Shoe lining. Replace if worn beyond the service limit (less than 1.5 mm [1/16 in.] thick), cracked, mating surfaces are gouged, or saturated with grease or oil.
- Springs. Replace the shoe return spring, mounting springs, or adjuster spring as needed.
- Magnets. Replace the magnets if there are signs of uneven wear or beyond the service limit (worn down to the rivets or screws). Always replace the magnets if the armature plate is resurfaced or the drum is replaced.
- Magnet components. Check for free movement of the magnet arm or actuating lever by manually moving it. Check for binding and replace as needed.

5.9.2 Cleaning

Use brake cleaner or a damp rag to clean the brake components. Never use compressed air to clean brake components as this will cause the dust to become air borne. Some brake components may contain asbestos. Use proper care and equipment when servicing brakes.

Apply a small amount of white lithium grease to the area behind the brake shoe where it rubs against the backing plate before reassembly.

5.9.3 Adjustment

The trailer must be raised adequately with the wheels off the ground and blocked safely using jack stands. Then remove the respective wheel.

1. Remove the rubber plug from the backing plate slot.
2. Insert an adjustment tool or large slotted screwdriver in the slot and rotate the star wheel to expand the shoe against the drum.

   Note:
   Star wheel rotation may be clockwise or counterclockwise depending upon brake manufacturer.
3. Expand the shoe until the drum can't be turned by hand. This will center each shoe evenly against the inside surface of the drum.
4. Then back off the adjustment is the other direction until the drum turns freely but has a slight resistance during rotation by hand.
5. Replace the rubber plug in the backing plate slot.
6. Repeat procedure for remaining wheels.

5.9.4 Electric Brake Controller

Use the vehicle's supplied component manual for all inspection, troubleshooting, and service maintenance.

Use the vehicle's supplied component manual for all electric brake adjustment and synchronization information.

5.10 Axle/Hub Bearing Service

Use the supplied component manual for all required inspection and service maintenance.

5.11 Suspension Service

The suspension system incorporated into the axles is designed to perform three basic functions:

- Attach the axle to the trailer
- Dampen the effects of road shock
- Provide stability to the trailer

Visually inspect all suspension components at the specified interval for signs of excessive wear, elongation of bolt holes, and loosening of fasteners. Replace worn or damaged components. Tighten all fasteners to the specified torque.

Use the supplied component manual for all required inspection and service maintenance.

5.12 Wheel and Tire Service

Tires and wheels are very important and a critical component of the trailer running gear. When replacing trailer tires and wheels match the tires, wheels, and axle for best compatibility. Do not use an inner tube to correct a rim leak—replace worn or damaged components.

The following characteristics are important when replacing wheels and tires.

- Wheel Bolt Circle. Many bolt circle dimensions are available and some vary so slightly that it may be possible to install an improperly matched wheel to an axle hub. Select wheels which match the axle hub.
- Load Capacity. Verify that the wheel and tire load carrying capacity and inflation pressure rating match the maximum trailer load.
- Wheel Offset. The offset refers to the relationship of the tire centerline to the axle hub face. Replacement wheels must match the offset of the originally equipped wheels. Mismatched offset can result in inadequate tire clearance or insufficient axle load capacity.
- Rim Contour. Replacement wheels must maintain the same rim size and contour as the originally equipped wheels to prevent possible tire and wheel separation.

Use the supplied component manual for all required inspection and service maintenance.

5.12.1 Wheel Installation Procedure

It is important to maintain correct wheel lug nut mounting torque and use a torque wrench whenever possible to establish correct wheel torque. Correct wheel torque prevents loose wheels, broken studs, and wheel/axle separation. Use the following procedure for wheel installation:

1. Start all wheel lug nuts by hand to prevent cross threading.
2. Tighten the nuts in the sequence shown in Figure 59.

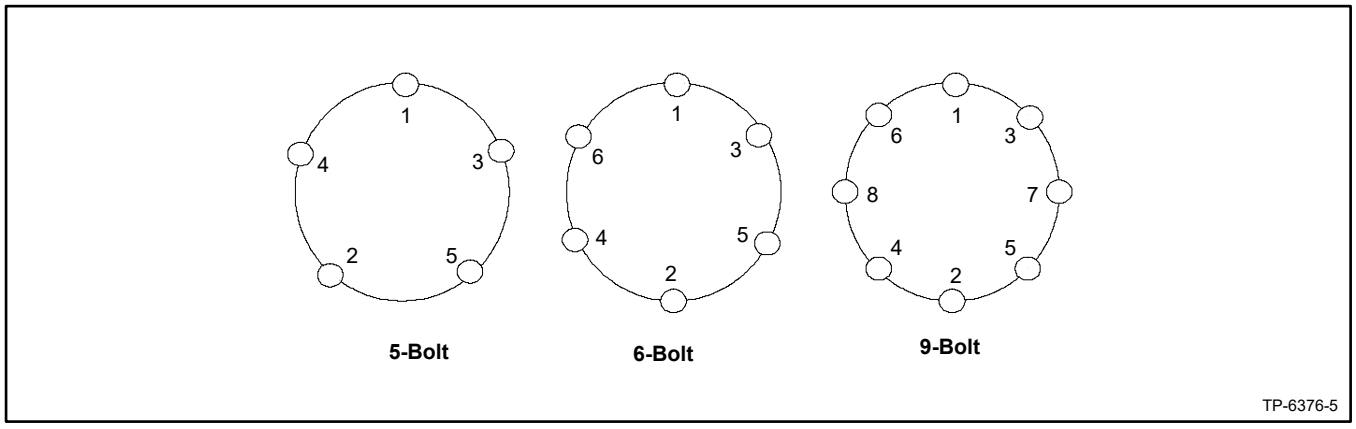


Figure 59 Lug Nut Torque Sequence

3. Perform the wheel lug nut tightening sequence in stages. Use the tightening sequence shown here and the torque value recommendations shown in Appendix B, Tire and Wheel Specifications.
4. Torque wheel lug nuts before the first road use and after each wheel removal. Check and retorque after the first 40 km (25 miles) and again at 120 km (75 miles). Check at the specified service interval.

5.12.2 Tires

Before mounting tires onto wheels, make certain that the wheel size and contour match. The tire must have a load rating sufficient to match the trailer load. Match the replacement tire to the existing tire. See Appendix B, Tire and Wheel Specifications.

Use the tire mounting procedures as outlined by the Rubber Manufacturer's Association or the tire manufacturer.

Tire inflation is the most important factor in tire life. Use the recommended inflation pressure for the load but never exceed the tire or wheel maximum pressure rating. Check inflation pressure before operation while the tire is cold. Do not bleed air from tires when they are hot. Check inflation pressure weekly during use to ensure maximum tire life and tread wear.

Check tire wear frequently because once a wear pattern becomes firmly established in a tire, uneven wearing is difficult to stop even after correcting the cause. Use the chart in Figure 60 to help determine causes and solutions to tire wear problems.

Wear Pattern	Cause	Action
Center wear	Overinflation	Adjust pressure to particular load per tire specifications.
Edge wear	Underinflation	Adjust pressure to particular load per specifications.
Side wear	Loss of camber or overloading	Verify that load does not exceed axle rating. Align at alignment shop.
Toe wear	Incorrect toe-in	Align at alignment shop.
Cupping	Out of balance	Check bearing adjustment and balance tires.
Flat spots	Wheel lockup and tire skidding	Avoid sudden stops when possible and adjust brakes.

Figure 60 Tire Wear Diagnostic Chart

5.13 Diesel Exhaust Fluid (DEF)

Some models are equipped with a DEF tank. DEF is used as a consumable in selective catalytic reduction (SCR) systems in order to lower the NO_x concentration in the diesel exhaust emissions.

Diesel exhaust fluid from a separate DEF tank is injected into the exhaust system where the urea/ionized water solution vaporizes and forms ammonia and carbon dioxide. Within the SCR catalyst, the NO_x concentration is reduced by the ammonia into water and nitrogen and is expelled out of the exhaust system into the atmosphere.

SCR systems are sensitive to potential impurities in the urea solution so keep open containers sealed. The urea solution is clear and non-toxic but it can corrode some metals including but not limited to aluminum, copper, iron, magnesium, nickel, steel, and zinc.

The DEF solution should meet the requirements for AUS 32 according to ISO 22241-1. It is recommended that surplus DEF be stored in a cool, dry, and well ventilated area with a temperature range of 10°C-30°C (50°F-86°F) and kept out of direct sunlight to ensure a one-year shelf life. It should be stored and transported per the manufacturer's recommendations in the original purchased container; otherwise, containers made of polyethylene, polypropylene, or stainless steel are acceptable.

If the generator set contains a DEF tank, check and fill the DEF tank as needed during the prestart check and during regular diesel fuel refill intervals. The DEF level is reported and displayed on the generator set controller. When the level falls below 10% a warning symbol is displayed.

5.14 Stationary Regeneration of the Exhaust System

The John Deere engines contain equipment and controls that comprise the emissions control system to meet Tier 4 Final Emissions requirements. This is a fully automated control system embedded within the engine ECM. The engine ECM communicates with the generator set controller, via CAN, to provide messages for status and diagnostics regarding the emissions control system. When permitted to operate automatically, the system will monitor and control the equipment to maintain optimum performance.

Part of this control system includes injecting Diesel Exhaust Fluid (DEF). See the Diesel Exhaust Fluid (DEF) section for more information.

The engine ECM controls exhaust temperatures to burn any residue accumulated in the exhaust system. However, short run durations, light loads, and cool ambient temperatures may negatively impact the ability for the engine ECM to adequately elevate the exhaust temperature to a point where residue may be incinerated. Also, since elevated exhaust temperatures may be undesirable in some applications, the user is provided a means to disable this cleaning action until it is more acceptable. The status parameter and dedicated symbol are shown on the generator set controller display.

In all these cases, residue levels may rise and decrease the performance of the exhaust system. When the engine ECM determines that residue has reached a serious level, a warning symbol is shown on the generator set controller display. In addition, the Emissions menu indicates a need for cleaning.

When the need for cleaning reaches the NEEDED HIGH level, the user should take action to enable or request cleaning. This may be a simple as clearing the PREVENT ACTIVE REGEN parameter by setting it to NO. This may include removing the generator set from service by disconnecting any loads and initiating the special cleaning process referred to as Stationary Regeneration.

This special cleaning process may be initiated in numerous ways and with several scenarios mentioned in the following paragraphs. Situations or scenarios include:

- Generator Set in OFF Mode
- Single Generator Set in RUN Mode
- Generator Set in Standby (AUTO Mode, Not Running)
- Single Generator Set in AUTO Mode with ATS
- Multiple Generator Sets in AUTO- RUN Mode
- Multiple Generator Sets in AUTO Mode with ATS
- Multiple Generator Sets in AUTO Mode with External Paralleling Switchgear

Also see the Stationary Regeneration Stages in the Emissions Information section for more details.

5.14.1 Generator Set in OFF Mode

In this scenario there is a single generator set, not a paralleling application, and there is no motor operated circuit breaker. There may or may not be a manually operated circuit breaker. The generator set is shut down after pressing the OFF button.

Loads may be removed by turning them off, disconnecting their power cords, or by tripping the manual circuit breaker.

Stationary regeneration may be initiated by setting the REQUEST REGEN parameter to YES. The RUN button must be pressed to proceed. After pressing RUN, the cleaning process should begin.

When complete, the user may press the OFF button to shut down the unit. If OFF is not pressed, the controller logic will automatically shut down after another 5 minutes.

The user must re-apply the loads by reversing the process that was used to disconnect them. Normal operation can resume. To run the generator set, press the RUN button. To put the generator set into standby, press the AUTO button.

The following is a summary of the steps required:

1. Generator set in OFF mode
2. Disconnect loads
3. Set REQUEST REGEN to YES
4. Press the RUN button to start the generator set
5. Stationary Regen in process
6. Stationary Regen complete
7. Press the OFF button or wait for shutdown
8. Generator set in OFF mode
9. Reconnect loads

5.14.2 Single Generator Set in RUN Mode

In this scenario there is a single generator set, not a paralleling application, and there is no motor operated circuit breaker. There may or may not be a manually operated circuit breaker. The generator set is running after pressing the RUN button.

Loads may be removed by turning them off, disconnecting their power cords, or by tripping the manual circuit breaker.

Stationary regeneration may be initiated by setting the REQUEST REGEN parameter to YES. If the PREVENT ACTIVE REGEN parameter is set to YES, it will automatically change to NO. The cleaning process should begin immediately.

When complete, the user may press the OFF button to shut down the unit. If OFF is not pressed, the controller logic will automatically shut down after another 5 minutes.

The user must re-apply the loads by reversing the process that was used to disconnect them. Normal operation can resume. To run the generator set, press the RUN button. To put the generator set into standby, press the AUTO button.

The following is a summary of the steps required:

1. Generator set in RUN mode
2. Disconnect loads
3. Set REQUEST REGEN to YES
4. Stationary Regen in process
5. Stationary Regen complete
6. Press the OFF button or wait for shutdown
7. Generator set in OFF mode
8. Reconnect loads
9. Press the RUN button to resume operation

5.14.3 Generator Set in STANDBY (AUTO Mode, Not Running)

In this scenario the generator set is in the AUTO mode, but there is no signal (remote start) to indicate the generator set should be running. The generator set may be single or may be included in a paralleling application.

The generator set should be moved to the OFF mode by pressing the OFF button.

Loads may be removed by turning them off, disconnecting their power cords, or by tripping the manual circuit breaker.

Stationary regeneration may be initiated by setting the REQUEST REGEN parameter to YES. The RUN button must be pressed to proceed. After pressing RUN, the cleaning process should begin.

When the cleaning process is complete, the user may press the OFF button to shut down the unit. If OFF is not pressed, the controller logic will automatically shut down after another 5 minutes.

The user must re-apply the loads by reversing the process that was used to disconnect them. Normal operation can resume. To put the generator set into standby, press the AUTO button.

The following is a summary of the steps required:

1. Generator set in STANDBY mode
2. Press the OFF button
3. Disconnect loads
4. Set REQUEST REGEN to YES
5. Press the RUN button to start the generator set
6. Stationary Regen in process
7. Stationary Regen complete
8. Press the OFF button or wait for shutdown
9. Generator set in OFF mode
10. Reconnect loads
11. Press the AUTO button to resume STANDBY mode

5.14.4 Single Generator Set in AUTO Mode with ATS

In this scenario there is a single generator set, not a paralleling application, and there is no motor operated circuit breaker. There may or may not be a manually operated circuit breaker. The generator set is operated by pressing the AUTO mode button and started remotely by an ATS using the remote start contacts.

Loads may be removed by turning them off, disconnecting their power cords, or by tripping the manual circuit breaker. More automatically, some ATS's may be used to disconnect loads by transitioning to the OFF position (see ATS documentation).

Since the ATS is presumed to be operating correctly, the generator set would be running from loss of utility power. Tripping the manual circuit breaker may remove power from the ATS causing it to turn off, unless supplied by an optional power supply. The remote start contacts will likely remain closed.

Press the RUN button to start the generator set. This causes the generator set controller to ignore the remote start contacts.

The cleaning process can be initiated by setting the REQUEST REGEN parameter to YES. When the cleaning process is complete, the generator set may be placed back into operation by pressing the AUTO button.

The user must re-apply the loads by reversing the process that was used to disconnect them.

Alternatively, the stationary cleaning process may be initiated during the cooldown state; after the remote start signal is removed. In this case, simply set the REQUEST REGEN parameter to YES during cooldown. After completion of the regeneration, the cooldown will resume and normal generator set operation will occur. The generator set will shut down after the cooldown delay if no remote start signal is present and the generator set will go into the STANDBY mode.

If stationary cleaning is initiated during cooldown, without pressing the RUN button, monitoring of the remote start contacts will continue. If a remote start signal is detected during stationary regeneration, the process will abort and normal generator set operation will resume. High soot levels may remain if the process is aborted before completion.

If the generator set is in the AUTO mode but not running, for lack of a remote start signal, refer to the Generator Set in STANDBY (AUTO Mode, Not Running).section.

The following is a summary of the steps required when in AUTO mode (running):

1. Generator set in AUTO mode (running)
2. Press the RUN button to start the generator set and ignore remote start
3. Disconnect loads
4. Set REQUEST REGEN to YES
5. Stationary Regen in process
6. Stationary Regen complete
7. Press the OFF button or wait for shutdown
8. Generator set in OFF mode
9. Reconnect loads
10. Press the AUTO button to resume STANDBY mode

The following is a summary of the steps required when in AUTO mode (cooldown):

1. Generator set in AUTO mode (cooldown)
2. Loads disconnected by ATS
3. Set REQUEST REGEN to YES
4. Stationary Regen in process
5. Stationary Regen complete
6. Resume cooldown
7. Loads reconnected by ATS

5.14.5 Multiple Generator Sets in AUTO-RUN Mode

In this scenario there are multiple generator sets running in a paralleling application with PGEN communications. All generator sets utilize a motor operated circuit breaker or contactor (such as in the paralleling box) for connecting to the paralleling bus. There may or may not be a manually operated circuit breaker.

The generator sets are operated by pressing the AUTO mode button (on all units) and started by simultaneously pressing AUTO and RUN (only one unit). Generator management may be enabled to automatically add or remove generator sets from operation.

Press the OFF button to remove the generator set from the paralleling system. The motorized circuit breaker should trip removing the load from the generator set. All other controllers should remain in the AUTO mode to allow them to operate in parallel.

The cleaning process can be conducted as described in the Generator Set in OFF Mode section.

Loads may be removed by turning them off, disconnecting their power cords, or by tripping the manual circuit breaker.

Stationary regeneration may be initiated by setting the REQUEST REGEN parameter to YES. The RUN button must be pressed to proceed. After pressing RUN, the cleaning process should begin.

When the cleaning process is complete, the user may press the OFF button to shut down the unit. If OFF is not pressed, the controller logic will automatically shut down after another 5 minutes.

To resume parallel operation, press the AUTO button. The generator set may remain in the OFF-standby mode or generator management may automatically tart the generator set and bring it back online. Loads will be re-applied automatically.

The stationary cleaning process may be initiated during the cooldown state, when generator management has removed the generator set from the bus. Set the REQUEST REGEN parameter to YES during cooldown. After completion of the regeneration, the cooldown will resume and normal generator set operation will occur. The generator set will shut down after the cooldown delay and the generator set will go into the STANDBY mode.

If the generator set is not running because of shut down by generator management, refer to the Generator Set in STANDBY (AUTO Mode, Not Running).section.

The following is a summary of the steps required when in AUTO-RUN (running):

1. Generator set in AUTO-RUN (running)
2. Press the OFF button to remove the generator set from parallel operation
3. Loads disconnected by paralleling breaker
4. Set REQUEST REGEN to YES
5. Press the RUN button to start the generator set and ignore remote start
6. Stationary Regen in process
7. Stationary Regen complete
8. Press the OFF button or wait for shutdown
9. Generator set in OFF mode
10. Press the AUTO button to resume paralleling operation
11. Loads reconnected by paralleling breaker

The following is a summary of the steps required when in AUTO-RUN (cooldown by generator management):

1. Generator set in AUTO-RUN (cooldown by generator management)
2. Loads disconnected by paralleling breaker
3. Set REQUEST REGEN to YES
4. Stationary Regen in process
5. Stationary Regen complete
6. Resume cooldown
7. Press the AUTO button to resume STANDBY mode
8. Loads reconnected by paralleling breaker

5.14.6 Multiple Generator Sets in AUTO Mode with ATS

In this scenario there are multiple generator sets running in a paralleling application with PGEN communications. All generator sets utilize a motor operated circuit breaker for connecting the paralleling bus. There may or may not be a manually operated circuit breaker.

The generator sets are operated by pressing the AUTO mode button (on all units) and started by closing the remote start contacts (any one controller is acceptable or by all controllers). Generator management may be enabled to automatically add or remove generator sets from operation.

Press the OFF button to remove the generator set from the paralleling system. The motorized circuit breaker should trip removing the load from the generator set. All other controllers should remain in the AUTO mode to allow them to operate in parallel.

The cleaning process can be initiated by setting the REQUEST REGEN parameter to YES. Press the RUN button to start the generator set.

When the cleaning process is complete, the user may press the OFF button to shut down the unit. If OFF is not pressed, the controller logic will automatically shut down after another 5 minutes.

To resume parallel operation, press the AUTO button. The generator set may remain in the OFF-standby mode or generator management may automatically start the generator set and bring it back online. Loads will be re-applied automatically.

The stationary cleaning process may be initiated during the cooldown state, when generator management has removed the generator set from the bus. Set the REQUEST REGEN parameter to YES during cooldown. After completion of the regeneration, the cooldown will resume and normal generator set operation will occur. The generator set will shut down after the cooldown delay if no remote start signal is present and the generator set will go into the STANDBY mode.

The following is a summary of the steps required when in AUTO mode (running):

1. Generator set in AUTO mode (running)
2. Press the OFF button to remove the generator set from parallel operation
3. Loads disconnected by paralleling breaker
4. Set REQUEST REGEN to YES
5. Press the RUN button to start the generator set and ignore remote start
6. Stationary Regen in process
7. Stationary Regen complete
8. Press the OFF button or wait for shutdown
9. Generator set in OFF mode
10. Press the AUTO button to resume paralleling operation
11. Loads reconnected by paralleling breaker

The following is a summary of the steps required when in AUTO-RUN (cooldown by generator management):

1. Generator set in AUTO-RUN (cooldown by generator management)
2. Loads disconnected by paralleling breaker
3. Set REQUEST REGEN to YES
4. Stationary Regen in process
5. Stationary Regen complete
6. Resume cooldown
7. Press the AUTO button to resume STANDBY mode
8. Loads reconnected by paralleling breaker

5.14.7 Multiple Generator Sets in AUTO Mode with External Paralleling Switchgear

In this scenario there are multiple generator sets running in a paralleling application. The generator sets are connected to the paralleling bus by circuit breakers or contactors controlled by external switchgear. There may or may not be a manually operated circuit breaker.

The generator sets are operated by pressing the AUTO mode button (on all units) and started by the remote start contacts (independently to each unit). The PGEN communications are not utilized for automated parallel operation. Generator management may or may not be included in the switchgear.

The generator set should be removed from operation by use of the switchgear (consult the appropriate documentation). This should force the generator set to change to the cooldown state. The action should further disconnect all loads from the generator set.

The cleaning process can be initiated by setting the REQUEST REGEN parameter to YES. When the cleaning process is complete, the generator set should return to the cooldown state. The switchgear can be utilized to bring the generator set back into service.

If the generator set is in the AUTO mode but not running, for lack of a remote start signal, refer to the Generator Set in STANDBY (AUTO Mode, Not Running).section.

The following is a summary of the steps required when in AUTO mode (running by external switchgear):

1. Generator set in AUTO mode (running by external switchgear)
2. Use switchgear to remove generator set from paralleling operation
3. Loads disconnected by switchgear
4. Generator set running in cooldown mode
5. Set REQUEST REGEN to YES
6. Stationary Regen in process
7. Stationary Regen complete
8. Generator set running in cooldown mode
9. Use switchgear to return generator set to paralleling operation
10. Loads reconnected by switchgear

5.15 Extended Storage Procedure

⚠ WARNING	
	**Accidental starting.** **Can cause severe injury or death.** 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.

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

Servicing the exhaust system. Hot parts can cause severe injury or death. Do not touch hot engine parts. The engine and exhaust system components become extremely hot during operation.

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

Servicing the generator set when it is operating. Exposed moving parts will cause severe injury or death. Keep hands, feet, hair, clothing, and test leads away from the belts and pulleys when the generator set is running. Replace guards, screens, and covers before operating the generator set.

Perform the following storage procedure before taking a generator set out of service for three months or longer. Follow the engine manufacturer's recommendations, if available, for fuel system and internal engine component storage.

5.15.1 Lubricating System

Prepare the engine lubricating system for storage as follows:

1. Run the generator set for a minimum of 30 minutes to bring it to normal operating temperature.
2. Stop the generator set.
3. With the engine still warm, drain the oil from the crankcase.
4. Remove and replace the oil filter.
5. Refill the crankcase with oil suited to the climate.
6. Run the generator set for two minutes to distribute the clean oil.
7. Stop the generator set.
8. Check the oil level and adjust, if needed.

5.15.2 Cooling System

Prepare the cooling system for storage as follows:

1. Check the coolant freeze protection using a coolant tester.
2. Add or replace coolant as necessary to ensure adequate freezing protection. Use the guidelines included in the engine operation manual.
3. Run the generator set for 30 minutes to redistribute added coolant.

5.15.3 Fuel system

Prepare the fuel system for storage as follows:

Diesel-Fueled Engines

1. Fill the fuel tank with #2 diesel fuel.
2. Condition the fuel system with compatible additives to control microbial growth.
3. Change the fuel filter/separator and bleed the fuel system. See the engine owner's manual.

5.15.4 Exterior

1. Clean the exterior surface of the generator set.
2. Seal all engine openings except for the air intake with nonabsorbent adhesive tape.
3. To prevent impurities from entering the air intake and to allow moisture to escape from the engine, secure a cloth over the air intake.
4. Mask electrical connections.
5. Spread a light film of oil over unpainted metallic surfaces to inhibit rust and corrosion.

5.15.5 Battery

Perform battery storage after all other storage procedures.

1. Confirm that the generator set is stopped.
2. Disconnect the battery(ies), negative (-) lead first.
3. Clean the battery. Refer to the Clean Battery section for the battery cleaning procedure.
4. Place the battery in a cool, dry location.
5. Connect the battery to a float/equalize battery charger or charge it monthly with a trickle battery charger. Refer to the battery charger manufacturer's recommendations.

   Maintain a full charge to extend battery life.

5.15.6 Trailer Storage Procedure

If the trailer will be out of service for an extended period of time, perform the following steps for trailer storage. Store the trailer in a weather-protected building if possible.

1. Inflate tires to the specified inflation pressure. If practical, jack up the trailer and place jack stands under the trailer frame so that the weight will be off the tires.
2. Lubricate mechanical moving parts, such as the hitch, that are exposed to inclement weather.
3. Close all doors and lock all accessible doors and access panels.
4. Cover or seal all openings, louvers, vents, and drains.

5.15.7 Trailer After Storage Inspection Procedure

1. Remove all wheels.
2. Inspect the suspension for wear.
3. Inspect oil or grease seals for wear or nicks. Replace as necessary.
4. Mount wheels and torque lug nuts per the recommend torque specifications.

Notes

6.1 Introduction

This section deals with trailer hookup, transport, and setup at the jobsite. Other topics include tire changing and removal of the generator set from the trailer.

The trailer and load gross weights and overall dimensions are shown in the Appendix. Tow vehicle selection and suitability is the sole responsibility of the user. If the trailer is a rental unit, the leasing distributor has the right to cancel any agreement/contract if the leasing distributor deems the tow vehicle unacceptable.

Driver licensing, qualifications, and liability vary by state and locality. The trailer owner must review these factors and act accordingly. If the trailer is a rental unit, the leasing agreement/contract states the leasing distributor's terms and requirements.

The trailer is equipped with a license plate bracket. The trailer owner must procure appropriate licensing. If the trailer is a rental unit, the leasing distributor is responsible for licensing.

The information in this section is a guideline for experienced and qualified drivers, including contracted employees.

6.2 Trailer Hookup

The following paragraphs detail the steps necessary to attach the trailer to the tow vehicle.

6.2.1 Trailer Tongue Jack

Use the tongue jack to raise or lower the trailer coupling to match the height of the tow vehicle's hitch. Fully raise the tongue jack after attaching the trailer to the tow vehicle.

6.2.2 Rear Stabilizing Jacks

The rear stabilizing jacks help stabilize the generator set trailer. Fully raise the rear leveling jacks prior to attaching the trailer to the tow vehicle.

6.2.3 Trailer Hitch

The models offer interchangeable ball hitch or lunette eye configurations.

Carefully back the tow vehicle to position the tow vehicle hitch below the trailer coupling. Use a trailer tongue jack to lower the trailer coupling onto the hitch. After the hitch ball is fully engaged in trailer coupling, close the top latch and secure it with a user-supplied pin or padlock.

6.2.4 Safety Chains/Hooks

All trailers are equipped with safety chains/hooks. Connect trailer chain hooks to the tow vehicle's hitch loops in a crossing pattern. Chains must not drag on the road surface. If necessary, secure chains to the trailer hitch with a short length of wire to keep chains from dragging on the road surface.

6.2.5 Electrical Connection, Trailer Lights (Electric Brake System)

The trailer has a round 7-pin socket and wiring harness. The tow vehicle requires a corresponding connector and wiring harness. Contact your authorized distributor and use the supplied axle and related component manual for additional information on correct connection and operation. See Figure 61.

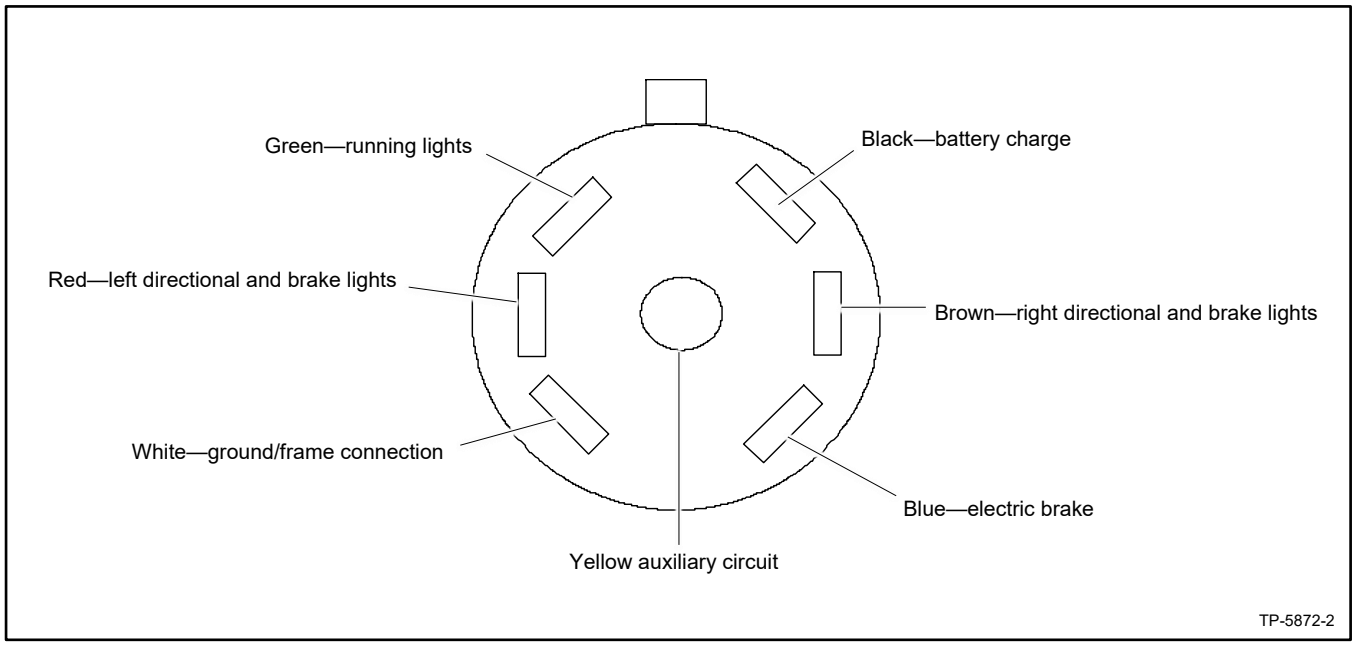


Figure 61 Trailer 7-Pin Socket and Wiring Harness with Electric Brake System (shown from tow vehicle receptacle end)

6.2.6 Trailer Brakes, Electric

The electric brake controller senses brake pedal pressure or tow vehicle deceleration and activates the electric brakes. Some brake controllers have a gain/ output control to vary the brake current, which affects brake force, and a level/synchronization switch to vary brake timing.

The trailer incorporates a breakaway switch and battery to actuate the trailer brakes should a trailer breakaway occur. Attach the breakaway switch cable to the tow vehicle hitch.

Use the vehicle's supplied component manual for all electric brake adjustment and synchronization information.

6.3 Pretransport Checklist

Following the rules below in caring for the trailer can add to its life. Use the following checklist before use. Check some items 2-3 weeks before planned transport to provide adequate maintenance time.

After about 80 km (50 miles) stop at a safe location and then at each tow vehicle fuel fill-up, recheck items such as the trailer hitch attachment, lights and electrical connections, and the trailer wheel lug torque.

- Check the engine and generator set maintenance schedule for up-to-date requirements.
- Generator set diesel fuel tank level should be minimized. See the Over the Road Gross Weight, Height, and Fuel Concerns section for additional information.
- Close the valve at the oil level regulator inlet hose when transporting the unit.
- Check the generator set-to-trailer mounting hardware. Replace all worn or damaged components and tighten hardware.
- Check the vehicle hitch and trailer coupler for compatibility and wear. The vehicle hitch and trailer coupler size must match. Replace components that show signs of wear or damage. Lubricate contact points with multipurpose grease.
- Fasten safety chains securely to tow vehicle in a crossing pattern. Check that trailer coupler is latched and secured with a pin or padlock.
- Check that the breakaway switch cable is attached to the tow vehicle hitch loop, if equipped.
- Verify that approximately 10%-15% of the trailer's total weight is on the hitch where the trailer coupling pushes downward on the hitch and does not pull upward. Check that the trailer tows in a level position. Adjust the hitch height if the trailer is not level.
- *Do Not Overload*. Stay within the gross vehicle rated capacity. See the Views and Features section and the trailer's nameplate for trailer weight.
- Inflate the tires according to the manufacturer's specifications. Replace tires that have cuts, excessive wear, or other defects.
- Check that the spare tire is inflated to the pressure indicated on the sidewall and locked in place.
- Check wheel mounting nuts/bolts with a torque wrench. Torque hardware to specifications in a star sequence.
- Check the tightness of the suspension hardware including the hanger bolt, the shackle bolt, and U-bolt nuts.
- Inspect the towing hookup for secure attachment. Check that the trailer tongue jack (and rear stabilizing jack(s), if equipped) are in the fully raised position.
- Check the operation of trailer lights. Replace burned- out lamps, broken lenses, and reflectors.
- Check that the trailer/generator set fire extinguisher is fully charged and securely stored, if equipped.
- Check that the hydraulic jack and lug nut wrench are in the utility box and the utility box is locked.
- Check that all cargo such as electrical cables and distribution boxes are secured to the trailer.
- Test drive vehicle and verify that the vehicle brake system functions.
- Synchronize the electric brakes, if equipped. Use the vehicle's supplied component manual for all electric brake adjustment and synchronization information.

6.4 Over the Road Gross Weight, Height, and Fuel Concerns

Keep a written record of the gross vehicle weight and overall tow vehicle/trailer height in the tow vehicle. Know your gross vehicle weight and stop at weigh stations in compliance with state and federal requirements.

If transporting the generator set fuel tank with fuel, do not exceed the 454 kg (1000 lb.) fuel limitation; this limitation equates to approximately 379 L (100 gal.) of diesel fuel. This limitation does not include vehicle or semitrailer fuel. Exemptions may require a CDL license and hazardous material labeling on trailer. Contact your local DOT or highway patrol for current state and federal restrictions.

Know the overall height of the tow vehicle and trailer for purposes of overhead clearances. Always plan your route in advance. Observe road signs for information about clearances of bridges, overpasses, signs, etc. If traveling in residential areas, be aware of truck routes and low clearances because of utility wires and trees.

6.5 Roadside Emergency Stopping

Be prepared for possible emergency stopping situations. The generator set trailer has a higher center of gravity when the fuel tank is empty. If conditions require pulling off the roadway and onto the road shoulder, select a suitable location. See the Surface Stability section for suitable surface recommendations.

Equip the tow vehicle with safety lights, reflective warning triangles, and/or safety flares. Carry safety equipment in compliance with state and local requirements.

Carry a fire extinguisher in the tow vehicle if the trailer/generator set is not equipped with a fire extinguisher.

6.6 Tire Changing Procedure

Follow the roadside emergency stopping procedure where applicable.

The hydraulic jack and lug wrench are located in the utility box and the spare tire is mounted on the trailer. See the General Views and Features section illustrations for further information on location. Use the following procedure for tire changing.

Use the following procedure for tire changing:

1. Stabilize the trailer using the tongue jack stand (and rear stabilizing jack(s), if equipped). It is not necessary to remove the trailer from the tow vehicle.
2. Inspect the spare tire for suitability—inflation pressure, size, load rating, etc. If required, procure a replacement equivalent type tire.
3. Use the lug wrench to loosen each lug nut on the flat tire one-half turn counterclockwise. Do not remove lug nuts at this time.
4. Select a location on the trailer nearest to the flat tire and mount the hydraulic jack. The ground surface must be flat and solid. Use a hardwood block as necessary to establish a firm base.
5. Raise the trailer using the hydraulic jack just high enough to remove the tire.
6. Remove the lug nuts and flat tire. Install the spare tire and lug nuts. Use the lug wrench and tighten the lug nuts using a star pattern. See Figure 62.

   If the trailer hub studs are lower than the spare tire holes, use the hydraulic jack to raise the trailer, as needed, to install the spare tire.
7. Lower the trailer using the hydraulic jack.

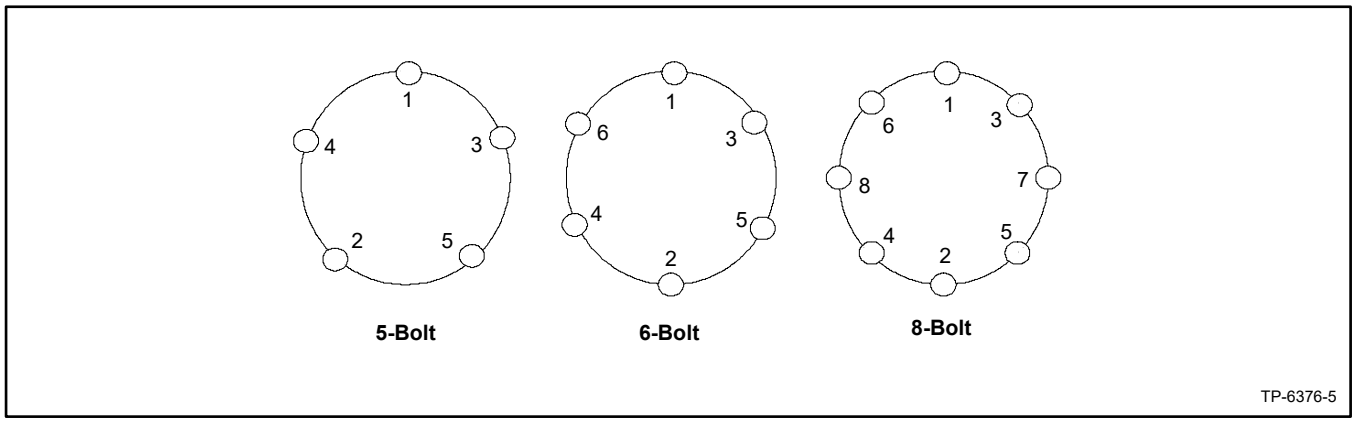


Figure 62 Wheel Lug Nut Torque Sequence

8. Tighten each lug nut to the specified torque shown in the Specifications section.

   If a torque wrench is not available when changing the flat tire, securely tighten each lug nut. Procure a torque wrench and torque the lug nuts at the first available opportunity.
9. Raise and secure the trailer tongue jack stand, rear stabilizing jack(s), or landing gear.
10. Repair/replace the flat tire at the first available opportunity.

6.7 Detaching Trailer from Tow Vehicle

The following paragraphs detail the steps necessary to detach the trailer from the tow vehicle.

6.7.1 Electrical Connection, Trailer Lights

Disconnect the wiring harness from tow vehicle. Secure both plug ends to prevent water or environmental damage.

6.7.2 Trailer Hitch

Remove the user-supplied pin or padlock from the trailer coupling's top latch and open the top latch.

6.7.3 Trailer Tongue Jack

Use a trailer tongue jack to raise the trailer coupling above the tow vehicle hitch. If the ground surface is sand or soft ground, place a hardwood block of suitable size directly beneath the trailer jack foot pad. Move tow vehicle away from the trailer and readjust the trailer tongue jack to level the trailer/generator set.

Use wheel chocks (not supplied) at each trailer wheel to further stabilize the trailer when located on inclined surfaces, in windy conditions, and in proximity to other vehicles where it might be accidentally bumped.

6.7.4 Rear Stabilizing Jacks

Use the rear stabilizing jack(s) to help stabilize the trailer. If the ground surface is sand or soft ground, place a hardwood block of suitable size directly beneath the rear stabilizing jack foot pad.

6.7.5 Safety Chains/Hooks

Disconnect trailer chain hooks from the tow vehicle. Secure the chains to the trailer tongue to prevent the chains from resting on the road surface.

6.8 Hoisting Towable Generator Set

The following paragraphs describe the method to move the towable generator set and trailer in applications where it is necessary to hoist the unit. Select moving equipment capable of handling the weight and size of the towable generator set. See the Appendix for weights. Have trained personnel lift and move the towable generator set.

The contractor and/or generator set distributor should decide on the best equipment based on the specific situation and conditions.

Before hoisting the towable generator set, empty the fuel tank when possible.

Lift the towable generator set at a single point or bridle. See Figure 63.

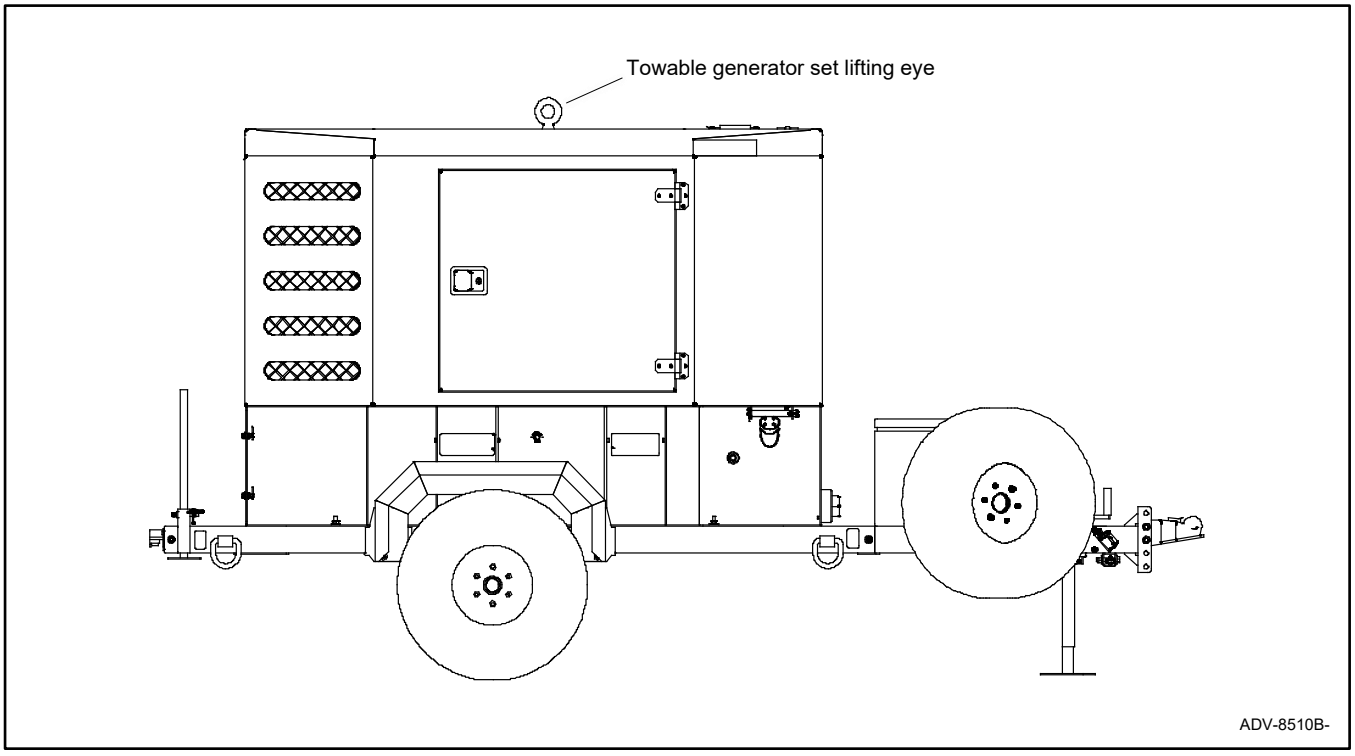


Figure 63 Single-Point Lifting Eye (35/45REOZT4 models shown)

6.9 Generator Set Removal from Trailer

The following paragraphs describe the method to remove the generator set/weather housing/fuel tank from the trailer. Select moving equipment capable of handling the weight and size of the generator set. See the Appendix for weights. Have trained personnel lift and move the generator set.

The contractor and/or generator set distributor should decide on the best equipment based on the specific situation and conditions.

Before removing the generator set/housing/fuel tank from the trailer, stabilize the trailer using the trailer tongue jack stand and rear leveling jacks. Empty the fuel tank, when possible, before removing the generator set/housing/fuel tank from the trailer.

Remove all mounting hardware between the generator set and trailer. Store mounting hardware in the trailer utility box.

Lift the generator set at a single point or bridle. See the Single-Point Lifting Eye (35/45REOZT4 models shown) figure.

Notes

7.1 Introduction

This section contains generator set, controller, general engine, trailer, and customer connection panel troubleshooting, diagnostic, and repair information. This section may refer to other literature for procedures and additional information. See the list of related materials In the Introduction section of this manual for literature part numbers. The information in this section is a guideline for generator set operating technicians and/or maintenance personnel.

Use the following charts to diagnose and correct common problems. First check for simple causes such as a dead engine starting battery or an open circuit breaker. The charts include a list of common problems, possible causes of the problem, recommended corrective actions, and references to detailed information or repair procedures.

Maintain a record of repairs and adjustments performed on the equipment. If the procedures in this manual do not explain how to correct the problem, contact an authorized distributor/dealer. Use the record to help describe the problem and repairs or adjustments made to the equipment.

7.2 Generator Set and Controller

Refer to the following charts for generator set and controller troubleshooting. Some of the corrective actions may reference the alternator and/or controller service manual for additional troubleshooting information.

7.3 Engine

Refer to the following charts for general engine troubleshooting. Refer to the engine operation manual and/or engine service manual for all specific engine troubleshooting.

7.4 Trailer

When troubles occur, do not overlook simple causes that might seem too obvious to be considered. A trailer handling problem, for example, could be attributed to low tire inflation.

Refer to the following charts as a general aid to diagnosing common trailer related problems.

Use the supplied axle and related component manual(s) for all required trailer inspection, troubleshooting, and service maintenance.

7.5 Customer Connection Panel

Some electrical problems may relate to the customer connection panel and not the generator set. Refer to the Customer Connection Panel Troubleshooting Chart.

All electrical connections and troubleshooting information in this section is for licensed electricians and/or qualified technicians. All electrical wiring and connections must comply with state and local codes based on National Electrical Code (NEC) guidelines.

7.6 Transfer Switch

Some applications may use an automatic transfer switch. Some of the following charts may reference transfer switch components and/or literature. Refer to the respective transfer switch manuals as needed.

7.7 Mobile Paralleling Box

This manual contains a separate and detailed section for troubleshooting the optional mobile paralleling box. Refer to the Mobile Paralleling Box Troubleshooting section.

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 and Emergency Stop Switch														
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			X								Controller internal fuse blown	Check for battery power to the circuit board. If fuse does not auto-reset troubleshoot the controller and wiring.†	W/D, Controller S/M
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.	Controller Specifications and Features section
X												Engine start circuit open	Press the controller master control RUN button to test the generator set. Troubleshoot the auto start circuit and time delays.	Controller Specifications and Features section; , W/D, Gen. I/M, S/M ATS O/M, S/M
X				X								Emergency stop switch activated, if equipped	Reset the emergency stop switch.	Controller Specifications and Features
			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		Controller firmware error	Review the controller display troubleshooting chart.	Controller Display and Voltage Regulation Troubleshooting
				X						X		Controller communication error	Verify that RS-485 cable “ shield” wire is connected on only one end.	W/D

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

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

Trouble Symptoms												Probable Causes	Recommended Actions	Section or Publication Reference*
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
			X									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 stator.†	Gen. S/M
									X			Vibration excessive	Tighten loose components. Ensure that the generator set is placed in an appropriate location and set up properly.†	—
			X	X								Voltage regulator settings incorrect	Adjust the voltage regulator.	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.	General Maintenance section
X	X											Battery weak or dead	Recharge or replace the battery. The spec sheet provides recommended battery CCA rating.	General Maintenance section, 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.	Controller Specifications and Features section, Prestart Checks and Controller Operation section

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

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

Trouble Symptoms												Probable Causes	Recommended Action	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 spec sheet 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. Ensure that the generator set is placed in an appropriate location and set up properly.†	—
X	X			X						X	X	Engine ECM and/or sensors	Troubleshoot the engine ECM and/or sensors.	Eng. O/M, Eng. S/M
Cooling System														
						X		X				Air openings clogged	Clean the air openings.	—
						X						Coolant level low	Restore the coolant to normal operating level.	General Maintenance section
						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.	General Maintenance section, Eng. O/M
				X								Low coolant level shutdown, if equipped	Restore the coolant to normal operating level.	General Maintenance section
						X						Thermostat inoperative	Replace the thermostat.	Eng. S/M

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

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

Trouble Symptoms												Probable Causes	Recommended Actions	Section or Publication Reference*
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			
Fuel System														
	X			X								Fuel tank empty or fuel valve shut off	Add fuel and move the fuel valve to the ON position.	—
	X	X			X							Air in fuel system (diesel only)	Bleed the diesel fuel system.	Eng. O/M
	X	X		X	X							Fuel filter restriction	Clean or replace the fuel filter.	Eng. O/M
	X	X			X							Fuel or fuel injectors dirty or faulty (diesel only)	Clean, test, and/or replace the inoperative fuel injector.†	Eng. S/M
	X											Fuel solenoid inoperative	Troubleshoot the fuel solenoid.†	Eng. S/M
	X	X			X			X				Fuel injection timing out of adjustment (diesel only)	Adjust the fuel injection timing.†	Eng. S/M
	X				X			X				Fuel feed or injection pump inoperative (diesel only)	Rebuild or replace the injection pump.†	Eng. S/M
Lube System														
						X	X		X			Oil level low	Restore the oil level. Inspect the generator set for oil leaks.	Eng. O/M
				X								Low oil pressure shutdown	Check the oil level.	Eng. O/M
	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

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

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

7.9 Controller Display and Voltage Regulation Troubleshooting Chart

Trouble Symptoms	Probable Causes	Recommended Actions	Section or Publication Reference*
Controller Display and Voltage Regulator			
Display is black	No/low battery charge	Recharge/replace battery	General Maintenance section, Battery
Display shows single segment	Low battery voltage	Recharge battery	General Maintenance section, Battery
Display shows an error message	Controller firmware fault has occurred or pushbutton/ rotary selector dial entry error	Review the System Fault Shutdown Lamp With Digital Displays section	Controller Specifications and Features section, Prestart Checks and Controller Operation section
Display locks up	No/low battery charge	Recharge/replace battery	General Maintenance section, Battery
Output voltage ramps	Defective exciter winding. Voltage ramp on startup is normal, but ramping past the target without recovering may indicate additional failures in the alternator or excitation circuit.	Troubleshoot alternator components †	Generator Service Manual
Output voltage unstable	Voltage regulation calibration incorrect	Readjust voltage regulation †	SiteTech O/M
Unable to change voltage and current calibrations	Calibration not enabled	Enable calibration in Generator Metering section	Calibration Submenu section, SiteTech O/M
Unable to find volt select menu	Volt select not enabled	Enable volt select in SiteTech	SiteTech O/M

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

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

7.10 Trailer Troubleshooting Chart

Problem	Possible Cause	Corrective Action
Trailer is unstable or noisy during towing.	Tire(s) worn or damaged	Check tire condition. Repair or replace.
	Tire pressure low	Check tire pressure and inflate as necessary.
	Wheel lug nuts loose	Torque wheel lug nuts.
	Tire/wheels mismatched on same axle	Check compatibility of wheels and tires on each end of axle.
	Trailer not level horizontally (side to side)	Check compatibility of wheels and tires of each axle. Check trailer weight distribution and cargo.
	Trailer not level horizontally (front to back)	Check and adjust trailer hitch height.
	Generator set not secured to trailer	Check mounting hardware.
	Trailer suspension noisy	Lubricate suspension contact points.
	Trailer suspension worn or damaged	Check components and replace as necessary.
	Tow vehicle suspension worn or damaged	Check tow vehicle suspension and replace as necessary.
	Trailer hitch worn or damaged or incorrectly attached	Reconnect trailer to tow vehicle. Replace worn or damaged components as necessary.
	Wheel bearings underlubricated	Disassemble, clean or replace, and repack.
	Axle shaft or spindle bent	Check components and replace as necessary.
	Bearings worn	Check components and replace as necessary.
	Trailer overloaded	Check trailer weight capacity and cargo.
Tow vehicle and trailer are unstable or noisy during braking	Tow vehicle brakes worn	Check brake fluid level. Add fluid as necessary.
	Brake components worn	Check component and replace as necessary.
	Brake linings/drums greasy or oily	Clean or replace.
	Rotors/drums out of round	Machine or replace.

7.11 Customer Connection Panel Troubleshooting Chart

Problem	Possible Cause	Corrective Action
Main circuit breaker(s) tripped or trips when reset	Circuit breaker overloaded	Reduce circuit load. Reset circuit breaker.
	Electrical circuit shorted	Check electrical circuit wiring and load connections.
	Circuit breaker inoperative	Contact an authorized service distributor/dealer or licensed electrician.
Duplex circuit breaker(s) tripped or trips when reset	Circuit breaker overloaded	Reduce circuit load. Reset duplex circuit breaker(s).
	Circuit breaker trip unit configured incorrectly	Configure trip unit to appropriate setting based on the generator set rated output in the given alternator output configuration.
	Electrical circuit shorted	Check electrical circuit wiring and load connections.
	Circuit breaker inoperative	Contact an authorized service distributor/dealer or licensed electrician.
	GFCI outlet tripped	Check ground circuit of GFCI outlet.
Duplex receptacles have no power	Generator set not running	Power to duplex receptacles is from the generator set- - not shore power.
	Duplex circuit breaker(s) tripped	Reduce circuit load. Reset duplex circuit breaker(s).
Voltage selector switch position does not match load voltage.	Unit not set up for application	Contact onsite electrician or rental distributor. See the Electrical Connections and Requirements section for more information.
Voltage selector switch knob does not rotate.	Padlock installed on lockout feature	Contact onsite electrician or rental distributor.
	Lockout button inoperative	Press lockout button and rotate (do not move the voltage selector switch while generator set is running). See the Electrical Connections and Requirements section for more information.
	Voltage selector switch inoperative (Voltage selector switch not used on all models)	Contact an authorized service distributor/dealer or licensed electrician.
User-supplied wiring between customer connection panel and load devices feels hot or has burning odor	Wiring undersized for application	Contact onsite electrician or rental distributor.
	Terminal connections loose and/or corroded	Clean, if required, and tighten terminal connections. Torque customer connection panel load lugs to specifications.
Battery charger and/or block heater not functioning	Devices not connected to receptacle	Plug devices into respective receptacle.
	Circuit breaker(s) open or tripped	Close circuit breaker(s)
	User-supplied wiring between electrical power and shore power disconnected	Connect user-supplied wiring from shore power to customer connection panel.
	Shore power circuit breaker(s) open or tripped	Close circuit breaker(s)

8.1 Introduction

The following sections describe potential problems and provide instructions on how to troubleshoot the mobile paralleling box and the Decision-Maker® 3500 controller on the generator set. SiteTech™ refers to the Rehlko SiteTech™ program installed on a laptop computer that is connected to the generator controller with a USB cable.

DANGER 	**Hazardous voltage.Electric shock, explosion, or arc flash.** **Will cause severe injury or death.** **HIGH VOLTAGE – KEEP OUT** Only trained and authorized personnel may open the enclosure. Any terminal may be energized when any cable is connected. Do not connect or disconnect cables under load. De-energize all cables at generator set prior to opening the cover.

8.2 Check Wiring and Communication Connections

8.2.1 Check Wiring

The first steps in troubleshooting a paralleling system should be to check the system wiring and communication. Perform the following steps before proceeding to the next sections.

1. Check the control cable connections between both generator sets and the paralleling box.
2. Review the connections to the paralleling box to double-check that the control cable for generator #1 is connected to the same generator set as the load cables for generator #1.
3. Verify that the pins in the control cable connectors are not damaged or corroded. Verify that the control cable connectors are firmly seated on both ends.
4. Ensure that the wiring inside each generator set and the wiring inside the paralleling box is not damaged or disconnected.
5. Follow the communications path using a multimeter. The PGEN communication lines should have a reading of about 1.6 VAC, increasing by about 0.1 VAC with each additional node connected. If the voltage is present, the wires are connected to at least one controller.
6. Note that a maximum of eight generator sets can be connected in one paralleling system. More than eight generator sets cannot communicate or parallel with the others.

8.2.2 Check PGEN Nodes Online

The number of PGEN Nodes Online displayed on the controller should match the total number of generator set in the paralleling system, including the generator set being observed. If the number shown for PGEN Nodes Online is not correct, check the wiring as described in the Check Wiring section first.

If the controller senses most, but not all, of the nodes present at the site, there is likely a connection error with one of the units. Use the voltage selector switch technique below to determine which generator sets are not communicating with the others.

1. On one of the generator sets indicating 2 or more connected nodes, move the voltage selector switch to a different position for about 5 seconds and then back to the appropriate position. One of the other generator sets should display a system voltage high or system voltage low shutdown, identifying itself as the generator set that is communicating with the generator set being tested.
    a. If the generator set that displays the fault is connected to the same paralleling box as the unit being tested, check that the communication cable between the paralleling boxes is connected.
    b. If the generator set that displays the fault is connected to a different paralleling box than the unit being tested, verify connection of the other generator set connected to the same paralleling box.

8.3 Output Matching

The generator set controller verifies that the output parameters of all paralleled generator sets match before permitting the appropriate contactor in the paralleling box corresponding to any of the generator sets to close. The System Voltage, System Frequency, and phase connection of the generator sets must match before the contactor will be energized. The controllers do not know which of the units are configured correctly (if any), so they will inhibit any of the generator sets from supplying the load until they all match (and are presumed to be correct).

Genset System Frequency High Warning indicates that the generator set displaying it has a higher system frequency than at least one other generator set that is connected to the paralleling communication lines. At least one of the generator sets will display a System Frequency Low Warning, allowing easy determination of the misconfigured generator set.

System Frequency Low Warning indicates that the generator set displaying it has a lower system frequency than at least one other generator set that is connected to the paralleling communication lines. At least one of the generator sets will display a System Frequency High Warning, allowing easy determination of the misconfigured generator set.

System Voltage L-L High Warning indicates that the generator set displaying it has a higher system voltage (by at least 5 volts) than at least one other generator set that is connected to the paralleling communication lines. At least one of the generator sets will display a System Voltage Low Warning, allowing easy determination of the misconfigured generator set.

System Voltage L-L Low Warning indicates that the generator set displaying it has a lower system voltage (by at least 5 volts) than at least one other generator set that is connected to the paralleling communication lines. At least one of the generator sets will display a System Voltage High Warning, allowing easy determination of the misconfigured generator set.

System Phase Erroneous Data Received Warning indicates that the generator set displaying it has a different alternator lead connection than at least one other generator set that is connected to the paralleling communication lines. All generator sets that are connected to the communication lines will display an identical fault, so the configuration will have to be reviewed individually to determine which generator set is configured differently.

8.4 Contactor in Paralleling Box Does Not Close

The generator set controller will attempt to close the contactor in the paralleling box under the following conditions:

- The control cable is connected correctly.
- The generator set controller senses communication with another generator set (PGEN Nodes Online is at least 2) or Synchronization Control is configured to Standalone Mode by setting the Standalone mode to true.
- There are no other units running with their contactors closed (if the sync mode is check) or the sync mode is set to active.
- The bus is not energized or is energized by another generator set in communication with the generator set being tested.
- There are no faults present that would inhibit the generator set from supplying the load.

If the above conditions are met but the contactor does not close, check the following.

1. **Dead Bus**

   A dead bus is a deenergized bus (measured bus voltage is below the dead bus threshold, which defaults to 10% of system voltage). The factors governing dead bus closure are less complicated than closure to a live bus, so the dead bus case should be tested first.

   a. Check the wiring and communication connections. See the Check Wiring and Communication Connections section.

   b. Ensure dead bus.

      Verify that the bus is dead by stopping all other generator sets and checking the bus metering under METERING->PARALLELING METERING or under Bus Metering in SiteTech™.

   c. Check sync mode.

      Verify that the Sync Mode in Run setting on the controller is set to Check. Start the generator set by pressing the RUN button.

   d. Check for warnings on the controller.

      (1) **Fail to close delay high warning** indicates that the contactor in the paralleling box did not close as expected.

a. Make sure that the control cable is connected correctly, the fuses in the contactor close circuit are intact and the pins in the control harness connectors are not bent, damaged, or corroded.

b. Check programmable digital output 1:2 or 116 in SiteTech™ to ensure that it is enabled and the event is set to Contactor.

c. Verify that wiring in the generator set and wiring in the paralleling box is undamaged and connected correctly.

(2) **Max close attempts high warning** indicates that the controller has tried multiple times to close the contactor in the paralleling box without success.

a. Make sure that the control cable is connected correctly, the fuses in the contactor close circuit are intact and the pins in the control harness connectors are not bent, damaged, or corroded.

b. Check programmable digital output 1:2 or 116 in SiteTech™ to ensure that it is enabled and the event set to Contactor.

c. Verify that wiring in the generator set and wiring in the paralleling box is undamaged and connected correctly.

(3) **Other warning.** See the Output Matching section.

e. Verify that the sync mode is not set to OFF.

The generator set controller uses Sync Mode in Auto if the Auto indicator (over the Auto button) is illuminated or Sync Mode in Run if the Run indicator (over the Run button) is illuminated.

The Sync Mode defaults to Active for Auto and Check for Run. The contactor in the paralleling box should close to a deenergized (dead) bus in either case. Setting the Sync Mode to Off will disable synchronization and closure to a dead bus.

2. Live Bus

A live bus is one that is powered by another generator set in the paralleling system or by another source such as a utility service. The paralleling box does not support paralleling to utility sources, so a live bus will be powered by other generator sets in the paralleling system for the purposes of this troubleshooting section.

a. Check the wiring and communication connections. See the Check Wiring and Communication Connections section.

b. Check bus metering. Check that the bus is live by checking the bus metering under METERING->PARALLELING METERING or under Bus Metering in SiteTech™. The bus voltage on all three phases should be close to the system voltage for the generator set. If the bus metering is inconsistent between phases or reads no voltage, check the following:

(1) The control cable from the generator set to the paralleling box should have no damaged pins or corrosion and should be firmly seated on both ends.

(2) Review the connections to the paralleling box to double-check that the control cable for generator #1 is connected to the same generator set as the load cables for generator #1.

(3) With all generator sets in the system stopped and locked out, check the fuses in the paralleling box. Refer to TT-1672 for fuse locations.

(4) Ensure that all wiring in the paralleling box and generator set is undamaged and connected as indicated by the wiring diagram.

c. Verify phase rotation.

Check the phase angle between the generator set and the paralleling bus (Phase Difference under GENERATOR INFO->PARALLELING OPERATION->SYNCHRONIZING SETUP or Phase Angle between Generator Voltage and Bus L-L). If the phase angle is not 0 (zero), check the cam-lock connections between the generator sets and the paralleling box. Make sure that the cam-lock cable connections are correctly matched: black connected to black, red to red, and blue to blue. If the cam-lock cables are not color coded, use black, red, and blue tape to label both ends of each cable to avoid connection errors. Use green tape to label the ground cables.

d. Verify synchronization.

Ensure that the generator set is able to maintain synchronization with the paralleling bus by performing this procedure:

(1) Start another generator set in the paralleling system.

(2) Close the paralleling contactor for that generator set.

(3) Verify that Sync Mode in Run is set to Check.

(4) Start the generator set being tested by pressing RUN.

(5) Verify that:

- Voltage between the two generator sets matches within 1%.
- Frequencies of the two generator sets match within 0.5 Hz (as long as the other generator set is able to support the load that is connected to the bus).
- Phase angle (phase difference) matches within 5°.

  If the phase varies more than 5° or if the engine hunts audibly, adjust the phase matching gains. If the phase angle is varying quickly (at least once per second), try decreasing the integral gain first, then the proportional gain. If the phase angle is varying slowly, try increasing the proportional gain.

e. Verify speed control.

On the GENERATOR INFO->CONFIGURATION->GENERATOR CONFIG menu, note the Engine Speed Adjustment setting. Then change it to 30 with the engine running. The engine should slow down noticeably and the output frequency should drop to 59.3–59.4 Hz.

Set the Engine Speed Adjustment to 70 with the engine running. Verify that the output frequency increases to 60.6–60.7 Hz with a noticeable change in engine speed.

After verifying the speed control, set the engine speed back to the original setting.

f. Check for warnings on the controller.

(1) **Fail to close delay high warning** indicates that the contactor in the paralleling box did not close as expected.

a. Make sure that the control cable is connected correctly, the fuses in the contactor close circuit are intact and no pins in the control harness connectors are bent, damaged, or corroded.

b. Check programmable digital output 1:2 or 116 in SiteTech™ to ensure that it is enabled and the event set to Contactor.

c. Verify that wiring in the generator set and wiring in the paralleling box is undamaged and connected correctly.

(2) **Max. close attempts high warning** indicates that the controller has tried multiple times to close the contactor in the paralleling box without success.

a. Make sure that the control cable is connected correctly, that the fuses in the contactor close circuit are intact and that the no pins in the control harness connectors are bent, damaged, or corroded.

b. Check programmable digital output 1:2 or 116 in SiteTech™ to ensure that it is enabled and the event set to Contactor.

c. Verify that wiring in the generator set and wiring in the paralleling box is undamaged and connected correctly.

(3) Other warnings. See the Output Matching section.

g. Verify the sync mode.

The generator set controller uses Sync Mode in Auto if the Auto indicator (over the Auto button) is illuminated or Sync Mode in Run if the Run indicator (over the Run button) is illuminated.

The Sync Mode defaults to Active for Auto and Check for Run. The contactor in the paralleling box will only close to a live bus if the mode is set to passive (not recommended) or active. Setting the Sync Mode to Off will disable synchronization and closure to a live bus.

8.5 Contactor Cycles Closed and Open

If the contactor status does not change within 0.5 seconds after the contactor is signaled to close, the controller will signal the contactor to open again. If the contactor cycles open and closed repeatedly, check the following:

1. Check the paralleling system wiring and connections as described in the Check Wiring and Communication Connections section.
2. Trace the wiring from the controller to the paralleling box. The voltage on the contactor status input to the controller (Programmable Analog Voltage Input 106) should read between -3 and -4 V when the contactor is open, or between -1 and 0 V when the contactor is closed.

8.6 No Bus Metering is Present

If the contactor closes and stays closed, the generator set is able to close and sense the closed condition correctly, but is not able to see the bus voltage increase to match that of the generator set.

1. Review the connections to the paralleling box to double-check that the control cable for generator #1 is connected to the same generator set as the load cables for generator #1.
2. Check the line circuit breaker on the generator set to make sure that it is closed.
3. Check the paralleling system wiring and connections as described in the Check Wiring and Communication Connections section.

8.7 Breaker Trips on Startup

The line circuit breaker on the generator set trips in a short circuit condition. Tripping on generator set startup indicates that the output is either connected incorrectly or connected to a short circuit.

1. Check wiring to the paralleling box to ensure that each phase is connected to the appropriate phase on the paralleling box. Connecting two or more phases on the generator set to a single phase on the paralleling box will cause a short circuit condition.
2. Check that no safety jumpers are connected inside the generator set or paralleling box.
3. Ensure that both contactors in the paralleling box are open.

8.8 Alternator Whines with No Output or Shuts Down for Alternator Protection

If the circuit breaker trip settings are set for 208 V or 240 V single-phase, the breaker may not trip in a short circuit condition when run on a different output configuration (such as 277/480).

See the Breaker Trips on Startup section.

8.9 Generator Produces No Output Voltage

If the generator set does not produce voltage when the engine is running, check the following:

1. Verify generator set output.

   The controller may not be able to measure output voltage if the alternator is damaged or short circuited, but it is also possible that the sensing is not connected. Measure the generator set output with a multimeter to validate the generator set controller's measurement.

   a. Voltage is present.
      Check the wiring to the sensing connector on the controller. Refer to the alternator service manual for further troubleshooting.
   b. Voltage is low (<20V).
      The alternator may be wired incorrectly or damaged. Refer to the alternator service manual for further troubleshooting.
   c. Voltage is very low (<1V).
      The generator set output may be short circuited or wiring may be improperly connected or disconnected altogether. Refer to the alternator service manual for further troubleshooting.

2. Check the contactor status.

   The generator set controller will not enable the voltage regulator if the contactor in the paralleling box appears to be closed.

   Contactor status is found under METERING->PARALLELING METERING under Connected to Bus. True indicates that the contactor is closed.

3. Make sure that the controller is reading engine speed.

   The controller must sense engine speed above the crank disconnect speed (default is 750 RPM) before the alternator output is enabled.

4. Verify that the generator set is operating in the running state.

   The Genset State is found under the Genset Info heading in SiteTech™. If the controller is operating in the cooldown state and the voltage regulator is not enabled (in the case where the start signal was removed before the generator set reached the crank disconnect speed), the generator set will continue to the end of the cooldown duration without enabling the voltage regulator.

8.10 Breaker Trips when Contactor Closes

1. Dead Bus.

   The line circuit breaker on the generator set trips in a short circuit condition, so it is likely that the paralleling or load bus is short-circuited, either by equipment malfunction or by an intentional means (such as safety jumpers).

   a. Make sure that the connections from the paralleling box to the load bus are connected correctly, with each set of phase conductors only connecting to the appropriate phases.

   b. Check the load bus for short-circuits.

2. Live Bus.

   If the line circuit breaker on the generator set trips when the contactor closes to a live bus (that another generator set is already supplying), it is probably caused by an out-of-phase or reverse rotation closure, meaning that the voltage across the contactor is out of phase. The controller will only signal the contactor to close when it senses that the generator set is synchronized with the paralleling bus, meaning that the connections between the generator set and the paralleling box are probably incorrect.

   To verify this, disconnect the other generator sets from the paralleling bus and close the generator set being tested to the dead bus, following the instructions under Check Bus Metering and Phase Rotation Verification in the Contactor in Paralleling Box Does Not Close section, 2 Live Bus.

8.11 Shutdown when Breaker Closed

If the circuit breaker trip settings are set for 208V or 240V single-phase, the breaker may not trip in a short circuit condition when run on a different output configuration (such as 277/480). The alternator protection, loss of AC sensing, or even undervoltage faults will stop the generator set in those conditions.

See the Breaker Trips when Contactor Closes section.

8.12 Contactor Opens Shortly After Closure (Protective Relays)

If the contactor opens and does not attempt to reclose, it is probably due to a protective relay. Protective relays are named from the old mechanical devices that they replace, hence the name “relay,” and are designated by ANSI numbers. Protective relays disconnect the generator set from the paralleling bus in an effort to protect the generator set and/or the load from damage.

Although the generator set controller supports a total of 8 protective relays, only 5 of them are likely to occur shortly after contactor closure. The protective relay that caused the contactor to open will be listed on the alarms page as a warning. Protective relay trips can be cleared by pressing the AUTO button when the control is already in auto mode or by pressing the OFF/RESET button.

Note:
The generator set will operate for the duration of the CB Trip to Shutdown Delay (5 minutes default) after a protective relay has opened the paralleling contactor. Then the generator set will shut down.

For a summary table of the information in this section, see Figure 64 at the end of the section.

1. **Reverse VARs (ANSI 40)**

   The Reverse VARs relay (also called loss of field, loss of excitation, or under excitation) monitors the reactive power absorbed by the generator set. If the reactive power absorbed by the generator set is too high, the generator set may be unable to maintain synchronization in parallel, potentially causing the alternator to slip a pole resulting in possible damage to the alternator and abnormal waveform provided to the load. To avoid this occurrence, the generator set controller has a Reverse VARs relay, indicated as Generator Total Reactive Power Low.

   The Reverse VARs protective relay usually triggers due to one of the following reasons:

   a. Voltage regulator target mismatch.

      If the voltage regulators are targeting different voltages on two generator sets, the generator set with the higher target produces more reactive power than the other in an effort to bring the voltage to the higher target. If the load demands enough reactive power, the reverse VAR protective relay may not act until the load is removed. The generator set that triggers the reverse VARs protective relay will be the one with the lowest target if the targets are mismatched.

      The Voltage Regulator Target can be found under the Voltage Regulator heading in SiteTech™ and under the GENERATOR INFO->VOLTAGE REGULATION menu on the controller.

   b. Improper calibration of generator voltage.

      The voltage regulators always attempt to match the metered voltage with the voltage regulator target. If two generator sets are calibrated differently, they may read the same voltage waveform at different levels, causing them to adjust the alternator excitation in an effort to match the measured voltage with the target. In a paralleled system, increasing the alternator excitation will primarily affect the produced reactive power, so the generator sets may not share reactive power well.

      With the generator sets operating in parallel, ensure that the generator set metering (L-L) reads within 0.25% between the two generator sets (0.5V @ 208 or 240, 1V at 480V). Calibration on one controller to match the other is a viable technique to resolve this issue, but use of a calibrated multimeter is preferred.

      The Line-Line Generator Voltage can be found under the Generator heading in SiteTech™ and under the METERING->GENERATOR METERING and CONTROLLER CONFIG->CALIBRATION menu on the controller.

c. Improper calibration of bus voltage.

The synchronization logic attempts to match the generator set output voltage with the measured bus voltage before closing the contactor in the paralleling box by adjusting the voltage regulator target. If the bus metering is inaccurate (does not match the generator set metering), the generator set may increase or decrease the output voltage enough to cause a reverse VARs protective relay trip short after the contactor closes.

The bus metering is found under the Bus Metering heading in SiteTech™ and under the METERING->PARALLELING METERING and CONTROLLER CONFIG->CALIBRATION menu on the controller.

d. Different droop setting.

If the voltage regulators are configured to operate at different reactive droop levels, it is possible that the one with a lower droop percentage will attempt to support far more of the load than the other. This can result in a reverse VARs protective relay operation on the generator set with the higher droop percentage, so the droop percentages should match between all paralleled units.

The Reactive droop setting is found under the Synchronization Control Heading in SiteTech™ or under the GENERATOR INFO->VOLTAGE REGULATION or GENERATOR INF->PARALLELING OPERATION->SHARING SETUP menu on the controller.

e. Different engine types.

Because the controller provides underfrequency unloading (Volts/Hz), the voltage regulator target of a generator set is decreased when the frequency of the paralleling bus is below the knee frequency for Volts/Hz. Different engines may have different Volts/Hs knees and slopes, causing the voltage regulator targets to differ significantly when load is applied. If the volts/Hz knee frequency or slope between the units differs significantly, it may be necessary to increase the proportional, integral, and derivative gains for the reactive load sharing by factors of 1.5 until unintended protective relay operation is not observed or the sharing becomes unstable. Adjusting the knee frequency or slope of the Volts/Hz changes the generator set performance during a transient condition and is not recommended.

f. Large capacitor banks on the load bus.

In some applications, the low power factor caused by large motor loads is offset by capacitor banks. Capacitor banks generate VARs, which means that the generator sets will have reverse VARS if only feeding into a capacitor bank. The capacitor bank could potentially cause damage to the generator sets if the real power demand of the load is too high, so the capacitors should be disconnected when the power system is fed by the generator sets or disconnected when the motor load is not present.

If all the generator sets in the system read negative (capacitive) VARs, the generator set system sees a capacitive load, which should be removed when operating the system with generator set power.

Note:
A large capacitor bank could potentially cause a single generator set (non- paralleling) to slip a pole as well, especially because the single generator set will be unable to disconnect from the load using a contactor in the paralleling box. Resolving the capacitive power factor of the load is the safe resolution to the scenario; obtaining a single large generator set is not a recommended solution.

g. Alternator damage.

If the alternator loses the ability to source current to the field, that alternator will absorb the necessary reactive power to excite itself (produce voltage) from the other generator sets in the system, resulting in a reverse VARs protective relay operation opening the contactor in the paralleling box.

Operating the generator set that disconnected from the bus without allowing it to reconnect will probably result in under-voltage or no voltage output at all if the alternator is unable to source current to the field.

In addition, if the alternator excitation system fails to a state where too much excitation is provided, the other alternators in the system will have to decrease excitation to keep the voltage within the target, resulting in the properly functioning generator sets disconnecting from the paralleling bus due to reverse VARs.

Operating the generator set that disconnected from the bus without allowing it to reconnect will probably result in over-voltage if the alternator is unable to control to the field. Refer to the appropriate alternator service manual for additional service instructions.

h. Excitation control wiring.

If the wiring to the excitation control on the alternator is disconnected or shorted, it will exhibit similar symptoms to a damaged excitation system. Be sure that the wiring is connected correctly before proceeding with any alternator repairs. Refer to the appropriate alternator service manual for additional service instructions.

i. Voltage sensing wiring.

If the generator set voltage sensing loses connection to the controller, the voltage regulator will adjust the alternator excitation up in an effort to reach the target, potentially causing a reverse VARs protective relay trip.

2. Reverse Power (ANSI 32R)

The reverse power relay (also called loss of fuel or anti-motoring relay) monitors the real power absorbed by the generator set. If the real power absorbed by the generator set is too high, the generator set may have run out of fuel or has a mechanical issue on the engine that prevents it from generating power, so the alternator is acting as a motor to maintain synchronous speed on the engine, adding the mechanical load of the losses of that engine to the load on the other generator sets in the paralleling system. To avoid this occurrence, the generator set controller has a reverse power relay, indicated as Generator Total Real Power Low.

The reverse power protective relay usually triggers due to one of the following reasons:

a. Engine speed governor target mismatch.

If the engine governors are targeting a different speed on two generator sets, the generator set with the higher target will produce more real power than the other in an effort to bring the speed up to the higher target. If the load demands enough real power, both generator sets may supply enough to prevent the reverse power protective relay from acting, but it will still act when the load is removed. The generator set that triggers the reverse power protective relay will be the one with the lowest target if the targets are mismatched.

The engine governor target speed is called Adjusted Engine Run Speed and can be found under the Engine Metering heading in SiteTech™ and under the GENERATOR INFO->CONFIGURATION->GENERATOR CONFIG menu on the controller.

b. Different droop setting.

If the ECMs or governors are configured to operate at different droop levels, it is possible that the one with a lower droop percentage will attempt to support far more of the load than the other. This can result in a reverse power protective relay operation on the generator set with the higher droop percentage, so the droop percentages should match between all paralleled units.

Note:
The generator set controller synchronizes and shares load effectively without droop programmed into the ECM. There is no need or benefit to programming droop into the otherwise isochronous engine governors.

c. Different engine types.

Because the throttle or rack may move more quickly on some engines than on others, it is possible that one engine takes the entire load when load is applied, in which case the other engine takes no load. This case doesn't typically result in a reverse power scenario (even the slow engine takes some power), but a more likely case for reverse power is on load rejection, where the quicker-responding engine is driven to a higher speed by the power that the slower-responding engine continues to produce until the control mechanism has time to react.

The most common scenario where this can happen is in applications that parallel two units with different fuel types or combustion processes like a diesel engine paralleled with a natural gas generator set.

In the case where the reverse power is caused by dissimilar generator sets, it may be necessary to extend the time on the reverse power protective relay or to increase the proportional, integral, and derivative gains for the real power sharing by factors of 1.5 until the protective relay is not acting at an undesirable time or the load sharing becomes unstable.

d. Engine out of fuel

If an engine runs out of fuel, it will not be able to supply power to the load, but will continue to rotate as long as another generator set is also connected to the load and has sufficient capacity to motor the engine without fuel. This is the scenario where the reverse power protective relay should trip, avoiding potential damage to the engine fuel system components from operating without fuel and undesired load on the other generator sets.

Note:
Generator Management provides a fuel-level management mode that works to equalize the fuel level in the base tanks of any generator sets in the paralleling system. The load must be low enough that a generator set can be stopped and generator management must be enabled and configured to equalize the fuel level.

e. Engine issue.

Some failures on an engine will result in a loss of the ability to provide power without issuing a fault or warning that would disconnect the generator set from the paralleling bus.

f. Communication loss.

If the controllers are not able to communicate loading information, they will tend to share load poorly if at all. Verify that the PGEN Nodes Online value is representative of the number of generator sets in the paralleling system.

3. Over Current (ANSI 51)

The Overcurrent protective relay indicates that the generator set is providing too much current. It measures all three phases and can trigger on any of them.

The overcurrent protective relay tripping the contactor in the paralleling box is usually an indication of one of the following:

a. Imbalanced loading on the generator set.

b. Excessive power consumption on the convenience outlets in 480V output configuration.

c. Large motor loads or transformers with a low power factor connected to the generator set.

4. Overpower (32O)

Overpower indicates that the controller opened the contactor in the paralleling box because the generator set was overloaded. This can occur for a variety of reasons that follow:

a. A generator set is not running. A generator set in the paralleling system is not running due to a protective shutdown, scheduled maintenance, incorrect setup, or operator intervention. The number of generator sets was selected to support the load, but the load is too much with one generator set not operating.

This is a good case to consider load management. Load management can potentially disable some of the larger and less critical loads when the generation capacity of the system is reduced, allowing some of the loads to retain power.

Load management is active in the controller any time that a generator set in the paralleling system is receiving a start signal (including a local system start request) and can be configured to outputs of any controller in the system, including the 15-relay dry contact board.

b. The load is too large for the generator sets. If all generator sets are running and the load is still too high for them, it may be necessary to install an additional generator set and paralleling box (if required).

Load management may be able to resolve the overload condition as well, especially if the overload condition is due to a transient or infrequent load.

c. Generator set rating is unexpectedly low. Many generator sets have a lower rating when configured for single-phase than when configured for three-phase. If configured for single-phase, additional generator sets may be required if load management is not utilized.

d. Improperly configured generator management. If generator management does not start an additional generator set quickly enough, the existing generator sets may be overloaded.

If available generator sets were not started before the protective relay opened the paralleling contactor, the generator management start percentage or generator management start time may need to be decreased. Both parameters are found under the Generator Management heading in SiteTech and GENERATOR INFO->PARALLELING OPERATION->GENERATOR MANAGEMENT on the controller.

e. Improperly configured load management. If load management does not remove loads quickly enough, the existing generator sets may be overloaded.

   If load management is used, check if all loads were shed before the contactor for the generator set tripped. If the loads were all shed, the load priority connections at the site should be reviewed to ensure that they remove enough load from the generator set system for a single generator set to support the critical load. If the loads were not all shed, decrease the base over load shed time or the generator overloaded percent under the Genset System Configuration heading in SiteTech™. The generator overload percent can also be found under GENERATOR INFO->PARALLELING OPERATION> LOAD CONTROL on the controller.

f. Operating in run. Load management is only operational when the system is receiving a start signal. If the generator sets are operating in run, load management may not be active.

5. Under Frequency (ANSI 81U)

The underfrequency condition is typically caused by the engine load being greater than the engine is capable of supplying. This fault will usually cause all generator sets to open their contactors, since they are all tied to the same paralleling bus. Several common causes of this fault include:

a. Altitude and environmental conditions.

   The engine on the generator set was rated under standard atmospheric conditions. Increased altitude, humidity, and temperature will decrease the output capability of the generator set. See the generator set documentation for derating instructions.

b. Inadequate maintenance.

   Dirty fuel filters or air filters can easily decrease the power output capability of an engine, but lack of Diesel Emission Fluid (DEF) or a dirty Diesel Particulate Filter (DPF) can also cause a derate in the output capability the engine. Most emissions-related derating will be annunciated on the controller display.

c. Insufficient fuel supply.

   Low gas pressure, undersized supply lines, or insufficient flow capacity can decrease available generator set power. Verify that the installation is configured in accordance with the installation manual for the affected generator set.

d. Generator set overload.

   See Step 4, Overpower (32O).

6. Undervoltage (ANSI 27)

Undervoltage and underfrequency are often related, but not always. Steeper slopes for the underfrequency unloading curve make the undervoltage protective relay more likely to trip, while less steep slopes will probably cause the underfrequency protective relay to trip.

If the engine speed is dropping, refer to Step 5, Underfrequency (ANSI 81U). If the engine speed (and output frequency) is not dropping, but the voltage is still falling out of specification, the following list will provide a few potential causes:

a. Slope of reactive droop curve is too steep. The system shares load well with 0.5% reactive droop, the default is 1% and the slope can be set as high as 10%. With 10% droop, it is entirely possible that a motor load will cause the voltage to go below the undervoltage limit for long enough to trigger the protective relay.

   The reactive droop can be found under Reactive Power Load Sharing in SiteTech™ or in the GENERATOR INFO->VOLTAGE REGULATION menu in the controller.

b. Voltage regulator gain is too low. The voltage regulator will drift significantly over time and/or load if the voltage regulator gain is set below 50. The factory default is 128 and the controller is usually stable up to 255.

   The voltage regulator gain can be found under Voltage Regulator in SiteTech™ or in the GENERATOR INFO->VOLTAGE REGULATION menu in the controller.

Protective Relay	Possible Cause	Action	Reference
Reverse VARS (ANSI 40) Also called loss of field, loss of excitation, or under excitation relay	Voltage regulator target mismatch.	Verify that voltage regulator target settings on the paralleled generator sets match. GENERATOR INFO>VOLTAGE REGULATION	Voltage Regulation Submenu section
	Incorrect voltage calibration.	Verify that L- L generator metering on paralleled generator sets match within 0.25% (0.5 V @ 208 VAC or 1V at 480 VAC). METERING>GENERATOR METERING and CONTROLLER CONFIG>CALIBRATION Use a calibrated meter to calibrate the generator set controllers, if necessary.	Metering Menu section Calibration Submenu section
	Incorrect calibration of bus voltage.	Check bus metering on the controller and use a calibrated meter to compare readings. Adjust calibration on the controller, if necessary. METERING>PARALLELING METERING CONTROLLER CONFIG>CALIBRATION	Paralleling Metering Submenu section Calibration Submenu section
	Droop settings do not match.	Check the reactive droop setting on each generator set. Droop percentages should match on all paralleled generator sets. GENERATOR INFO>VOLTAGE REGULATION or GENERATOR INFO>PARALLELING OPERATION>SHARING SETUP	Voltage Regulation Submenu section Paralleling Operation section
	Different engine types.	Try adjusting the proportional, integral, and derivative gains for the reactive load sharing by factors of 1.5 until the protective relay does not trip or until sharing becomes unstable.	Voltage Regulation Submenu section
	Large capacitor banks used to offset motor loads on the load bus.	**Note:** Large capacitor banks can damage the generator set. Disconnect capacitors when the system is powered by the generator sets or when motor load is not present.	—
	Alternator damage.	Service the alternator.	Alternator service manual.
	Excitation control wiring disconnected or shorted.	Check and correct wiring and connections.	TT-1672
	Voltage sensing wiring connection problems.	Check and correct wiring and connections.	TT-1672
Reverse Power (ANSI 32R) Also called loss of fuel or anti-motoring relay	Engine speed governor targets do not match.	Check the Adjusted Run Speed on each generator set controller and adjust to match. GENERATOR INFO > GENERATOR CONFIG	
	Engine ECM or governor droop settings do not match.	Check the droop percentage levels on the engine ECM or governor and adjust, if necessary. Do not program droop into isochronous engine governors.	
	Different engine types or fuel types.	Try extending the time on the reverse power relay or increasing the proportional, integral, and derivative gains for the real power sharing by factors of 1.5 until the protective relay does not trip or until sharing becomes unstable.	Generator Set Service Manual

Protective Relay	Protective Relay	Protective Relay	Protective Relay
	No fuel.	Check all engines and add fuel.	—
	Engine issue. Some engine failures may not trigger a generator set fault or warning.	Service the engine.	Engine Service Manual
	Communication loss.	Check PGEN Nodes online. Check communication wiring and connections.	Check PGEN Nodes Online section
Over Current (ANSI 51)	Imbalanced loading on the generator sets.	Redistribute the load.	
	Excessive power consumption on the convenience outlets in 480 V output configuration.	Reduce or redistribute the load.	
	Large motor loads or transformers with a low power factor connected to the generator set.		
Overpower (32O)	A generator set is not running.	Check and correct the cause of the generator set shutdown.	
	Load is too large even when all generator sets are running.	Add another generator set or a load management system.	
	Generator set rating is unexpectedly low.	Check the generator set rating for the applicable voltage and phase configuration. Add another generator or a load management system.	Generator set specification sheet
	Generator management is not configured correctly.	Check and adjust the generator management start capacity percentage and/or generator management start time.	Paralleling Operation section
	Load management is not configured correctly.	Check that all loads were shed before the contactor opened. Decrease the base over lad shed time or the generator overloaded percent if necessary. GENERATOR INFO>PARALLELING OPERATION>LOAD CONTROL Review load shed priority connections.	Paralleling Operation section TT-1672
	Generator sets are operating in RUN.	Load management may not be active if the generators are not in AUTO.	
Under Frequency (ANSI 81U)	Generator set output capacity is reduced due to altitude or environmental conditions.	Check the generator set derate information.	Generator set specification sheet
	Inadequate generator set maintenance.	Check engine maintenance items including fuel filters, air filters, diesel emission fluid, diesel particulate filter, etc. Perform engine maintenance as required.	General Maintenance section
	Insufficient fuel supply.	Check fuel pressure, fuel supply lines, and fuel flow capacity. Verify that fuel system installation complies with fuel requirement specifications.	Engine Service Literature
	Generator set overload.	See Overpower (32O).	
Undervoltage (ANSI 27)	Reduced engine speed.	See Underfrequency (ANSI 81U).	
	Reactive droop setting is too high.	Check the reactive droop setting. Default is 1%.; 10% may be too high. Reduce if necessary. GENERATOR INFO>VOLTAGE REGULATION	Voltage Regulation Submenu section
	Voltage regulator gain is too low.	Check the voltage regulator gain. If it is set below 50, increase it. Default setting is 128; maximum recommended setting is 255. GENERATOR INFO>VOLTAGE REGULATION	Voltage Regulation Submenu section

Figure 64 Protective Relays, Summary

8.13 Reactive Power Imbalance

The generator set controller shares power by percentages, meaning that two generator sets of different sizes should share the reactive power such that the ratio between the reactive power on the generator sets is the same as the ratio between their power ratings. In other words, the reactive power should be identical between all generator sets in the paralleling system when the reactive power is expressed as a percentage of the generator set rating.

Reactive Power is listed as a percentage in the GENERATOR INFO->PARALLELING OPERATION->SHARING SETUP menu on the controller. Both the bus% kVAR and generator set % kVAR are listed on the screen allowing for easy comparison.

1. **Imbalance only on contactor closure.**

   Due to the running generator set supplying reactive power to the load and the incoming generator set being unloaded, an imbalance in reactive power is expected immediately following contactor closure, but neither generator set should absorb reactive power for more than a few cycles in that scenario.

   If one of the generator sets absorbs reactive power from the other (negative reactive power) immediately following the closure of a contactor in a paralleling box (connecting another generator set to the paralleling bus), but works to stabilize shortly afterward, the bus metering is probably in need of calibration or the voltage matching window is set too large.

   The bus metering is calibrated under CONTROLLER CONFIG->CALIBRATION, the voltage matching window is available in SiteTech™ under the Synchronization Control heading or in the GENERATOR INFO->PARALLELING OPERATION->SYNCHRONIZING SETUP.

2. **Imbalance only on load application or rejection.**

   Reactive power imbalance on load application is caused by different response rates of the alternator portion of the paralleled generator sets. The response rates could be caused by many things, including:

   a. Different excitation topology.

      Some of the towable generators use wound-field alternators (such as the 4D5.6 and 4D8.3 alternators used on the 35REOZT4 and 45REOZT4 models), while others use the Fast-Response® II or Fast-Response® X alternators (such as the 30REZGT and the 55REOZT4). The Fast-Response® alternators are able to react much more quickly to transient loading due to their permanent magnet topology and direct control of the current on the main rotor.

      Imbalance on load acceptance and rejection is expected when alternator topologies are mismatched, but the imbalance should be largely corrected by the sharing logic within 5 seconds. If the sharing logic does not correct the issue within 5 seconds, it may be necessary to continue increasing the proportional, integral, and derivative gains for the kVAR load sharing by 50% until the recovery time drops below 5 seconds or the sharing becomes unstable.

      The kVAR sharing gains are found under the Reactive Power Load Sharing heading in SiteTech™ and under the GENERATOR INFO->PARALLELING OPERATION->SHARING SETUP menu on the controller.

   b. Different alternator sizes.

      Small alternators typically respond more quickly than large alternators, so two alternators of significantly different sizes can respond significantly differently, resulting in an imbalance in reactive power under transient conditions.

      Imbalance on load acceptance and rejection is expected when alternator sizes are significantly mismatched, but the imbalance should be largely corrected by the sharing logic within 5 seconds. If the sharing logic does not correct the issue within 5 seconds, it may be necessary to continue increasing the proportional, integral, and derivative gains for the kVAR load sharing by 50% until the recovery time drops below 5 seconds or the sharing becomes unstable.

      The kVAR sharing gains are found under the Reactive Power Load Sharing heading in SiteTech™ and under the GENERATOR INFO->PARALLELING OPERATION->SHARING SETUP menu on the controller.

   c. Voltage regulator gain mismatch.

      If the alternators being paralleled are similar, the voltage regulator gains should match between them. The gain should also be greater than 50 to ensure that the voltage regulator reaches the target voltage.

      The voltage regulator gain is found under the Voltage Regulator heading in SiteTech™ and under the GENERATOR INFO->VOLTAGE REGULATION menu on the controller.

d. Reactive droop mismatch.

Reactive droop determines how the voltage regulator target responds to a sudden change in load.

The reactive droop is listed in % at 100% kVAR, meaning that it is the percentage that the output voltage will dip when the alternator has 100% reactive load on it. Because it is listed as a percentage, it is expected to be set to the same level for all generator sets in a paralleling network.

The reactive droop is found under the Voltage Regulator heading in SiteTech™ and under the GENERATOR INFO->VOLTAGE REGULATION menu on the controller.

e. Underfrequency unloading settings mismatch.

Not only does each alternator respond differently, but each engine also responds differently. In an effort to optimize transient performance of each generator set, the Volts/Hz settings may vary significantly, meaning that the voltage target of each generator set may vary when the bus frequency decreases from a load condition. If the voltage target varies, the reactive power will also vary, but the reactive power should stabilize as the engine speed recovers.

Imbalance on load acceptance and rejection is expected when alternator sizes are significantly mismatched, but the imbalance should be largely corrected by the sharing logic within 5 seconds. If the sharing logic doesn't correct the issue within 5 seconds, increase the proportional, integral, and derivative gains for the kVAR load sharing by 50% until the recovery time drops below 5 seconds or the sharing becomes unstable.

3. Continuous Imbalance.

Constant imbalance on the reactive power output of paralleled generator sets is a different scenario than transient differences because it is not corrected by the kVAR sharing logic. In addition, imbalanced reactive load indicates that the paralleling system is vulnerable to reverse VAR protective relay triggering if the bus load is low enough.

See the Step 1, Reverse VARs (ANSI 40) of the Contactor Opens Shortly After Closure section.

8.14 Real Power Imbalance

1. Imbalance only on contactor closure.

Engine load is related to the position of the torque regulation mechanism (throttle, wastegate, fuel rack, or pulse-width in an ECM) at the time of contactor closure. Due to the need for a difference in speed for synchronization, a variation in load immediately following the closure of the contactor is normal, but the power on running and incoming generator sets should be positive or become positive very shortly after contactor closure.

The real power will follow a ramp rate to reach equilibrium with the other generator sets, so the power level on any generator sets that recently closed should ramp up to match the ones that were already running and supplying the load, while the power on the running generator sets will ramp down to match the ones that recently closed.

If the power remains negative for an extended period of time, the reverse power protective relay may trip the paralleling contactor.

Refer to the Step 2, Reverse Power (ANSI 32R) of the Contactor Opens Shortly After Closure (Protective Relays) section.

2. Imbalance only on load application or rejection.

Real power variation during a load application or rejection should be minimal when paralleling two generator sets with the same model number, but variations are normal when the sizes or the fuel types of the generator sets differ significantly.

While dissimilar generator sets may cause imbalance, the imbalance should be largely corrected by the sharing logic within 5 seconds. If the sharing logic does not correct the issue within 5 seconds, increase the proportional, integral, and derivative gains for the kW load sharing by 50% until the recovery time drops below 5 seconds or the sharing becomes unstable.

The kW sharing gains are found under the Real Power Load Sharing heading in SiteTech and under the GENERATOR INFO->PARALLELING OPERATION->SHARING SETUP menu on the controller.

3. Continuous real power imbalance.

If the real power imbalance persists past a transient event, it is likely to cause a reverse power protective relay trip.

See the Step 2, Reverse Power (ANSI 32R) of the Contactor Opens Shortly After Closure (Protective Relays) section.

8.15 Generator Stops for Over Power or Underfrequency

The generator set shutdowns for overpower and underfrequency are secondary protections to prevent damage to the generator set or customer loads during adjustment of the protective relays. The shutdowns act in the case where there is no paralleling contactor to allow the generator set to disconnect from the load. They should be coordinated to trigger after the corresponding protective relay so that they do not act under paralleling conditions.

See the Step 4, Overpower (ANSI 32O) and Step 5, Underfrequency (ANSI 81U) of the Contactor Opens Shortly After Closure (Protective Relays) section.

8.16 Breaker Trip to Shutdown Delay

The breaker trip to shutdown delay determines how long the controller continues to run after a protective relay has tripped the breaker or the breaker has failed to close. In these cases, the fault can be cleared by pressing the AUTO button while in auto. If the fault is not cleared, the generator set is unable to provide power to the load, and it is appropriate for the generator set to stop.

8.17 Generator Set Stops Unintentionally

If Generator Management is enabled, generator sets will stop when they are not needed. Set Generator Management Enabled to OFF for each generator set unless generator management is required for the application.

8.18 Generator Set Does Not Stop When Expected

Generator Management will only stop generator sets if it is enabled. Generator management will operate to full capacity only when all generator sets have generator management enabled and are running in the AUTO mode.

In addition, the following settings must be the same for all nodes. Any differences or inconsistencies in these settings will result in the Generator Management Enabled: Erroneous Data Received fault. For generator management to be active, the following parameters must match for all generator sets in a paralleling system:

- Order selection mode (runtime or manual)
- Minimum number of generator sets online
- Minimum load shed priority
- The length of the stability delays
- Maximum runtime hour difference
- Maximum fuel level difference

In addition, generator management requires that none of the generator sets have any of the following preemptive warnings or alarms:

- Low oil pressure warning
- Low fuel pressure warning
- High engine coolant temperature warning
- Failure to synchronize warning
- Water In fuel warning
- Fuel tank leak
- Loss of fuel

8.19 Generator Set Always Starts in Auto

The generator set will start when placed in AUTO if it receives a start signal. Start signals can be sent over CAN, Modbus, or SiteTech™ to any controller in the system and cleared by pressing the off/reset button on the appropriate controller. Start signals can also be hard-wired to any controller in the system using engine start leads 3 and 4, but this signal cannot be cleared except by removing the signal.

The most common source of confusion for unexpected start signals is the system start request, generated by pressing AUTO and RUN simultaneously. To clear this command, press AUTO and OFF simultaneously.

Notes

Appendix A. Abbreviations

A, amp	ampere	blk. htr.	block heater	DAC	digital to analog converter
ABDC	after bottom dead center	BMEP	brake mean effective pressure	dB	decibel
AC	alternating current	bps	bits per second	dB(A)	decibel (A weighted)
A/D	analog to digital	br.	Brass	DC	direct current
ADC	advanced digital control; analog to digital converter	BTDC	before top dead center	DCR	direct current resistance
adj.	adjust, adjustment	Btu	British thermal unit	DEF	diesel exhaust fluid
ADV	advertising dimensional drawing	Btu/min.	British thermal units per minute	deg., °	degree
AGM	absorbent glass mat	C	Celsius, centigrade	dept.	department
Ah	amp-hour	cal.	Calorie	dia.	Diameter
AHWT	anticipatory high water temperature	CAN	controller area network	DI/EO	dual inlet/end outlet
AISI	American Iron and Steel Institute	CARB	California Air Resources Board	DIN	Deutsches Institut fur Normung e. V. (also Deutsche Industrie Normenausschuss)
ALOP	anticipatory low oil pressure	CAT5	Category 5 (network cable)	DIP	dual inline package
alt.	alternator	CB	circuit breaker	DPDT	double-pole, double-throw
Al	aluminum	CC	crank cycle	DPST	double-pole, single-throw
ANSI	American National Standards Institute (formerly American Standards Association, ASA)	cc	cubic centimeter	DS	disconnect switch
AO	anticipatory only	CCA	cold cranking amps	DVR	digital voltage regulator
APDC	Air Pollution Control District	ccw.	Counterclockwise	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 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

Notes

Overall Dimensions and Weight

Standard Skid	35REOZT4	45REOZT4	55REOZT4	90REOZT4	120REOZT4	145REOZT4	175REOZT4
Trailer length, * mm (in.)	3993 (157.2)		4397 (173.1)	4772 (187.9)		5202 (204.8)	
Trailer width, † mm (in.)	1867 (73.5)		1725 (67.9)	2018 (79.4)		2009 (79.1)	
Trailer height, ‡ mm (in.)	2206 (86.9)		2398 (94.4)	2682 (105.6)		2855 (112.4)	
Trailer weight, kg (lb.)	326 (720)		381 (840)	581 (1280)		650 (1433)	
Gross weight, § kg (lb.)	1724 (3800)	1769 (3900)	2427 (5350)	3159 (6965)	3241 (7145)	4188 (9233)	4256 (9382)

***** Length includes trailer tongue.
† Width includes trailer fenders.
‡ Height includes generator set and sound enclosure.
§ Gross weight includes trailer, generator set (with engine fluids), sound enclosure, and fuel tank with no fuel.

Field Draggable Skid	35REOZT4	45REOZT4	55REOZT4	90REOZT4	120REOZT4	145REOZT4	175REOZT4
Trailer length, * mm (in.)	3993 (157.2)		4397 (173.1)	4772 (187.9)		N/A	
Trailer width, † mm (in.)	1867 (73.5)		1725 (67.9)	2018 (79.4)		N/A	
Trailer height, ‡ mm (in.)	2206 (86.9)		2398 (94.4)	2682 (105.6)		N/A	
Trailer weight, kg (lb.)	326 (720)		381 (840)	581 (1280)		N/A	
Gross weight, § kg (lb.)	1787 (3940)	1833 (4040)	2440 (5380)	3239 (7140)	3320 (7320)	N/A	

***** Length includes trailer tongue.
† Width includes trailer fenders.
‡ Height includes generator set and sound enclosure.
§ Gross weight includes trailer, generator set (with engine fluids), sound enclosure, and fuel tank with no fuel.

General Trailer Specifications

	35REOZT4	45REOZT4	55REOZT4	90REOZT4	120REOZT4	145REOZT4	175REOZT4
Trailer capacity, kg (lb.)	2266 (4995)		2722 (6000)	4536 (10000)		4608 (10160)	
Brake size, mm (in.)	305 (12)						
Brake type	Electric with breakaway system						
Trailer hitch types	2 5/16 in. ball (standard)/lunette eye (optional)						

Tire and Wheel Specifications

	35REOZT4	45REOZT4	55REOZT4	90REOZT4	120REOZT4	145REOZT4	175REOZT4
Tire size	ST225/75R15 LRD						
Tire rated capacity: quantity, kg (lb.)	Two, 1152 (2540)			Four, 1152 (2540)			
Tire load range max., kg (lb.)	1284 (2830)						
Tire inflation pressure @ rated load, kPa (psi)	552 (80 psi)						
Wheel rim, in.	15 x 6, 6-bolt steel						
Wheel lug nut torque, Nm (ft. lb.)	122 (90)						
Wheel stud size	1/2-20						

Axle and Suspension Specifications

	35REOZT4	45REOZT4	55REOZT4	90REOZT4	120REOZT4	145REOZT4	175REOZT4
Axle type: quantity, capacity, kg (lb.)	Single axle, 2266 (4995)		Single axle, 2722 (6000)	Dual Axle, 2268 (5000) per axle		Dual Axle, 2722 (6000) per axle	
Axle bearing type	Tapered roller						
Axle bearing grease type	Lithium complex						
Hub material	G-3000 gray iron						
Hub size	6-bolt, 140 mm (5 1/2 in.) bolt circle						
Suspension type	Torsion						

Trailer Electrical Specifications

	35REOZT4	45REOZT4	55REOZT4	90REOZT4	120REOZT4	145REOZT4	175REOZT4
Trailer running light voltage	12						
Trailer wiring harness type, conductor qty.	SAE round, 7-wire (with electric brakes *)						
* Powered by tow vehicle battery via the 7-wire plug.							

Fuel Tank, DEF Tank, and Fuel System Specifications

	35REOZT4	45REOZT4	55REOZT4	90REOZT4	120REOZT4	145REOZT4	175REOZT4
Recommended fuel	ASTM D975 or EN 590 Ultra Low Sulfur Diesel (ULSD) with sulfur content <15 mg/kg (15 ppm)						
Diesel fuel tank, L (gal.)	293 (77)		386 (102)	727 (192)		923 (244)	
Recommended DEF	—			Meet the requirements of AUS 32 according to ISO 22241-1			
DEF tank capacity				41 L (10.8 gal.)		44.2 L (11.7 gal.)	
Fuel inlet (supply), external fuel tank fitting	3/8 NPT (female)						
Fuel return, external fuel tank fitting	3/8 NPT (female)						
Fuel tank fill	2 NPT						
Fuel tank drain							
Fuel filter—prefilter	74 Microns		—				
Fuel filter primary/water separator	5 Microns @ 98% Efficiency		5 Microns @ 95% Efficiency	2 Microns			

Password Protected Menus

Password (default)	00000 (5 zeros)
Password changes	Requires SiteTech™ software

Use the default password to access the password protected menus as needed. Use the SiteTech™ software to change the password. Some menu selections require a password in order to make changes. Use the following procedure to activate the edit mode. Access can be made at any menu level.

1. Press and hold the selector knob until the Password menu appears (approx. 5 seconds).
2. Enter each numeric digit of the password by rotating the selector knob to the respective number and then pressing the selector knob to acknowledge the selection. Repeat this for each password digit.
3. The next menu will indicate Password Correct Now in Edit Mode. Use the selector knob to choose Ok and press the selector knob.

Editable entries will show as highlighted text with dark background and inverse color text.

The controller will remain in the Edit mode as long as the selector knob and menus are actively used. The Edit mode will terminate after approximately 5 minutes of inactivity. Otherwise, to exit the Edit mode, press and hold the selector knob until the highlighted text disappears (approx. 5 seconds).

Notes

Appendix D Controller Displays from the Engine ECM

The controller display showing engine information is dependent upon the engine manufacturer and the corresponding Engine Control Module (ECM). The following list indicates what engine displays are available by the engine manufacturer. This information is subject to change by the engine manufacturer.

Controller Displays as Provided by the Engine ECM (availability subject to change by the engine manufacturer)		
Display	**Rehlko KDI**	**John Deere (JDEC)**
Ambient temperature		
Charge air pressure	X	
Charge air temperature	X	X
Coolant level		
Coolant pressure		
Coolant temperature		X
Crankcase pressure		
ECM battery voltage		
ECM fault codes		X
ECM serial number		
Engine model number		X
Engine speed	X	X
Fuel pressure		
Fuel rate	X	X
Fuel temperature	X	X
Oil level		
Oil pressure		X
Oil temperature		
Trip fuel		

Some engines do not have an ECM and in some cases the ECM information is not available as a controller display. In these situations, critical information like oil pressure and coolant temperature are displayed by the controller using independent engine sensors not used by the ECM.

Notes

Appendix E 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

	Operating Hours		Service Record	
Date Run	Hours Run	Total Hours	Service Date	Service

System Configuration for Parallel Operation

This section provides additional information regarding the mobile paralleling box setup. Use this information in conjunction with TT-1672 Paralleling Box Instruction and SiteTech™ Software Manual TP-6701.

1. I/O Configuration

The controller use RDO2 to control the contactor in the paralleling box. Programmable Digital Output 116 in SiteTech controls the function of RDO2, which is a programmable output. In order for the contactor to operate appropriately, Set Programmable Digital Output 116 to Contactor as shown in Figure 65:

I/O Configuration settings are found under the following menus in the Decision-Maker® 3500 controller:

I/O->DIGITAL OUTPUT->DIGITAL OUTPUT 1:2

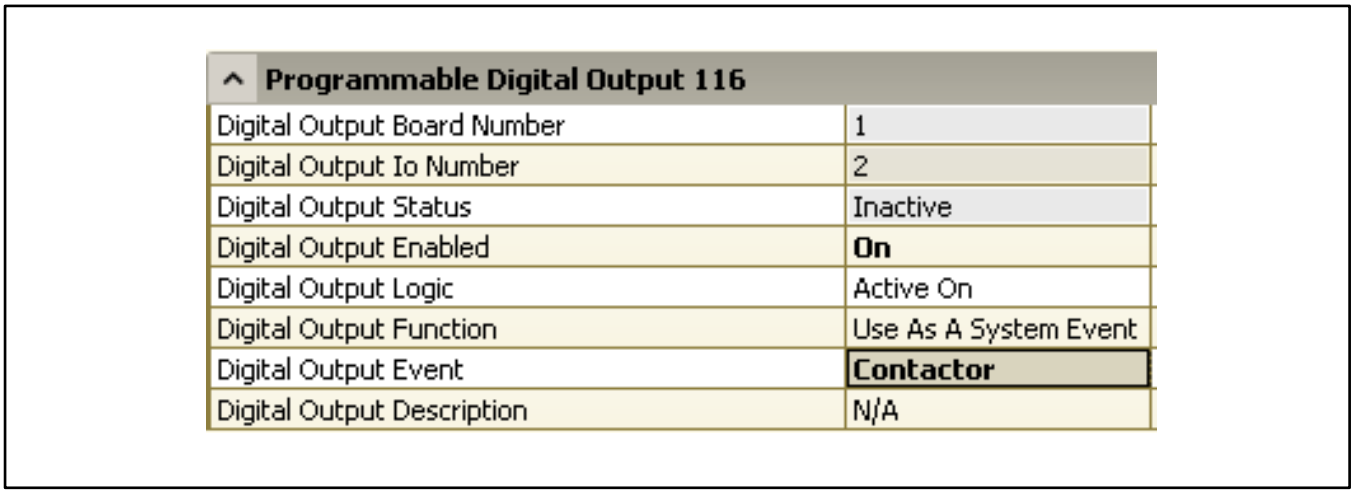


Figure 65 SiteTech Menu, Output to Control the Contactor

2. Reactive Droop

The voltage regulator can react very quickly to increased or decreased field current based on a deviation from the target voltage. If the voltage regulator target differs between the two generator sets, even slightly, the excitation level of the alternator can change significantly. The excitation level of the alternator adjusts output voltage in a single generator set application, but primarily changes the reactive power produced by the generator set when paralleled.

Reactive droop acts to equalize the reactive loading on the generator sets by decreasing the voltage target if the reactive power output of the generator set increases. See Figure 66. This behavior is desirable in a paralleling application, but results in decreased terminal voltage under reactive load, which is not always desirable in single generator set applications (especially when the generator set is located a long distance from the building).

Because towable generator sets are often used in single generator set applications, it is possible that the droop was set to 0% at a previous installation to minimize voltage droop under load.

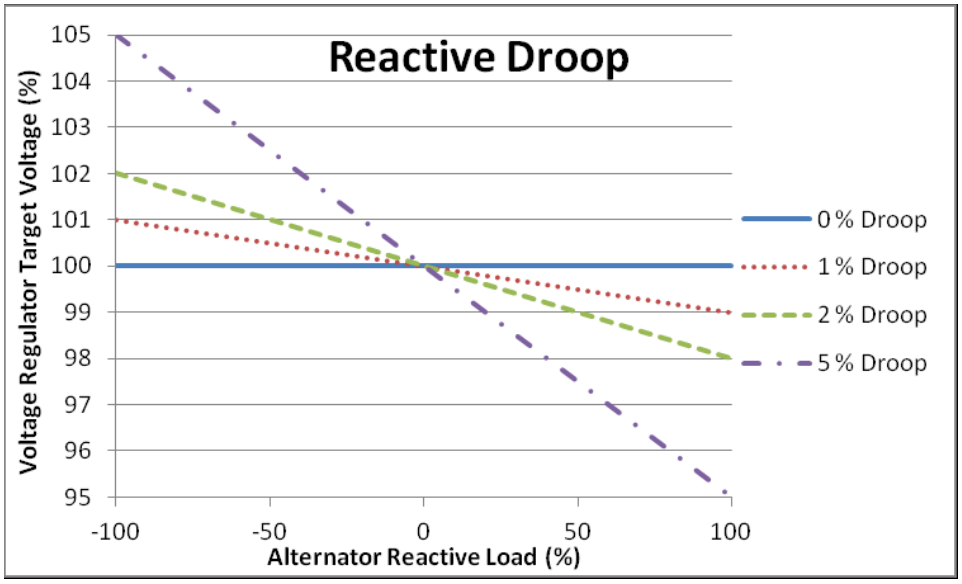


Figure 66 Reactive Droop

For paralleling applications, the reactive droop should be set to 0.5–2% (higher droop numbers are not necessary for stability and are undesirable because they cause larger voltage variations). See Figure 67. The controller will correct the output voltage to offset the droop in paralleling applications, but the process takes several seconds after a load change, so the droop setting is important.

Note:
The controllers on all paralleled generator sets should be configured to provide the same reactive droop in the voltage regulator; otherwise, load acceptance and rejection will cause unequal loading between the generator sets.

Reactive Power Load Sharing	
Reactive Power Baseload Setpoint	50.0 %
Power Factor Setting	0.80
Reactive Droop Slope	1.0 %@FL
Voltage Bias	0.00
Var Control Mode	Pf Control Mode
Reactive Power Sharing Proportional Gain	1.00
Reactive Power Sharing Integral Gain	1.00
Reactive Power Sharing Derivative Gain	1.00
Voltage Trim Proportional Gain	1.00
Voltage Trim Integral Gain	1.00
Voltage Trim Derivative Gain	1.00
Reactive Power Baseload Proportional Gain	1.00
Reactive Power Baseload Integral Gain	1.00
Reactive Power Baseload Derivative Gain	1.00
Power Factor Baseload Proportional Gain	1.00
Power Factor Baseload Integral Gain	1.00
Power Factor Baseload Derivative Gain	1.00
System Reactive Power Control Proportional Gain	1.00
System Reactive Power Control Integral Gain	1.00
System Reactive Power Control Derivative Gain	1.00
System Power Factor Control Proportional Gain	1.00
System Power Factor Control Integral Gain	1.00
System Power Factor Control Derivative Gain	1.00

Figure 67 SiteTech Menu, Reactive Droop

The default Reactive Droop is 1%, which works in nearly all applications.

Reactive Droop settings are found under the following menus in the DEC3500:

GENERATOR INFO->VOLTAGE REGULATION (called VOLT DROOP AT 100% kVAR)

GENERATOR INFO->PARALLELING OPERATION->SHARING SETUP

3. Target Voltage

The voltage regulators must target the same voltage in order to ensure that they share reactive power. Small differences in the targets may only result in unequal reactive power sharing (until the droop offsets the difference in the target), but large differences in the targets may result in a generator set opening its paralleling contactor to protect itself from a potential pole-slipping scenario (low reactive power).

Target voltage is often set well above the nominal voltage of the generator set in order to offset voltage drop in the cabling between the generator set and the facility that the generator set is supplying with power. It is completely acceptable to set the target voltage higher than nominal in a paralleling application, but all paralleled generator sets should target the same value. See Figure 68.

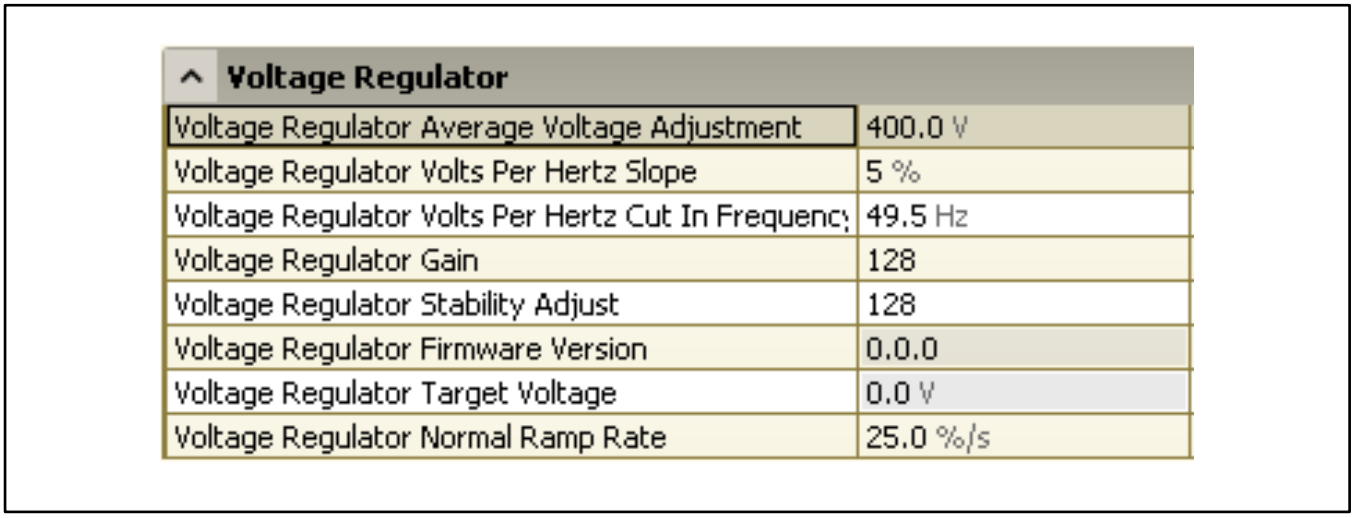


Figure 68 SiteTech Menu, Target Voltage

Voltage Regulator Target settings are found under the following menus in the controller:

GENERATOR INFO- VOLTAGE REGULATION

4. Target Speed

The target speed is passed to the engine ECM to control the AC frequency of the generator set. The paralleling logic overrides this setting to synchronize, but a different target speed between two paralleled generator sets will result in a difference in real power between them. The target speed is set based on the nominal frequency and the Engine Speed Adjustment:

Engine Target Speed = System Frequency * 30+(Engine Speed Adjustment-50)

The Engine Speed Adjust is often set slightly higher than nominal (nominal speed adjust is 50, while a common adjustment is 53) to allow for intentional slippage relative to the utility in systems where a closed-transition ATS is used. See Figure 69.

Although a speed adjustment of 53 is acceptable for a paralleling system, all generator set controllers should have the same speed adjustment so that they send the appropriate target speed to the engine, allowing them to share load equally.

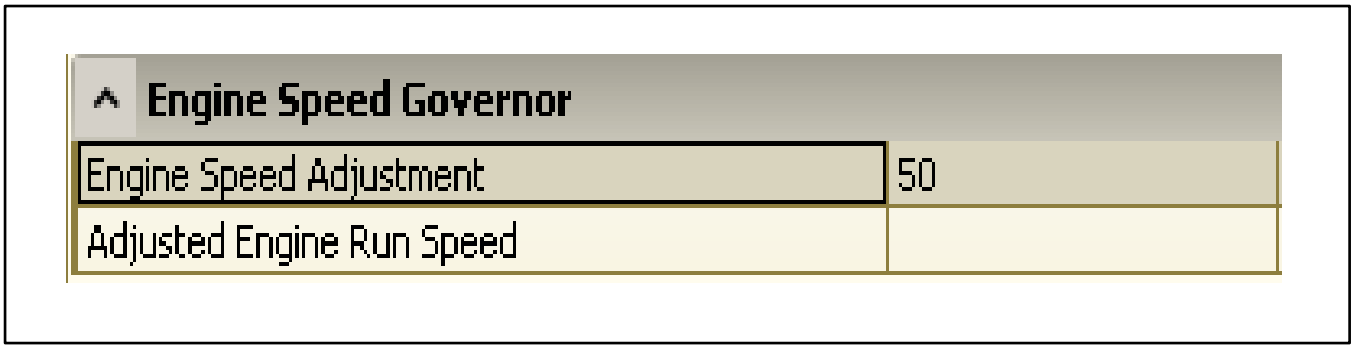


Figure 69 SiteTech Menu, Engine Speed Adjustment

Engine Speed Adjustment settings are found under the following menus in the controller:

GENERATOR INFO->CONFIGURATION->GENERATOR CONFIG

5. Calibration

Note:
Copying personality profiles from one controller to another can overwrite the calibration coefficients. This requires re-calibrating the controller, but can often be easier than attempting to change all the settings twice.

Line–Neutral voltage is used for power metering in wye-connected systems, so it should be calibrated to ensure accurate power metering. Paralleling compares Line-Line voltages (generator set and paralleling bus), and the voltage regulator also regulates to Line-Line voltage, so Line-Line voltage calibration is more important from a system performance point of view.

A multimeter with a recent calibration verification is necessary to calibrate the generator set controller. The controller should be within 2% accuracy without calibration. Using an uncalibrated meter could make the controller less accurate than it was previously.

a. Generator Voltage

The controllers must be calibrated to ensure that they are measuring voltage correctly so that they can produce the correct output voltage. The controller attempts to match the three-phase average voltage to the target, but it uses the measured voltage to do so. If the measured voltage is incorrect, the controller will control the generator set to produce the incorrect voltage.

Generator set voltage is calibrated most easily from the front panel of the controller, using a calibrated multi-meter. The voltage is measured using the multimeter and the correct value is entered in the CONTROLLER CONFIG->CALIBRATION screen on the controller.

b. Bus Voltage

During synchronization, the controller matches the generator set voltage to the measured bus voltage to ensure that the reactive power exchange is a minimum when the breaker closes. If the bus metering is not calibrated correctly, the controller will match the generator set voltage to an incorrect voltage that is either higher or lower than the actual bus voltage, resulting in reactive power transfer when the breaker closes and potentially causing a generator set to disconnect from the paralleling bus to protect itself.

Bus voltage is calibrated most easily from the front panel of the controller, using a calibrated multi-meter. The voltage is measured using the multimeter and the correct value is entered in the CONTROLLER CONFIG->CALIBRATION screen on the controller.

6. Sync Mode

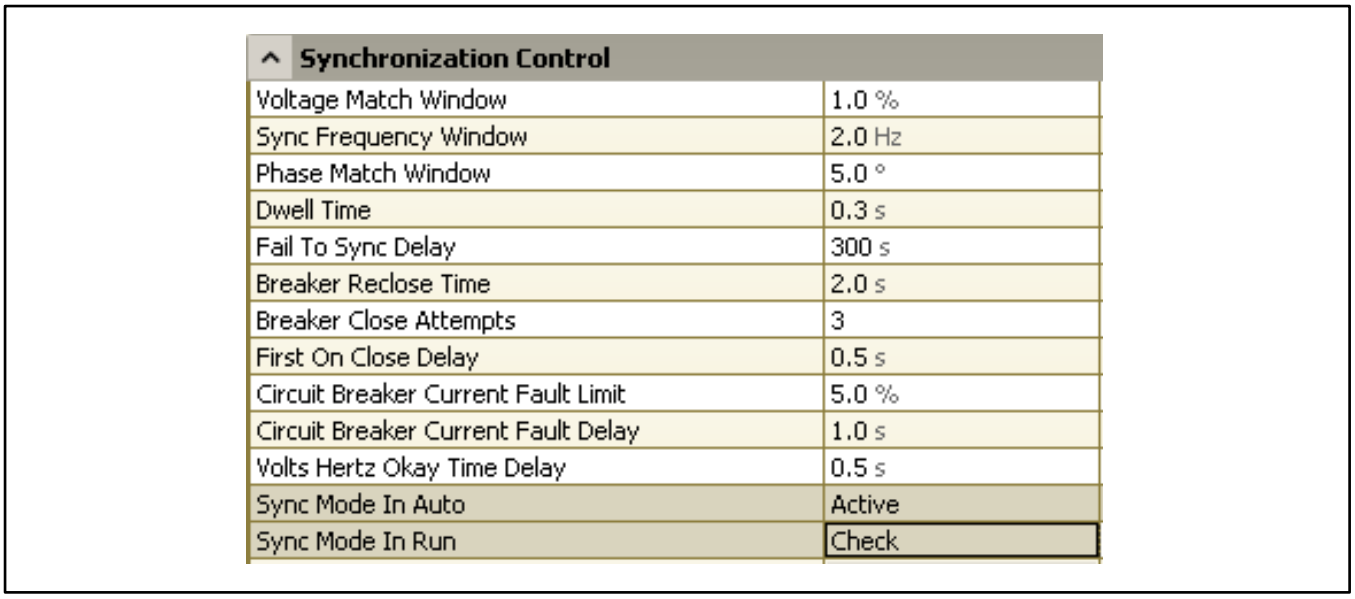
The controller uses a synchronization mode for paralleling. Refer to Figure 70. The mode can be set to:

Off: The controller does not attempt to synchronize in any way.

Check: The controller actively controls the speed and voltage of the generator set in an effort to synchronize with the paralleling bus, but doesn't close the contactor in the paralleling box unless no other generator sets are powering the bus.

Passive: The controller does not attempt to synchronize in any way, but if it remains in phase with the paralleling bus for the duration of the dwell timer, it will close the paralleling contactor. This mode is used when the controller is unable to adjust engine speed or can only adjust engine speed to a higher speed.

Active: The controller actively controls the speed and voltage of the generator set in order to reach synchronism with the paralleling bus, closing the contactor in the paralleling box when it remains synchronized for the duration of the dwell timer.



Synchronization Control	
Voltage Match Window	1.0 %
Sync Frequency Window	2.0 Hz
Phase Match Window	5.0 °
Dwell Time	0.3 s
Fail To Sync Delay	300 s
Breaker Reclose Time	2.0 s
Breaker Close Attempts	3
First On Close Delay	0.5 s
Circuit Breaker Current Fault Limit	5.0 %
Circuit Breaker Current Fault Delay	1.0 s
Volts Hertz Okay Time Delay	0.5 s
Sync Mode In Auto	Active
Sync Mode In Run	Check

Figure 70 SiteTech Menu, Sync Mode

a. Sync Mode In Auto is the synchronization mode that the controller uses when the engine control switch is in Auto, as indicated by the blue indicator over the auto button.

   This Sync Mode defaults to Active, which will work for almost all applications.

b. Sync Mode in Run is the synchronization mode that the controller uses when the engine control switch is in Run, as indicated by the blue indicator over the auto button.

   If the generator sets will be primarily operated by pressing the RUN button on each generator set, this sync mode should be set to Active.

c. Starting In AUTO

   All generator sets in the paralleling system will run in AUTO if any generator set in the system receives a start signal from the Remote Start input, CAN, Modbus, SiteTech, or a Local Start Request (pressing the AUTO and RUN button simultaneously on the front panel).

   Note:
   Holding AUTO and pressing RUN will keep the generator set in AUTO and send the Local Start request. Holding RUN and pressing AUTO will keep the generator set in RUN, but still send the Local Start request.

d. Clearing a Start Signal

   The Local Start Request is removed by pressing the AUTO and OFF buttons simultaneously on any generator set in the system, but the other types of start signal will not be cleared by this action.

   Note:
   Holding AUTO and pressing OFF will keep the generator set in AUTO but clear the Local Start request. Holding OFF and pressing AUTO will put the generator set in the OFF state when clearing the Local Start request.

   CAN, Modbus and SiteTech start signals can be cleared by their respective sources or by pressing the OFF button on the generator set that received the signal, but the Local Start request and Remote Start input are not cleared by pressing OFF.

Synchronization Mode settings are found under the following menus in the DEC3500:

GENERATOR INFO->PARALLELING OPERATION->SYNCHRONIZING SETUP

7. Generator Management

Some sites utilize generator management for convenience, while others may require it, and still others prohibit it. Generator Management sends stop requests to generator sets in the system when they are not needed to support the load. If generator management is disabled, all the generator sets that are able to run (in AUTO without a fault) will run when receiving a start signal. Generator management has to be enabled in order for it to stop unneeded generator sets. Generator management is disabled by setting the Gen Management Enabled flag to Off, and enabled when the flag is On.
See Figure 71.

Generator management is disabled from the factory, but it may be enabled from the previous application, depending on the needs of the previous site. If Generator Management is not requested, it should be disabled.

Note:
Generator Management must be disabled at all controllers independently. Many generator management settings are automatically updated between paralleling generator sets if the cables to the paralleling box are connected, but the Generator Management enable/disable setting is individual to each unit.

Generator Management settings are found under the following menus in the DEC3500:

GENERATOR INFO->PARALLELING OPERATION->GENERATOR MANAGEMENT

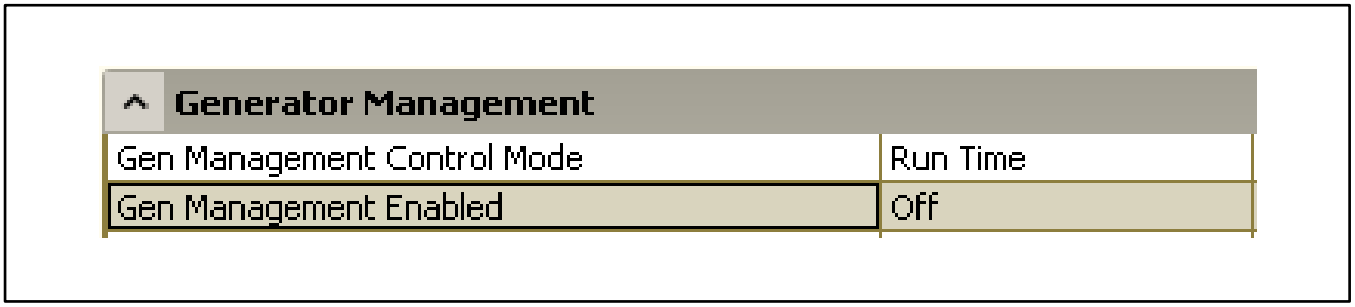


Figure 71 SiteTech Menu, Generator Management

8. Load Management

Most paralleling applications require some type of load management. Load management allows the removal of any loads that would overload a single generator set in the paralleling system in order to prevent overload of a generator set if one or more generator sets are out of service or otherwise unavailable. Large loads that are not critical to human health and safety or the operation of the facility are good candidates for load management.

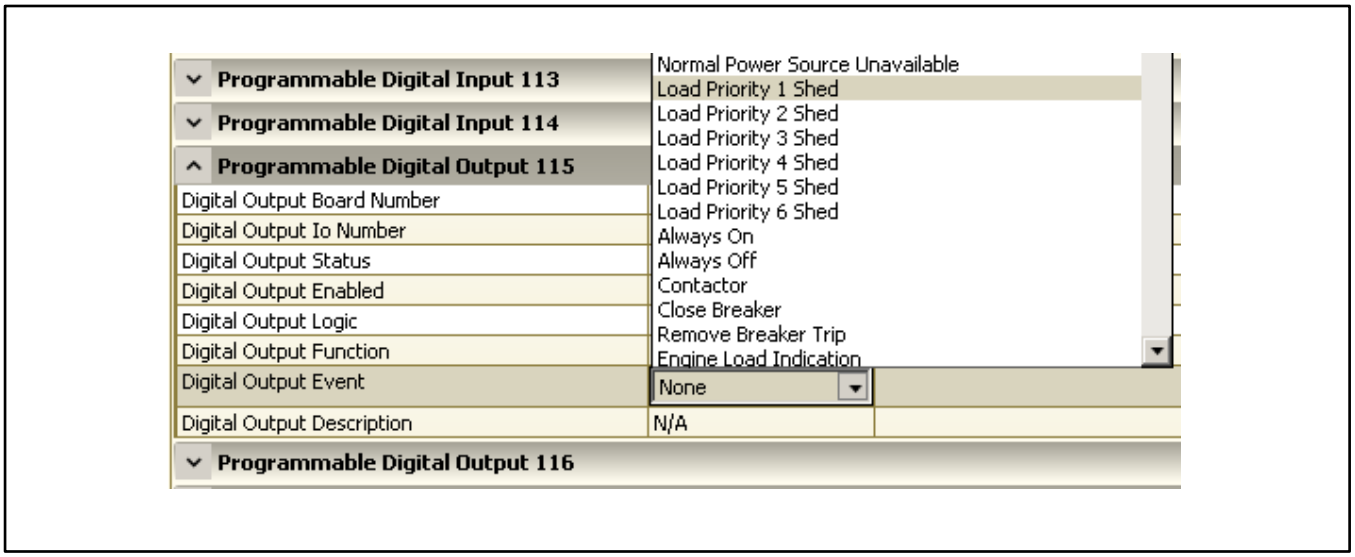


Figure 72 SiteTech Menu, Load Priorities

The DEC3500 supports 6 load priorities. See Figure 72. The priorities are added in increasing numerical order (priority 1 adds first, priority 6 adds last) and shed in decreasing numerical order (priority 6 is shed first and priority 1 is shed last). The priorities are shared throughout the paralleling system, meaning that priority 1 will shed simultaneously on all controllers, regardless of whether the generator sets are running or stopped.

Connection of 1-3 priorities to each generator set provides better redundancy than connecting all priorities to a single generator set.

Generator Management settings are found under the following menus in the DEC3500:

GENERATOR INFO->PARALLELING OPERATION->LOAD CONTROL

TP-6895 2/26g

Original Instructions (English)

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