Service

Residential/Commercial Generator Sets

Models:

14RESA/RESAL
20RESA/RESAL
20RESB
20RESC/RESCL
20RESD

Controllers:
RDC2 Controller
DC2 Controller

ISO 9001
KOHLER POWER SYSTEMS
NATIONALLY REGISTERED

KOHLER®
Power Systems

TP-6805 8/15b

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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 the presence of a hazard that ***will cause severe personal injury, death***, or ***substantial property damage***.

⚠ WARNING

Warning indicates the presence of a hazard that ***can cause severe personal injury, death,*** or ***substantial property damage***.

⚠ CAUTION

Caution indicates the presence of a hazard that ***will*** or ***can cause minor personal injury*** or ***property damage***.

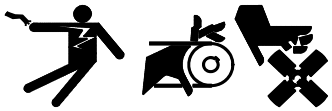
NOTICE

Notice communicates installation, operation, or maintenance information that is safety related but not hazard related.

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 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.

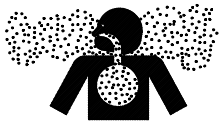
Servicing the fuel system. A flash fire can cause severe injury or death. Do not smoke or permit flames or sparks near the carburetor, fuel line, fuel filter, fuel pump, or other potential sources of spilled fuels or fuel vapors. Catch fuels in an approved container when removing the fuel line or carburetor.

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 detectors. Carbon monoxide can cause severe nausea, fainting, or death. Install carbon monoxide detectors on each level of any building adjacent to the generator set. Locate the detectors to adequately warn the building's occupants of the presence of carbon monoxide. Keep the detectors operational at all times. Periodically test and replace the carbon monoxide detectors according to the manufacturer's instructions.

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.

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

Hazardous Noise

⚠ CAUTION

Hazardous noise.
Can cause hearing loss.

Never operate the generator set without a muffler or with a faulty exhaust system.

Hazardous Voltage/ Moving Parts

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

⚠ WARNING

Hazardous voltage. Moving parts.
Can 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.

⚠ CAUTION

Welding the generator set.
Can cause severe electrical equipment damage.

Never weld components of the generator set without first disconnecting the battery, controller wiring harness, and engine electronic control module (ECM).

Grounding electrical equipment. Hazardous voltage can 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.

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

High voltage test. Hazardous voltage can 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.

Connecting the battery and the battery charger. Hazardous voltage can 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 can 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.

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 can 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)

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 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.

Servicing the engine heater. Hot parts can cause minor personal injury or property damage. Install the heater before connecting it to power. Operating the heater before installation can cause burns and component damage. Disconnect power to the heater and allow it to cool before servicing the heater or nearby parts.

Notice

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.

NOTICE

Electrostatic discharge damage. Electrostatic discharge (ESD) damages electronic circuit boards. Prevent electrostatic discharge damage by wearing an approved grounding wrist strap when handling electronic circuit boards or integrated circuits. An approved grounding wrist strap provides a high resistance (about 1 megohm), *not a direct short*, to ground.

This manual provides troubleshooting and repair instructions for the generator set models listed on the front cover. This manual may also be supplied for similar models not listed on the front cover.

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

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

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

For engine service procedures not covered in this manual, refer to the Engine Service Manual.

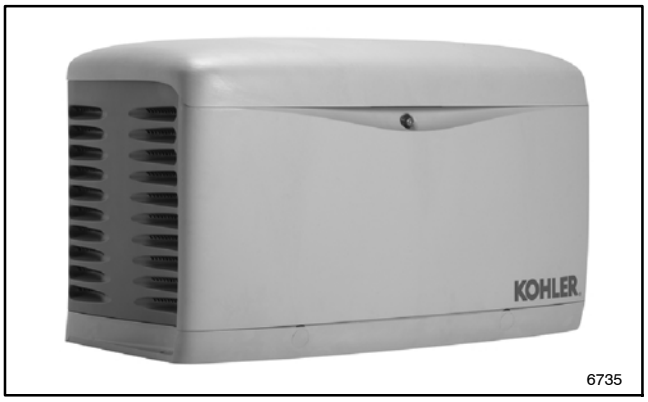


Figure 1 Model 20RESA Generator Set

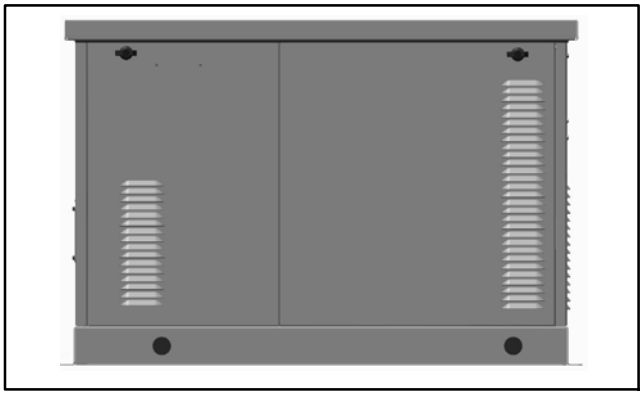


Figure 2 Model 20RESB Generator Set

List of Related Materials

Separate manuals contain operation, installation, and parts information not provided in this manual. Separate engine operation and service manuals are also available. The following table lists the available manual part numbers.

Generator Set Literature	Part Number
Installation Manual, 14/20RESA/RESAL, 20RESC/RESCL	TP-6803
Operation Manual, 14/20RESA/RESAL, 20RESC/RESCL	TP-6804
Parts Catalog, 14/20RESA/RESAL, 20RESC/RESCL	TP-6806
Installation Manual, 20RESB/D	TP-6925
Operation Manual, 20RESB/D	TP-6926
Parts Catalog, 20RESB/D	TP-6927
Engine Literature	
Engine Service Manual, CH740 (14 kW models)	24 690 06
Engine Service Manual, CH1000 (20 kW models)	62 690 01
Transfer Switch Literature	
Operation/Installation Manual, Model RXT Transfer Switch	TP-6807
Service/Parts Manual, Model RXT Transfer Switch	TP-6808
Operation/Installation Manual, Model RDT Transfer Switch	TP-6345
Service/Parts Manual, Model RDT Transfer Switch	TP-6346
Installation Manual, Model RSB Transfer Switch	TP-6486
Operation Manual, Model RSB Transfer Switch	TP-6487
Accessory Literature	
SiteTech™ Software Operation Manual	TP-6701
OnCue® Plus Software Operation Manual	TP-6928
Installation Instructions, Load Control Module (LCM)	TT-1574
Installation Instructions, Programmable Interface Module (PIM)	TT-1584
Installation Instructions, Load Shed Kit for RXT and RDT ATS	TT-1609
Instructions, USB Utility	TT-1636
Additional accessory literature is available. Refer to the documentation provided with the accessory kit.	

Service Assistance

For professional advice on generator set power requirements and conscientious service, please contact your nearest Kohler distributor or dealer.

- Consult the Yellow Pages under the heading Generators—Electric.
- Visit the Kohler Power Systems website at KohlerPower.com.
- Look at the labels and decals on your Kohler product or review the appropriate literature or documents included with the product.
- Call toll free in the US and Canada 1-800-544-2444.
- Outside the US and Canada, call the nearest regional office.

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India, Bangladesh, Sri Lanka
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Bangalore, India
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(91) 80 3366231
Fax: (91) 80 3315972

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

Latin America
Latin America Regional Office
Lakeland, Florida, USA
Phone: (863) 619-7568
Fax: (863) 701-7131

1.1 Introduction

The specification sheets for each generator set provide specific generator and engine information. Refer to the generator set specification sheet for ratings and other data not supplied in this manual. Consult the generator set installation manual, engine operation manual, and engine service manual for additional specifications.

Consult the generator set nameplate for specific generator set ratings.

1.2 Controller Specifications

Model 14RESA and 20RESA/RESB/RESC/RESD generator sets are equipped with the RDC2 controller. Model 14RESAL and 20RESAL/RESCL generator sets are equipped with the DC2 controller. For a specific description of the controller, see the generator set operation manual.

Environmental Specifications	
Operating temperature	-30° to 70°C
Storage temperature	-40° to 85°C
Humidity	0-95% condensing
Power requirements	
Voltage	12 VDC
Current (standby state)	250 mA @ 12 VDC

1.3 Torque Specifications

Torque Specifications	**Nm (ft. lb.)**
Alternator overbolts	14.9 (11)
Alternator thrubolt	85 (63)
Generator adapter screws	40 (29) *
Muffler flange bolts	24 (17.7)
Oil filter	3/4 to 1 turn after gasket contact
Spark plug	24.4-29.8 (18-22)

* Not applicable to 20 kW models.

1.4 Engine Service

Generator sets covered in this manual are equipped with four-cycle, twin cylinder, air-cooled Kohler engines.

For engine service information and specifications not covered in this manual, see the engine service manual. See the List of Related Materials in the Introduction section.

1.5 Engine Specifications

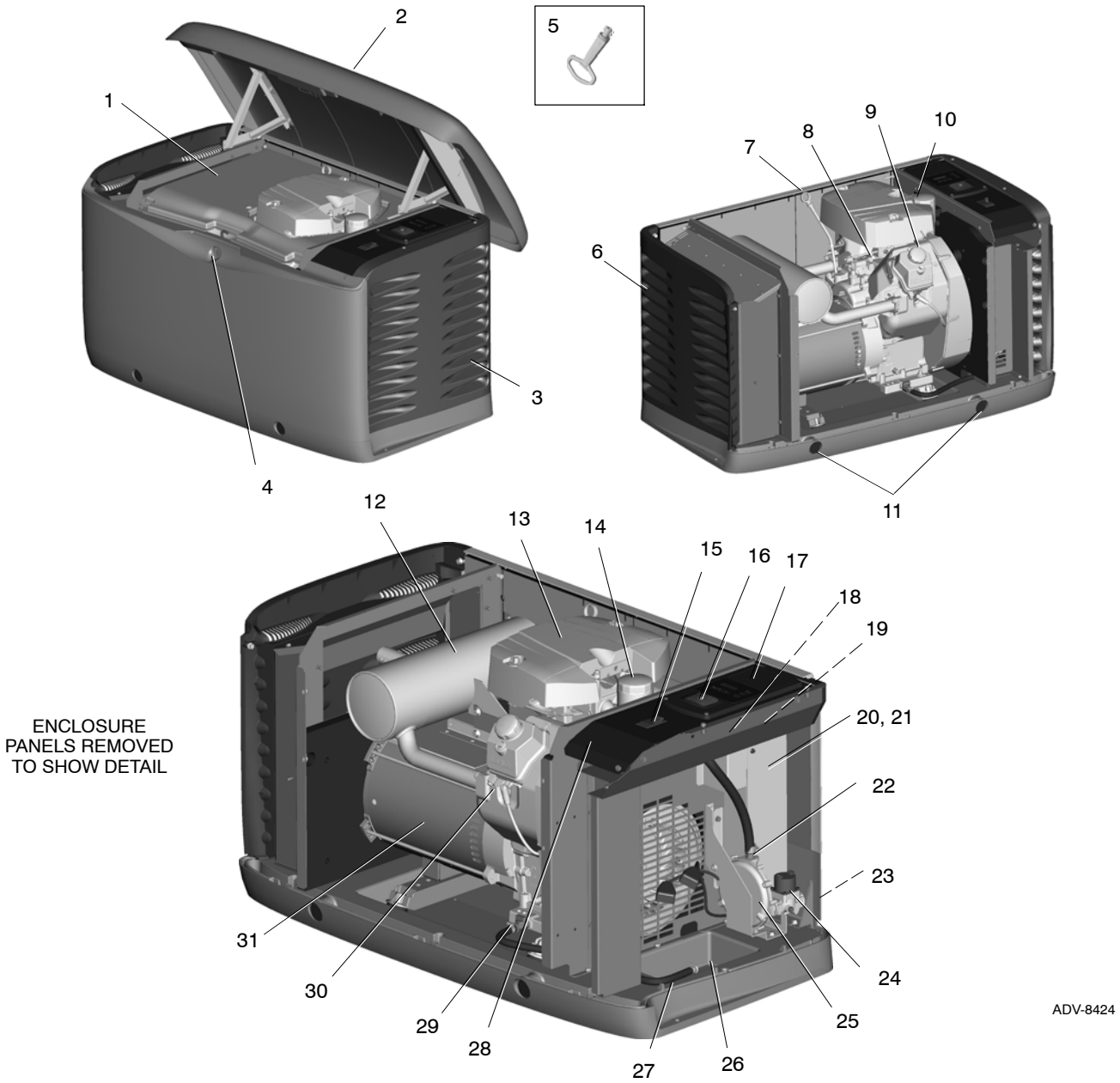
Engine Specification	**14 kW Models**	**20 kW Models**
Manufacturer	Kohler	
Model	CH740	CH1000
Cycle	4	4
Number of cylinders	2	2
Compression ratio	9:1	8.8:1
Displacement, cc (cu. in.)	725 (44)	999 (61)
Rated power, propane fuel, kW (HP)	17.6 (23.6)	23.0 (30.9)
Rated power, natural gas, kW (HP)	15.3 (20.5)	20.2 (27.1)
Rpm, 60 Hz	3600	
Rpm, 50 Hz	3000	
Bore x stroke, mm (in.)	83 x 67 (3.27 x 2.64)	90 x 78.5 (3.54 x 3.1)
Valve material	Steel/Stellite®	
Cylinder block material	Aluminum w/cast iron liners	
Cylinder head material	Aluminum	
Piston rings	2 compression/ 1 oil	
Crankshaft material	Heat-treated ductile iron	
Main bearings: number, type	2, parent material	
Lubrication system	Full pressure	
Oil capacity (w/filter), L (qt.)	1.8 (1.9)	1.9 (2.0)
Oil pressure, kPa (psi)	172-241 (25-35)	
Fuel system	LP gas or natural gas	
Minimum fuel supply pressure, kPa (in. H_2O)	NG: 1.2- 2.7 (5-11) LP: 1.7-2.7 (7-11)	
Battery voltage	12 VDC	
Battery ground	Negative	
Spark plug gap, mm (in.)	0.76 (0.030)	
Ignition system	Capacitor discharge	
Starter motor	Electric, solenoid shift	
Cooling system	Air-cooled	

1.6 Alternator Specifications

Alternator Specification	14RESA(L)	14RESA	20RESA(L) 20RESB 20RESC(L) 20RESD	20RESA 20RESC
Alternator model	2F5	2G5	2F7	2G7
Frequency Hz	50/60	50/60	50/60	50/60
Phase	1	3	1	3
Number of leads	4	12	4	12
Excitation method	Static excited			
Voltage regulator type	Digital			
Coupling type	Direct			
Insulation (rotor and stator)	Epoxy varnish, vacuum impregnated; class 180 (H)			
Winding material	Copper			
Bearing, number and type	1, Sealed ball			
Brush length, new	19.05 mm (0.75 in.)			
Circuit protection				
Aux. winding mini-breaker	20 amps			
Rotor resistance, ohms, cold	5.2	5.2	5.6	5.6
Stator resistance, ohms,* cold:				
Single-Phase Leads 1-2, 3-4	0.06	—	0.02	—
Single-Phase Leads 11-44	0.13	—	0.04	—
Three-Phase Leads 1-4, 2-5, 3-6, 7-10, 8-11, 9-12	—	0.09	—	0.06
Leads 55-66	0.60	0.19	0.44	0.18
Stator output voltage with separately excited rotor using 12-volt battery, minimum:				
Single-Phase Leads: 1-2, 3-4	105 V	—	88 V	—
Single-Phase Leads 11-44	210 V	—	176 V	—
Three-Phase Leads 1-4, 2-5, 3-6, 7-10, 8-11, 9-12	—	140	—	112
Leads 55-66	142 V	190	117 V	150
Rotor field voltage/current readings at rated output voltage, hot				
No load	19 V/3.2 A	12 V/2.5 A	19 V/3.9 A	15 V/2.2 A
Full load	48 V/7.2 A	63 V/9.8 A	53 V/7.4 A	69 V/9.6 A

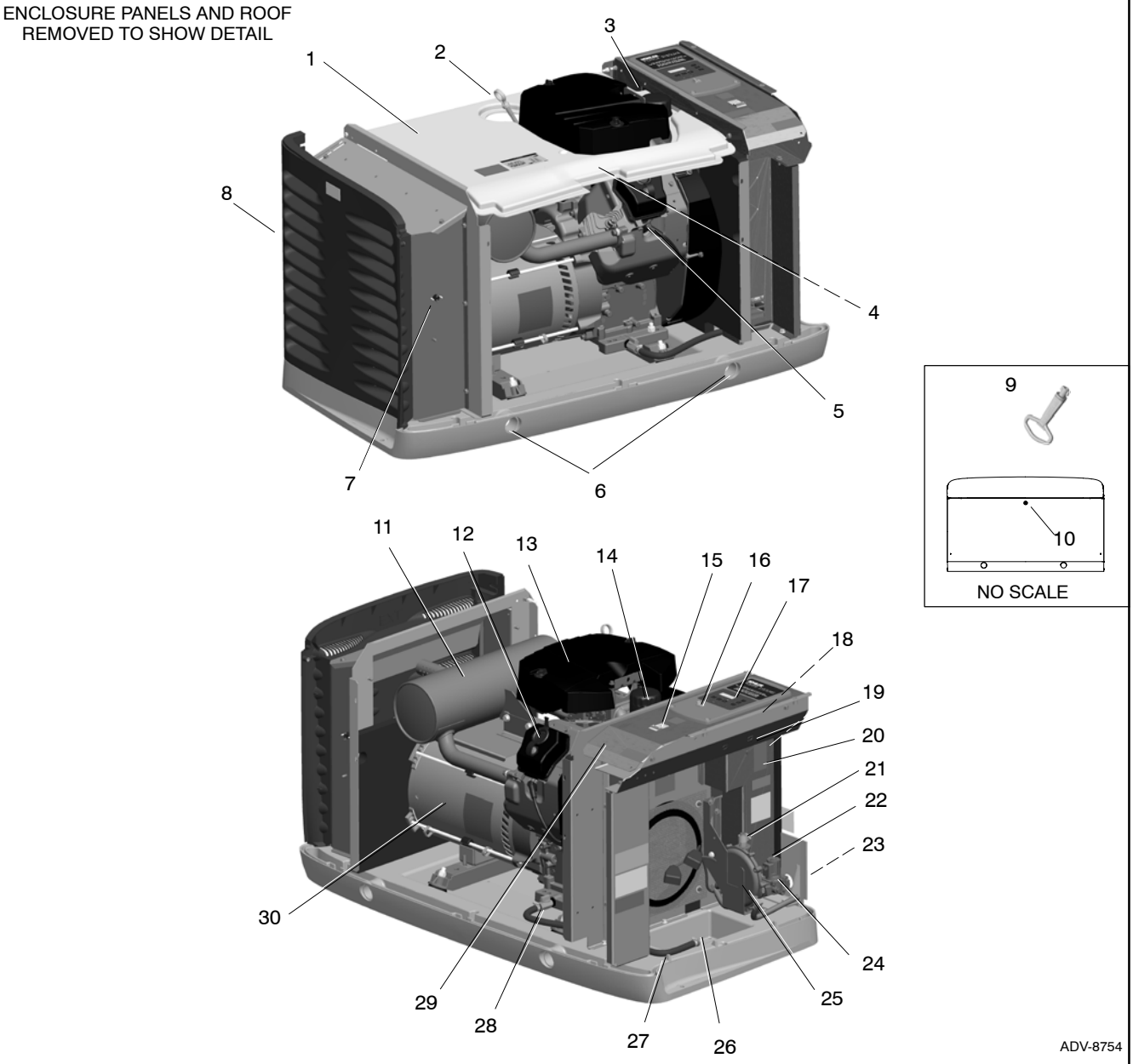
* Most ohmmeters do not give accurate readings when measuring less than 1 ohm. The stator can be considered good if a low resistance reading (continuity) is obtained and there is no evidence of shorted windings (discoloration). Do not confuse a low resistance reading with a reading indicating a shorted winding.

1.7 Service Views



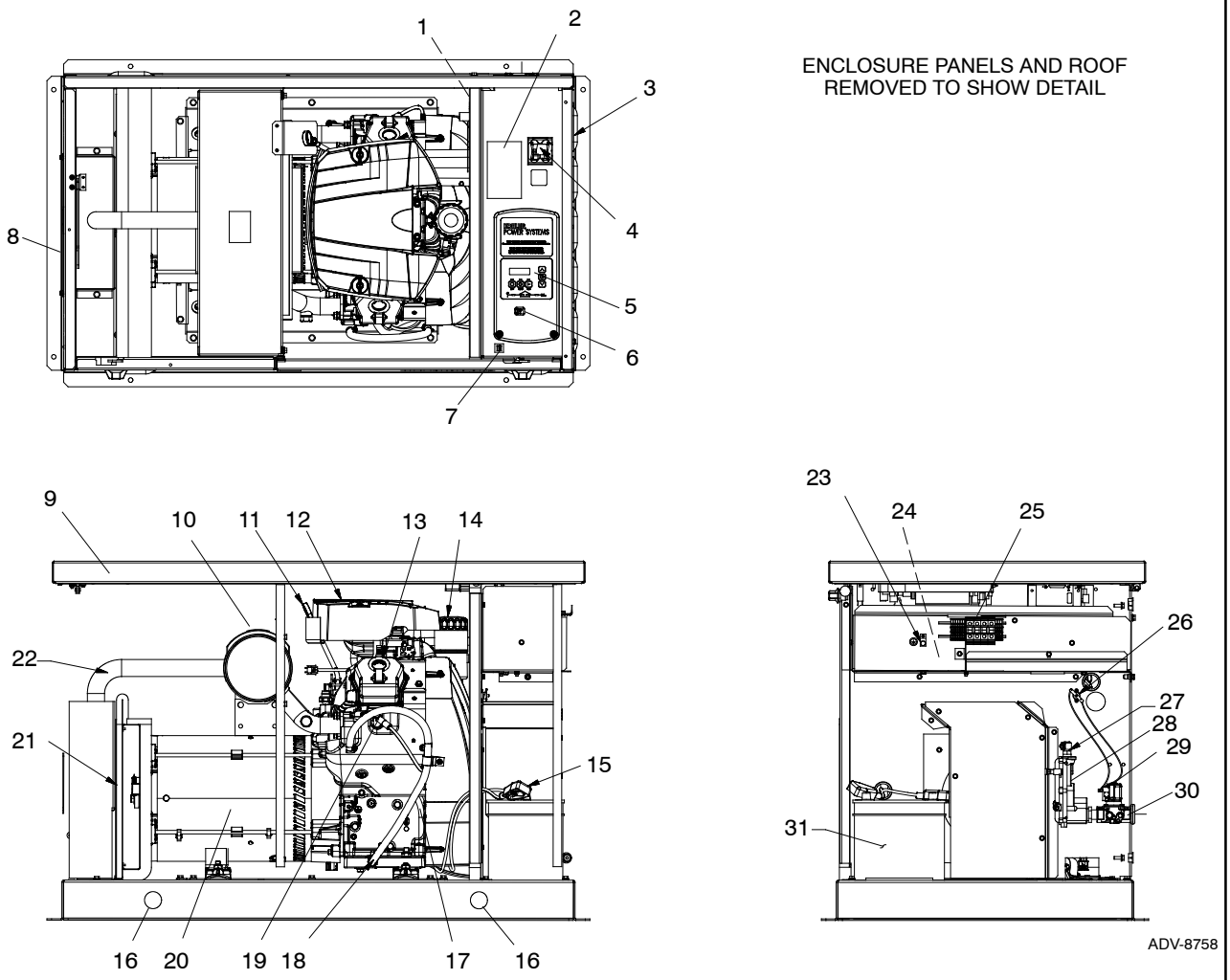
1. Hinged inner cover
2. Hinged roof
3. Air intake
4. Lock
5. Key, provided with generator set
6. Exhaust outlet
7. Oil check (dipstick)
8. Governor assembly
9. Oil fill
10. 120 VAC receptacle for optional carburetor heater
11. Lifting holes
12. Muffler
13. Air cleaner
14. Oil filter
15. Line circuit breaker
16. Mini-breaker and USB connector (for firmware updates)
17. RDC2 or DC2 controller (original controller shown)
18. Alternate mini-breaker location (See Section 5.4)
19. Starter relay (below controller)
20. Field-connection terminal block (behind panel)
21. Ignition timing leads
22. Fuel block (early 14 kW models only) or fuel orifice location (inside hose fitting)
23. Fuel inlet
24. Fuel solenoid valve
25. Fuel regulator assembly
26. Engine starting battery location (battery purchased separately)
27. Oil drain hose
28. Nameplate location
29. Oil drain valve
30. Spark plugs
31. Alternator

Figure 1-1 Service Views, 14/20RESA(L)



1. Hinged inner cover
2. Oil check (dipstick)
3. 120 VAC receptacle for optional carburetor heater
4. Governor assembly (below air cleaner)
5. Spark plugs
6. Lifting holes
7. Thermostat
8. Exhaust outlet
9. Key, provided with generator set
10. Lock
11. Muffler
12. Oil fill
13. Air cleaner
14. Oil filter
15. Line circuit breaker
16. USB connector (for firmware updates)
17. RDC2 or DC2 controller
18. Starter relay (below controller)
19. Mini-breaker (alternator protection)
20. Field-connection terminal block (behind panel)
21. Fuel orifice location (inside hose fitting)
22. Ignition timing leads
23. Fuel inlet
24. Fuel solenoid valve
25. Fuel regulator assembly
26. Engine starting battery location (battery purchased separately)
27. Oil drain hose
28. Oil drain valve
29. Nameplate location
30. Alternator

Figure 1-2 Service Views, 20RESC(L)

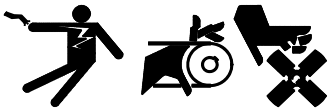


1. 120 VAC receptacle for optional carburetor heater (not shown)
2. Nameplate location
3. Air intake
4. Line circuit breaker
5. RDC2 controller (revised controller shown)
6. USB connector (for firmware updates)
7. Mini-breaker (alternator protection)
8. Exhaust outlet
9. Roof, hinged and lockable
10. Muffler
11. Oil check (dipstick)
12. Air cleaner
13. Oil fill
14. Oil filter
15. Battery cables (included)
16. Lifting holes
17. Oil drain hose
18. Oil drain valve
19. Spark plugs
20. Alternator
21. Air intake
22. Exhaust pipe
23. Equipment ground
24. Start and run relay locations
25. Field-connection terminal block
26. Thermostat
27. Fuel orifice location (inside hose fitting)
28. Fuel regulator assembly
29. Fuel solenoid valve
30. Fuel inlet
31. Engine starting battery location (battery purchased separately)

Figure 1-3 Service Views, 20RESB and 20RESD

Notes

⚠ 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

Hazardous voltage. Moving parts.
Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

This equipment must be installed and serviced by qualified electrical personnel.

⚠ 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.

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 engine heater. Hot parts can cause minor personal injury or property damage. Install the heater before connecting it to power. Operating the heater before installation can cause burns and component damage. Disconnect power to the heater and allow it to cool before servicing the heater or nearby parts.

⚠ WARNING

Risk of fire.
Can cause severe injury or death.

Do not smoke or permit flames or sparks near fuels or the fuel system.

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.

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.

See the Safety Precautions and Instructions at the beginning of this manual before attempting to service, repair, or operate the generator set.

Alternator Service. Under normal operating conditions the generator set alternator does not require scheduled service. Refer to the service schedule for items that require maintenance.

Engine Service. Perform generator set engine service at the intervals specified by the engine service literature.

All generator sets have emission-certified engines. The carburetors on emission-certified engines are not adjustable.

Routine Maintenance. Refer to the following generator set service schedule, the engine service schedule, and the runtime hours displayed on the generator set controller to determine when to schedule routine maintenance. Service the generator set more frequently if it is subject to extreme weather, long operating hours, or dusty or dirty conditions.

Maintenance Reminders. The RDC2 controller displays a reminder message every 150 hours of engine run time. Change the oil and perform other maintenance tasks listed on the service schedule. Then reset the reminder. See Section 2.3 for instructions to reset the maintenance reminder.

Service Schedule. Perform maintenance on each item in the service schedule at the designated interval for the life of the generator set.

Tools. Tools and instruments used to perform some maintenance items are not generally available to the generator set owner. Service must be performed by an authorized distributor/dealer or trained service technician.

2.1 Service Schedule

Perform the items listed in the service schedule at the designated intervals for the life of the generator set. For example, an item serviced every 150 hours of operation must also be serviced after 300 hours, 450 hours, etc.

System Component or Procedure	See Section	Procedure				
		Visually Inspect	Check	Change	Clean	Test
Fuel						
Flexible lines and connections		Q		R		
Main tank supply level (LP)			W			
Fuel piping		Y				
Fuel regulator vent tubes, if equipped (20 kW models)	2.10	Y			Y	
Lubrication	2.2					
Oil level	2.2.2		8 or E			
Change oil, 14 kW	2.2.4			Y or 100		
Change oil, 20 kW	2.2.4			Y or 150		
Replace filter	2.2.4			Y or 150		
Crankcase breather hose		Y or 500				
Oil cooler, if equipped	2.2.5, 2.2.6	Y			Y or 150	
Cooling	2.6					
Air ducts, louvers			Y		Y	
Exhaust System	2.6					
Leakage		W	W			
Insulation, fire hazards		Y				
Obstructions or combustible materials near exhaust outlet		W				
DC Electrical System						
Check battery charger operation, voltage and charge rate			M			
Remove corrosion, clean and dry battery and rack	2.8		Y		Y	
Check battery electrolyte level and specific gravity †	2.8		Y			
Clean and tighten battery terminals and inspect boots		Y	Y			
Tighten DC electrical connections			Y			
AC Electrical System						
Tighten control and power wiring connections			Y			
Remote control system, if equipped						M
Visible wear or damage		Q				
Wire abrasions where subject to motion		6 months	6 months			
Wire-cable insulation condition		3Y or 500				
Engine and Mounting						
Visible wear or damage		W				
Air cleaner service *	2.5		150	300		
Spark plugs	2.4		150	300		
Replace stepper motor coupling and bushing	2.7			500		
Generator						
Visible wear or damage		Q				
Exercise generator set						W
Brushes and collector ring	6.5, 6.6	Y or 300			Y or 300	
Measure and record resistance readings of windings with insulation tester (Megger®, with controller or rectifier and load leads disconnected)						3Y (D)
General Condition of Equipment						
Evidence of vibration, leakage, deterioration, unusual or excessive noise or temperature		W	W		W	
Interior of sound enclosure		Q			Q	

* Service more frequently under extremely dusty/dirty conditions.

† Service more frequently in temperatures above 29°C (85°F).

Megger® is a registered trademark of Biddle Instruments.

E Each use
W Weekly
M Monthly
Q Quarterly
Y Yearly

Number = hours of operation
R Replace as necessary

Figure 2-1 Service Schedule

2.2 Lubrication System

See Section 2.1, Service Schedule, for oil change and oil filter replacement intervals. See Section 1.7, Service View, for the oil drain, oil check, oil fill, and oil filter locations.

2.2.1 Low Oil Pressure Shutdown

The low oil pressure (LOP) shutdown feature protects the engine against internal damage if the oil pressure drops below a minimum pressure because of oil pump failure or other malfunction.

Note: The LOP shutdown feature does not protect against damage caused by operating when the oil level is low; it is not a low oil level shutdown. Check the oil level regularly, and add oil as needed.

2.2.2 Oil Check

The generator set is shipped with oil. Before operating the generator set, check the engine oil in the crankcase. See Figure 2-2 for the dipstick location.

Maintain the oil level at or near, not over, the full mark on the dipstick. Add 5W-30 or 10W-30 synthetic oil when the oil level is low. See Section 2.2.3, Engine Oil Recommendation.

Check the oil level before each use. For extended operation, check the oil level every 8 hours. Do not check the oil level when the generator set is running. Shut down the generator set and wait several minutes before checking the oil.

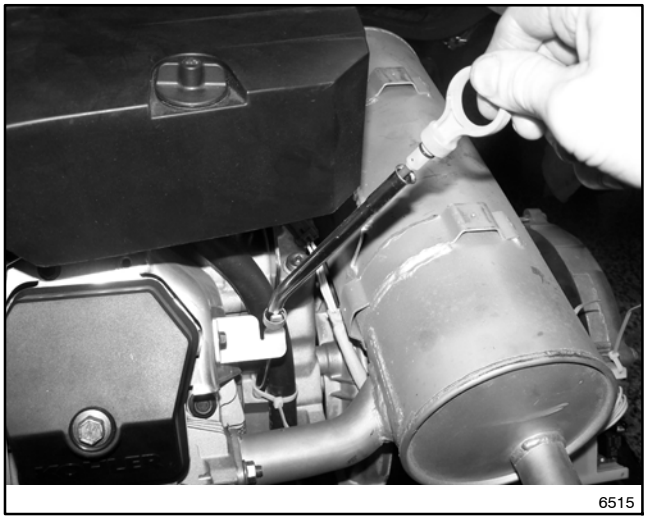


Figure 2-2 Oil Check

2.2.3 Engine Oil Recommendation

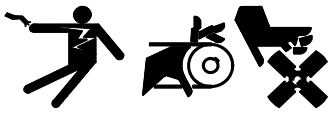
Use 5W-30 or 10W-30 API (American Petroleum Institute) Service Class SG, SH, or SJ synthetic oil. Synthetic oil oxidizes and thickens less than other oils and leaves the engine intake valves and pistons cleaner.

Model	Oil Capacity, L (qt.)
14	1.8 (1.9)
20	1.9 (2.0)

Figure 2-3 Oil Capacity (approximate)

2.2.4 Oil Change 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.

Note: Dispose of all waste materials (engine oil, fuel, filter, etc.) in an environmentally safe manner and in accordance with all applicable laws.

Drain the oil while it is still warm.

1. **Drain the oil.**
   a. Press the OFF button on the controller.
   b. Remove the housing intake panel.
   c. Disconnect the utility power to the generator set.
   d. Disconnect the generator set engine starting battery, negative (–) lead first.

e. Clean the area around the dipstick and oil fill cap.

f. Remove the cap from the oil drain hose and lower the hose into an oil collection container.

g. Open the oil drain valve on the engine.

h. Remove the dipstick and oil fill cap. Allow time for the engine oil to drain completely.

i. Close the oil drain valve. Replace the cap on the oil drain hose. Replace the oil drain hose in its retaining clip.

j. Replace the dipstick.

2. **Replace the oil filter.**

a. Clean the area around the oil filter. Remove the oil filter by rotating it counterclockwise with an oil filter wrench.

b. Clean the gasket sealing surface of the oil filter adapter.

c. Apply a light coat of clean oil to the rubber seal of the new oil filter.

d. Install the new oil filter following the instructions provided with the filter.

3. **Fill with oil.**

a. Fill the engine to the F mark on the dipstick. Section 2.2.3, Engine Oil Recommendation, for oil selection. See Figure 2-3 for the engine oil capacity.

b. Reinstall the dipstick and the oil fill cap.

c. Reconnect the generator set engine starting battery, negative (-) lead last.

d. Reconnect utility power to the generator set.

e. Press the RUN button to start and run the generator set for a minute to allow the oil pressure to reach operating range.

f. Stop the generator set, wait 1 minute, and then recheck the oil level. Add oil to bring the level up to the F mark on the dipstick.

4. **Check for leaks.**

a. Check for oil leaks.

b. Fix leaks and recheck the oil level.

c. Reinstall the housing side panel.

2.2.5 Oil Cooler, 14kW Models

Inspect and clean the oil cooler at the intervals shown in the Service Schedule. The oil cooler must be kept free of debris.

Remove the front enclosure panel to access the oil cooler. See Section 7.2 for instructions to remove the front panel.

See Figure 2-4 for the oil cooler location. Clean the outside of the oil cooler with a brush or compressed air. If it is necessary to clean the back of the oil cooler, remove the two screws holding the oil cooler unit to the blower housing. Tilt the cooler and clean with a brush or compressed air as shown in Figure 2-5. After cleaning, reinstall the oil cooler and secure with the mounting screws.

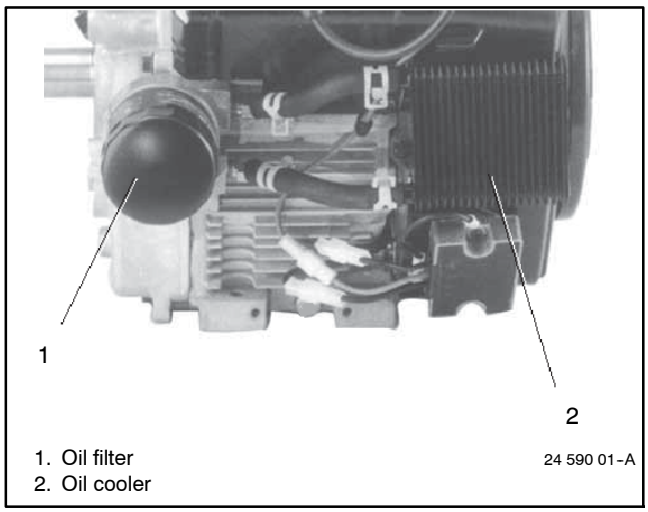


Figure 2-4 Oil Cooler Location, 14 kW Models

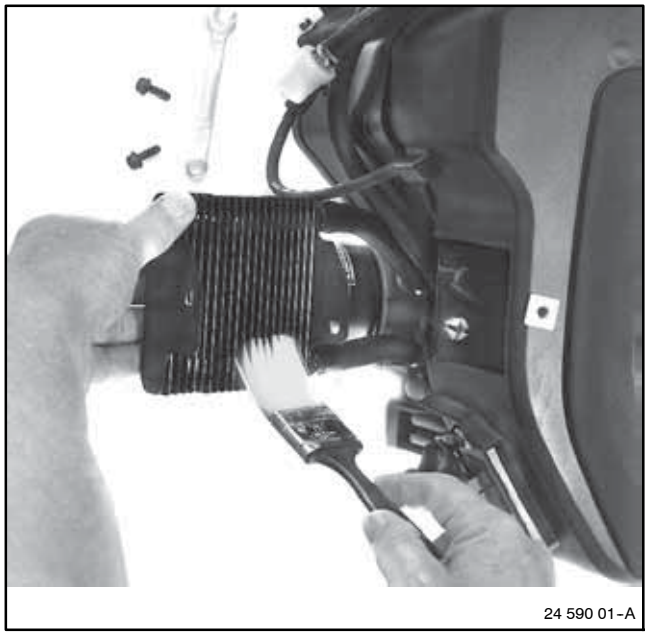


Figure 2-5 Cleaning the Oil Cooler

2.2.6 Oil Cooler, 20RESA/RESAL/RESB

The oil cooler is used on models 20RESA, 20RESAL, and 20RESB.

Inspect and clean the oil cooler at the intervals indicated in the service schedule. The oil cooler must be kept free of debris.

Remove the front enclosure panel to access the oil cooler. See Section 7.2 for instructions to remove the front panel.

See Figure 2-6 for the oil cooler location. The oil cooler is located under the No. 2 cylinder shroud. Remove the top mounting screw and loosen the two side screws, then lift off the cylinder shroud. Clean the outside of the oil cooler fins with a brush or with compressed air.

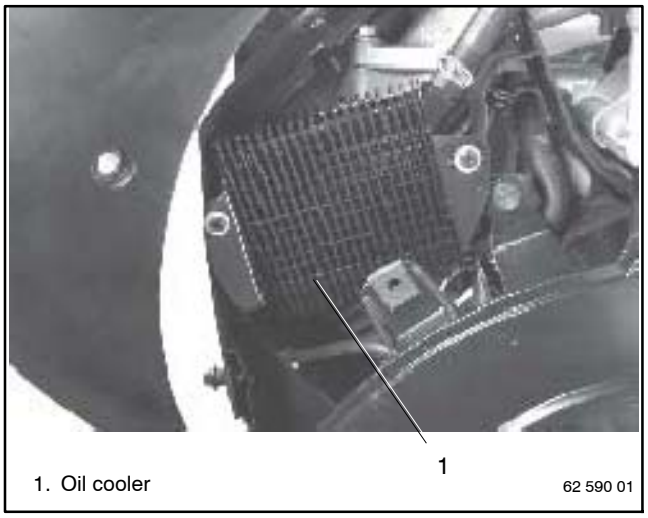


Figure 2-6 Oil Cooler, 20 kW Models

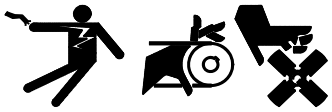
2.3 Resetting the Maintenance Reminder

The RDC2 controller displays maintenance reminder messages when it is time to change the oil and perform other routine maintenance. After changing the oil and performing other maintenance items shown in the maintenance schedule in Section 2.1, reset the maintenance reminder on the controller.

1. In the Overview menu, step down to the Next Maintenance screen.
2. Press the Select button.
3. Press the Up arrow button so that “Reset Maint Timer? Yes” is displayed.
4. Press the Select button. The next maintenance interval and date will be displayed.

2.4 Spark Plugs

⚠ 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.

Reset the spark plug gap or replace the plugs with new plugs as necessary.

1. Clean the area around the base of the spark plug to keep dirt and debris out of the engine.
2. Remove the spark plug and check its condition. Replace the spark plug if it is worn or if its reuse is questionable.
3. Check the spark plug gap using a wire feeler gauge. Adjust the gap to 0.76 mm (0.030 in.) by carefully bending the ground electrode. See Figure 2-7 and Figure 2-8.
4. Reinstall the spark plug into the cylinder head. Torque the spark plug to 24.4–29.8 Nm (18–22 ft. lb.).

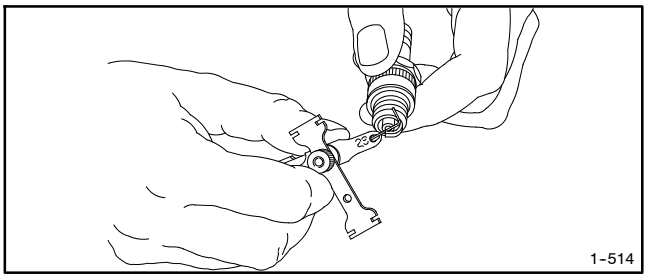


Figure 2-7 Checking the Spark Plug Gap

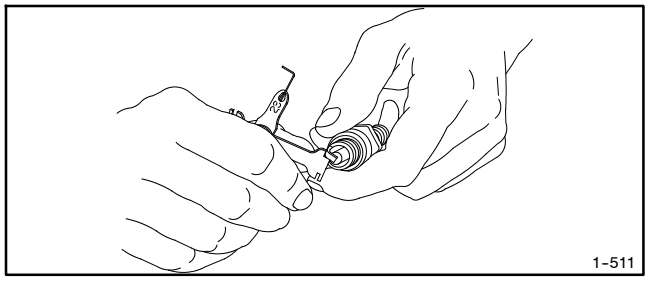
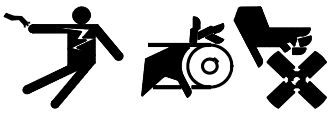


Figure 2-8 Adjusting the Spark Plug Gap

2.5 Air Cleaner Service

⚠ 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

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

2.5.1 Air Cleaner, 14 kW Models

The engine has a replaceable high-density paper air cleaner element. See Figure 2-9.

Check for a buildup of dirt and debris around the air cleaner system. Keep this area clean. Also check for loose or damaged components. Replace all bent or damaged air cleaner components.

Note: Operating the engine with loose or damaged air cleaner components could allow unfiltered air into the engine causing premature wear and failure.

Paper Element Service

Use the following procedure to replace the paper element at the intervals specified in the service schedule. Replace the paper element more often under extremely dusty or dirty conditions.

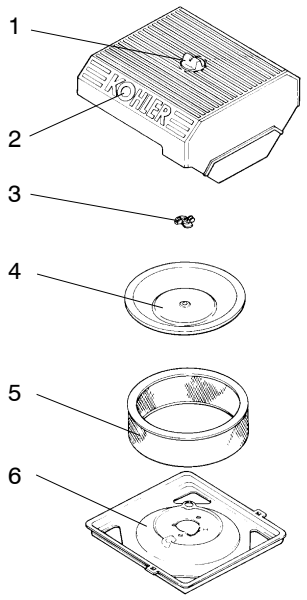
1. Press the OFF button on the generator set controller.
2. Disconnect the utility power to the generator set.
3. Disconnect the generator set engine starting battery, negative (-) lead first.
4. Loosen the cover retaining knob and remove the cover.
5. Remove the element cover nut, element cover, and the paper element.

   Note: Do not wash the paper element or clean it with pressurized air, as this will damage the element.

6. Replace the element if it is dirty, bent, or damaged.
7. Check the air cleaner base. Make sure it is secure and not bent or damaged. Also check the element cover for damage and fit. Replace all damaged air cleaner components. Remove any loose dirt or debris from the air cleaner base. Wipe the base carefully so that no dirt drops into the intake throat. Check the condition of the rubber seal on the air cleaner stud and replace the seal if necessary.
8. Reinstall the paper element, element cover nut, and the air cleaner cover. Secure the cover with the cover retaining knob.

9. Reconnect the utility power to the generator set.

10. Reconnect the generator set engine starting battery, negative (–) lead last.



1. Cover knob
2. Air cleaner cover
3. Element cover nut
4. Element cover
5. Air cleaner element
6. Air cleaner base

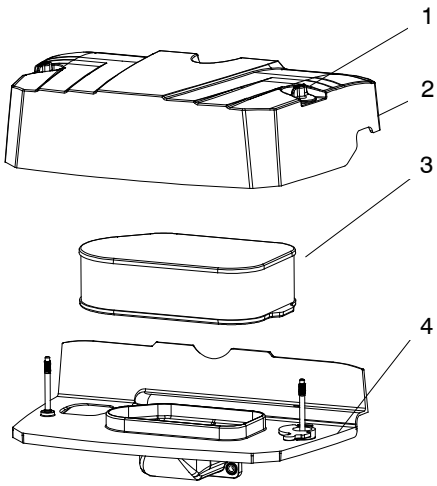
Figure 2-9 Air Cleaner Components, 14 kW Models

2.5.2 Air Cleaner, 20 kW Models

The engine is equipped with a replaceable, high density paper air cleaner element. See Figure 2-10.

Check the air cleaner daily or before starting the engine. Check for a buildup of dirt and debris around the air cleaner system. Keep this area clean. Also check for loose or damaged components. Replace all bent or damaged air cleaner components.

Note: Operating the engine with loose or damaged air cleaner components could allow unfiltered air into the engine causing premature wear and failure.



1. Knobs (qty. 2)
2. Cover
3. Paper element
4. Base

Figure 2-10 Air Cleaner Components, 20 kW Models

Paper Element Service

Replace the paper element at the intervals indicated in the service schedule. See Figure 2-1 for the service schedule. See Figure 2-10 for the air cleaner components. When element replacement is necessary, order genuine Kohler parts.

1. Press the OFF button on the generator set controller.

2. Disconnect the utility power to the generator set.

3. Disconnect the generator set engine starting battery, negative (–) lead first.

4. Loosen the two cover retaining knobs and remove the cover.

5. Remove the paper element.

6. Do not wash the paper element or use pressurized air, as this will damage the element. Replace a dirty, bent, or damaged element. Handle new elements carefully; do not use if the sealing surfaces are bent or damaged.

7. When servicing the air cleaner, check the air cleaner base. Make sure it is secured and not bent or damaged. Also, check the element cover for damage or improper fit. Replace all damaged air cleaner components.

Note: If any loose dirt or debris fell on the air cleaner base when the element was removed, carefully remove it and wipe the base clean. Be careful that none of it drops into the intake throat.

8. Reinstall the paper element onto the air cleaner base. Make sure the element is flat and properly seated.

9. Install the air cleaner cover and secure with the two retaining knobs.

2.6 Air Intake and Exhaust System

⚠ WARNING

Hot engine and exhaust system.
Can cause severe injury or death.

Do not work on the generator set until it cools.

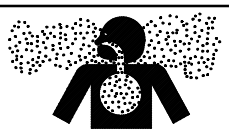
Servicing the exhaust system. Hot parts can cause severe injury or death. Do not touch hot engine parts. The engine and exhaust system components become extremely hot during operation.

⚠ CAUTION

Hazardous noise.
Can cause hearing loss.

Never operate the generator set without a muffler or with a faulty 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 detectors. Carbon monoxide can cause severe nausea, fainting, or death. Install carbon monoxide detectors on each level of any building adjacent to the generator set. Locate the detectors to adequately warn the building's occupants of the presence of carbon monoxide. Keep the detectors operational at all times. Periodically test and replace the carbon monoxide detectors according to the manufacturer's instructions.

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.

The engine fan draws cooling air through the openings in the sides and end near the battery. The alternator fan draws cooling air through openings on the side walls of the enclosure. The cooling air mixes with the engine exhaust and is discharged at the exhaust outlet. See Figure 2-11 or Figure 2-12. To prevent generator set

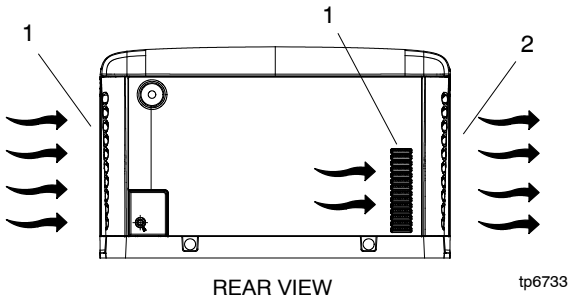
damage caused by overheating, keep the housing cooling inlets and outlets clean and unobstructed at all times.

Note: Do not block the generator set cooling air inlets or mount other equipment above them. Overheating and severe generator damage may occur.

Remove all combustible materials from the exhaust location. Combustible materials include building materials as well as natural surroundings. Keep dry field grass, foliage, and combustible landscaping material a minimum of 2.4 m (8 ft.) from the exhaust outlet.

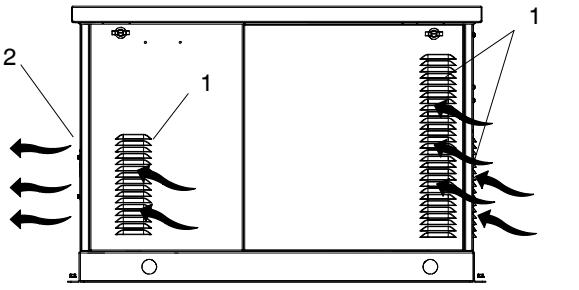
Periodically inspect the exhaust system components for cracks, leaks, and corrosion.

- Check for corroded or broken metal parts and replace them as needed.
- Check that the exhaust outlet is clear.
- Check that all covers, doors, and panels are undamaged, in place, and locked.



1. Air intake
2. Exhaust outlet

Figure 2-11 Cooling Air Intake and Exhaust, Composite Enclosure



1. Air intake
2. Exhaust outlet

Figure 2-12 Cooling Air Intake and Exhaust, Metal Enclosure

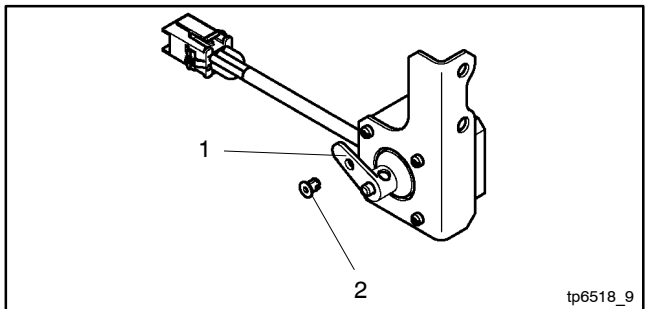
2.7 Stepper Motor Coupling

Replace the stepper motor coupling and bushings at the intervals shown in the service schedule. See the Parts Catalog for replacement part numbers.

Figure 2-13 shows the location of the coupling assembly under the air cleaner. Loosen the set screw to remove the coupling from the motor shaft.

1. Coupling and bushing

Figure 2-13 Stepper Motor Coupling



1. Coupling
2. Bushing

Figure 2-14 Stepper Motor Coupling and Bushing

2.8 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.

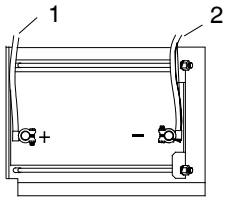
Battery acid cleanup. Battery acid can cause severe injury or death. Battery acid is electrically conductive and corrosive. Add 500 g (1 lb.) of bicarbonate of soda (baking soda) to a container with 4 L (1 gal.) of water and mix the neutralizing solution. Pour the neutralizing solution on the spilled 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 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.

This section contains general battery information and maintenance instructions. Also consult the battery manufacturer's instructions for battery maintenance.

All generator set models use a negative ground with a 12-volt engine electrical system. Consult the generator set nameplate for the engine electrical system voltage. Consult the generator spec sheet for battery capacity recommendations for replacement purposes. Wiring diagrams provide battery connection information. See Figure 2-15 for typical battery connections.



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

Figure 2-15 12-Volt Engine Electrical System Single Starter Motor, Typical Battery Connection

2.8.1 Cleaning the Battery

Clean the battery and cables and tighten battery terminals using the service schedule recommendations. To prevent corrosion, maintain tight, dry electrical connections at the battery terminals. To remove corrosion from battery terminals, disconnect the cables from the battery and scrub the terminals with a wire brush. Clean the battery and cables with a solution of baking soda and water. After cleaning, flush the battery and cables with clean water and wipe them with a dry, lint-free cloth.

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

2.8.2 Checking Electrolyte Level

Check the electrolyte level of batteries with filler caps monthly. Remove filler caps and verify that electrolyte level reaches bottom of filler holes. Refill as necessary with distilled water. DO NOT add fresh electrolyte. Tighten all filler caps. If water is added during freezing temperatures, run the generator set for 20–30 minutes to mix the electrolyte and water to prevent battery damage from freezing.

2.8.3 Checking Specific Gravity

Use a battery hydrometer to check the specific gravity of the electrolyte in each battery cell. While 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, use the correction factors in Figure 2-18. Determine specific gravity and electrolyte temperature of battery cells. Locate temperature in Figure 2-18 and adjust the specific gravity by the amount shown.

The battery is fully charged if the specific gravity is 1.260 at an electrolyte temperature of 80°F (26.7°C). The difference between specific gravities of each cell should not exceed ±0.01. Charge the battery if the specific gravity is below 1.215 at an electrolyte temperature of 80°F (26.7°C). See Figure 2-16.

Specific Gravity, Corrected to 80°F (26.7°C)	Battery Condition
Below 1.215	Needs charging
1.260	Fully charged

Figure 2-16 Specific Gravity Interpretation

Some battery testers have four or five beads in the test tube. Draw electrolyte into the tube as performed with the battery hydrometer described previously. Use the manufacturer's instructions. Figure 2-17 interprets typical test results.

Number of Floating Beads	Battery Condition
5	Overcharged
4	Fully charged
3	Good charge
1 or 2	Low charge
0	Dead battery

Figure 2-17 Bead-Type Test Interpretation

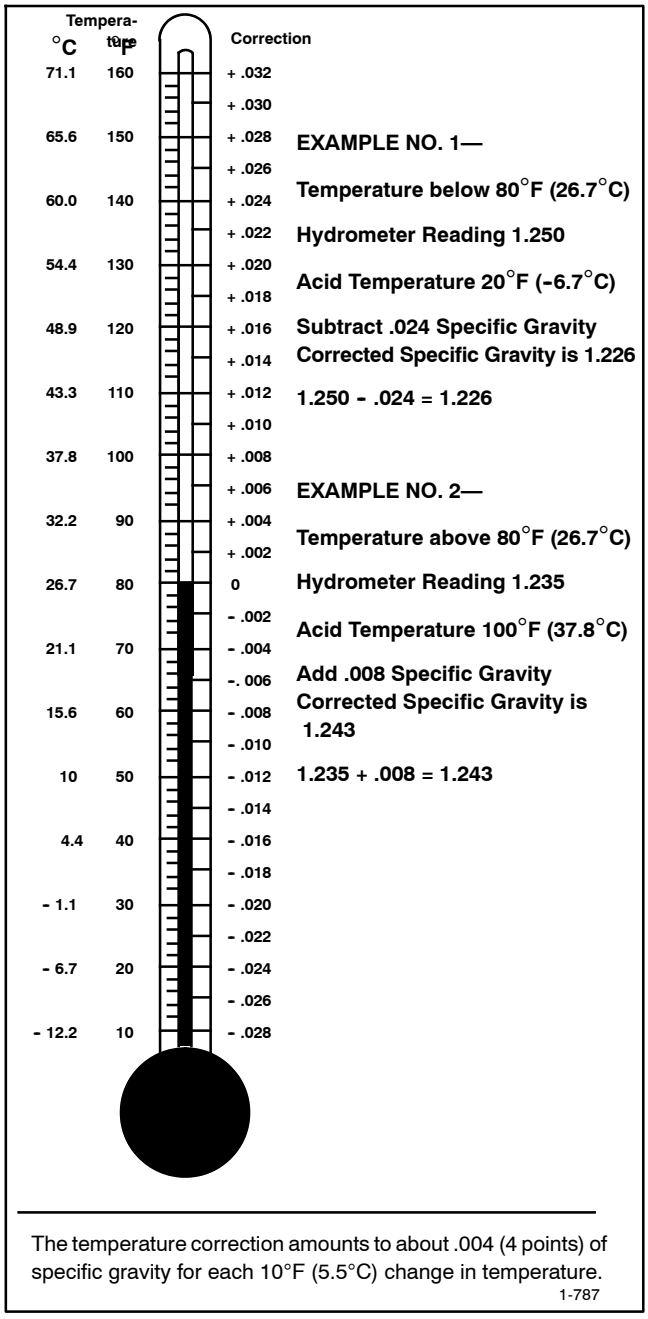


Figure 2-18 Specific Gravity Temperature Correction

2.9 Fuel System Maintenance

⚠ 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.

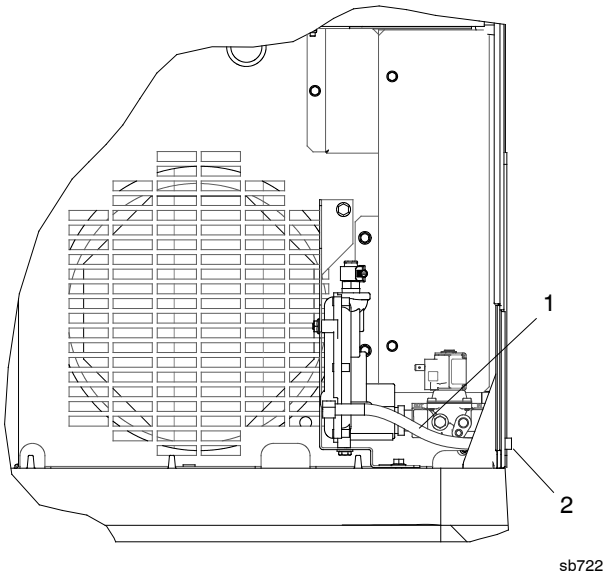
Gas fuel leaks. Explosive fuel vapors can cause severe injury or death. Fuel leakage can cause an explosion. Check the LPG vapor or natural gas fuel system for leakage by using a soap and water solution with the fuel system test pressurized to 6–8 ounces per square inch (10–14 inches water column). Do 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.

Routine service items include draining water/sediment from piping at petcock or pipe end cap, checking for fuel leakage at pipe connections, checking flexible sections for cracking or chafing, and keeping components clean including fuel regulator vent holes.

A grease or wax residue tends to accumulate in the piping and fuel regulators over time. If fuel system problems persist, disassemble the fuel system components and check for residue buildup. Remove any residue with a brush and mild detergent.

2.10 Fuel Regulator Vent Tubes

Models 20RESA(L) and 20RESC(L) may be equipped with the fuel regulator vent tubes shown in Figure 2-19. If the generator is equipped with the regulator vent tubes, check that the tubes are not blocked. Clean out the tubes, if necessary.



1. Regulator vent tubes, qty. 2
2. Check for debris. Clean out the tubes, if necessary.

Figure 2-19 Fuel Regulator Vent Tubes (if equipped)

2.11 Storage Procedure

Perform the following storage procedure before removing the generator set from service for three months or longer. Follow the engine manufacturer's recommendations for storage, if available.

Note: Run the generator set monthly whenever possible.

2.11.1 Lubricating System

1. Operate the generator set until it reaches operating temperature, or about 15 minutes.
2. Stop the generator set.
3. While the engine is still warm, drain the engine lubrication oil from the engine crankcase.
4. Refill the engine crankcase with oil. See Section 2.2.3 for oil recommendations.
5. Run the generator set for a few minutes to distribute the clean oil.
6. Stop the generator set.

2.11.2 Fuel System

1. Start the generator set.
2. With the generator set running, shut off the gas supply.
3. Run the generator set until the engine stops.
4. Press the OFF button on the controller.

2.11.3 Cylinder Lubrication

1. Remove the spark plugs.
2. Pour one tablespoon of engine oil into each spark plug hole. Install the spark plugs and *ground* the spark plug leads. *Do not connect the leads to the plugs.*
3. Press RUN and then OFF to crank the engine two or three revolutions to lubricate the cylinders.

2.11.4 Exterior Preparation

1. Clean the exterior surface of the generator set.
2. Seal all openings in the engine with nonabsorbent adhesive tape.
3. Mask all areas to be used for electrical contact.
4. Spread a light film of oil over unpainted metallic surfaces to prevent rust and corrosion.

2.11.5 Battery

Perform battery storage last.

1. Press the OFF button on the generator set controller.
2. Disconnect the battery, negative (–) lead first.
3. Clean the battery.
4. Place the battery in a warm, dry location.
5. Connect the battery to a float/equalize battery charger, or charge the battery monthly using a trickle charger. Follow the battery charger manufacturer's recommendations.

3.1 Voltage Reconnection

The reconnection procedure explains voltage reconnections only. Do not attempt to change the frequency (e.g. from 60 Hz to 50 Hz) in the field.

The following instructions explain the reconnection of 12-lead generator sets. In all cases, follow the National Electrical Code (NEC) guidelines.

Reconnect the stator leads of the generator set if a different output phase or voltage is desired. Refer to the following procedure and the connection schematics. Follow all safety precautions at the front of this manual and in the text while performing this procedure.

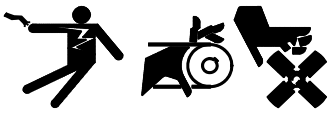
Note: Order voltage reconnection decal 246242 and affix decal to generator set after reconnecting to a voltage different than the nameplate.

NOTICE

This generator set has been rewired from its nameplate voltage to

246242

⚠ 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 connected equipment, 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.

⚠ WARNING

Hazardous voltage. Moving parts. Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

Grounding electrical equipment. Hazardous voltage can 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 can 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 Four-Lead (Single-Phase) Generator Sets

See the generator specification sheet for available voltage and frequency configurations. See Figure 3-1 and Figure 3-2 for the single-phase alternator connections.

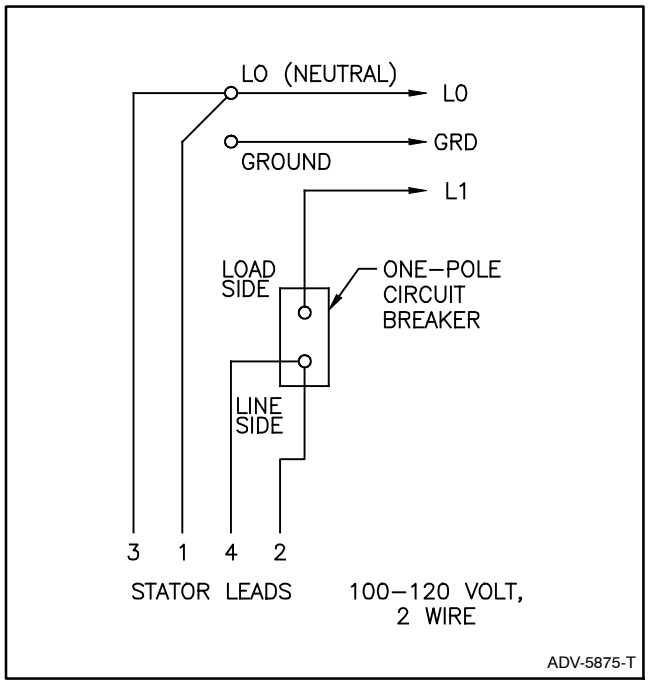


Figure 3-1 Single-Phase Connection, 1-Pole Breaker

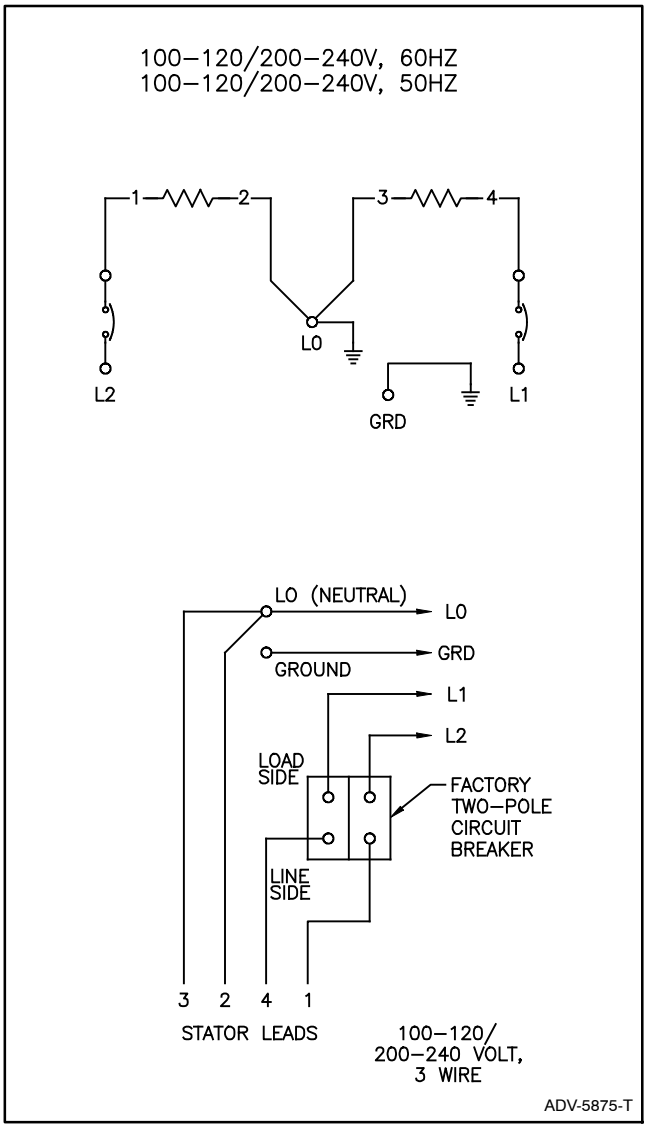


Figure 3-2 Single-Phase Connection, 2-Pole Breaker

3.3 12-Lead (Three-Phase) Generator Sets

Three-phase, 12-lead generator sets are reconnectable to the voltages shown on the generator set specification sheet.

See Figure 3-3 for alternator connections. Some voltage changes do not require alternator reconnection. For example, 50 Hz 3-phase voltage configurations of 220/380, 230/400, and 240/415 use the same alternator connection. Change the system voltage by changing the voltage setting on the controller. Use Kohler® SiteTech™ software or the controller menus to change the voltage setting. See Section 4.7 for instructions.

If alternator reconnection is required, use the following procedure to reconnect the generator to the desired voltage configuration, change the system voltage setting, and adjust the output voltage.

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

Reconnection Procedure

1. Press the OFF button on the RDC2 controller.
2. Disconnect engine starting battery, negative (–) lead first.
3. Disconnect utility power to the generator set.
4. Select desired voltage connection. See Figure 3-3. Connect the leads according to the diagram for desired phase and voltage.
5. Reconnect generator set engine starting battery, negative (–) lead last.
6. Follow the instructions in Section 4.7 to check the system voltage, frequency, and phase settings, and change them if necessary.
7. Connect a digital multimeter (DVM) to the generator set output.
8. Press RUN to start the generator set.
9. Use a voltmeter to check for the correct voltage output from the generator set. Follow the instructions in Section 4.8 to calibrate the voltage on the RDC2 controller, if necessary.
10. Press OFF to stop the generator set.
11. Reconnect utility power to the generator set.
12. Press AUTO to place the generator set in automatic mode.

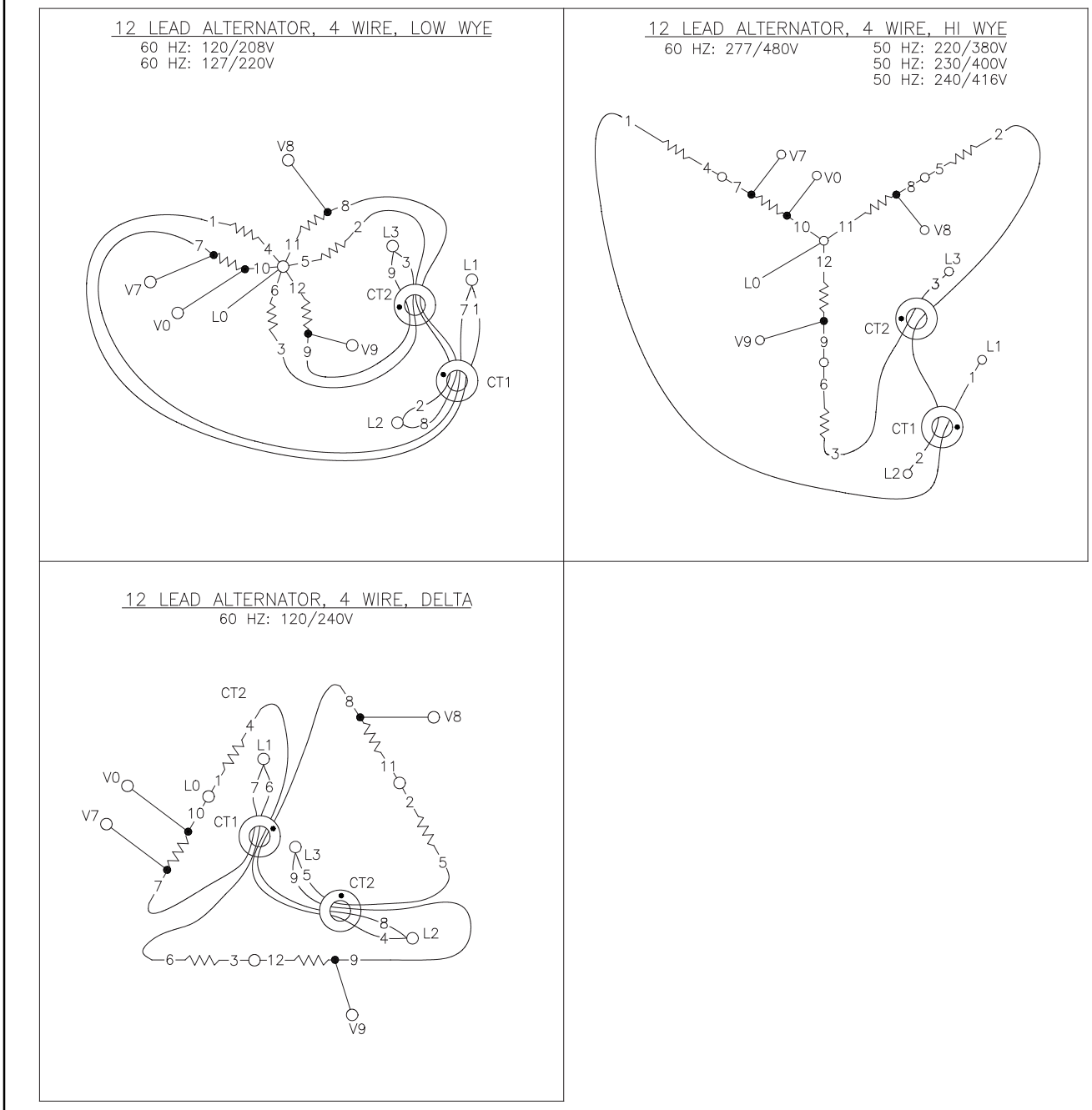


Figure 3-3 12-Lead Generator Reconnection

4.1 Introduction

The RDC2 and DC2 controllers manage the operation of the generator set, a Model RXT transfer switch (if equipped), the optional Programmable Interface Module (PIM), and optional load management device. See the generator set Operation Manual for controller operation instructions.

This section covers adjustment and replacement of the RDC2 and DC2 controllers. See Section 5.14 for troubleshooting information.

4.2 Controllers

Model RESA/B/C/D generator sets are equipped with the RDC2 controller. RESAL/RESCL models have the DC2 controller. Revised RDC2 and DC2 controllers were introduced in 2014. Operation and setup of the revised controllers are the same as the original.

The original controller can be identified as follows:

- The USB port and mini circuit breaker are located behind a cover with a thumbscrew.
- The circuit board, visible on the back of the controller, is green.

The original RDC2 and DC2 controllers are shown in Figure 4-1.

Revised controllers can be identified as follows:

- The USB port is located behind a small rubber cover.
- The mini circuit breaker is located near, but not on, the controller. See Section 5.4.
- The circuit board, visible on the back of the controller, is red.

Revised controllers are shown in Figure 4-2.

See the service view for the controller location on the generator set.

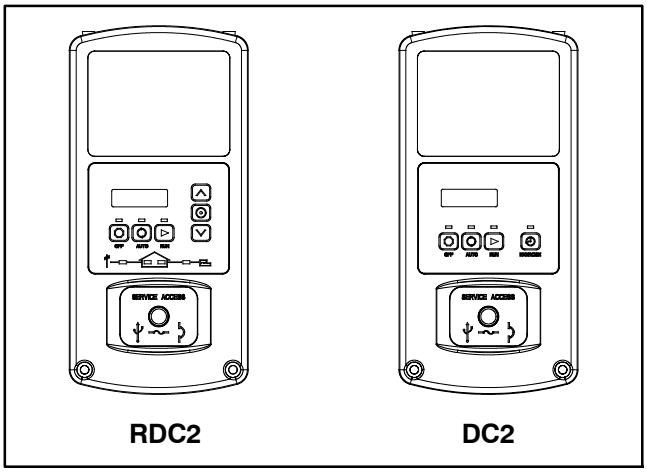


Figure 4-1 RDC2 and DC2 Original Controllers (green board)

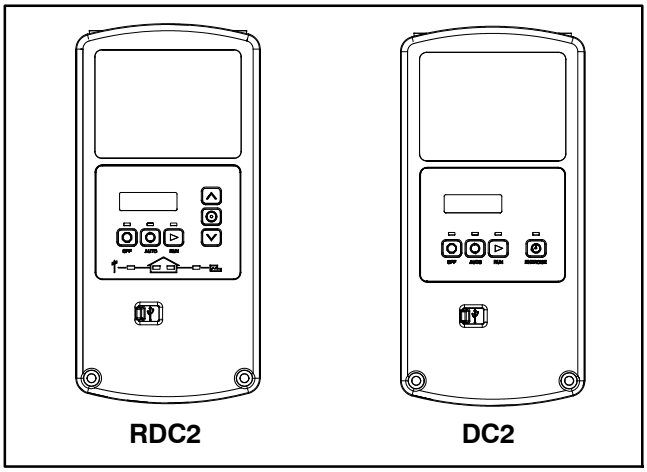


Figure 4-2 Revised Controllers (red board)

Generator Set Model	Controller
14RESA	RDC2
20RESA	
20RESB	
20RESC	
20RESD	
14RESAL	DC2
20RESAL	
20RESCL	

Figure 4-3 Controllers, by Model

4.3 SiteTech Software

Many procedures in this manual require the use of a personal computer (or laptop) with Kohler® SiteTech™ software to change controller settings or update firmware. SiteTech software is available to Kohler-authorized distributors and dealers. See the SiteTech Operation Manual, TP-6701, for general software operation instructions.

Use a USB cable to connect the personal computer directly to the device. See Figure 4-5. The USB cable must have a male USB A connector on one end and a male mini-B connector on the other and must be less than 5 m (16.4 ft.) long. See Figure 4-4.

Figure 4-4 USB Cable

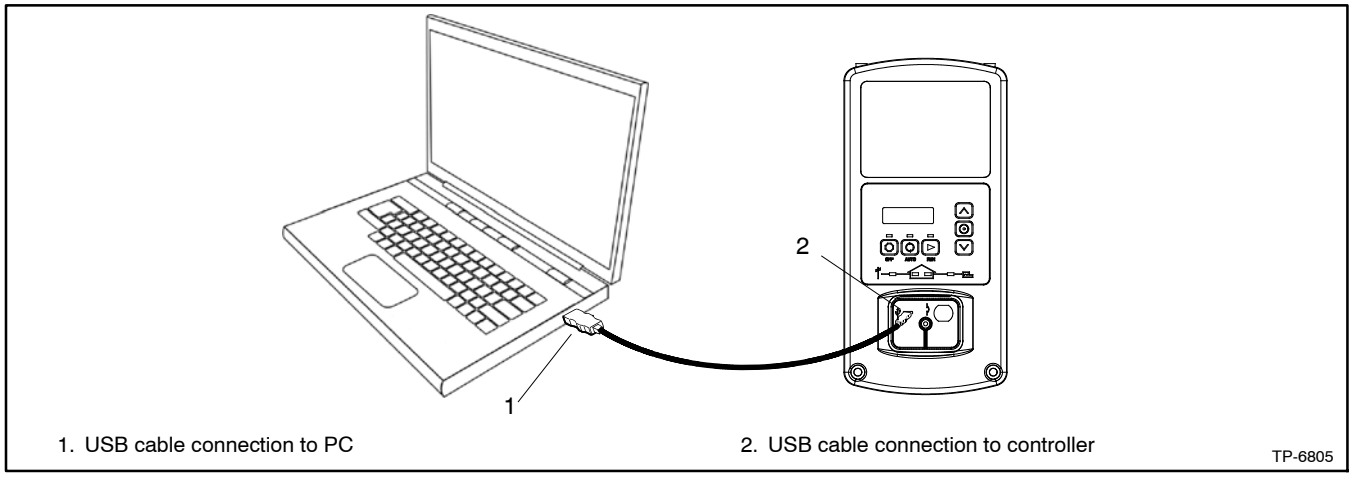


Figure 4-5 USB Connection (original RDC2 controller shown)

4.4 Controller Parameters

Adjustable parameter settings can be changed using a personal computer (or laptop) with Kohler® SiteTech™ software. See Section 4.3, SiteTech Software, for USB connection information. See the SiteTech Operation Manual, TP-6701, for general software operation instructions.

Some parameter settings can also be changed at the RDC2 controller. See the generator set operation manual for instructions to navigate through the controller menus and change settings.

4.4.1 Controller Parameters Table

The table on the following pages lists controller parameters that are visible in SiteTech. Parameters marked Read Only are not user-adjustable.

Some parameters that are visible in SiteTech do not apply to the generator set models covered in this manual. Those parameters are marked N/A in the last column, and the line in the table is shaded gray.

Parameters that apply to an optional Model RXT transfer switch, programmable interface module (PIM), or load management device (LCM, load shed kit, or RXT combined interface/load management board) are noted in the last column.

The table indicates the following:

- The group in SiteTech that contains the parameter
- Factory default settings
- Units for the setting (e.g. RPM)
- Adjustment range for user-adjustable settings

4.4.2 Notes on Selected Parameters

Temperature Settings

In SiteTech, all temperature settings are shown in degrees F but stored as degrees C. When you highlight a parameter value (click it), the °F value changes to the equivalent °C value. Enter temperature settings in °F. The new setting is calculated from a conversion equation, so the final value may include some rounding that makes the setting higher or lower by 1 degree.

Engine Speed Governor Settings

Engine Speed Adjustment. The default setting for the engine speed adjustment is 50. This gives engine speeds of 3600 RPM for 60 Hz models, and 3000 RPM for 50 Hz models. See Section 6.9.2 for instructions to adjust the engine speed, if necessary.

Note: The system frequency must be set correctly before adjusting the engine speed setting.

Engine Speed Gain Adjustment. The recommended setting for the engine speed gain adjustment is 50, which is the default setting. See Section 6.9.1 for instructions to adjust the Engine Speed Gain, if necessary.

Genset Info

Model numbers and serial numbers are factory-set for each unit. If the controller is replaced, the genset model number and serial number will need to be entered by the installer. For the genset model number, select the appropriate model from the dropdown list. Find the generator set serial number on the nameplate and enter it using SiteTech. See Section 4.6, Controller Replacement, for information about other setup required on a replacement controller.

Changing the genset model number will update the engine model number automatically. Select the genset model number and then click Apply Changes in SiteTech to see the updated engine model number.

Genset Fuel Type

The Genset Fuel Type setting is located in the Genset System Configuration group in SiteTech. Generator set power and current ratings are different for different fuel types (natural gas or LP). The fuel type setting is available in SiteTech with controller firmware versions 4.5 and higher.

Changing the Genset Fuel Type setting automatically updates the the Genset Power Rating and Genset Rated Current settings. The power rating is used to determine setpoints for the optional load management device. If load management device is connected and the generator set is converted to a different fuel, use SiteTech to change the Genset Fuel Type setting.

Digital Inputs and Outputs

Digital inputs and outputs are available only if the optional Programmable Interface Module (PIM) is connected to the RDC2 controller. One PIM provides two digital inputs and 6 digital outputs.

Dropdown menus allow selection of the digital input and output events. Be sure to select Digital Inputs B1–B2 and Digital Outputs B1–B6 in SiteTech. Digital Inputs A1–A2 and Digital Outputs A1–A2 do not apply to the PIM. Digital outputs B7–B12 are reserved for load

management and cannot be changed by the user. These outputs will display the load management relay status.

Refer to Installation Instruction Sheet TT-1584, provided with the PIM, for information about the input and output events.

RBUS Devices

Up to four RBUS modules can be connected to the generator set. RBUS modules can include one Model RXT transfer switch, one programmable interface module (PIM), one automatic paralleling module (APM), and one load management device (load control module (LCM), load shed kit, or the RXT combined interface/load management board). If two generators are paralleled using the APM, the second generator is also considered an RBUS device but does not reduce the number of RBUS modules that can be used.

Note: An RXT transfer switch with the combined interface/load management board counts as two RBUS devices (unless load management is disabled on the combined board).

Load Management Devices

A load management device can be a load control module (LCM), a load shed kit installed in an RDT or RXT transfer switch, or a combined interface/load management board installed in an RXT transfer switch. Only one load management device can be connected. The load management device counts as one RBUS device.

A relay module (GM92001-KP1-QS) is a power relay designed for use with the load shed kit or the combined interface/load management board. The relay module does not act as an RBUS device. See TT-1646.

SiteTech Group	Parameter	Units	Adjustment Range *	Default Setting	Notes †
Identity	Vendor		Read Only	Kohler Company	
	Product		Read Only	RDC 2	
	Firmware Version		Read Only	N/A	
Engine Metering	Engine Speed	R/min	Read Only	N/A	
	Engine Target Speed	R/min	Read Only	N/A	
	Engine Oil Pressure	kPa	Read Only	N/A	
	Engine Coolant Temperature	°C	Read Only	N/A	N/A
	Battery Voltage	V	Read Only	N/A	
	Lube Oil Temperature	°C	Read Only	N/A	
	Genset Controller Temperature	°C	Read Only	N/A	
	Engine Low Oil Pressure Switch		Read Only	N/A	
	Engine Compartment Temperature	°C	Read Only	N/A	N/A
Engine Speed Governor	Engine Speed Adjustment		0 – 99 See Section 4.4.2.	50	
	Engine Speed Gain Adjustment		35–65	50	
Generator Metering	Generator Rotation Actual		Read Only	N/A	3-phase
	Generator Current Lead/Lag L1		Read Only	N/A	N/A
	Generator Current Lead/Lag L2		Read Only	N/A	N/A
	Generator Current Lead/Lag L3		Read Only	N/A	3-phase
	Generator Current Total Lead/Lag		Read Only	N/A	N/A
	Generator Power Factor L1		Read Only	N/A	N/A
	Generator Power Factor L2		Read Only	N/A	N/A
	Generator Power Factor L3		Read Only	N/A	3-phase
	Generator Total Power Factor		Read Only	N/A	N/A

* Read Only = Not adjustable

† Notes indicate applicability to genset model and accessories. N/A = Not applicable to these generator sets.

‡ See TT-1584 for more information about digital inputs and outputs.

§ Load management device (LCM, load shed kit, or RXT with combined interface/load management board)

SiteTech Group	Parameter	Units	Adjustment Range *	Default Setting	Notes †
Generator Metering	Generator Apparent Power L1	VA	Read Only	N/A	N/A
	Generator Apparent Power L2	VA	Read Only	N/A	N/A
	Generator Apparent Power L3	VA	Read Only	N/A	N/A
	Generator Total Apparent Power	VA	Read Only	N/A	N/A
	Generator Reactive Power L1	VAR	Read Only	N/A	N/A
	Generator Reactive Power L2	VAR	Read Only	N/A	N/A
	Generator Reactive Power L3	VAR	Read Only	N/A	N/A
	Generator Total Reactive Power	VAR	Read Only	N/A	N/A
	Generator True Power L1	W	Read Only	N/A	N/A
	Generator True Power L2	W	Read Only	N/A	N/A
	Generator True Power L3	W	Read Only	N/A	3-phase
	Generator True Total Power	W	Read Only	N/A	N/A
	Generator True Percent Of Rated Power	%	Read Only	N/A	N/A
	Generator Voltage L1-L2	V	Read Only	N/A	
	Generator Voltage L2-L3	V	Read Only	N/A	3-phase
	Generator Voltage L3-L1	V	Read Only	N/A	3-phase
	Generator Voltage Average Line To Line	V	Read Only	N/A	
	Generator Current L1	A	Read Only	N/A	N/A
	Generator Current L2	A	Read Only	N/A	N/A
	Generator Current L3	A	Read Only	N/A	3-phase
	Generator Current Average	A	Read Only	N/A	
	Generator Frequency	Hz	Read Only	N/A	
Genset Info	Genset Model Number Select		Dropdown list: 14KW 20KW	Factory-set per unit. See Section 4.4.2	
	Genset Serial Number		0–20 characters		
	Alternator Part Number		0–20 characters		N/A
	Genset Controller Serial Number		1–10 characters		
	Engine Part Number		0–20 characters		N/A
	Engine Model Number		CH-740 (14) or CH-1000 (20) (Selected automatically with genset model)		
	Engine Serial Number		0–10 characters		N/A
	Genset State	N/A	Read Only	N/A	
Genset Run Time	Genset Controller Clock Time		Read Only	N/A	
	Genset Controller Total Operation Time	h	Read Only	N/A	
	Engine Total Run Time	h	Read Only	N/A	
	Engine Total Run Time Loaded	h	Read Only	N/A	N/A
	Engine Total Number Of Starts		Read Only	N/A	
	Genset Date Time Of Last Maintenance		Read Only (See Section 2.3, Resetting the Maintenance Timer)	1/1/01 12:00:00 AM	

***** Read Only = Not adjustable

† Notes indicate applicability to genset model and accessories. N/A = Not applicable to these generator sets.

‡ See TT-1584 for more information about digital inputs and outputs.

§ Load management device (LCM, load shed kit, or RXT with combined interface/load management board)

SiteTech Group	Parameter	Units	Adjustment Range *	Default Setting	Notes †
Genset Run Time	Engine Run Time Until Maintenance	h	Read Only	200.0	
	Genset Controller Date Format		MM/DD/YYYY or DD/MM/YYYY	MM/DD/ YYYY	
	Genset Controller Time Format		12 or 24 hr	12 Hr	
	Genset Date Time of Next Maintenance		Read Only	N/A	
	Maintenance Period In Days	days	Read Only	365	
	Maintenance Period Remaining	s	Read Only	31536000	
	Genset Controller Clock Time Zone Offset		Read Only	1/1/01 12:00:00 AM	
Genset Personality Profile	ECM Model		**DO NOT CHANGE**	No ECM	N/A
	Maximum Alternator Current	A	Read Only	920	
	Engine Number Of Flywheel Teeth		Locked	1	
	Engine Warmed Up Temperature	°C/F	77 – 140 °C	90°C	N/A
	Engine Cooled Down Temperature	°C/F	Locked	79°C	
	Engine Crank Disconnect Speed	RPM	300 –1000	750	
	Engine Idle Speed	RPM	DO NOT CHANGE	2700	
	Engine Run Speed	RPM	1000 – 3900	3600	
	Engine Coolant Temperature Protectives Enabled		No effect		N/A
	Engine Coolant Temperature Sensor		No effect.		N/A
	Engine High Coolant Temperature Inhibit Delay	s	No effect.		N/A
	Engine Low Coolant Temperature Warning Delay	s	No effect.		N/A
	Engine High Coolant Temperature Warning Delay	s	No effect.		N/A
	Engine Low Coolant Temperature Shutdown Delay	s	No effect.		N/A
	Engine High Coolant Temperature Shutdown Delay	s	No effect.		N/A
	Engine Low Coolant Temperature Warning Limit	°C/F	No effect.		N/A
	Engine High Coolant Temperature Warning Limit	°C/F	No effect.		N/A
	Engine High Coolant Temperature Shutdown Limit	°C/F	No effect.		N/A
	Engine Coolant Temperature Deadband	°C/F	No effect.		N/A

***** Read Only = Not adjustable

† Notes indicate applicability to genset model and accessories. N/A = Not applicable to these generator sets.

‡ See TT-1584 for more information about digital inputs and outputs.

§ Load management device (LCM, load shed kit, or RXT with combined interface/load management board)

SiteTech Group	Parameter	Units	Adjustment Range *	Default Setting	Notes †
Genset Personality Profile	Personality Alternator Manufacturer		No effect.		N/A
	Personality Alternator Toc Time Constant	s	No effect.		N/A
	Personality Alternator Number Of Poles		No effect.		N/A
	Personality Alternator Type		No effect.		N/A
	Personality Fixed Voltage 50 Hz	V	No effect.		N/A
	Personality Power Rating Single Phase 50 Hz 10 PF	kW	No effect.		N/A
	Personality Power Rating Single Phase 50 Hz 8 PF	kW	No effect.		N/A
	Personality Power Rating Fixed Volt 50 Hz	kW	No effect.		N/A
	Personality Power Rating 50 Hz 220 440	kW	No effect.		N/A
	Personality Power Rating 50 Hz 208 415	kW	No effect.		N/A
	Personality Power Rating 50 Hz 200 400	kW	No effect.		N/A
	Personality Power Rating 50 Hz 190 380	kW	No effect.		N/A
	Personality Power Rating 50 Hz 173 346	kW	No effect.		N/A
	Personality Power Rating 50 Hz Delta	kW	No effect.		N/A
	Personality Fixed Voltage 60 Hz	V	No effect.		N/A
	Personality Power Rating Single Phase 60 Hz 10 PF	kW	No effect.		N/A
	Personality Power Rating Single Phase 60 Hz 8 PF	kW	No effect.		N/A
	Personality Power Rating Fixed Volt 60 Hz	kW	No effect.		N/A
	Personality Power Rating 60 Hz 240 480	kW	No effect.		N/A
	Personality Power Rating 60 Hz 230 460	kW	No effect.		N/A
	Personality Power Rating 60 Hz 220 440	kW	No effect.		N/A
	Personality Power Rating 60 Hz 208 416	kW	No effect.		N/A
	Personality Power Rating 60 Hz 190 380	kW	No effect.		N/A
	Personality Power Rating 60 Hz Delta	kW	No effect.		N/A
	Personality Installed Options		No effect.		N/A

* Read Only = Not adjustable

† Notes indicate applicability to genset model and accessories. N/A = Not applicable to these generator sets.

‡ See TT-1584 for more information about digital inputs and outputs.

§ Load management device (LCM, load shed kit, or RXT with combined interface/load management board)

SiteTech Group	Parameter	Units	Adjustment Range *	Default Setting	Notes †
Genset System Configuration	Genset System Voltage	V	110 – 600	240.0	
	Genset System Frequency	Hz	50/60	60.0	
	Genset Voltage Phase Connection		Dropdown menu	Single Phase	
	Genset Power Rating	kW	DO NOT CHANGE	Auto select based on genset model and fuel type	
	Genset Rated Current	A	Read Only		Load Mgmt§
	Genset System Battery Voltage	V	12/24	12	
	Prime Power Application		Standby or prime	Standby	N/A
	Current Transformer Ratio		Locked	400	Load Mgmt§
	Local Start Mode		Read Only	Off	
	Measurement System		English or metric	English	
	ECM Power		True or False	False	N/A
	Display Contrast		0 – 100	50	
	Genset System Language		No effect.	English	N/A
	Genset Maximum Percent Capacity	%	0 – 120	70.0	Load Mgmt§
	Generator Overloaded Percent	%	0 – 120	85.0	
	Under Frequency Shed Level	Hz	0 – 5	0.5	
	Base Load Add Time	s	10 – 2400	60	
	Base Over Load Shed Time	s	2 – 30	30	
	Base Under Frequency Shed Time	s	1 – 20	5	
	Genset Fuel Type (firmware versions 4.5 or higher)		Natural Gas or LP (pulldown)	Natural Gas	
	Automatic Start Minimum Voltage	V	15 – 60	51	
	Automatic Stop Minimum Percent Load	%	0 – 100	20	
	Automatic Start Minimum Voltage Delay	s	1 – 3600	180	
	Automatic Stop Minimum Load Delay	s	1 – 3600	180	
	ECM Powered Mode		On or Off	Off	
Genset Calibration	Genset Calibration Factor Voltage L1-L2		0.9 – 1.1	1.0063	
	Genset Calibration Factor Voltage L2-L3		0.9 – 1.1	0.9909	3-phase
	Genset Calibration Factor Voltage L3-L1		0.9 – 1.1	0.9427	3-phase
	Genset Calibration Factor Current L1		0.9 – 1.1	1.000000	Load Mgmt§
	Genset Calibration Factor Current L2		0.9 – 1.1	1.000000	N/A

* Read Only = Not adjustable

† Notes indicate applicability to genset model and accessories. N/A = Not applicable to these generator sets.

‡ See TT-1584 for more information about digital inputs and outputs.

§ Load management device (LCM, load shed kit, or RXT with combined interface/load management board)

SiteTech Group	Parameter	Units	Adjustment Range *	Default Setting	Notes †
Advanced Speed Control	Proportional Gain		Factory set per unit. **DO NOT ADJUST** unless instructed by the Kohler Generator Service Department.		
	Transient Integral Gain				
	Derivative Gain				
	Slow Correction Integral Gain				
	Diagnostic Derivative Gain				
	Diagnostic Transient Integral Gain				
Voltage Regulator	Voltage Regulator Average Voltage Adjustment	V	108 – 660 (Auto select with system voltage)	240.0 (System Voltage)	
	Voltage Regulator Volts Per Hertz Slope	%	1– 10	5	
	Voltage Regulator Volts Per Hertz Cut In Frequency	Hz	42 – 62	59	
	Voltage Regulator Gain		1 – 255	16	
	Voltage Regulator Firmware Version		Read Only	N/A	N/A
Engine Timing	Engine Start Delay	s	0 – 300	0	
	Engine Cool Down Delay	s	300 – 600	300	
	Engine Crank On Delay	s	10 – 30	15	
	Engine Crank Pause Delay	s	1 – 60	15	
	Engine Number Of Crank Cycles		1 – 6	3	
Genset Protection	Genset Low Battery Voltage Warning Delay	s	Read Only	90	
	Genset High Battery Voltage Warning Delay	s	Read Only	10	
	Genset Low Battery Voltage Warning Limit	%	80 – 100	100	
	Genset High Battery Voltage Warning Limit	%	110 – 135	125	
	Genset Battery Low Cranking Voltage Warning Delay	s	Read Only	6	
	Genset Battery Low Cranking Voltage Warning Limit	%	Read Only	60	
Engine Protection	Engine Low Oil Pressure Shutdown Delay	s	5	5	
	Engine Locked Rotor Shutdown Delay	s	3	3	
	Genset Low Engine Speed Shutdown Limit	%	75 – 95	85	
	Genset High Engine Speed Shutdown Limit	%	105 – 120	115	
	Engine Low Oil Pressure Warning Limit	kPa	No effect.		N/A
	Engine High Oil Pressure Shutdown Limit	kPa	No effect.		N/A

***** Read Only = Not adjustable

† Notes indicate applicability to genset model and accessories. N/A = Not applicable to these generator sets.

‡ See TT-1584 for more information about digital inputs and outputs.

§ Load management device (LCM, load shed kit, or RXT with combined interface/load management board)

SiteTech Group	Parameter	Units	Adjustment Range *	Default Setting	Notes †
Generator Protection	Loss Of AC Sensing Shutdown Delay	s	Read Only	3	
	Genset Low Voltage Shutdown Delay	s	Read Only	10	
	Genset High Voltage Shutdown Delay	s	Read Only	2	
	Genset Low Voltage Shutdown Limit	%	Read Only	80	
	Genset High Voltage Shutdown Limit	%	Read Only	120	
	Genset Short Term Low Frequency Shutdown Delay	s	Read Only	10	
	Genset Long Term Low Frequency Shutdown Delay	s	Read Only	60	
	Genset High Frequency Shutdown Delay	s	Read Only	10	
	Genset Low Frequency Shutdown Limit	%	Read Only	90	
	Genset High Frequency Shutdown Limit	%	Read Only	110	
Digital Input A1	Digital Input A1 Value		Read Only	False	N/A
	Digital Input A1 Enabled		True or False	True	N/A
	Digital Input A1 Event		See dropdown list in SiteTech. ‡	Fuel Pressure Low Warning	N/A
Digital Input A2	Digital Input A2 Value		Read Only	False	N/A
	Digital Input A2 Enabled		True or False	True	N/A
	Digital Input A2 Event		See dropdown list in SiteTech. ‡	Auxiliary Input Warning	N/A
Digital Input B1	Digital Input B1 Value		Read Only	False	PIM
	Digital Input B1 Enabled		True or False	False	
	Digital Input B1 Event		See dropdown list in SiteTech. ‡	None (0)	
Digital Input B2	Digital Input B2 Value		Read Only	False	PIM
	Digital Input B2 Enabled		True or False	False	
	Digital Input B2 Event		See dropdown list in SiteTech. ‡	None (0)	
Digital Output A1	Digital Output A1 Value		Read Only	False	N/A
	Digital Output A1 Event		See dropdown list in SiteTech. ‡	NFPA 110 Alarm Active	N/A
Digital Output A2	Digital Output A2 Value		Read Only	N/A	N/A
	Digital Output A2 Event		See dropdown list in SiteTech. ‡	N/A	N/A
Digital Output B1	Digital Output B1 Value		Read Only	False	PIM
	Digital Output B1 Event		See dropdown list in SiteTech. ‡	Generator Running	

* Read Only = Not adjustable

† Notes indicate applicability to genset model and accessories. N/A = Not applicable to these generator sets.

‡ See TT-1584 for more information about digital inputs and outputs.

§ Load management device (LCM, load shed kit, or RXT with combined interface/load management board)

SiteTech Group	Parameter	Units	Adjustment Range *	Default Setting	Notes †
Digital Output B2	Digital Output B2 Value		Read Only	False	PIM
	Digital Output B2 Event		See dropdown list in SiteTech. ‡	Common Fault	
Digital Output B3	Digital Output B3 Value		Read Only	False	PIM
	Digital Output B3 Event		See dropdown list in SiteTech. ‡	Low Battery Voltage Warning	
Digital Output B4	Digital Output B4 Value		Read Only	False	PIM
	Digital Output B4 Event		See dropdown list in SiteTech. ‡	Not In Auto Warning	
Digital Output B5	Digital Output B5 Value		Read Only	False	PIM
	Digital Output B5 Event		See dropdown list in SiteTech. ‡	Engine Cool Down Active	
Digital Output B6	Digital Output B6 Value		Read Only	False	PIM
	Digital Output B6 Event		See dropdown list in SiteTech. ‡	Normal Source Failure	
Digital Output B7	Digital Output B7 Value		Read Only	False	Load Mgmt§
	Digital Output B7 Event		Read Only	65004	
Digital Output B8	Digital Output B8 Value		Read Only	False	
	Digital Output B8 Event		Read Only	65007	
Digital Output B9	Digital Output B9 Value		Read Only	False	
	Digital Output B9 Event		Read Only	65003	
Digital Output B10	Digital Output B10 Value		Read Only	False	
	Digital Output B10 Event		Read Only	65005	
Digital Output B11	Digital Output B11 Value		Read Only	False	
	Digital Output B11 Event		Read Only	65006	
Digital Output B12	Digital Output B12 Value		Read Only	False	
	Digital Output B12 Event		Read Only	65008	
ATS Metering Summary	ATS Contactor Position		Read Only	N/A	RXT
	ATS Sources Available		Read Only	N/A	
Source 1 Metering	Source 1 Rotation Actual		Read Only	N/A	RXT
	Source 1 Voltage L1-L2	V	Read Only	N/A	
	Source 1 Voltage L2-L3	V	Read Only	N/A	
	Source 1 Voltage L3-L1	V	Read Only	N/A	
	Source 1 Voltage Average Line To Line	V	Read Only	N/A	
	Source 1 Frequency	Hz	Read Only	N/A	
Source 2 Metering	Source 2 Rotation Actual		Read Only	N/A	RXT
	Source 2 Voltage L1-L2	V	Read Only	N/A	
	Source 2 Voltage L2-L3	V	Read Only	N/A	
	Source 2 Voltage L3-L1	V	Read Only	N/A	
	Source 2 Voltage Average Line To Line	V	Read Only	N/A	
	Source 2 Frequency	Hz	Read Only	N/A	

***** Read Only = Not adjustable

† Notes indicate applicability to genset model and accessories. N/A = Not applicable to these generator sets.

‡ See TT-1584 for more information about digital inputs and outputs.

§ Load management device (LCM, load shed kit, or RXT with combined interface/load management board)

SiteTech Group	Parameter	Units	Adjustment Range *	Default Setting	Notes †
ATS Connection Configuration	ATS Source		Read Only	N/A	RXT
Source 1 System Configuration	Source 1 System Voltage	V	110.0 – 600.0 (Auto select with system voltage)	Genset System Voltage	RXT
	Source 1 System Frequency	Hz	48.0 – 62.0 (Auto select with system frequency)	Genset System Frequency	
	Source 1 Voltage Debounce Delay	s	1 – 99	0.5	
	Source 1 Low Voltage Pickup	%	85 – 100	90	
	Source 1 Low Voltage Dropout	%	75 – 98	90	
Source 1 Calibration	Source 1 Calibration Factor Voltage L1-L2		Read Only	1	RXT
	Source 1 Calibration Factor Voltage L2-L3		Read Only	1	
	Source 1 Calibration Factor Voltage L3-L1		Read Only	1	
Source 2 System Configuration	Source 2 System Voltage	V	110.0 – 600.0 (Auto select with system voltage)	Genset System Voltage	RXT
	Source 2 System Frequency	Hz	48.0 – 62.0 (Auto select with system frequency)	Genset System Frequency	
	Source 2 Voltage Debounce Delay	s	0.1 – 9.9	0.5	
	Source 2 Low Voltage Pickup	%	85 – 100	90	
	Source 2 Low Voltage Dropout	%	75 – 98	90	
Source 2 Calibration	Source 2 Calibration Factor Voltage L1-L2		Read Only	1	RXT
	Source 2 Calibration Factor Voltage L2-L3		Read Only	1	
	Source 2 Calibration Factor Voltage L3-L1		Read Only	1	
ATS Exercise	Exercise Interval		Weekly or Every Other Week	Weekly	RXT
	Exercise Run Duration	min	10 – 30	20	
	Exercise Mode		Pulldown See List	Unloaded Cycle (2)	
	Exercise Warning Enabled		True or False	True	
ATS Delays	ATS Transfer From Preferred Delay	s	1 – 10	3	RXT
	ATS Transfer From Standby Delay	s	1 – 600	120	
	ATS Source 2 Engine Start Delay	s	1 – 10	3	
Modbus	Is Modbus Master		True or False	False	

* Read Only = Not adjustable

† Notes indicate applicability to genset model and accessories. N/A = Not applicable to these generator sets.

‡ See TT-1584 for more information about digital inputs and outputs.

§ Load management device (LCM, load shed kit, or RXT with combined interface/load management board)

SiteTech Group	Parameter	Units	Adjustment Range *	Default Setting	Notes †
Network Configuration	DHCP Enabled		True or False	True	OnCue Plus
	Static IP Address		0.0.0.0 – 255.255.255.255	0.0.0.0	
	Static Subnet Mask		0.0.0.0 – 255.255.255.255	0.0.0.0	
	Static Default Gateway		0.0.0.0 – 255.255.255.255	0.0.0.0	
	Static DNS Server 1		0.0.0.0 – 255.255.255.255	0.0.0.0	
	Static DNS Server 2		0.0.0.0 – 255.255.255.255	0.0.0.0	
	Server Host Name		devices.kohler.com	devices.kohler.com	
Network Status	IP Address		Read Only	0.0.0.0	OnCue Plus
	Subnet Mask		Read Only	0.0.0.0	
	Default Gateway		Read Only	0.0.0.0	
	DNS Server 1		Read Only	0.0.0.0	
	DNS Server 2		Read Only	0.0.0.0	
	MAC Address		Read Only	N/A	
	Connected Server IP Address		Read Only	0.0.0.0	
	Network Connection Established		Read Only	False	
	Media Connected		Read Only	False	
Rbus Network	Rbus Active		Read Only	False	
	Rbus Connection Count		Read Only	0	
	Rbus Net Cycle Time	ms	Read Only	100	
	Rbus Timeouts		Read Only	0	
	Rbus Errors		Read Only	0	
Rbus Devices B1	Rbus Devices B1 Serial Number		Read Only	N/A	RXT, PIM, or Load Mgmt §
	Rbus Devices B1 Type		Read Only	N/A	
	Rbus Devices B1 Communication Errors		Read Only	N/A	
	Rbus Devices B1 Communication Timeouts		Read Only	N/A	
	Rbus Devices B1 Modbus Id		Read Only	N/A	
	Rbus Devices B1 Last Connection Date		Read Only	N/A	
	Rbus Devices B1 Firmware Version		Read Only	N/A	
	Rbus Devices B1 Connected		Read Only	N/A	

* Read Only = Not adjustable

† Notes indicate applicability to genset model and accessories. N/A = Not applicable to these generator sets.

‡ See TT-1584 for more information about digital inputs and outputs.

§ Load management device (LCM, load shed kit, or RXT with combined interface/load management board)

SiteTech Group	Parameter	Units	Adjustment Range *	Default Setting	Notes †
Rbus Devices B2	Rbus Devices B2 Serial Number		Read Only	N/A	RXT, PIM, or Load Mgmt §
	Rbus Devices B2 Type		Read Only	N/A	
	Rbus Devices B2 Communication Errors		Read Only	N/A	
	Rbus Devices B2 Communication Timeouts		Read Only	N/A	
	Rbus Devices B2 Modbus Id		Read Only	N/A	
	Rbus Devices B2 Last Connection Date		Read Only	N/A	
	Rbus Devices B2 Firmware Version		Read Only	N/A	
	Rbus Devices B2 Connected		Read Only	N/A	
Rbus Devices B3	Rbus Devices B3 Serial Number		Read Only	N/A	RXT, PIM, or Load Mgmt §
	Rbus Devices B3 Type		Read Only	N/A	
	Rbus Devices B3 Communication Errors		Read Only	N/A	
	Rbus Devices B3 Communication Timeouts		Read Only	N/A	
	Rbus Devices B3 Modbus Id		Read Only	N/A	
	Rbus Devices B3 Last Connection Date		Read Only	N/A	
	Rbus Devices B3 Firmware Version		Read Only	N/A	
	Rbus Devices B3 Connected		Read Only	N/A	
Rbus Devices B4	Rbus Devices B4 Serial Number		Read Only	N/A	N/A
	Rbus Devices B4 Type		Read Only	N/A	N/A
	Rbus Devices B4 Communication Errors		Read Only	N/A	N/A
	Rbus Devices B4 Communication Timeouts		Read Only	N/A	N/A
	Rbus Devices B4 Modbus Id		Read Only	N/A	N/A
	Rbus Devices B4 Last Connection Date		Read Only	N/A	N/A
	Rbus Devices B4 Firmware Version		Read Only	N/A	N/A
	Rbus Devices B4 Connected		Read Only	N/A	N/A
Rbus Devices B5	Rbus Devices B5 Serial Number		Read Only	N/A	N/A
	Rbus Devices B5 Type		Read Only	N/A	N/A
	Rbus Devices B5 Communication Errors		Read Only	N/A	N/A
	Rbus Devices B5 Communication Timeouts		Read Only	N/A	N/A
	Rbus Devices B5 Modbus Id		Read Only	N/A	N/A
	Rbus Devices B5 Last Connection Date		Read Only	N/A	N/A
	Rbus Devices B5 Firmware Version		Read Only	N/A	N/A
	Rbus Devices B5 Connected		Read Only	N/A	N/A

***** Read Only = Not adjustable

† Notes indicate applicability to genset model and accessories. N/A = Not applicable to these generator sets.

‡ See TT-1584 for more information about digital inputs and outputs.

§ Load management device (LCM, load shed kit, or RXT with combined interface/load management board)

4.5 Controller Firmware

The manufacturer may release new versions of controller firmware. Kohler® distributors can download the latest software from the TechTools area of the Kohler Power Resource Center website. Controller firmware is also available for download on the Kohler dealer portal and at www.KohlerGenerators.com/usb.

The firmware version number is shown in the RDC2 controller's Overview menu. See SW Version in Figure 4-6. The firmware version number is also displayed in SiteTech™ and OnCue® Plus. To check the firmware version number, select the parameters view in SiteTech or OnCue Plus. The firmware version number is shown in the Identity Group, which is the first group displayed.

A personal computer (laptop), a USB cable, and Kohler® SiteTech™ or the USB Utility are required for firmware updates. Use a USB cable to connect the computer to the controller's USB port. See Section 4.3.

Refer to the SiteTech Software Operation Manual or the USB Utility instruction sheet for instructions to load new firmware onto the controller.

Firmware version numbers: Preceding zeroes may be dropped from firmware version numbers. For example, version number 4.03 is the same as version 4.3. The version number displayed in SiteTech may show a third number. For example, SiteTech may display version 4.3.5 for software version 4.3.

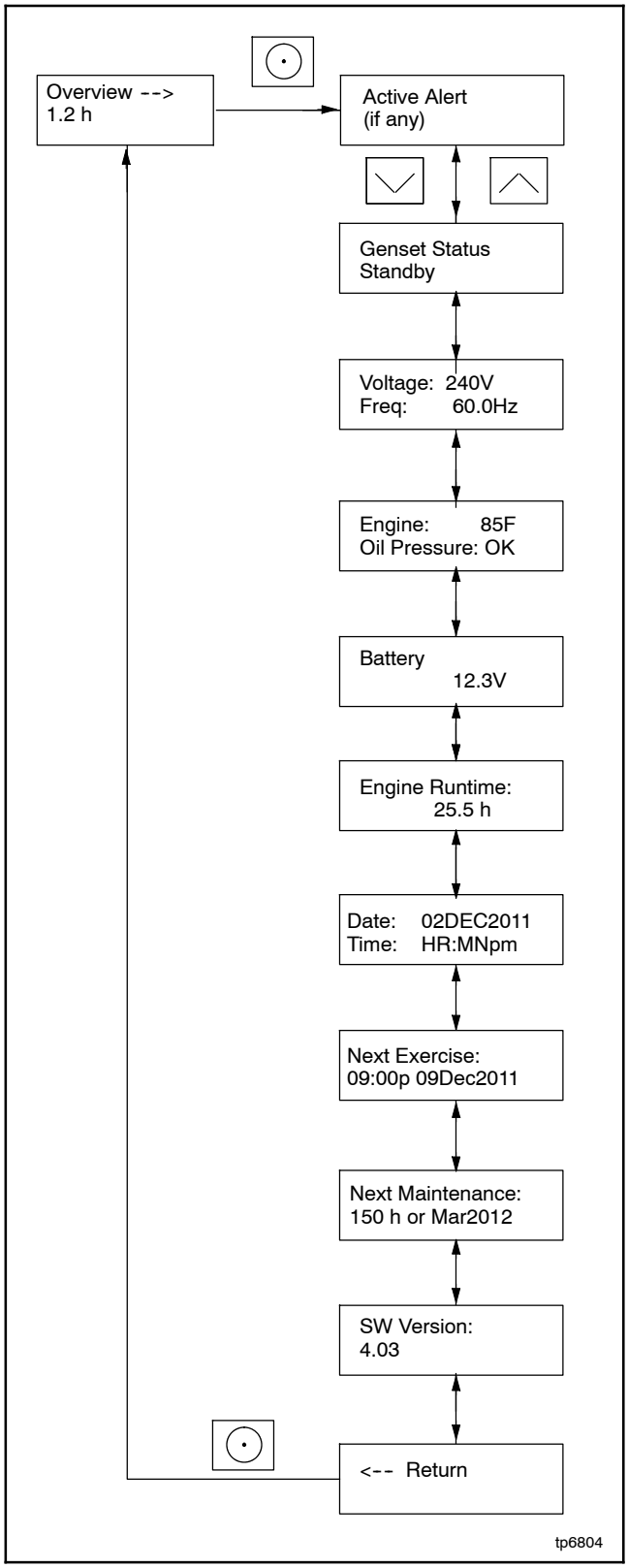
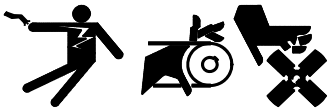


Figure 4-6 SW Version Number in Overview Menu

4.6 Controller Replacement

⚠ 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.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

Testing live electrical circuits. Hazardous voltage or current can 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)

Short circuits. Hazardous voltage/current can 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.

Always check the controller settings, wiring, and connections before replacing the controller. Use the procedure in this section for controller replacement, when necessary.

Some setup is required after the new controller is installed. See Section 4.7 after replacing the controller. The RDC2 controller can be set up using the buttons on the controller or using a personal (laptop) computer and Kohler® SiteTech™ software. A personal (laptop) computer and SiteTech are required for setup of the DC2 controller.

IMPORTANT NOTE about replacing an original (green board) controller with a revised (red board) controller:

If it is necessary to replace an original (green board) controller with a revised (red board) controller, **an additional relay and mini-circuit breaker for the auxiliary winding are required.** See Figure 4-1 and Figure 4-2 for controller identification. Order kit number GM95104 to obtain the relay, adapter harness, and circuit breaker.

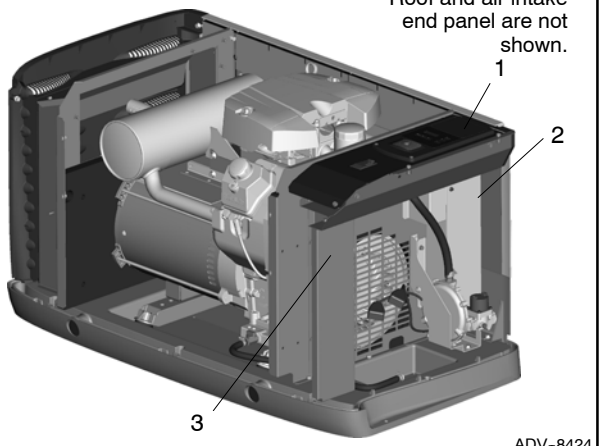
Controller Replacement Procedure

1. Using the enclosure locking tool provided with the generator set, open the enclosure roof.

2. Press the OFF button on the controller.

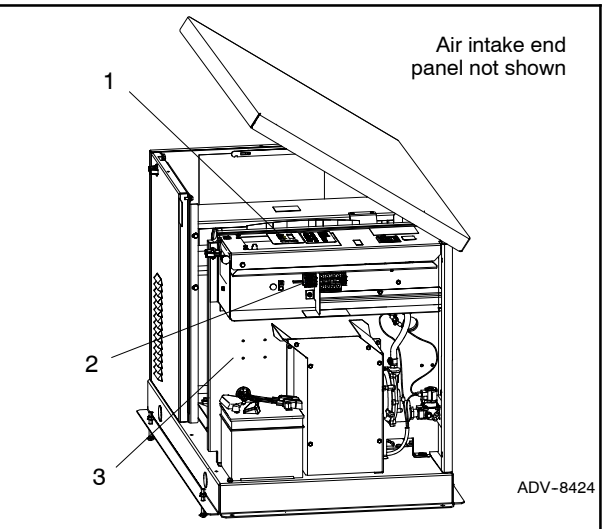
   Note: Utility power is connected to the generator's terminal block. This power must be turned off before the controller is removed.

3. Disconnect utility power to the generator set by opening the circuit breaker in the building's distribution panel. Use a voltmeter to verify that utility power has been disconnected. See Figure 4-7 (14/20RESA/L, 20RESC/L) or Figure 4-8 (20RESB/D) for the utility power connection location. See Figure 4-9 for the utility power connection detail on the generator set terminal block.



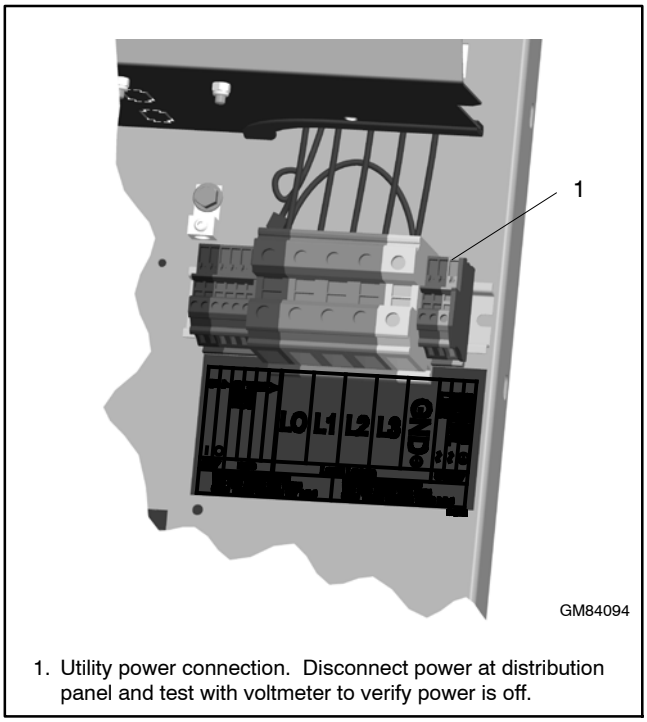
1. Controller location
2. Utility power connection location (terminal block behind panel)
3. Nameplate location

Figure 4-7 Controller, Utility Power Connection, and Nameplate Locations, 14/20RESA(L), 20RESC(L)



1. Controller location
2. Utility power connection location (terminal block behind panel)
3. Nameplate location

Figure 4-8 Controller, Utility Power Connection and Nameplate Locations, 20RESB/RESD



1. Utility power connection. Disconnect power at distribution panel and test with voltmeter to verify power is off.

Figure 4-9 Power Connection Detail (RESA shown)

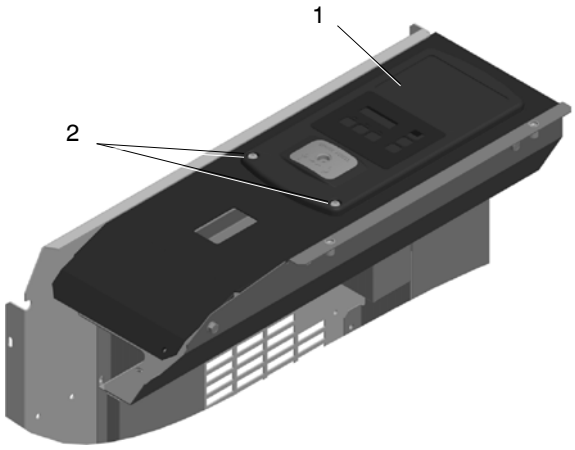
4. Disconnect the generator set engine starting battery, negative (–) lead first.

5. Remove the two (2) screws securing the controller to the junction box and *carefully* lift the bottom edge of the controller. See Figure 4-10.

   Note: Be careful of the leads and harness connected to the controller panel.

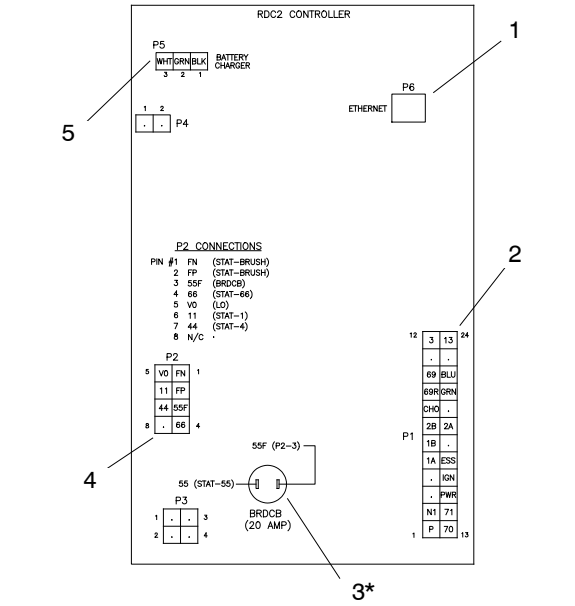
6. Note the connections on the back of the controller, and then disconnect all harnesses and leads from the controller. See Figure 4-11 or the wiring diagram.

7. Remove the old controller.



1. Controller
2. Controller mounting screws (qty. 2)

Figure 4-10 Controller Mounting (14/20RESA shown)



1. P6 Ethernet connection for OnCue Plus
2. P1
3. Field circuit breaker*
4. P2
5. P5

* Generators with revised controllers have the mini-breaker located elsewhere on the generator set.

Figure 4-11 Controller Connections

8. If an original (green board) controller is being replaced with an original controller, OR if a revised (red board) controller is being replaced with a revised controller, go to step 10.

9. If an original (green board) controller is being replaced with a revised (red board) controller, install the new relay (with fuse) and mini circuit breaker provided in kit GM95104.

   a. Use the hardware provided in the relay kit to install the new run relay in the trough under the controller, near the existing relay. See Figure 4-12.

   b. Install fuse P22, which connects to the relay adapter harness, near the new relay. Make sure that the fuse is located close enough to the relay for the lead lengths in the harness.

   c. Connect the relay adapter harness to P1 on the controller. Connect the other end to the 24-pin connector on the engine harness. Connect the adpater harness to the relay and the fuse.

   d. Leads 55 and 55F were disconnected from the mini circuit breaker on the old controller. Connect leads 55 and 55F to the new mini circuit breaker assembly.

   e. Use a cable tie to secure the mini circuit breaker to the harness as shown in Figure 4-13.

   f. Proceed to step 10.

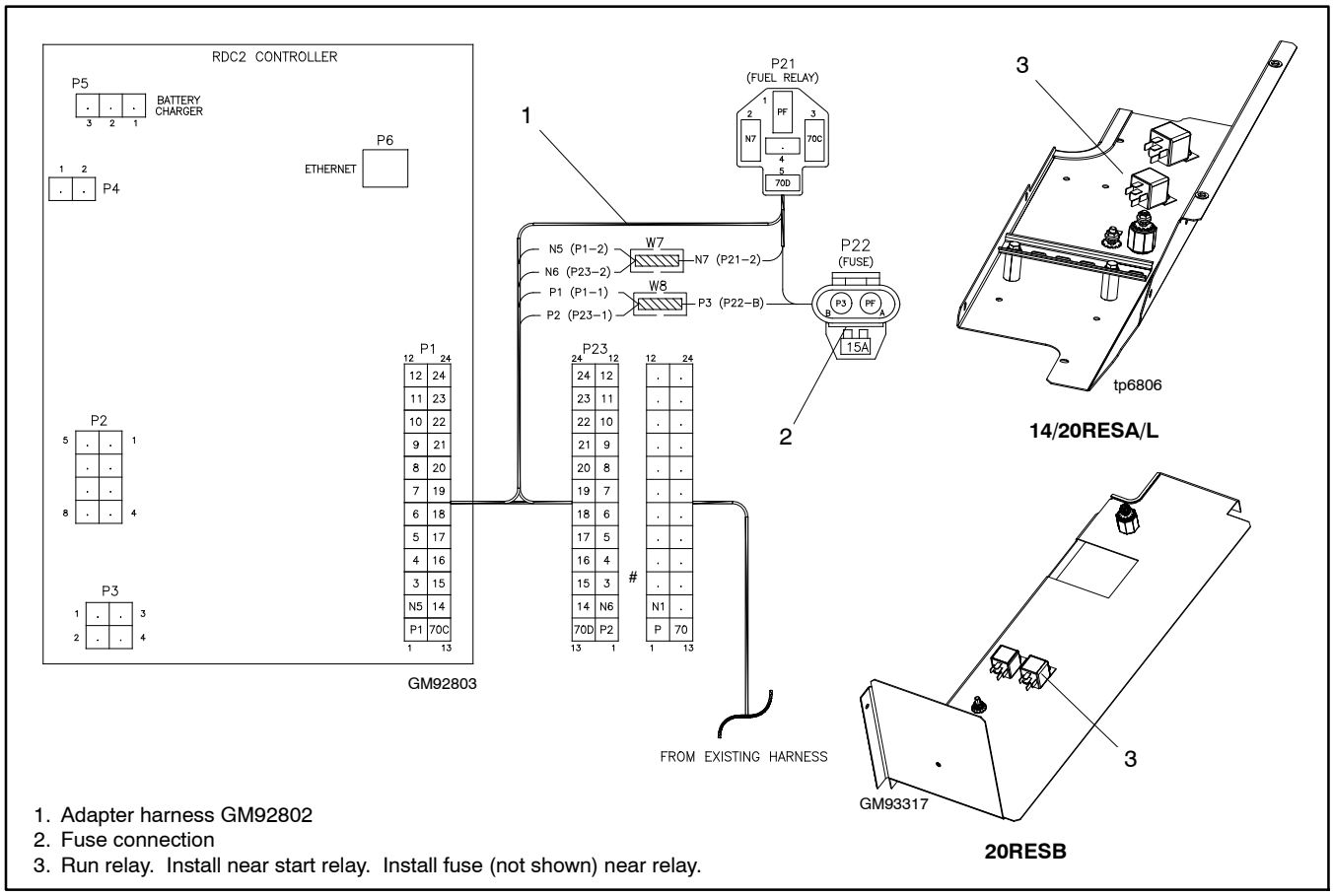
10. Reconnect all harnesses to the new controller assembly.

11. Install the controller onto the junction box using the two (2) screws removed in step 5.

12. Reconnect the engine starting battery, negative (–) lead last.

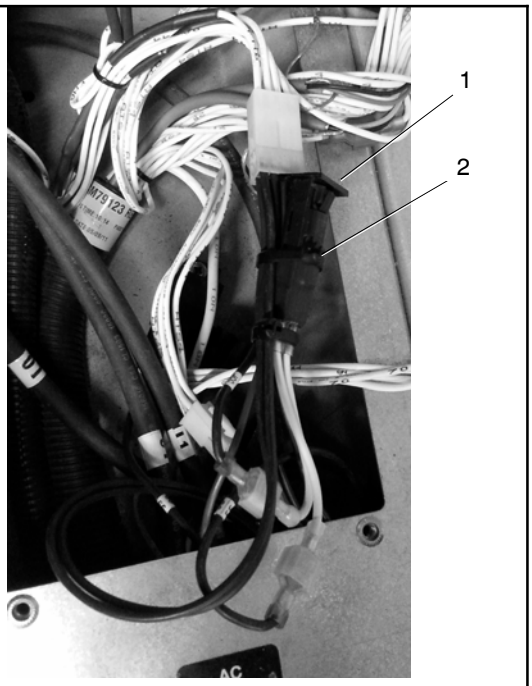
13. Reconnect the utility power to the generator set by closing the circuit breaker in the distribution panel.

14. The controller will prompt you to set the date and time, and then to set the exerciser. See the generator set Operation Manual for instructions, if necessary.



1. Adapter harness GM92802
2. Fuse connection
3. Run relay. Install near start relay. Install fuse (not shown) near relay.

Figure 4-12 Relay and Adapter Harness (for replacing original controller with revised controller only)



1. Mini circuit breaker
2. Cable tie

141329

Figure 4-13 Mini Circuit Breaker (for replacing original controller with revised controller only)

15. Check the firmware version on the controller. See Section 4.5. Use SiteTech or the USB utility with a laptop computer connected to the controller's USB port to update the firmware to the latest released version. See the SiteTech Software Operation Manual or the USB Utility instruction sheet for instructions.

16. Set up the controller as instructed in Section 4.7, Controller Setup.

17. Calibrate the voltage. See Section 4.8, Voltage Calibration.

18. If OnCue® Plus is used to monitor this generator set, reset the OnCue password on the controller and note the new password. See Section 4.9, Setting the OnCue Password. Then connect with OnCue Plus and enter the new password.

19. Verify that OnCue® Plus can communicate with the generator set over the Internet before leaving the job site.

4.7 Controller Setup

Controller setup is required after installation. Follow the instructions in this section to set the necessary parameters.

Controller Setup Notes:

- Some of the required information can be found on the generator set nameplate. See Figure 4-7 or Figure 4-8 for the nameplate location.
- The Fuel Type parameter is available with controller firmware versions 4.5 or higher. The fuel type setting affects the generator set power rating, which is used to determine setpoints for the optional load management device. Setting the Fuel Type is recommended if the generator set is connected to a load management device.
- See Figure 4-15 for additional information.

Controller Setup Procedure

1. Use one of the following methods to set the parameters shown in Figure 4-15.

   a. Set up the RDC2 controller using the buttons on the controller to navigate through the controller menus and change the settings. See the required controller menus in Figure 4-16 and Figure 4-17. See the generator set operation manual for additional instructions, if necessary.

   b. Kohler® SiteTech™ software and a personal (laptop) computer are required for setting up the DC2 controller. The RDC2 controller can also be set up using SiteTech. The computer connects directly to the controller through the USB port. Refer to TP-6701, SiteTech Software Operation Manual, for instructions if necessary.

2. Check the voltage calibration and adjust, if necessary. See Section 4.8, Voltage Calibration.

Exporting Settings from a File

If a personal computer (laptop) and Kohler® SiteTech™ software were used to create a controller settings file at the time of generator set installation (when the controller was known to be operating correctly), then SiteTech software can be used to load the saved settings onto the new controller. In some cases, the Kohler Generator Service Department may provide a settings file to load onto the controller for testing or troubleshooting. See TP-6701, SiteTech Software Operation Manual, for instructions to export and import controller settings.

Note: Load the old controller settings onto the new controller only if you are certain that the settings are correct. Many generator set operation problems can be caused by incorrect settings.

Do not load settings from an original green-board controller onto a revised red-board controller (or vice versa).

System Voltage	Frequency, Hz	Phases	Phase Connection
120	60	1	Single
220	50	1	Single
230	50	1	Single
240	50	1	Single
100/200	50	1	Single
100/200	50	3	Delta
110/220	60	1	Single
110/220	60	3	Delta
115/230	50	1	Single
120/208	60	3	Wye
120/240	60	1	Single
120/240	60	3	Delta
127/220	50	3	Wye
220/380	50	3	Wye
230/400	50	3	Wye
240/416	50	3	Wye
277/480	60	3	Wye

Figure 4-14 Three-Phase Voltage Configurations for 14/20RESA, 20RESC

Parameter	Controller Menu	SiteTech Group	Settings		
			14RESA(L)	20RESA(L), 20RESC(L)	20RESB, 20RESD
Genset Model Number	Genset Information	Genset Info	14kW	20kW	20kW
Genset Serial Number			From nameplate		
Fuel Type †	Genset System	Genset System Configuration	Natural Gas or Liquid Propane (LP)		
Phase Connection			See the nameplate and Figure 4-14		Single Phase
Genset System Voltage			From nameplate		
Genset System Frequency			50 or 60 Hz		
† Fuel Type is available with controller firmware versions 4.5 or higher.					

Figure 4-15 Controller Setup

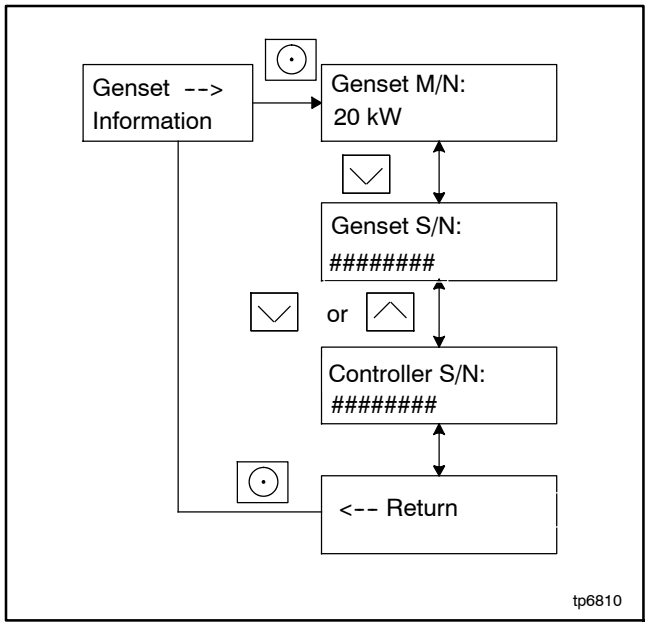
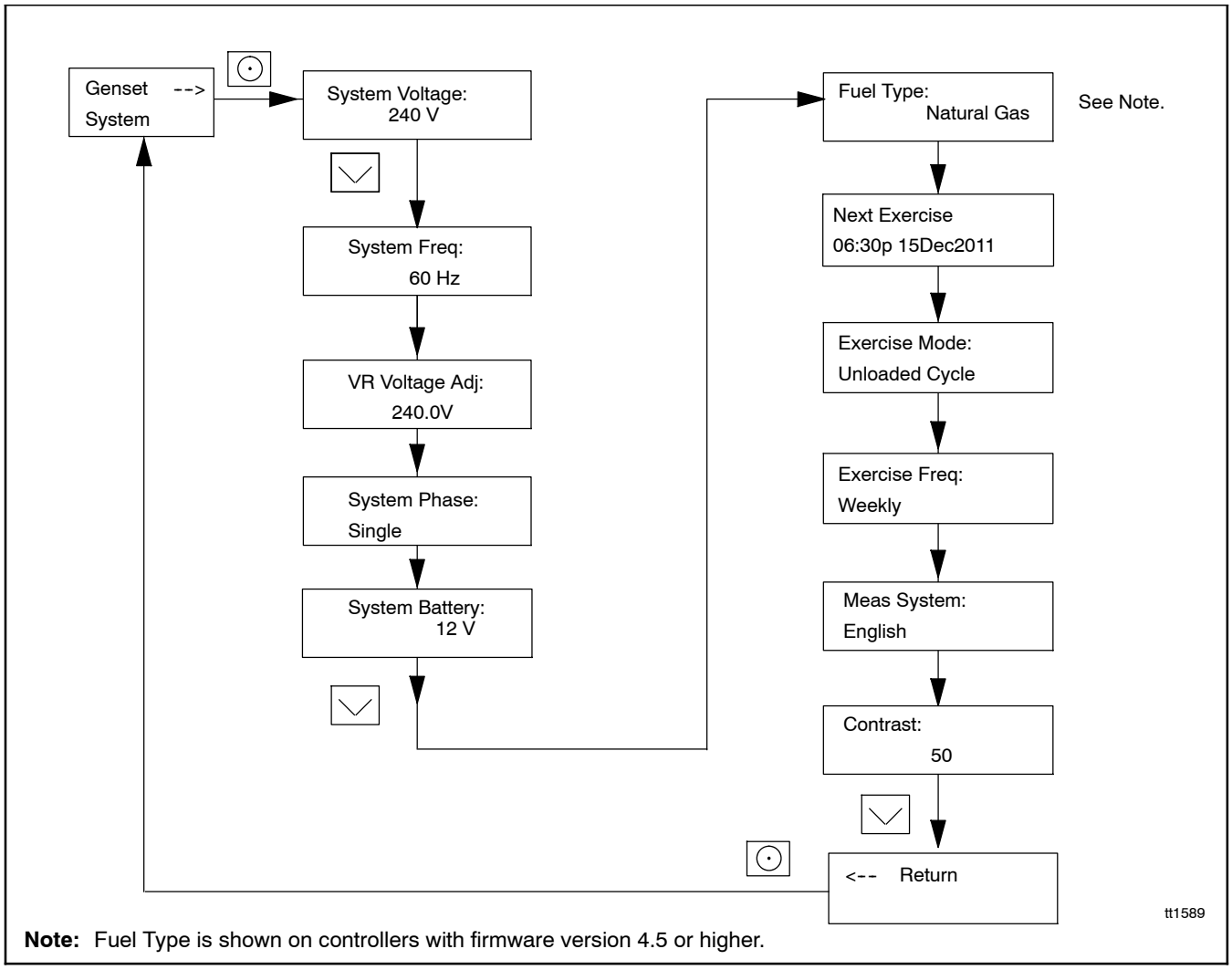


Figure 4-16 Generator Set Information Menu, RDC2



Note: Fuel Type is shown on controllers with firmware version 4.5 or higher.

Figure 4-17 Genset System Menu, RDC2

4.8 Voltage Calibration

⚠ WARNING

Hazardous voltage. Moving parts. Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

Testing live electrical circuits. Hazardous voltage or current can 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)

Short circuits. Hazardous voltage/current can 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.

Correct voltage calibration is necessary for proper generator set operation. Check the voltage calibration after controller replacement or generator set reconnection, and adjust if necessary.

The RDC2 controller can be calibrated using the controller keypad and menus, or using a personal computer with Kohler® SiteTech™ software.

4.8.1 Calibration using the RDC2 Controller Keypad and Menus

The controller's voltage calibration can be adjusted using the controller keypad. See Figure 4-18 and follow the procedure below.

Note: A digital voltmeter is required for these adjustments.

1. With the generator set off, connect a digital multimeter to measure output voltage across L1 and L2. Set the meter to measure AC volts.
2. Start the generator set by pressing the RUN button on the RDC2 controller.
3. On the RDC2 controller, press the Select button and then use the arrow buttons to navigate to the Generator Metering menu on the RDC2 controller.
4. Press the Select button to display Volts L1-L2. Compare the number displayed with the voltmeter reading.
5. If the correct voltage is not displayed, follow these steps to adjust it:
   a. Press the Select button. The voltage will flash.
   b. Press the up or down arrow button to adjust the voltage to match the voltmeter reading.
   c. Press Select to save the voltage setting. The voltage stops flashing.
   d. Wait for the voltmeter reading to stabilize. This may take 30 to 60 seconds.
6. For three-phase models, press the Down arrow button and repeat the calibration procedure for voltage across L2–L3 and L3–L1.
7. Use the arrow buttons to step down to the Return screen. Press Select to exit the Generator Metering menu.
8. Press OFF to stop the generator set.

Reset Calibration

Pressing the select button when "Reset Calibration? Yes" is displayed will discard the changes and reset the calibration to the original settings. See Figure 4-18.

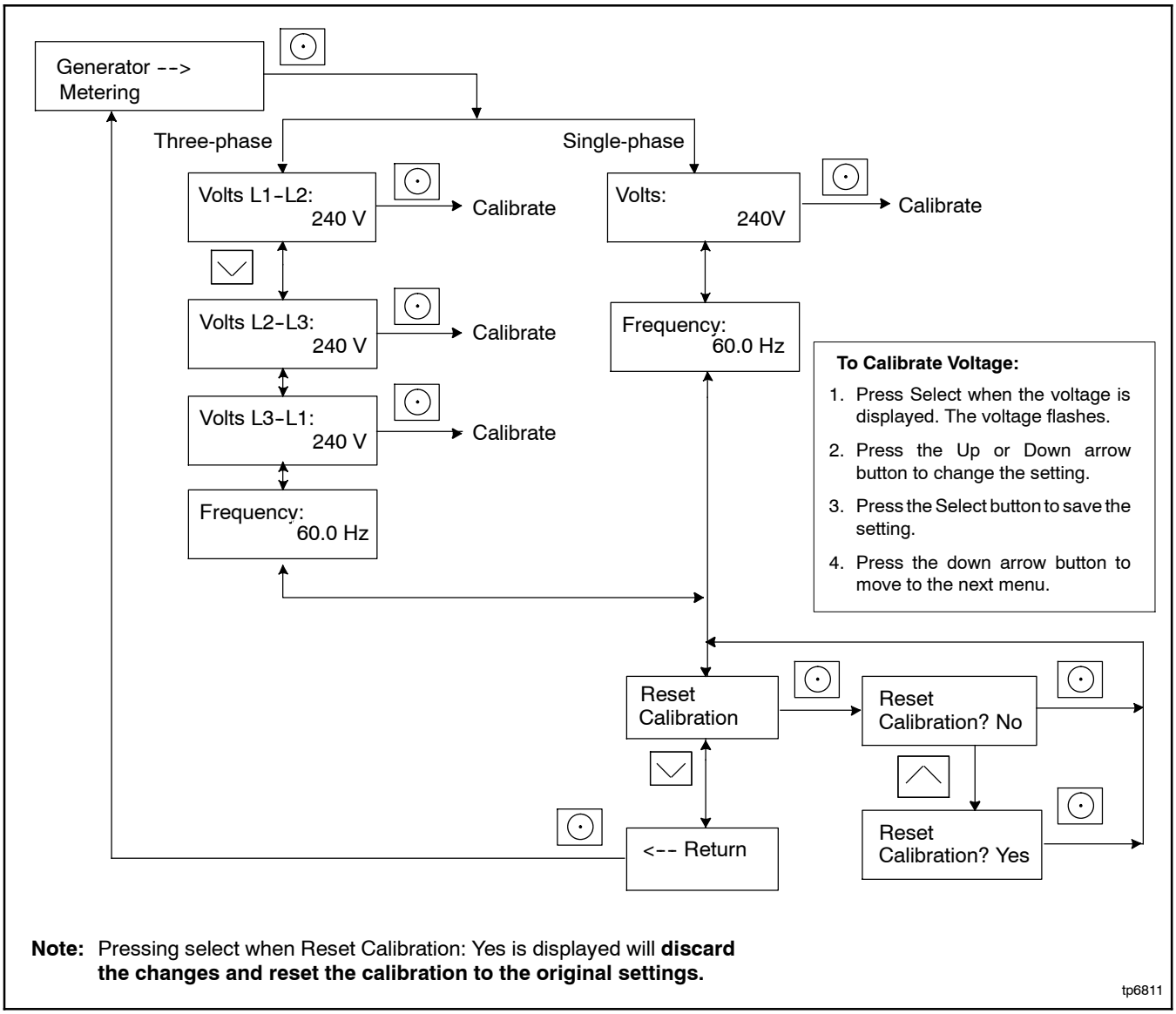


Figure 4-18 Voltage Calibration

4.8.2 Calibration Using SiteTech

Voltage calibration factors can be adjusted using SiteTech software to calibrate the RDC2 or DC2 controller. Connect a personal computer (laptop) to the controller using a USB cable and follow this procedure to use Kohler® SiteTech™ software to calibrate the controller.

The voltage calibration factors are located in the Genset Calibration group in SiteTech™. Find the parameter labelled Genset Calibration Factor Voltage, L1–L2. See Figure 4-20.

Note: A digital voltmeter is required for these adjustments.

1. With the generator set off, connect a digital multimeter to measure output voltage across L1 and L2. Set the meter to measure AC volts.
2. Start the generator set by pressing the RUN button on the RDC2 controller.
3. Compare the voltage reading on the digital voltmeter to the voltage displayed by the controller.

Note: On the DC2 controller, the voltage is shown in the scrolling status displays when the generator set is running. Generator Voltage L1-L2 is also displayed in SiteTech in the Generator Metering group.

4. If the voltage displayed on the controller does not match the measured voltage, use the equation in Figure 4-19 to calculate a new value for Genset Calibration Factor Voltage, L1–L2.
5. Type the new value for Genset Calibration Factor Voltage, L1–L2 into SiteTech and click on Apply Changes. See Figure 4-20.
6. Allow a few seconds for the controller to adjust to the new factor and then compare the voltmeter reading with the voltage displayed on the controller.
7. If the voltage readings do not match, check your calculations. Check the calibration factor and both voltage readings again. Repeat the procedure using the new values, if necessary.

Note: To simplify the calculation, set the calibration factor to 1.0000 and then repeat the calibration procedure from step 3.

8. Press OFF to stop the generator set.
9. For three-phase models, repeat the procedure for voltage across L2–L3 and L3–L1.

$$(V_{meter} \div V_{control}) \times F_{old} = F_{new}$$

V_{meter} = Voltmeter reading

$V_{control}$ = Voltage displayed on controller

F_{old} = Genset Calibration Factor Voltage, L1–L2, from SiteTech before calibration

F_{new} = New value to enter for Genset Calibration Factor Voltage, L1–L2, in SiteTech

Example:

Voltmeter reading: 241.2

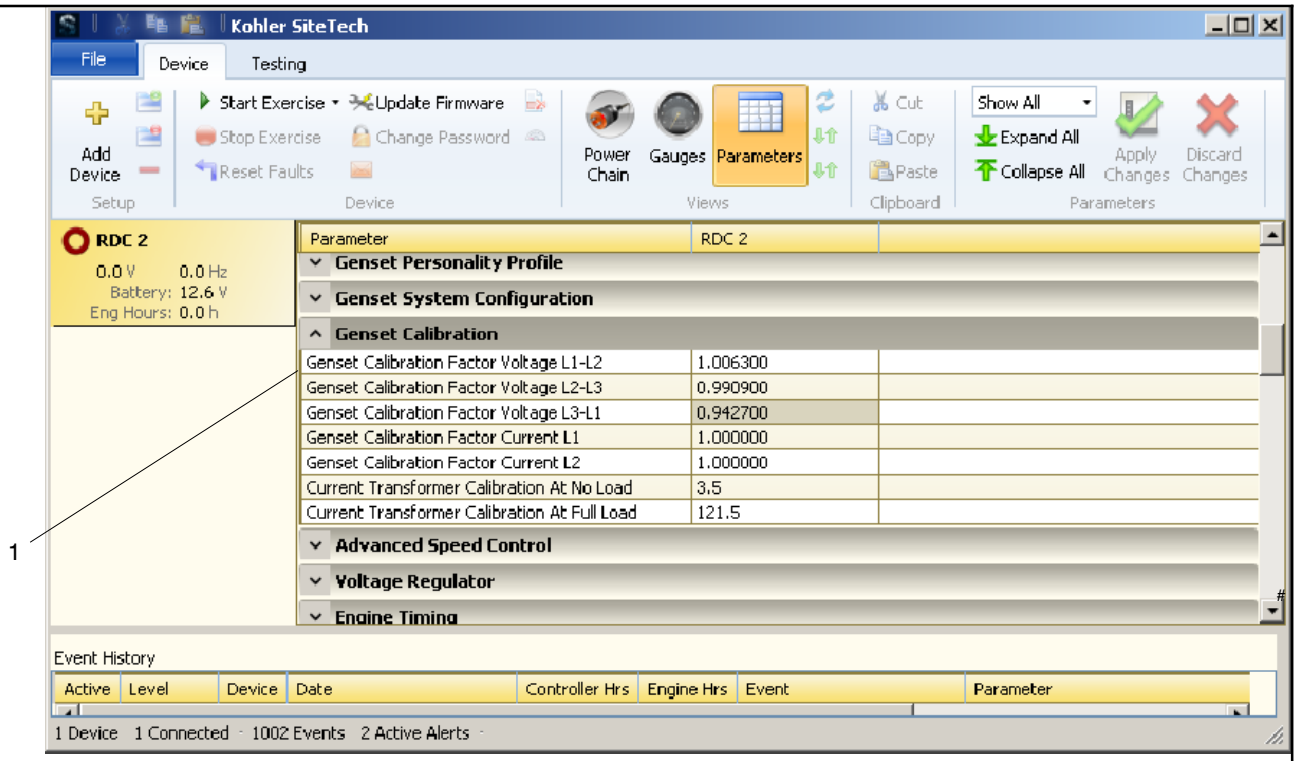
Controller display: 240

Old calibration factor (from SiteTech): 1.0063

New calibration factor:

(241.2 ÷ 240) x 1.0063 = **1.0113**

Figure 4-19 Voltage Calibration Factor



1. Voltage calibration factor

Figure 4-20 Voltage Calibration Factor in SiteTech™

4.9 Setting the OnCue Password

If the Kohler® OnCue Plus® Generator Management System is used to monitor the generator set, reset the OnCue password as described in Section 4.9.1 for the RDC2 or Section 4.9.2 for the DC2 controller.

4.9.1 RDC2 Controller

Refer to Figure 4-21 during this procedure.

1. Press Select and then press the down arrow button to navigate to the networking Information menu.
2. Press Select. Networking Status is displayed.
3. Press the Down arrow button. Networking Configuration is displayed.
4. Press Select. Reset OnCue Password is displayed.
5. Press and HOLD the Select button until Reset OnCue Password? No appears. The word No will flash.
6. Press the Up arrow button to change the word No to Yes.
7. Press Select to reset the password. The generator set serial number and new password are displayed for 10 seconds. Be sure to write down the new password for entry into OnCue Plus.

4.9.2 DC2 Controller

1. Press the OFF button and verify that the generator set is not running.
2. Press and HOLD the EXERCISE button until *Press Again to Reset OnCue PW* is displayed.
3. Release the EXERCISE button and press it again within 5 seconds.

   Note: If the EXERCISE button is not pressed within 5 seconds, the controller exits the password reset mode.
4. The generator set serial number and new password will be displayed for 10 seconds. Be sure to write down the new password for entry into OnCue Plus.

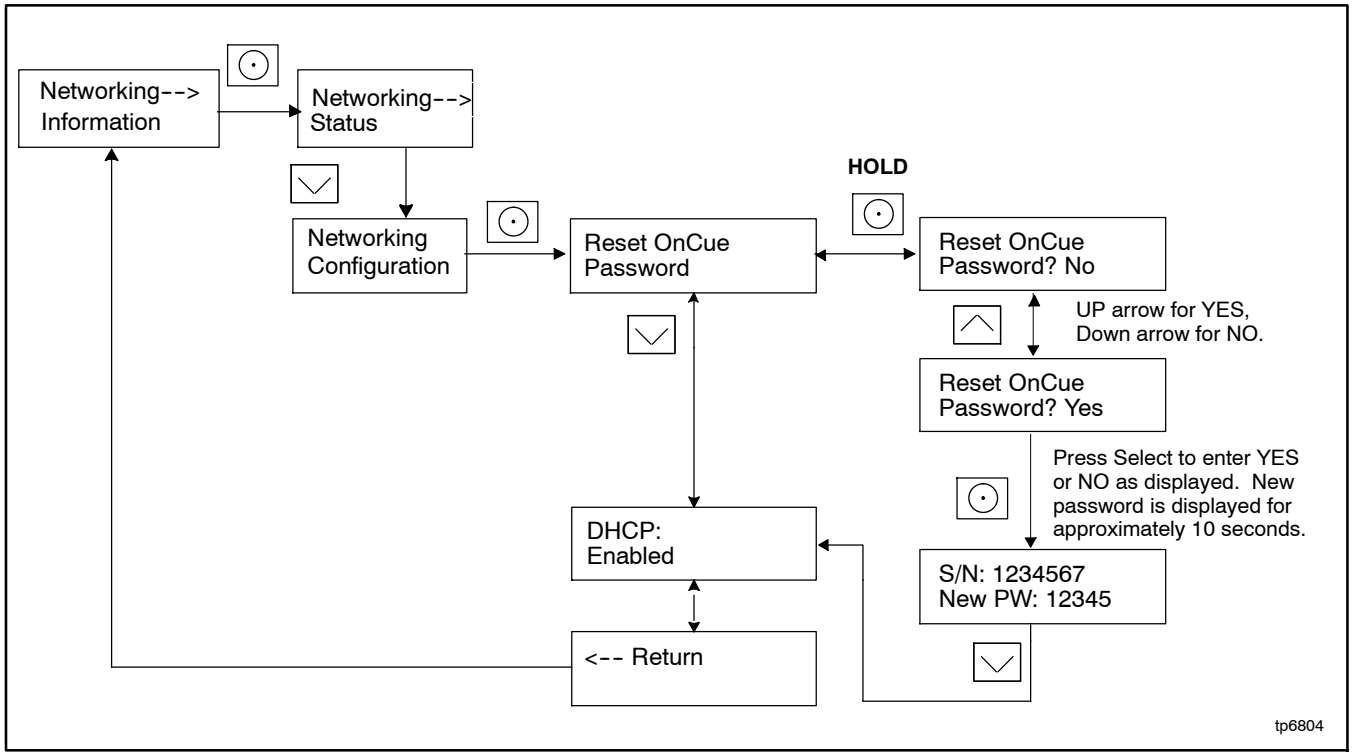


Figure 4-21 Setting the OnCue Password, RDC2

5.1 Introduction

Corrective action and testing in many cases requires knowledge of electrical systems and electronic circuits. Testing and service must be performed by an authorized distributor/dealer or trained service technician.

Refer to the engine service manual for engine service information. See the List of Related Materials for the document part number.

If the troubleshooting procedures in this section identify a failed part, refer to the parts catalog for replacement part numbers. See the List of Related Materials in the Introduction for the parts catalog number.

5.2 Theory of Operation, Electronic Start Sequence

The following steps trace the electronic system as different leads and components are energized during the start sequence. A start signal can come from any of the following:

- Pressing the Run button on the RDC2 or DC2 controller
- A remote start signal through RBUS (from an RXT transfer switch, for example)
- Closing a contact across engine start connections 3 and 4 (remote start/stop switch or non-RBUS transfer switch engine start signal)
- A start signal over Ethernet from OnCue Plus

The start signal begins the series of events that adds fuel, ignition, and engine crank to the start sequence. Use the steps below and refer to the wiring schematics in Section 8 to assist with troubleshooting and checking for loose connections or damaged leads.

1. Engine Crank
   a. When the start signal is received, the RDC2 or DC2 controller energizes FP and lead 71.
   b. FP provides 12VDC to flash the rotor field.
   c. Lead 71 energizes the starter relay.
   d. The starter relay closes the starter relay contact which energizes the start solenoid.
   e. The start solenoid closes and energizes the starter motor, which cranks (turns) the engine.
   f. The engine rotation and field excitation produces alternator voltage.
2. Fuel and Ignition
   a. When the RDC2/DC2 controller detects acceptable alternator voltage (leads 11 and 44) or frequency (leads 55 and 66), the RDC2 controller energizes lead 70 and removes the ground to the ignition (plug 1, pin 16).

      If acceptable voltage or frequency is not detected within 3 seconds, the cranking cycle terminates and crank pause begins.
   b. Lead 70 energizes run relay P17 (if equipped), sending 12 VDC to the fuel valve and ignition. Fuel flows to the carburetor and the ignition produces spark.
   c. When the RDC2 controller senses alternator voltage in winding 55 and 66, the RDC2 controller governor circuit sends 12 VDC to the stepper motor through leads 1A, 1B, 2A, and 2B.
   d. The stepper motor actuates the throttle arm on the carburetor, allowing fuel to enter the engine.
   e. When the controller senses that the engine has reached 750 RPM (12.5 Hz), the RDC2 controller will drop power to lead 71, ending the start sequence.
3. If running speed is not reached within 15 seconds, the cranking cycle terminates and a crank pause begins.
4. If the engine does not start successfully after 3 crank cycles, an Overcrank fault occurs.

5.3 Initial Checks

When troubleshooting, always check for simple problems first. Check for the following common problems before replacing parts:

- **Loose connections or damaged wiring.**
- **Dead battery.**

- **Inadequate fuel supply.** Check for damaged primary or secondary fuel regulators, loose connections to the fuel solenoid valve, a damaged or closed fuel shutoff valve, an empty LP fuel tank, or other problems with the fuel supply. Check the fuel supply pressure to the generator set. See Section 6.11, Fuel Systems.

- **Fault shutdown.** Check for a fault message on the controller display. Section 5.11 describes the warning and shutdown fault messages. If a fault message is displayed, identify and correct the cause of the fault condition. Then press the OFF button on the controller to clear the fault.

- **Incorrect controller settings.** Always check the controller settings before replacing the controller. See Section 4.4.1 for controller settings. Refer to the operation manual for instructions to check and change the controller settings from the controller keypad, or use a personal computer and Kohler® SiteTech™ software.

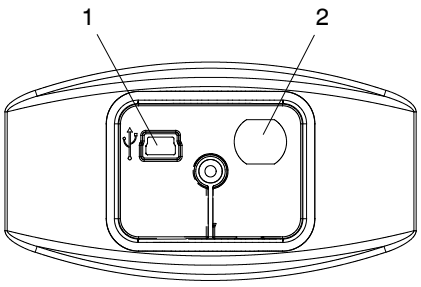
5.4 USB Port and Auxiliary Winding Mini-Breaker

On original RDC2/DC2 controllers, the USB port and alternator winding mini circuit breaker are located in the service access area as shown in Figure 5-1.

Revised controllers have the USB port located under a small rubber cover as shown in Figure 5-2. The alternator winding circuit breaker may be located as shown in Figure 5-2 or Figure 5-3. If an original (green board) controller has been replaced with a revised (red board) controller, the circuit breaker may be located inside the controller trough, under the controller. See Section 4.6 and Figure 4-13.

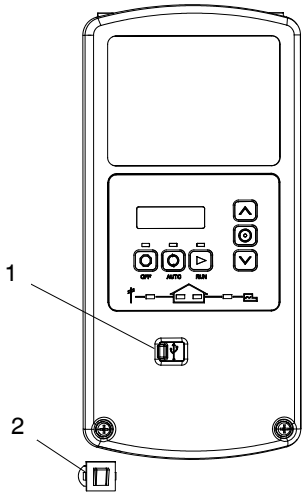
A personal computer (laptop) with Kohler® SiteTech™ software can be used to view the event history and adjust controller settings. Use a USB cable with a mini-B connector to connect the controller's USB port to your PC. Some settings can be changed from the controller keypad. All other adjustable settings require a personal computer (laptop) with Kohler® SiteTech™ software for changes. Section 4.4 lists controller settings.

See TP-6701, SiteTech™ Software Operation Manual, for software operation instructions.



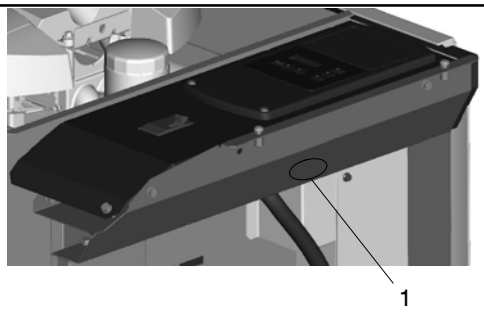
1. USB port (for service)
2. Alternator winding circuit breaker

Figure 5-1 Controller Service Access (cover removed)



1. USB port
2. Auxiliary winding mini-breaker located near the controller

Figure 5-2 Revised Controller and Mini-Breaker



1. Alternate mini-breaker location (access through air intake area)

Figure 5-3 Alternate Location, Auxiliary Winding Mini-Breaker

5.5 Circuit Protection

Line Circuit Breaker

The line circuit breaker interrupts the generator output in the event of an overload condition or a fault in the wiring between the generator and the load. If the circuit breaker trips, reduce the load and check the wiring.

Auxiliary Winding Circuit Breaker

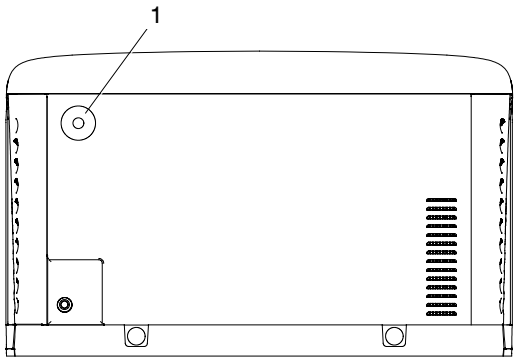
The mini-breaker in the controller's service area protects the alternators auxiliary winding. See Figure 5-1 or Figure 5-2. If the breaker trips, check connections 55, 66, FP, and FN to the alternator.

Controller Internal Circuit Protection

The controller is equipped with internal circuit protection for accessory and main power overload conditions. Press OFF to reset.

5.6 Emergency Stop Button

The generator set may be equipped with an optional emergency stop button. See Figure 5-4 for the location. If the emergency stop button is activated, the controller display will show Emerg Stop Shutdwn.



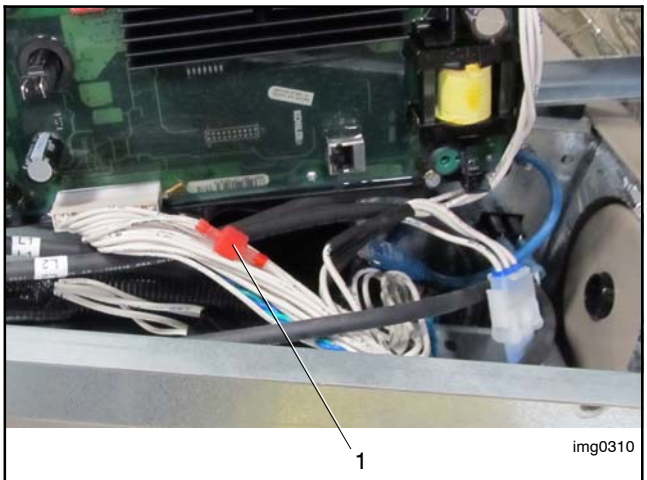
1. Emergency stop button location

Figure 5-4 Emergency Stop Button (optional)

Emergency Stop Switch Operation

1. Push the red emergency stop button to stop the generator set. The generator set shuts down immediately and the controller displays Emerg Stop Shutdwn.
2. To reset the generator set after an emergency stop:
   a. Pull out the emergency stop button.
   b. Open the enclosure roof to access the generator set controller. Press the OFF button on the controller to clear the shutdown condition.
3. Press the AUTO button for automatic generator set operation, if desired.

If the controller shows an emergency stop shutdown but the button is not activated, check the ESS and ESN lead connections to the emergency stop button assembly. If there is no emergency stop button, connect ESS and ESN securely together. See Figure 5-5.



1. Leads ESS and ESN in harness (controller mounting plate removed for illustration only)

Figure 5-5 Emergency Stop Leads ESS and ESN under the Controller

5.7 Thermostat

Model 20RESB, 20RESC(L), and 20RESD generator sets include a resettable thermostat that detects excess heat inside the enclosure. If the thermostat trips, the generator will shut down and the controller will display a fault (underspeed, underfrequency, or undervoltage). If the thermostat trips, check for blocked air inlets and exhaust outlets. Then follow the instructions below to reset the thermostat.

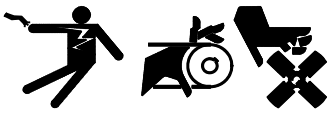
Observe the following safety precautions while resetting the thermostat.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

⚠ 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 connected equipment, 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.

⚠ 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.

Procedure to Reset the Thermostat

See Figure 5-6 or Figure 5-7 for the thermostat location.

1. Disconnect the utility power to the generator by opening (turning OFF) the corresponding circuit breaker at the building's distribution panel.
2. Open the enclosure roof and secure it with the roof stay on the left side of the enclosure.
3. 20RESC(L) Models: Remove the service door from the right side of the enclosure by removing the plug and two screws. Lift the door up and off. Then remove four screws and remove the front panel.

   20RESB/20RESD Models: Remove the air intake end panel.
4. Disconnect the generator set engine starting battery(ies), negative (-) lead first.
5. Press the button on the thermostat to reset it.
6. Reconnect the generator set engine starting battery, negative (-) lead last.
7. Replace the enclosure panels.
8. Reconnect utility power to the generator set by closing the circuit breaker in the distribution panel.
9. Reset the fault on the RDC2 controller. Refer to the generator Operation Manual for instructions, if necessary.

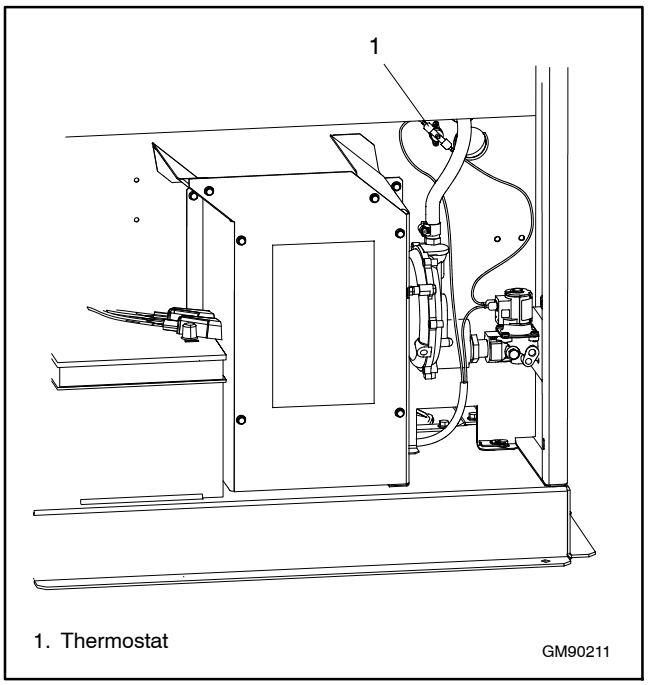


Figure 5-6 Thermostat Location, 20RESB/RESD

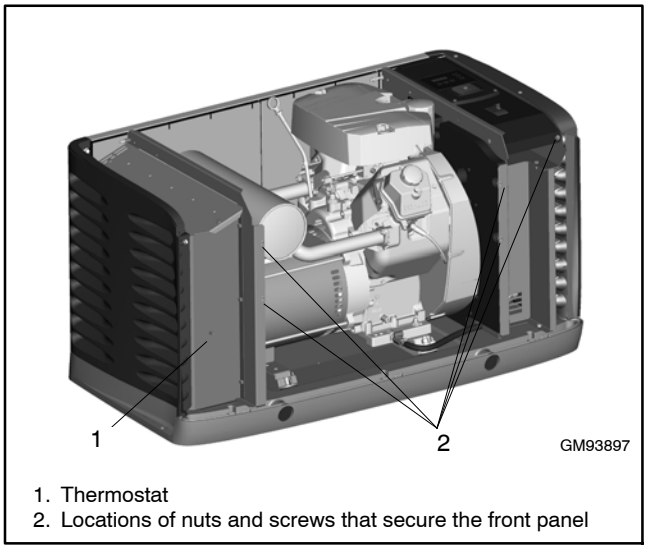


Figure 5-7 Thermostat Location, 20RESC/RESCL

5.8 OnCue Plus Troubleshooting

See the OnCue® Plus Operation Manual for troubleshooting instructions for the OnCue Plus Generator Management System.

5.9 Fuel System Troubleshooting

Most problems with gas fuels involve either fuel pressure or fuel regulator function. Basic troubleshooting consists of verifying fuel pressures and checking each fuel system component.

Check the following items:

- Check primary fuel regulator outlet pressure. This is the line pressure.
- Check the primary regulator vent for obstructions and clean, if necessary.
- Check fuel shutoff inlet pressure.
- Check secondary fuel regulator inlet pressure.
- Check fuel inlet pressure at the gas mixer.
- Perform fuel system maintenance if necessary. See Section 2.9, Fuel System Maintenance.

5.10 Troubleshooting Engine Hunting, 20 kW Models

⚠ WARNING

Hazardous voltage. Moving parts. Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

Adapted from SB-722.

Engine hunting can be the result of a number of factors. Experience has shown that replacement of the controller or stepper motor is typically **not** effective in solving hunting-related issues.

The following steps outline a troubleshooting sequence to help diagnose and pinpoint the cause of the frequency fluctuation and suggestions for resolving the condition. Perform the steps in the order shown and test the operation after each step. If one step does not solve the hunting, proceed to the next step.

1. To prevent automatic starting, disconnect the ATS by disconnecting PWR and COM (RXT) or engine start leads 3 and 4 (RDT).

2. Confirm the operating conditions that produce generator hunting: no load, loaded, and/or only during exercise.

3. Most hunting cases can be solved by completing the following two steps:

   a. Update to the most current version of firmware available. The Kohler Generator Service Department will provide the most current version if it is not yet available on TechTools.

   b. Models 20RESA(L) and 20RESC(L): Install vent tubes on the two reference ports on the fuel regulator. Procure the parts shown in Figure 5-8 locally, or order Regulator Vent Tube Kit GM87489. Drill two 13 mm (0.5 in.) holes, one on each side the fuel inlet opening in the enclosure, and route both tubes to the outside. See Figure 5-9 and Figure 5-10.

Qty.	Description	Part Number
2	Elbow, 90°, 1/8” NPT x 3/8” hose barb	25-155-38
2	Tubing, 3/8” ID x 9” long, clear flexible plastic	GM76024

Figure 5-8 Regulator Vent Tube Kit GM87489

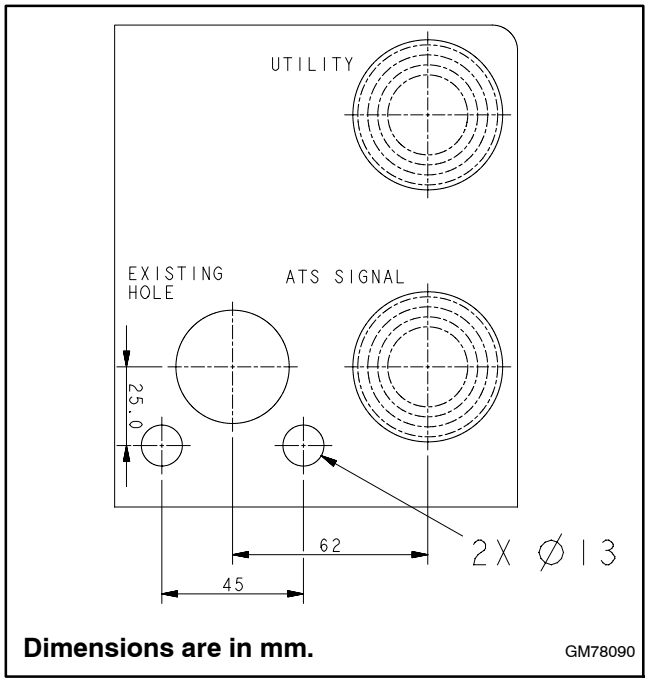
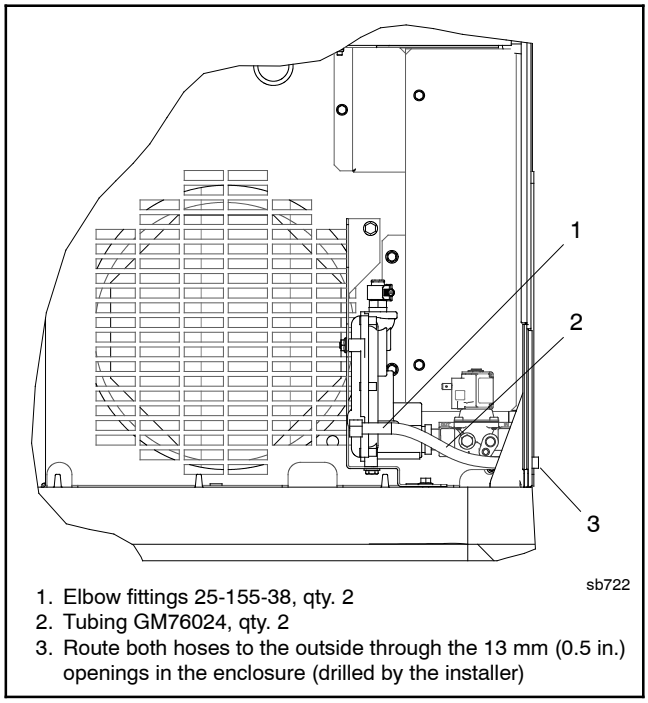


Figure 5-9 Hole Locations for Vent Tubes



1. Elbow fittings 25-155-38, qty. 2
2. Tubing GM76024, qty. 2
3. Route both hoses to the outside through the 13 mm (0.5 in.) openings in the enclosure (drilled by the installer)

Figure 5-10 Fuel Regulator Vent Tube Installation

If the unit still hunts after performing the preceding steps, continue following the troubleshooting steps below.

4. Use SiteTech to check the Engine Speed Gain Adjustment setting. The default setting is 50 and it normally is not adjusted.

   a. If the setting is not 50, reset to 50 and run the engine again.

   b. If the setting is 50, change the value in downward increments of 5. Note the effect that the change has on the speed of the hunting.

   c. If decreasing the setting is not effective, reset to 50 and increase in increments of 5.

5. Check the air cleaner filter element. Replace the filter element if it is dirty and proceed to the next step.

6. Check the air intake tube that runs from the filter housing to the controller J-box. Is the tube seated properly on the filter housing? Is the grommet completely inserted in the housing?

   a. No? Adjust tubing and grommet as needed.

   b. Yes? Proceed to the next step.

7. Verify that the unit is set up for the proper fuel source. See the generator set Installation Manual for instructions.

   - LPG: Insert orifice and disconnect ignition timing leads.

   - NG: Remove orifice and connect ignition timing leads.

8. Is fuel pressure from the source steady and at acceptable levels during all phases of operation? Verify the minimum and maximum fuel pressures with the spec sheet. Pressure should not vary more than 10% from static pressure when starting and accepting full load.

   a. If the pressure varies more than 10% during operation, check the fuel supply and adjust as needed.

   b. If the pressure is steady, proceed to the next step.

9. Energize the fuel solenoid valve to verify that it is opening and closing properly. You should hear an audible click if the solenoid is operating. Is it operating correctly?

   a. No? Replace the fuel solenoid valve.

   b. Yes? Proceed to next step.

10. Monitor voltage at the fuel solenoid valve to verify that battery voltage is present when running and absent when not running.

11. Are the carburetor or intake bolts loose, allowing movement and excess air to be introduced into the system?

    a. Yes? Reposition the carburetor so that the throttle plate will not touch the carburetor gasket. Apply Loctite® to the bolt threads and tighten as needed.

    b. No? Proceed to the next step.

12. Do the throttle plate, linkage between throttle and stepper motor, and stepper motor itself move freely?

    a. No? Check for restrictions including:

       - Linkage. Go to step 13.
       - Worn bushings. Go to step 14.
       - Carburetor gasket. Go to step 15.

    b. Yes? Proceed to step 16.

13. On the linkage, is the bias spring in place, around both bushings and/or connected to the holes the bushings are inserted in?

    a. No? Replace bias spring.

    b. Yes? Try different positions on the throttle linkage plate. If it has no effect, replace bias spring to original position and proceed to the next step.

14. Are the bushings worn, causing excessive movement of the linkage?

    a. Yes? Replace the bushings.

    b. No? Proceed to the next step.

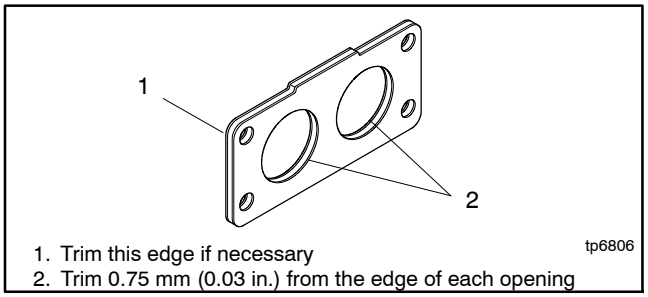
Loctite® is a registered trademark of the Henkel-Loctite Corporation.

15. Is the carburetor gasket interfering with the throttle plate or linkage?

    a. Yes? Trim the carburetor gasket and test the operation before replacing the carburetor. See Figure 5-11.

    Note: Engines with serial numbers 4223605221 or higher have a new carburetor gasket that does not require trimming.

    b. No? Proceed to the next step.



1. Trim this edge if necessary
2. Trim 0.75 mm (0.03 in.) from the edge of each opening

Figure 5-11 Trimming the Carburetor Gasket

16. While running the unit with no load, unplug the stepper motor harness. Does hunting continue?

    a. Yes? Then it is not a controller or governor issue. We can now narrow it down to these possibilities:

    - Regulator replacement
    - Fuel solenoid replacement
    - Spark plug condition check/replacement
    - Perform a cylinder leak-down test. See the engine service manual for instructions.
    - If none of these procedures remedy the hunting, contact the Kohler Generator Service Department.

    b. No? Controller issue. Update the RDC2 controller software to version 4.09 or higher.

Note: For the Model 20RES with RDC controller only, test the magnetic pickup as described below.

- Is the magnetic pickup operating correctly? Measure output voltage at the quick disconnects. Should be a minimum of 3 VAC while cranking.
- Monitor the magnetic pickup frequency measurement while manually holding the engine RPM steady. The frequency should remain constant. If it is erratic, check the wiring and crimp connections. Check that the mag pickup air gap is 0.5 mm (0.020 in.) and adjust if necessary. If measurements are still erratic, replace the magnetic pickup.

17. Reconnect the ATS by connecting PWR and COM (RXT) or engine start leads 3 and 4 (RDT).
18. Verify the generator set operation. See the generator set Operation Manual for instructions.

Note: If the generator set still hunts after performing these procedures, please contact the Kohler Generator Service Department for assistance.

5.11 Fault Messages

The RDC2 controller displays fault messages to aid in troubleshooting. Fault messages, descriptions, and recommended checks are listed in Figure 5-12.

Fault messages will also appear in the Event History in SiteTech. The wording of the message in the Event History may vary slightly from the message shown on the controller display.

Identify and correct the cause of the fault condition. Refer to the troubleshooting charts in Section 5.13 for additional recommendations. Then press the OFF button to reset the controller after a fault shutdown.

5.11.1 Main Power Overload Shutdown

The Main Power Overload shutdown can be caused by an overcurrent condition on the DC power supply circuit. Check the crank, run, and flash relay circuits for short circuits. Refer to the wiring diagrams to identify the relay leads. Also see Section 6.13 for crank and run relay information.

Nuisance shutdowns due to the Main Power Overload (MPO) fault have been observed with earlier versions of the RDC2 controller firmware. Update the controller firmware to version 6.7 or higher to eliminate the nuisance shutdowns.

Fault Message	Action	Description/ Comments	Check
AC Sens Loss Shutdwn (Loss of AC sensing shutdown)	Shutdown	The controller shut down the generator because there was less than 5% of rated voltage measured on Phase A for 3 seconds, only in AUTO, only after acceptable voltage (> 5% of UV setting) has been detected.	Check for loose wiring and connections. Check all AC leads. Troubleshoot alternator.
AC Sens Loss Warning (Loss of AC sensing warning)	Warning	The controller has measured less than 5% of rated voltage on Phase A for 1 second, 10 seconds after crank disconnect.	Check for loose wiring and connections. Check all AC leads. Troubleshoot alternator.
AccyPwrOver Warning (Accessory Power Overload)	Warning	An overcurrent fault (short circuit) on the accessory controller power output.	Check wiring to accessories. Troubleshoot the accessories; refer to the documentation provided with the accessories.
ATS ComError Warning (ATS communication error)	Warning	The controller has lost communication with the RXT ATS that had previously been communicating properly.	Check connection to ATS module.
ATS Fail Xfr Warning (ATS fail to transfer)	Warning	The RXT ATS has reported a fail to transfer, the digital output for ATS Fail To Transfer (PIM) is active (contacts closed).	Consult ATS manual for troubleshooting.
ATS PhaseRot Warning	Warning	The RXT ATS has reported a phase rotation mismatch (3-phase only) and the ATS will not transfer.	Check wiring to the ATS. Consult ATS manual for troubleshooting.
Aux Input Shutdwn * (Auxiliary input shutdown)	Shutdown	The controller shut down the generator because the digital input for a custom shutdown (AuxiliaryInputShutdown - PIM) was activated (low).	Check customer equipment connected to the PIM module.
Aux Input Warning * (Auxiliary input warning)	Warning	The digital input for a custom warning (AuxiliaryInputWarning - PIM) is active (low).	Check customer equipment connected to the PIM module.
Batt Chg Flt Warning * (Battery charger fault warning)	Warning	The digital input for Battery Charger Fault Warning (PIM) is active (low). For an external battery charger only, not applicable to the RDC2 built-in battery charging.	Check customer equipment connected to the PIM module.
Battery High Warning	Warning	The controller has measured battery voltage that is above the high warning setting for 10 seconds or more. Operates during exercise and normal operation.	Check engine starting battery.

* Programmable Interface Module (PIM) required.
† Applies during exercise runs and normal operation.
‡ RBUS devices include the APM, PIM, LCM, load shed kit, RXT transfer switch, and the RXT combined interface board.

Fault Message	Action	Description/ Comments	Check
Battery CRLow Warning †	Warning	Battery voltage dropped to 11 VDC or less for 30 seconds or more.	Check engine starting battery. Check battery charger DC output voltage from RDC2 on lead CHO (P1-8) or lead P (P1-1) to the battery.
Battery Low Warning †	Warning	The controller has measured battery voltage that is below the low warning setting for 90 seconds or more. The battery voltage is checked before allowing an exercise to start.	Check engine starting battery. Check battery charger DC output voltage from RDC2 on lead CHO (P1-8) or lead P (P1–1) to the battery.
Chk DateTime Warning (Check date and time warning)	Warning	DC power to the controller has been interrupted and the date and time may not be correct. Event history may not have accurate time/date stamps.	Verify the time and date settings to ensure proper operation of scheduled operations and for event history logging.
Default Pars Warning (Default Parameters)	Warning	The controller has been loaded with default parameters.	Configure settings as required for desired operation.
Emerg Stop Shutdwn	Shutdown	The optional emergency stop button has been pressed or emergency stop leads ESS and/or ESN are not connected.	Reset the emergency stop button and clear the fault as described in Section 5.6. Check lead ESS and ESN connections to the emergency stop button. If there is no E-stop button, connect ESS and ESN together.
Engine M/N Invalid Shutdwn	Shutdown	Generator model number has not been entered. (Engine model number is selected automatically based on generator set model.)	Enter the generator set model number from the RDC2 keypad, or use SiteTech to select the genset model number.
Engine Speed High Shutdwn	Shutdown	The controller shut down the generator because engine speed, as calculated from AC frequency, was above the high speed setting for 0.3 seconds or more.	Troubleshoot engine operation per the engine service manual.
Engine Speed Low Shutdwn	Shutdown	The controller shut down the generator, after crank disconnect, because engine speed, as calculated from AC frequency, was below the low speed setting for 3 seconds or more. On 20RESB/C/CL/D, the cause may be a tripped thermostat.	Troubleshoot engine operation per the engine service manual. Check for evidence of high temperatures inside the enclosure. Reset the thermostat.
Exer Not Sch Warning	Warning	There is no exercise scheduled.	Set the exercise schedule.
Frequency High Shutdwn	Shutdown	The controller shut down the generator because the frequency measured on Phase A exceeded the high frequency setting for 10 seconds, 10 seconds or more after crank disconnect.	Troubleshoot engine operation per the engine service manual.
Frequency Low Shutdwn †	Shutdown	The controller shut down the generator because the frequency measured on Phase A was less than the low limit for 10 seconds or the measured frequency was 10 Hz or more less than rated for 60 seconds or more, 10 seconds or more after crank disconnect. On 20RESB/C/CL/D, cause may be a tripped thermostat.	Troubleshoot engine operation per the engine service manual. Check for evidence of high temperatures inside the enclosure. Reset the thermostat.

* Programmable Interface Module (PIM) required.

† Applies during exercise runs and normal operation.

‡ RBUS devices include the APM, PIM, LCM, load shed kit, RXT transfer switch, and the RXT combined interface board.

Fault Message	Action	Description/ Comments	Check
Fuel Leak Shutdwn *	Shutdown	The controller shut down the generator because the digital input for Fuel Tank Leak Shutdown (PIM) was activated (low).	Check customer equipment connected to the PIM module.
Fuel Leak Warning *	Warning	The digital input for Fuel Tank Leak Warning (PIM) is active (low).	Check customer equipment connected to the PIM module.
Fuel Level CrHi Warning *	Warning	The digital input for Critically High Fuel Level Warning (PIM) is active (low).	Check customer equipment connected to the PIM module.
Fuel Level High Warning *	Warning	The digital input for High Engine Fuel Level Warning (PIM) is active (low).	
Fuel Level Low Shutdwn *	Shutdown	The controller shut down the generator because the digital input for Low Fuel Level Shutdown (PIM) was activated (low).	Check customer equipment connected to the PIM module.
Fuel Level Low Warning *	Warning	The digital input for Low Fuel Level Warning (PIM) is active (low).	
GenBrkerOpen Warning (Generator Circuit Breaker Open)	Warning	There is voltage at the generator set but no voltage measured on the emergency side of the ATS (Model RXT transfer switch required).	Check line circuit breaker. Check for and correct short circuits or overloading on the load side before resetting the circuit breaker.
Ground Fault Warning *	Warning	The digital input for Ground Fault Warning (PIM) is active (low).	Check customer equipment connected to the PIM module.
High Lube Oil Temperature	Warning	Oil temperature higher than 300°F (149°C).	See Overheats in the troubleshooting charts in Section 5.13.
High Lube Oil Temperature	Shutdown	Oil temperature higher than 325°F (163°C).	
Lo Crank Vlt Warning	Warning	During cranking, the controller measured battery voltage less than 60% (7.2V or 14.4V) for 6 seconds or more during cranking.	Check cranking battery.
Locked Rotor Shutdwn	Shutdown	The controller shut down the generator because no rotation of the engine or alternator was detected, for 3 seconds or more, during cranking.	Check cranking circuit. Troubleshoot the engine. See Engine Service Manuals. Check alternator connections to controller and auxiliary winding circuit breaker. Troubleshoot the alternator.
MainPwrOverL Shutdwn	Shutdown	The internal current limit circuit has tripped, indicating an overcurrent condition on the DC power supply circuit.	Check crank, run, and flash relay circuits for short circuits. See Section 5.11.1. Update controller firmware to version 6.7 or higher.
Maint Req'd Warning	Warning	Engine run time, or calendar days, has exceeded the maintenance reminder setting.	Change the oil and perform other maintenance according to the service schedule in Section 2.1. Reset the maintenance timer after service. See Section 2.3.
Not In Auto Warning	Warning	The RDC2 controller is not in AUTO. The generator will not start from an ATS or remote device. The digital output for Not In Auto (PIM) is active (contacts closed).	Press the Auto button to ensure automatic system operation.
OB1 CommLoss (RBUS device‡)	Warning	Communication with option board #1 has been lost.	Check RBUS wiring to inoperative option board.

* Programmable Interface Module (PIM) required.

† Applies during exercise runs and normal operation.

‡ RBUS devices include the APM, PIM, LCM, load shed kit, RXT transfer switch, and the RXT combined interface board.

Fault Message	Action	Description/ Comments	Check
OB2 CommLoss (RBUS device‡)	Warning	Communication with option board #2 has been lost.	Check RBUS wiring to inoperative option board.
OB3 CommLoss (RBUS device‡)	Warning	Communication with option board #3 has been lost.	Check RBUS wiring to inoperative option board.
OB4 CommLoss (RBUS device‡)	Warning	Communication with option board #4 has been lost.	Check RBUS wiring to inoperative option board.
Oil Level Low Shutdwn *	Shutdown	The controller shut down the generator because the digital input for Low Oil Level Shutdown (PIM) was activated (low).	Check customer equipment connected to the PIM module.
Oil Level Low Warning *	Warning	The digital input for Low Oil Level Warning (PIM) is active (low).	Check customer equipment connected to the PIM module.
Oil Pressure Low Shutdwn	Shutdown	The low oil pressure switch was closed for 5 seconds or more, indicating low oil pressure. Function is inhibited until 30 seconds after crank disconnect.	Check for oil leaks. Check the oil level and add oil if low. Check the oil pressure sensor; see Engine Service Manuals.
Oil Pressure OpenCR Warning	Warning	When the generator set is not running and controller is in OFF or AUTO, the low oil pressure switch is not working properly.	Check the oil pressure switch connection. Replace the LOP switch if necessary. See Section 6.10.2.
Over Crank Shutdwn	Shutdown	The controller shut down the generator, and ceased cranking, because the engine was not successfully started after the completion of the last of the crank cycles setting delay 15 seconds.	Check fuel supply. Check cranking circuit. Check cranking battery. Troubleshoot engine; see Engine Service Manuals.
RBUS ComError Warning	Warning	The controller has lost communication with an RBUS device that had previously been communicating properly. ‡	Check connection to the RBUS device ‡
Spd Sens Flt Shutdwn (Speed sensor fault)	Shutdown	The controller shut down the generator because the speed signal was lost.	Check leads 55, 66, F+, and F– between the alternator and the controller. This fault also occurs if the engine stalls; check the engine and see the troubleshooting chart in Section 5.13.
Volts L1-L2 (AB) High Shutdwn †	Shutdown	The controller shut down the generator because the voltage measured from Phase A to Phase B exceeded the high limit for a time greater than the delay setting 2 seconds.	Troubleshoot alternator. See Section 5.13, Troubleshooting Charts, and Section 6, Component Testing and Adjustment.
Volts L1-L2 (AB) Low Shutdwn †	Shutdown	The controller shut down the generator because the voltage measured from Phase A to Phase B was greater 5% of rated, but less than the low voltage setting for a time greater than the delay setting 10 seconds. On 20RESB/C/CL/D, cause may be a tripped thermostat.	Troubleshoot alternator. See Section 5.13, Troubleshooting Charts, and Section 6, Component Testing and Adjustment. Check for evidence of high temperatures inside the enclosure. Reset the thermostat.

* Programmable Interface Module (PIM) required.

† Applies during exercise runs and normal operation.

‡ RBUS devices include the APM, PIM, LCM, load shed kit, RXT transfer switch, and the RXT combined interface board.

Figure 5-12 Fault Messages Displayed on the RDC2 Controller

5.11.2 Faults Related to Paralleling

If the PowerSync® Automatic Paralleling Module (APM) is used with two 14 kW or two 20 kW generator sets, additional faults and events related to the paralleling system may be displayed on the controller and/or in OnCue® Plus. This section lists those faults and events in Figure 5-13 and Figure 5-14. See the installation instructions provided with the APM for additional paralleling information.

Fault Text	Description	When Active	Warning Delay, sec.	Display Cleared On
Current A High Warning	Over Current	Paralleled	10	Press AUTO or OFF *
Frequency High Warning	Over Frequency	Paralleled	10	Press AUTO or OFF *
Frequency Low Warning	Under Frequency	Paralleled	10	Press AUTO or OFF *
Reactive Power Low Warning	Loss of Field	Paralleled	10	Press AUTO or OFF *
Real Power High Warning	Over Power	Paralleled	10	Press AUTO or OFF *
Real Power Low Warning	Reverse Power	Paralleled	10	Press AUTO or OFF *
Voltage L1-L2 High Warning	Over Voltage	Paralleled	10	Press AUTO or OFF *
Voltage L1-L2 Low Warning	Under Voltage	Paralleled	10	Press AUTO or OFF *
* Pressing OFF will stop the generator set.				

Figure 5-13 Warning Messages (protective relay disconnect)

Fault Text	Description	Possible Causes *
BusDeadLive	The bus is measured to be dead when one of the generators is supposed to be supplying voltage to the bus (closed contactor).	Bus metering V9A and V9B connections to V9 of paralleling protection harness are connected incorrectly.
BusLiveDead	The bus is measured to be live when no generators are connected to it (both contactors open).	Bus metering V9A and V9B connections to V9 of paralleling protection harness connected incorrectly.
CfgModelNum	The two generators that are intended to be paralleled have incompatible model numbers.	Incorrect configuration of one of the generators. Different generator types. The paralleled generator sets must be the same kW model. (i.e. two 14 kW or two 20 kW models.)
CfgSysVolt	The system voltage of the two generators intended to be paralleled is not the same. Because the system does not know which voltage is correct, the generators will not be allowed to start.	One of the two generators is incorrectly configured. Intermittent connections on RBUS network wiring.
ChkngMeter	This generator has paralleled to the other generator and is verifying that the metering is connected and establishing the connection direction.	Status message appears the first time the two generators are paralleled.
ConCheckFail	Failure to Auto-Discover APM connections.	Wires 9A and 9B crossed between the generators. Wires 9A or 9B not connected
ConChecking	Performing APM connection auto-discovery.	This generator has started in RUN, the other generator is in OFF.
ConNotDeterm	APM connection auto-discovery is not complete. This means that the generator does not know which contactor is connected to it.	Generators not yet started in RUN with other generator in OFF. See the APM instruction sheet for instructions to perform the auto-discovery procedure.
ContactorOk	Successful auto-discovery of APM connections.	Auto-discovery was activated by placing other generator in OFF and this generator in RUN.

Fault Text	Description	Possible Causes *
ErraticSig	The power metering on this controller gives a signal that is not consistent with the system configuration. Reversing the power direction does not resolve the problem.	Bad wiring to the CT. Too much tension on wires from the CT to the controller.
LossOfComAPM	The Automatic Paralleling Module has stopped communicating on RBUS. (An APM was detected on the RBUS network but is no longer communicating.)	APM is unplugged. Primary controller is powered down. Check the battery connections. See previous page for more information. Intermittent connections on RBUS network wiring. Check RBUS communication connections.
LossOfComm2	The primary controller has lost communication with the secondary controller. (A secondary controller was detected, then communication was lost.)	RBUS disconnected, secondary controller battery disconnected, updating firmware in secondary controller, or intermittent RBUS connections.
LossOfField	This generator has absorbed more than 25% reactive power (magnetic excitation current) for 20 seconds.	Generator voltage on this generator is not calibrated correctly. Generator voltage on other generator is not calibrated correctly. Bus voltage on this generator is not calibrated correctly. Bus voltage on the other generator is not calibrated correctly.
MeteringOk	The generator has verified that the metering is connected correctly and that the direction is consistent with expected power direction.	Status message indicates that the CT is connected to the generator correctly.
MeterUnknown	This generator does not know if the metering is connected or the orientation of the connection. This means that the generators can't share load accurately until this information is known.	System commissioning and startup not yet complete. See the APM instructions.
NoCurrent	The generator has applied load (using the other generator) and has observed no current on the power sensing inputs.	The CT is not connected to the controller. The output leads from the generator do not go through the CT in the correct direction. See the APM instructions.
SyncFailure	The generator has been attempting to synchronize for over 2 minutes without success.	Generator is hunting. Advanced speed control settings need adjustment. Load is changing frequently to disturb the online generator.
* For paralleling system troubleshooting and service, contact an authorized distributor or dealer.		

Figure 5-14 Events Related to Paralleling

5.12 Status Messages

The messages shown in Figure 5-15 and Figure 5-16 are displayed to show system status. Notices are displayed in the Event History in SiteTech when active but do not appear on the controller display. Some status messages are displayed when a digital input is activated; the optional Programmable Interface Module (PIM) is required for display of those messages as noted in the table.

Most status messages indicate normal system operation and do not require action unless the generator is not operating correctly.

Status Message	Action	Description/ Comments	Check
Always Off *	Notice	OnCue Plus has been used to control this PIM digital output. The digital output is no longer controlled by the generator set.	Click on the PIM output in OnCue Plus to turn the output on or off. See the OnCue Plus Operation Manual.
Always On *	Notice	Applies to digital outputs B3 through B6 on the PIM only.	To reset the PIM digital output to a function controlled by the generator set, use SiteTech software to re-assign the output event.
Auto Locked * (Chicago Code Active)	Notice	The digital output for Chicago Code Active (PIM) is active (contacts closed), indicating the digital input for Chicago Code Active (PIM) is active (low) and thus master switch is locked in the AUTO position.	Check customer equipment connected to the PIM module.
Common Fault	Notice	The digital output for Common Fault (PIM) is active (contacts closed), indicating the generator is shutdown for any (all) fault.	Check for faults and troubleshoot any/all fault conditions individually.
Common Warng	Notice	The digital output for Common Warning (PIM) is active (contacts closed), indicating that any (all) warning is active.	Check for warnings and troubleshoot any/all warning conditions individually.
Emerg Pwr On (Emergency Power System Supplying Load)	Notice	The digital output for EPS Supplying Load (PIM) is active (contacts closed), indicating there is current output (>5%) from the alternator, only if CTs are installed.	—
Eng Cooldown	Notice	The digital output for Engine Cooldown Active (PIM) is active (contacts closed), indicating the generator is running in cooldown. (Delay 5 min.)	Check remote start circuit if it was expected that the generator should be running. Consult ATS operations manual.
Fuel Spill *	Notice	The digital output for Fuel Spill (PIM) is active (contacts closed), indicating any of the digital inputs for Fuel Tank Leak Warning, Fuel Tank Leak Shutdown, Engine Fuel Level Warning or Engine Fuel Level Critically High (PIM) is active (low).	Check customer equipment that is connected to the Fuel Tank Leak Warning, Fuel Tank Leak Shutdown, Engine Fuel Level Warning or Engine Fuel Level Critically High input on the PIM.

* Programmable Interface Module (PIM) required.

‡ A load management device is an LCM, load shed kit, or RXT combined interface/load management board.

† Load management device required.

Status Message	Action	Description/ Comments	Check
Gen Running	Notice	The digital output for Generator Running (PIM) is active (contacts closed), indicating the generator is running.	Check controller front panel buttons for potential RUN command. If in AUTO, check remote start lines. Consult ATS operation manual for events that may cause the generator to start.
Low Fuel *	Notice	The digital output for Low Fuel (PIM) is active (contacts closed), indicating any of the digital inputs for Low Fuel Pressure Warning, Low Fuel Level Warning or Low Fuel Level Shutdown (PIM) is active (low).	Check customer equipment connected to the PIM module.
Minor Fault	Notice	The digital output for Minor Fault (PIM) is active (contacts closed), indicating either the digital input for Ground Fault Indicator Warning (PIM) is active (low) or the controller detected Low Cranking Voltage.	Check customer equipment connected to the PIM module. Check cranking battery condition.
NormSrcUnavl (RXT required)	Notice	The normal power source (source1) is disconnected, unavailable or unacceptable.	Check for utility source power outage. Check wiring and connections to the ATS.
OB1 CommLoss (option board)	Notice	Communication with option board #1 has been lost.	Check RBUS wiring to inoperative option board. (PIM, RXT, or load mgmnt device) ‡
OB2 CommLoss (option board)	Notice	Communication with option board #2 has been lost.	Check RBUS wiring to inoperative option board. (PIM, RXT, or load mgmnt device) ‡
OB3 CommLoss (option board)	Notice	Communication with option board #3 has been lost.	Check RBUS wiring to inoperative option board. (PIM, RXT, or load mgmnt device) ‡
OB4 CommLoss (option board)	Notice	Communication with option board #4 has been lost.	Check RBUS wiring to inoperative option board. (PIM, RXT, or load mgmnt device) ‡
Rmt StartCmd (Remote Start Command Issued)	Notice	The controller has received a remote start signal while the master switch is in AUTO, and will go to normal running.	Verify remote start signal. Consult ATS operations manual for cause of generator start.
Run Btn Ack (Run Button Acknowledged)	Notice	The RUN button on the controller has been pushed.	—
Start Delay (Engine Start Delay Active)	Notice	The digital output for Engine Start Delay (PIM) is active (contacts closed), indicating the engine is in between active cranking cycles.	—
System Ready	Notice	The digital output for System Ready (PIM) is active (contacts closed), indicating the generator has no active faults or warnings.	—
VSpdStartCmd (Variable Speed Start Command)	Notice	A diagnostic exercise request has been received by the controller.	Check for a remote exercise command from OnCue.

* Programmable Interface Module (PIM) required.

‡ A load management device is an LCM, load shed kit, or RXT combined interface/load management board.

† Load management device required.

Status Message	Action	Description/ Comments	Check
Load Shed 1 Status Info †	Notice	The digital output for LoadPriority1Shed is active (contacts closed), indicating the 1st priority load shed has been activated.	—
Load Shed 2 Status Info †	Notice	The digital output for LoadPriority2Shed is active (contacts closed), indicating the 2nd priority load shed has been activated.	—
Load Shed 3 Status Info †	Notice	The digital output for LoadPriority3Shed is active (contacts closed), indicating the 3rd priority load shed has been activated.	—
Load Shed 4 Status Info †	Notice	The digital output for LoadPriority4Shed is active (contacts closed), indicating the 4th priority load shed has been activated.	—
Load Shed 5 Status Info †	Notice	The digital output for LoadPriority5Shed is active (contacts closed), indicating the 5th priority load shed has been activated.	—
Load Shed 6 Status Info †	Notice	The digital output for LoadPriority6Shed is active (contacts closed), indicating the 6th priority load shed has been activated.	—

***** Programmable Interface Module (PIM) required.

‡ A load management device is an LCM, load shed kit, or RXT combined interface/load management board.

† Load management device required.

Figure 5-15 Status Messages Displayed on the RDC2 Controller

Generator Set State	Description
Generator Management Off	This generator has been stopped by generator management because it is not presently needed to supply the load. The generator is available and will start if it is needed again.
ProtectiveRelayTrippedContactor	The contactor has been forced to open to protect one of the generators or the customer's load.
Synchronizing	The generator is actively trying to match frequency, voltage and phase with that of the paralleling bus.
Unloading	The generator is actively trying to transfer load from itself to the other generator.

Figure 5-16 Generator Set States Related to Paralleling

5.13 Troubleshooting Chart

Use the following table as a reference in troubleshooting individual problems. Generator set faults are listed in groups and include likely causes and remedies. The simplest and most likely causes of the problem are listed first; follow the recommendations in the order shown. The reference column provides additional sources of information in this and related manuals regarding the problem and solution.

Problem	Possible Cause	Test	Corrective Action	Reference
Generator set engine does not crank	Battery connections	Check for reversed or poor battery connections.	Correct and tighten battery connections.	—
	Weak or dead battery	Check the battery voltage. Test battery according to battery manufacturer's recommendations.	Recharge or replace battery.	O/M
		Check battery charger connections and utility power connection to the generator set.	Tighten connections. Connect 120VAC power to the genset terminal block.	I/M
	Open circuit in engine/controller connections	Check for loose connections. Check the wire harness continuity.	Tighten connections. Replace harness or harness leads if damaged.	Section 6.14 Section 8
	Poor ground (-) connection	Test ground connection.	Clean and retighten.	—
	Starter relay	Check connections to the starter relay.	Tighten connections. Replace wiring if damaged.	Section 6.13 W/D Section 8
		Check continuity of circuit.		Section 6.14 W/D Section 8
		Check that the starter relay picks up when 12 VDC is applied at lead 71 connection.	Replace starter relay.	W/D Section 8
	Starter	Check starter connections.	Tighten connections. Replace wiring if damaged.	W/D Section 8
		Troubleshoot the starter. See the engine service manual for instructions.	Rebuild or replace starter.	Engine S/M
	Controller	Check for 12 VDC to the controller.	Check battery and connections.	W/D
		Check the genset model, engine model, and other controller settings.	Adjust controller settings, if necessary.	Section 4.4
		Troubleshoot the controller as described in Section 5.14.	See Section 5.14.	Section 5.14
	Emergency Stop circuit open	Check for Emerg Stop Shutdown on controller display. Check optional emergency stop button position and connections.	Reset emergency stop button and reset controller fault. Check ESS and ESN connections. If not equipped with E-Stop button, verify that ESS and ESN are connected together.	Section 5.6

W/D = Wiring Diagram(s) (Section 8) S/S = Generator Set Specification Sheet O/M = Generator Set Operation Manual
I/M = Generator Set Installation Manual Engine S/M = Engine Service Manual

* RDC2 controller settings can be checked and adjusted using the controller user interface or using a personal computer running SiteTech software. DC2 controller settings can only be changed using SiteTech.

Problem	Possible Cause	Test	Corrective Action	Reference
Cranks but does not start	No fuel	Verify that manual fuel valve is open. Check fuel supply tank (LP).	Open (turn on) manual fuel valve. Contact fuel supplier to add fuel to fuel supply tank (LP).	—
	Insufficient fuel pressure	Check fuel pressure to the generator set. Verify adequate fuel pressure and pipe size for the generator set plus all other gas appliances.	Contact fuel supplier to replace fuel supply lines with larger pipe and replace gas meter if fuel pressure is insufficient.	Section 6.11.3
	Fuel regulator/valve	Check regulator/valve operation.	Check regulator/valve operation.	Section 6.11 Section 4
	Weak battery	Check the battery voltage. Check battery charger connections and utility power connection to the generator set.	Recharge or replace battery. Tighten loose connections.	O/M W/D Section 8
	Spark plugs or spark plug connections	Check spark plug wires and connections. Check spark plugs.	Tighten connections. Replace spark plug wires if damaged. Replace or clean and regap spark plugs.	O/M
	Loose connection or open circuit	Check for loose or open connection at the fuel valve (lead 70A) and at the engine spark control module (leads IGN and 70B). Check controller/engine wiring continuity.	Tighten connections. Replace wiring if damaged.	Section 8
	Air cleaner clogged	Check for a dirty air cleaner element.	Replace air cleaner element. Check and replace air cleaner element at the intervals shown in the Service Schedule.	O/M
	Incorrect controller settings	Check the genset model setting.	Enter the correct genset model number setting. Engine model is selected automatically based on genset model.	Section 4.4
	Ignition system spark control or ignition coil	Test according to instructions in the engine service manual.	Adjust or replace components as indicated in engine service manual.	Engine S/M
	Igntion timing leads incorrectly connected or disconnected	Check ignition timing leads. Check for loose connections.	Connect for natural gas. Disconnect for LP. Tighten connections. Replace wiring if damaged.	Section 6.11.2
	No engine rotation sensed (check for an overcrank or locked rotor fault shutdown)	Check the cranking circuit.	Troubleshoot engine and alternator.	Engine S/M

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Problem	Possible Cause	Test	Corrective Action	Reference
Starts hard	Low battery voltage	Check battery voltage during cranking. Check battery charger connections and utility power connection to the generator set.	Charge battery. Replace battery if necessary. Tighten loose connections.	O/M W/D Section 8
	Air cleaner clogged	Check for a dirty air cleaner element.	Replace element.	O/M
	Fuel mixture adjustment incorrect	Use oxygen sensor to check fuel mixture.	Adjust fuel mixture.	Section 6.11
	Ignition timing leads incorrectly connected or disconnected	Check ignition timing connection.	Connect for natural gas. Disconnect for LP.	Section 6.11.2
	Spark plug(s)	Check spark plug condition and gap.	Replace or regap spark plug(s).	O/M
	Spark plug wire(s)	Check spark plug wires and connections.	Tighten connections. Replace spark plug wires if damaged.	Engine S/M
	Ignition components (spark control or ignition module)	Test ignition components according to instructions in the engine service manual.	Replace ignition components if necessary.	Engine S/M
	Insufficient fuel pressure	Check fuel pressure to the generator set. Verify adequate fuel pressure and pipe size for the generator set plus all other gas appliances.	Contact fuel supplier to replace fuel supply lines with larger pipe and replace gas meter if fuel pressure is insufficient.	Section 6.11.3
	Engine problem.	Troubleshoot the engine.	See engine service manual.	Engine S/M
Noisy operation	Exhaust system leaks	Check silencer and connections for leaks.	Replace gaskets and exhaust system components as necessary.	—
	Engine not running smoothly	See “Erratic operation,” this table.	See “Erratic operation,” this table.	—
	Broken or damaged vibromount(s)	Inspect vibromounts.	Replace as necessary.	Section 7
	Loose or vibrating sheet metal/ housing	Check for loose screws and rivets.	Retighten screws, replace rivets.	—
	Exhaust piping or air inlets/outlets not securely installed	Inspect for loose parts.	Secure loose parts as necessary.	—
	Excessive engine/ generator vibration	Check rotor, crankshaft, bearing, etc. (disassembly of engine and/ or alternator may be required).	Check, rotor, crankshaft, bearing, etc. (disassembly of engine and/ or alternator may be required).	Section 7 Engine S/M
Overheats	Inadequate cooling	Inspect engine and enclosure for air intake obstructions.	Clear any air intake obstructions.	O/M
	Air cleaner clogged.	Check for a dirty air cleaner element.	Replace air cleaner element.	O/M

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Problem	Possible Cause	Test	Corrective Action	Reference
Stops suddenly	Fault shutdown	Check for a fault shutdown message on the controller display. Identify the cause of the fault.	Correct the fault and then press the controller's OFF button to reset the controller.	Section 5.11
	No fuel	Check fuel valves and fuel supply.	Open manual fuel valve. Contact fuel supplier to replenish fuel supply.	—
	Fuel line restriction	Inspect fuel lines.	Clear restriction.	—
	Fuel lines too long	Check fuel line length and pipe size.	Contact fuel supplier to replace fuel lines with larger pipe.	Generator set S/S, I/M
	Air cleaner clogged	Check for a dirty air cleaner element.	Replace air cleaner element.	O/M
	Spark plug(s)	Check spark plug(s).	Replace or regap plug(s).	O/M
	Engine overheated (hot engine only)	Check air intake and generator set enclosure air inlets and outlet. Use oxygen sensor to check fuel mixture. Check oil level.	Clear air intake and enclosure air inlets and outlets. Adjust fuel mixture. Add oil. Check and replace oil at the intervals shown in the Service Schedule.	O/M Section 6.11 O/M
	Low oil pressure (LOP) switch	Check oil pressure. Attempt startup. If unit shuts down, remove lead from LOP switch and reset controller. A successful restart attempt indicates a faulty LOP shutdown switch. **Note:** Check engine oil pressure before performing test and/or replacing LOP shutdown switch.	See engine S/M. Replace faulty LOP shutdown switch. **Note:** Check engine oil pressure before performing test and/or replacing LOP shutdown switch.	Engine S/M Section 6.10.2
	Fuel valve/fuel regulator	Check fuel valve connections. Check regulator/valve operation. Check fuel pressure.	Tighten fuel valve connections. Replace damaged wires. Replace regulator or valve.	Section 6.11
	Engine overloaded	Reduce electrical load and check operation.	Unplug some lights or appliances connected to the generator set.	—
	Engine speed sensing connections	Check for loose connections: FP, FN, 55, 66, and connections to the line circuit breaker.	Tighten connections. Replace damaged wiring.	W/D, Section 8
	Ignition module	Test the ignition system according to the instructions in the engine service manual.	Service the ignition system according to the instructions in the engine service manual.	Engine S/M
	Loss of generator output voltage to controller	Check connections at P2 plug. Check continuity of AC sensing leads 11 and 44. See Section 6 for alternator test procedures.	Tighten connections at P2 plug. Replace wiring if damaged. Repair or replace components if necessary, as indicated by tests in Section 6.	Section 8 Section 6.3 Section 6
	Tripped thermostat (20RESB/C/CL/D)	Check for evidence of high temperature inside enclosure.	Reset thermostat by pressing button. Reset fault at controller.	Section 5.7

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* RDC2 controller settings can be checked and adjusted using the controller user interface or using a personal computer running SiteTech software. DC2 controller settings can only be changed using SiteTech.

Problem	Possible Cause	Test	Corrective Action	Reference
Erratic operation	Air cleaner clogged	Check air filter element.	Replace element.	O/M
	Spark plug(s)	Check spark plug condition and gap.	Replace or regap plugs.	O/M
	Spark plug wire(s)	Check spark plug connections and wires.	Tighten connections. Replace damaged spark plug wires.	Engine S/M
	DSAM leads incorrectly connected or disconnected	Check DSAM/ignition timing lead connection.	Connect for natural gas. Disconnect for LP.	Section 6.11.2
	Fuel line restriction	Check fuel lines. Check fuel pipe size.	Clear restricted fuel lines. Contact fuel supplier to install larger diameter pipe.	Section 6.11.3
	Fuel mixture adjustment incorrect	Use oxygen sensor to check fuel mixture.	Adjust fuel mixture.	Section 6.11
	Governor adjustment incorrect	Check governor operation. Check controller engine speed setting. *	Adjust governor. Adjust engine speed setting on controller. *	Section 6.8 Section 4.4
	Ignition system	Test ignition system according to instructions in engine service manual.	Service ignition system according to instructions in engine service manual.	Engine S/M
	Inadequate cooling (hot engine only)	Check air inlet and outlet.	Clear air inlet and outlet.	—
	Other engine service required	See engine service manual.	Service according to instructions in engine service manual.	Engine S/M
High output voltage	Incorrect controller settings	Check genset model, engine model, system voltage, and other controller settings. *	Adjust the controller settings. *	Section 4.4
	Incorrect voltage calibration	Check the voltage calibration.*	Adjust the voltage calibration. *	Section 4.8
	Loose voltage sensing connections	Check connections: stator leads 11 and 44 and P2 controller connection.	Tighten connections.	Section 8 W/D

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* RDC2 controller settings can be checked and adjusted using the controller user interface or using a personal computer running SiteTech software. DC2 controller settings can only be changed using SiteTech.

Problem	Possible Cause	Test	Corrective Action	Reference
Lacks power	Air intake restriction, inadequate cooling	Inspect air intakes and exhaust for obstructions. Check air cleaner.	Clear air intakes and exhaust area. Maintain clearances shown on the genset dimension drawing. Replace air cleaner element.	I/M O/M
	Generator overloaded	Reduce electrical load and check operation.	Unplug some lights or appliances connected to the generator set.	—
	Spark plug(s)	Check spark plugs.	Regap or replace plug(s).	O/M
	Spark plug connections	Check tightness and condition of spark plug wires.	Tighten or replace spark plug wires.	Engine S/M
	Ignition timing leads incorrectly connected or disconnected	Check ignition timing leads. Connect for natural gas. Disconnect for LP.	Connect for natural gas. Disconnect for LP.	Section 6.11.2
	Low fuel pressure	Check fuel pressure at carburetor outlet. Check for adequate fuel pipe size and meter capacity for generator set and all gas-fired appliances.	Contact fuel supplier to replace pipe and/or meter as required to provide sufficient fuel supply pressure for the generator set and all gas-fired appliances.	Section 6.11
	Fuel line restriction	Check fuel pipe size.	Contact fuel supplier to provide larger pipe.	Section 6.11
	Fuel regulator	Check function of fuel regulator.	Repair or replace fuel regulator.	Section 6.11
	Engine not running at rated rpm	Check controller setting for engine model. * Check engine speed.	Select the correct engine model. * Adjust engine speed.	Section 4.4
	Engine power loss	Refer to the engine service manual for troubleshooting and repair instructions.	Refer to the engine service manual for troubleshooting and repair instructions.	Engine S/M
	Governor malfunction or misadjustment	Test governor.	Adjust governor.	Section 6.8
	Ignition system	See the engine service manual for service procedures.	See the engine service manual for service procedures.	Engine S/M
Low output or excessive drop in voltage (continues on next page)	Generator overloaded	Reduce electrical load and check operation.	Unplug some lights or appliances connected to the generator set.	—
	Incorrect controller settings	Check the controller settings. *	Adjust the controller settings. *	Section 4.4
	Incorrect controller voltage settings	Check the controller voltage settings. *	Adjust the controller voltage settings. *	Section 4.4
	Alternator or control system	Perform separate excitation procedure to isolate problem to the alternator or the control system.	Troubleshoot the alternator or control system as indicated by test results.	Section 6.2
	Controller	Check the controller settings.	Adjust controller settings.	Section 4.4
		Test the controller as described in Section 5.14.	See Section 5.14.	Section 5.14
	Rotor	Test rotor for open, grounded, or shorted windings.	Replace rotor if faulty windings are found.	Section 6.4
	Stator	Test stator for open, grounded, or shorted windings.	Replace stator if faulty windings are found.	Section 6.3

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* RDC2 controller settings can be checked and adjusted using the controller user interface or using a personal computer running SiteTech software. DC2 controller settings can only be changed using SiteTech.

Problem	Possible Cause	Test	Corrective Action	Reference
Low output or excessive drop in voltage, continued	Brush connection	Check for loose brush connections. Check for loose brush mounting. Check the resistance through the brushes. Resistance through the brushes should be low, 0.1–0.2 ohms without meter lead resistance.	Tighten loose brush connections. Tighten mounting screws. Replace brushes if they show uneven wear or are worn to one-half their original length.	Section 6.6
	Low engine speed causing voltage roll-off	Check system voltage, system frequency, and engine model settings. Check engine speed setting. Engine problem.	Change the controller settings if not correct. * Adjust engine speed setting. Troubleshoot the engine.	Section 4.4 Section 4.4 Engine S/M
No output voltage	AC output circuit breaker open	Check for AC voltage on the generator side of circuit breaker. If there is AC voltage on the generator side of the breaker, then a problem in the load circuits is causing the line circuit breaker to trip.	Check for and correct short circuits or overloading on the load side before resetting the circuit breaker.	—
	Alternator or control system	Perform separate excitation procedure to isolate the problem to the alternator or the control system.	Troubleshoot the alternator or control system components as described below and elsewhere in this table.	Section 6.2
	Controller	Check the controller settings.	Adjust controller settings.	Section 4.4
		Troubleshoot the controller as described in Section 5.14.	See Section 5.14.	Section 5.14
	Open wiring, terminal, or pin in buildup circuit	Check wiring.	Replace wiring as necessary.	Section 8 W/D
	Brushes	Inspect brushes.	Replace brushes if worn.	Section 6.6
		Check for brushes sticking in brush holder or broken brush spring.	Replace brush spring or brush assembly.	Section 6.6
		Check that brush holder is securely mounted.	Tighten brush holder screws.	Section 6.6
	Rotor slip rings dirty or corroded	Check slip ring condition.	Clean slip rings as described in Section 6.5. Machine slip rings if necessary.	Section 6.5
	Rotor (open, grounded, or shorted windings)	Check voltage and continuity as described in Section 6.4.	Repair or replace rotor if indicated by the tests.	Section 6.4
	Stator (open, grounded, or shorted windings)	Check voltage and continuity as described in Section 6.3.	Repair or replace the stator if indicated by the test results.	Section 6.3
	Aux. winding circuit breaker tripped	Check the breaker in the service access area of the controller. If breaker trips again, check stator.	Reset breaker. If breaker trips again, check stator.	Figure 5-1 Section 6.3

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* RDC2 controller settings can be checked and adjusted using the controller user interface or using a personal computer running SiteTech software. DC2 controller settings can only be changed using SiteTech.

5.14 Controller Troubleshooting

Refer to the controller troubleshooting table in Figure 5-17 when troubleshooting procedures in Section 5.13 indicate a possible controller problem. Also check the controller display for fault messages and refer to Section 5.11, Fault Messages.

Always check the controller settings before replacing the controller. RDC2 controller settings can be checked and adjusted through the controller's user interface or using a personal computer and Kohler® SiteTech™ software. The generator set operation manual contains the instructions for checking and changing the controller settings. The DC2 controller settings can only be changed using SiteTech™. See TP-6701, SiteTech Software Operation Manual. Kohler® SiteTech™ software is available to authorized distributors and dealers.

Problem	Possible Cause	Corrective Action	Reference
Controller LCD display is off.	Low or no battery voltage	Check controller connections. Check DC power to the RDC2 controller. Check generator set battery connections and condition. Check utility power connection to the generator set terminal block (power for battery charging).	W/D, Section 8
Controller display backlight is off.	Backlight turns off after about 1 minute with no activity	Backlight will turn on when a button is pressed or the generator set starts.	—
Loss of communication to accessory modules.	Bad connections	Check wiring and connections. Verify that cable size and length of run comply with the instructions in the Installation manual.	Generator set Installation Manual or accessory module documentation.
	Low or no battery voltage	Check generator set battery connections and condition. See "Low or no battery voltage" above.	—
Load management relays do not operate (if equipped).	Bad connections	Check wiring and connections. Verify that cable size and length of run comply with specifications.	Documentation for the load management device or power relay modules.
	Low or no battery voltage	Check generator set battery connections and condition. See "Low or no battery voltage" above.	—
Date is flashing.	Controller power was disconnected and then reconnected	Check battery connections. Check controller connections. Check utility power connection to the generator set terminal block. Reset the time, date, and exercise schedule.	 W/D, Section 8 Generator set O/M

Figure 5-17 RDC2 Controller Troubleshooting

5.15 Troubleshooting Load Management Problems

The load control module (LCM), load shed kit, and the combined interface/load management board on the RXT transfer switch are all load management devices that are controlled by the RDC2 or DC2 controller. If the load management device does not operate as expected, follow the procedures in this section to troubleshoot the equipment. First check that the controller is communicating with the load management device as shown in the following procedure. Then check the troubleshooting tables for potential problems and recommendations.

Also refer to the documentation provided with the load management device for more information about installation, connections, and operation.

5.15.1 Check Controller Firmware

Check the firmware version number on the RDC2/DC2 controller. RDC2/DC2 firmware version 4.03 or higher is required for load management. If a Model RDT ATS with a load shed kit is used, RDC2/DC2 controller firmware versions 5.04 or higher is recommended. Update the firmware if necessary.

5.15.2 Verify that the Controller Recognizes the Load Shed Kit

There are three ways to verify that the RDC2 controller recognizes the load management device.

1. On the RDC2 controller, navigate to the Networking Menu and check the number of modules connected and the information for remote devices. See Figure 3 and Figure 4. The number should equal the number of RBUS devices connected, including the load management device, RXT transfer switch (if used), APM (if used), and the PIM (if used). A Model RDT transfer switch is not an RBUS device. Power relay modules connected to the load management device are not RBUS devices.

2. For the RDC2 or DC2 controller, use a laptop computer connected to the controller's USB port and Kohler® SiteTech software. In the Parameters view of SiteTech, check that the RBUS network screen shows the correct number of RBUS devices connected (one load management device, RXT transfer switch, PIM, and/or APM, if used). See SiteTech Operation Manual TP-6701 for instructions.

3. For the RDC2 or DC2 controller, use OnCue Plus. Go to the Controls screen and check that a Load Shed tab is visible below the exercise information. See the OnCue Plus Operation Manual, TP–6928 for instructions.

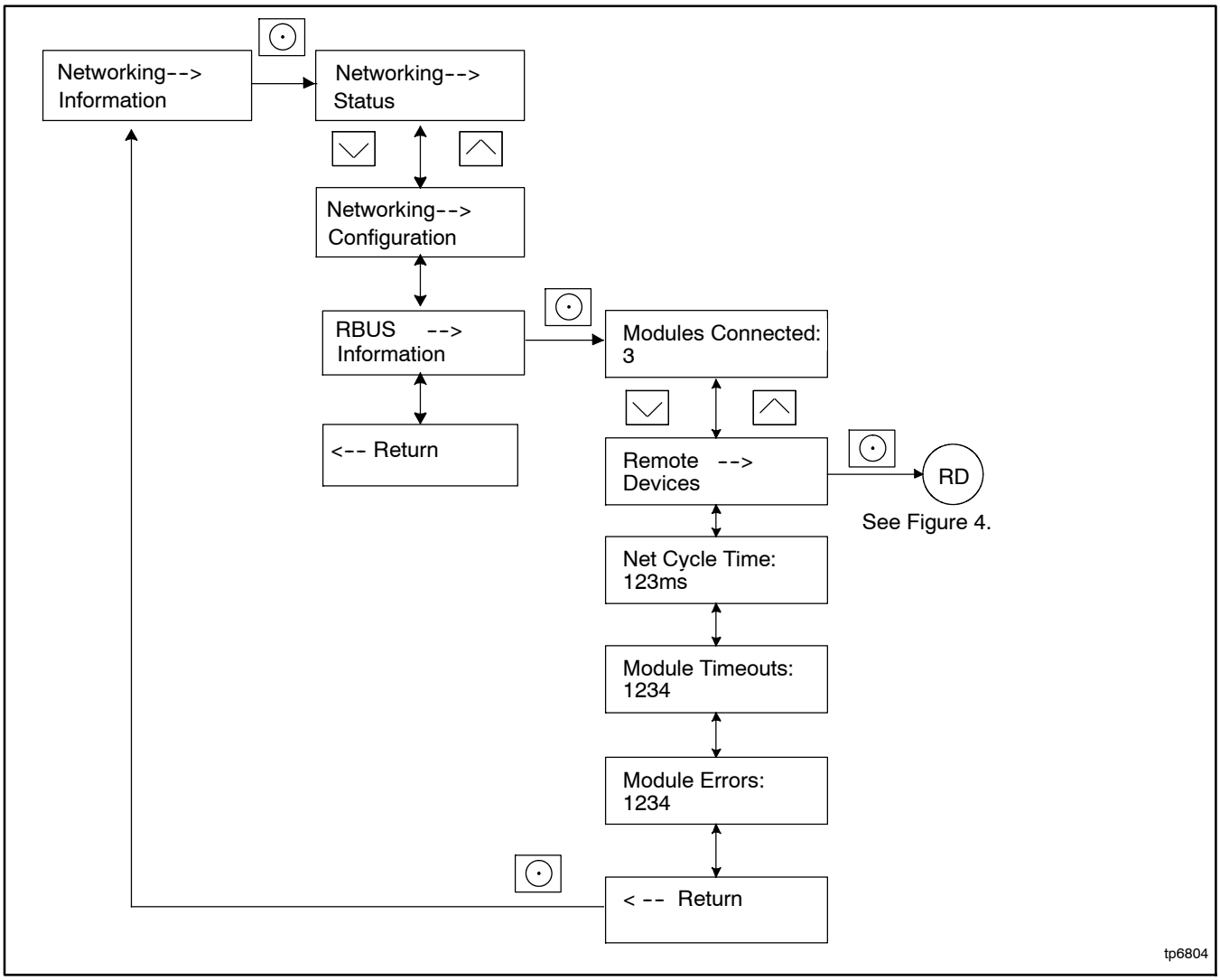


Figure 3 RDC2 Controller, Networking Information Menu

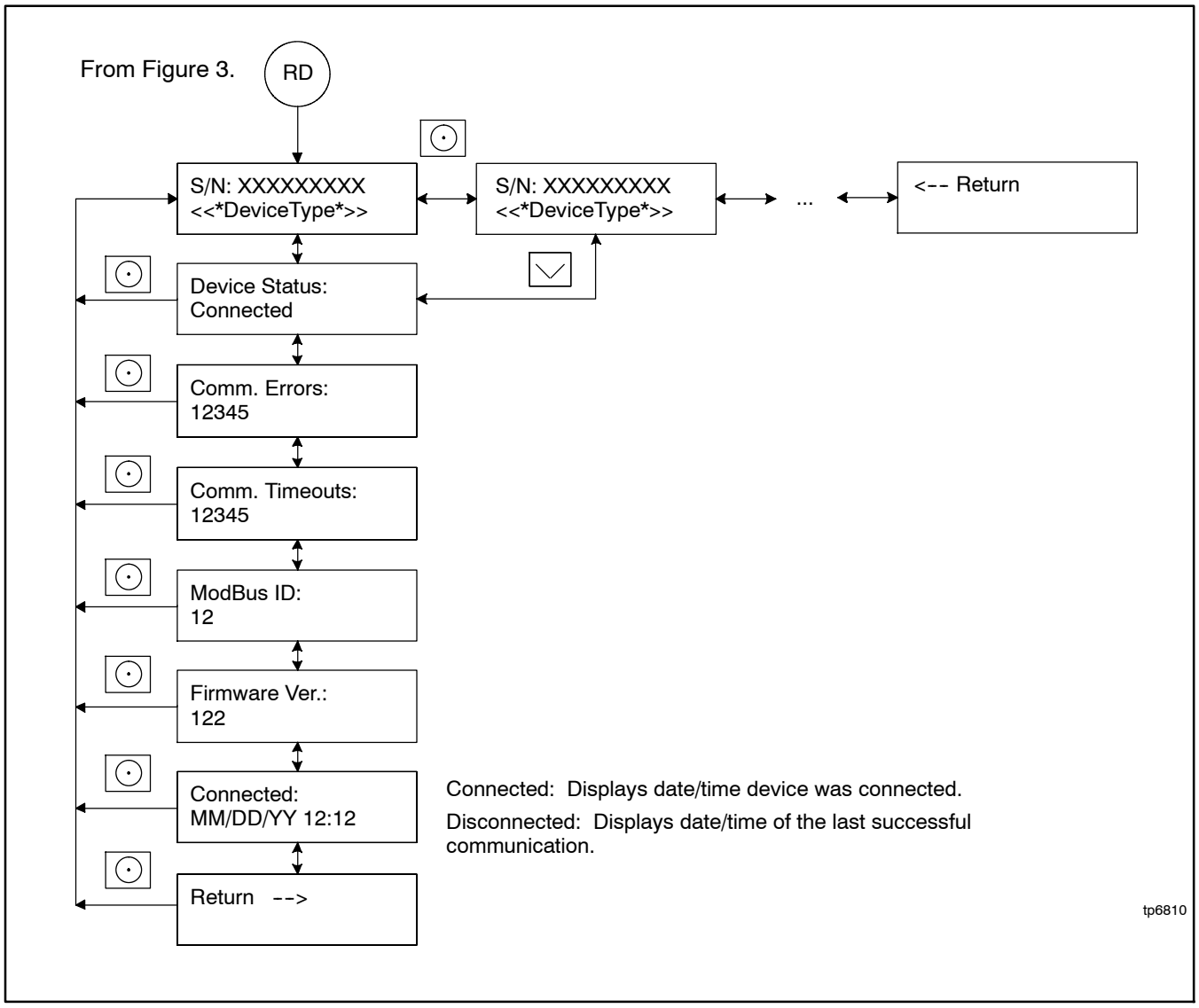


Figure 4 RDC2 Controller, Remote Devices Submenu

Troubleshooting Tables

The following tables list potential load management device operation problems and recommendations for troubleshooting.

Load management functional issues.	
Problem	**Check**
Load shed AC relays do not activate.	Verify 120 VAC supply voltage to relays. Verify correct wiring to the load management device board and AC relays.
Metering always reads 0% under load.	Verify that the Emergency feed to the ATS goes through the CT correctly. Verify that the CT leads are connected to the load management device input correctly. Verify that the correct CT is used. (400 A to 3V)
Metering never reads 0%.	Verify that the CT is wired correctly. Verify that twisted-pair cable was used. Verify that CT wiring is in separate conduit from AC leads.
Load A does not add after initial shed.	Verify that the correct size wires are used for PWR and COM connections from the generator set controller to the load management device. See the installation instructions for the load management device.

Load management does not shed enough load for the generator to recover.	
Problem	**Check**
HVAC units do not shed.	Verify normally closed (NC) output is used to control HVAC.
Does not shed when load is between 85% and 90%.	Verify that the load is not intermittently dropping below 85%. Verify that the load remains above 90% for at least 40 seconds. Verify that the % load is metering correctly. Verify that the overload percent is set at 10% or more below indicated level. Verify that the load management device is communicating with the generator set controller.
Does not shed when load is at 100%.	Verify that the % load is steady at 100% for approximately 25 seconds. Verify that the % load is metering correctly. Verify that the overload percent is set at 10% or more below indicated level. Verify that the load management device is communicating with the generator set controller.
Does not shed when load is greater than 110%.	Wait at least 15 seconds. Verify that frequency is greater than 59 Hz. Verify that the load management device is communicating with the generator set controller.
Generator still overloaded when all loads are shed.	Verify that only non-essential loads are connected through the Load Shed Kit. Correctly set up unused relays for the run length. Verify that all load management device AC relays are properly supplied. Verify that the wire size is correct for the run length.

Loads do not add when they should.	
Problem	**Check**
Loads do not add when load is below 56%.	Verify that the generator set maximum load capacity is adequately sized for the application. Verify that the load is not jumping above the maximum capacity.
Loads never add.	Verify that % load is below 50%. Verify that the wiring between the load management device and the generator set controller is correct. Verify that the generator set maximum load capacity is adequately sized for the application. Verify that the load is not jumping above the maximum capacity.

Sporadic load adds and sheds.	
Problem	**Check**
Load adds and then sheds after about 6 seconds.	Verify that the fuel pressure to the generator set is within specification. Verify that the % load is correctly measured. Verify that the wiring between the load management device and the CT meets specifications. Verify that the Generator Set maximum Load Capacity is not set too high. One AC relay may have too much load. Even out the loads on the AC relays. Verify that generator frequency is within specification.
Loads continually add and shed.	One AC relay may have too much load. Even out the loads on the AC relays. Verify that the controller firmware has been updated. See Section 5.15.1. Verify that generator frequency is within specification.
Some loads add but then all loads shed suddenly.	Verify stable communication between the load management device and the ATS with the generator controller. One AC relay may have too much load. Even out the loads on the AC relays. Verify that generator frequency is within specification.

Load does not shed after transfer to Emergency.	
Problem	**Check**
Load does not shed after transfer to Emergency.	Verify that frequency is greater than 59 Hz. Verify that the transfer switch is a model RXT. Verify that the remote start signal is true. Verify that generator set controller is configured as a single-phase unit. Verify that the load management device sensed load is less than 7%.
Load sheds when Normal is available.	Verify that the ATS is connected correctly. Verify that the system indicates that the Normal source is available. If an RDT transfer switch is used, verify that the remote start signal is off (false). Verify that the load management device sensed load is less than 7%.

6.1 Theory of Operation

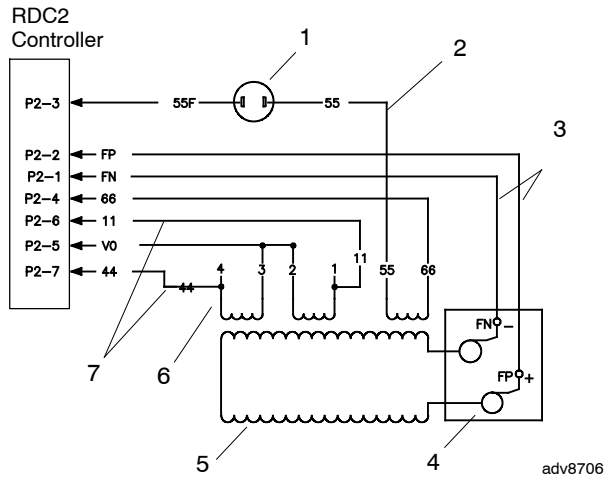
The generator set utilizes a rotating-field alternator to produce AC voltage. See Figure 6-1 and Figure 6-2. Refer to Section 8 for the complete generator set schematics.

When the controller receives a start signal, it energizes leads FP and 71. FP energizes the rotor field and lead 71 energizes the crank relay P16. The field current generates a magnetic field that produces AC voltage when it rotates. The controller monitors this AC voltage to determine the engine speed. When the controller senses cranking speed, run relay P17 is energized and the engine is permitted to start. When the engine speed reaches about 750 RPM, the alternator produces sufficient voltage to self-excite. The controller drops power to lead 71, ending the start sequence. (See Section 5.2 for a step-by-step engine start sequence.)

When self-excited, the alternator field is energized by voltage produced in the auxiliary windings, which are designed solely to provide current to the alternator field. This current is controlled by the generator controller to maintain output voltage at the generator's rated level (more field current is required as the load on the generator increases).

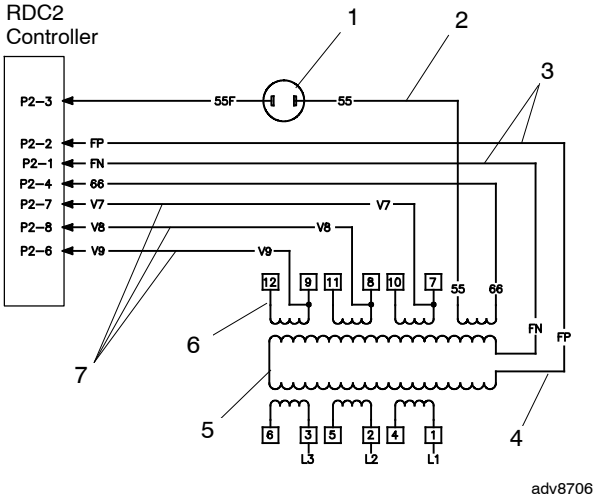
Note: The controller does not excite the field during the warmup or cooldown portion of the cycle exercise. The field is also disabled during cooldown and fault cooldown (occurs after certain faults prior to shutting down).

The controller monitors the generator output voltage through leads 11 and 44 (single-phase) or leads V7, V8, and V9 (three-phase 14/20RESA, 20RESC). It receives a speed signal and power for exciting the field from the auxiliary windings 55 and 66 and supplies current to the alternator field through outputs FP and FN.



1. Circuit breaker (20 amps)
2. Power lead 55
3. Excitation to rotor
4. Brushes
5. Main field (rotor)
6. Stator windings
7. Sensing leads 11–44

Figure 6-1 Single-Phase Alternator Schematic



1. Circuit breaker (20 amps)
2. Power lead 55
3. Excitation to rotor
4. Brushes
5. Main field (rotor)
6. Stator windings
7. Sensing leads V7, V8, V9

Figure 6-2 Three-Phase Alternator Schematic, (14/20RESA, 20RESC)

6.2 Alternator Excitation

⚠ WARNING

Hazardous voltage. Moving parts. Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

Testing live electrical circuits. Hazardous voltage or current can 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)

Short circuits. Hazardous voltage/current can 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.

6.2.1 No to Low Voltage Operation

This section covers the operation of the alternator excitation and troubleshooting information for low or no voltage output.

Before beginning the test procedures, read all safety precautions at the beginning of this manual. Many of the test procedures include additional safety precautions.

After crank disconnect, controller will disengage the flash relay when the AC output of the generator reaches 1/4 of the output voltage. At this level, the output on the auxiliary windings should have reached a level sufficient to self-excite the alternator rotor field. If the output voltage does not exceed 1/3 of rated voltage, the generator is only producing voltage using the flash relay. To further isolate the cause of this failure:

1. Check the condition of the alternator circuit breaker. The circuit breaker is located in the service access area on the controller. If this breaker is open, the auxiliary winding current will not be able to reach the field and the field will only be supplied by the flash relay. If the breaker is tripped, stop the generator, disconnect P2 and verify no continuity between ground and each of 55, 66, FP, FN.
2. Verify the connections for 55, 55F and 66 per Figure 6-1.
3. Reconnect P2, start the generator and check for voltage between 55 and 66. This voltage should exceed 30 Volts AC when the AC output voltage is above 60 Volts AC. If the voltage does not exceed 30 VAC, stop the generator and complete the rotor and stator checks in Sections 6.3 and 6.4.
4. Check DC voltage between FP and FN. If this voltage is above 20 VDC, stop the generator and complete the rotor and stator checks in Sections 6.3 and 6.4.
5. If the auxiliary winding voltage exceeds 30 VAC and the field voltage does not exceed 20 VDC, replace the generator controller.

6.2.2 Erratic Voltage Regulation

Dramatic variations in the alternator voltage (more than 5 VAC) while the generator is operating at a steady load may cause flicker. Connect a flicker lamp to the generator output to determine if the generator is producing flicker. If flicker is observed, it can be caused by any of the following:

- Engine speed fluctuation. Refer to Sections 6.8 and 6.9 for troubleshooting.
- Alternator fault. Refer to Sections 6.3 and 6.4 for troubleshooting.
- Outer loop gain too high. Refer to Section 6.7.
- Internal controller stability circuit failure, indicated by excessive throttle movement, excessive voltage fluctuation, and dramatic flicker.

6.2.3 Separate Excitation

Use the following procedure to separately excite the generator using an external voltage source (a 12-volt automotive battery).

Separately exciting the generator can identify faulty voltage regulation by the controller or reveal a running fault in the rotor and/or stator. An external power source duplicates the role of the voltage regulator and excites the generator field (rotor). A generator component that appears to be in good condition while stationary may exhibit a running fault (open or short circuit) while moving. Centrifugal forces acting on the windings during rotation may cause a broken circuit to open. Increasing temperatures can cause the insulation to break down, resulting in a running fault. If this test shows that the rotor and stator are in good condition, test the voltage regulation using the tests in Section 6.7.

⚠ WARNING

Hazardous voltage. Moving parts. Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

Testing live electrical circuits. Hazardous voltage or current can 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)

Grounding electrical equipment. Hazardous voltage can 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 can 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.

Separate Excitation Procedure

Perform the following procedure to use an external voltage source to excite the main field (rotor).

1. Disconnect the black FN and FP leads from the alternator at the brush holder terminals.

2. Connect a DC ammeter, 10-amp fuse, and a 12-volt automotive battery to the positive (FP) and negative (FN) brush leads as shown in Figure 6-3. Note and record the ammeter reading.

   Note: The approximate ammeter reading should be the battery voltage divided by the specified rotor resistance. See Section 1, Specifications, for specified rotor resistance values.

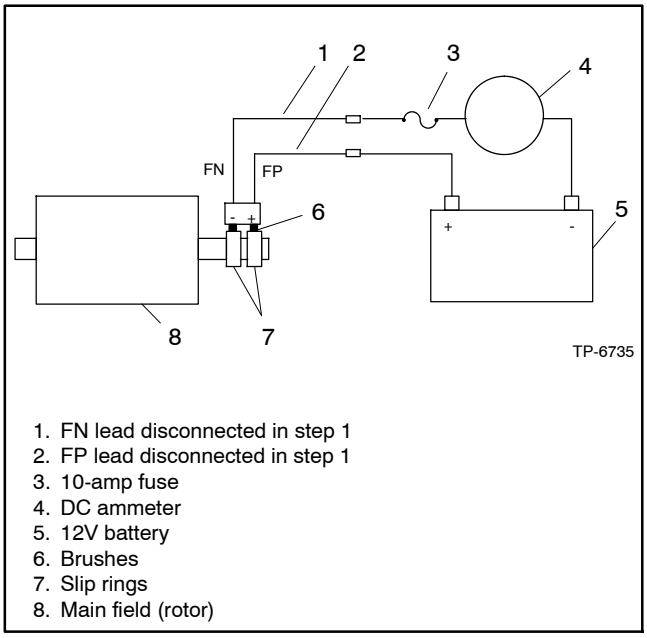
   Example:

   $$\frac{\text{12 volts (battery voltage)}}{\text{4 ohms (rotor resistance)}} = \text{3 amps (rotor current)}$$

3. Start the engine and check that the ammeter reading remains stable. An increasing meter reading indicates a shorted rotor. A meter reading decreasing to zero or an unstable reading suggests a running open. Refer to Section 6.4, Main Field (Rotor), to test the rotor. If the ammeter reading is stable, proceed to step 4.

4. Check for AC output across the stator leads; see Section 6.3, Stator. Compare the readings to the AC output values shown in Section 1, Specifications. If the readings vary considerably, a faulty stator is likely. Refer to Section 6.3, Stator, for further information.

5. If this test shows that the rotor and stator are in good condition, check the wiring and fuses. Check the controller settings and connections. See Section 4, Controller.



1. FN lead disconnected in step 1
2. FP lead disconnected in step 1
3. 10-amp fuse
4. DC ammeter
5. 12V battery
6. Brushes
7. Slip rings
8. Main field (rotor)

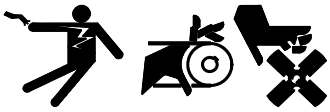
Figure 6-3 Separate Excitation Connections

6.3 Stator

The stator contains a series of coils of wire laid in a laminated steel frame. The stator leads supply AC voltage to the load and voltage regulator. Before testing the stator, inspect it for heat discoloration and visible damage to housing lead wires, exposed coil windings, and exposed areas of frame laminations. Be sure the stator is securely fastened to the stator housing.

Note: Disconnect all stator leads before performing all stator tests.

⚠ 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.

High voltage test. Hazardous voltage can 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.

Short circuits. Hazardous voltage/current can 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.

Stator Continuity and Resistance Tests

1. Press the OFF button on the controller to turn off the generator set.
2. Disconnect utility power to the generator set.
3. Disconnect the generator set engine starting battery, negative (–) lead first.
4. Disconnect all stator leads before performing all stator tests.
5. To check for stator continuity, set the ohmmeter on R x 1 scale. First set the ohmmeter zero by holding the red and black meter leads together and setting the ohmmeter reading to zero. Then check the stator continuity by connecting the meter leads to the stator leads as shown in Figure 6-4.

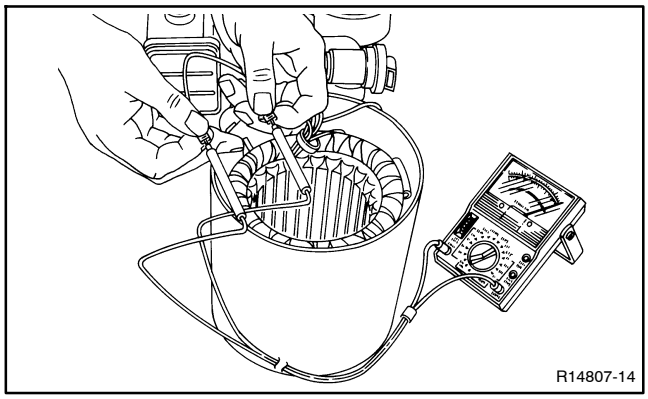


Figure 6-4 Testing Stator Windings

Note: For single-phase models. leads 1, 2, 3, and 4 are the generator output leads. Leads 11, 44, 55, and 66 are the controller sensing and supply leads. Refer to the schematic in Figure 6-5 when performing the following steps.

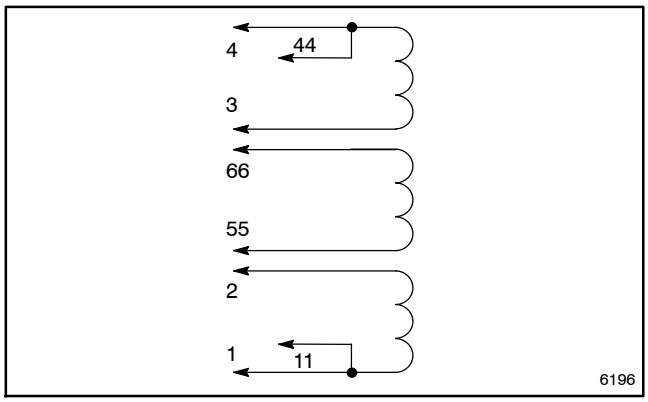


Figure 6-5 Single-Phase Alternator Stator Leads

Note: For 14/20RESA and 20RESC three-phase models, leads 1–12 are the generator output leads. Leads V7, V8, V9, 55, and 66 are the controller sensing and supply leads. Refer to the schematic in Figure 6-6 when performing the following steps.

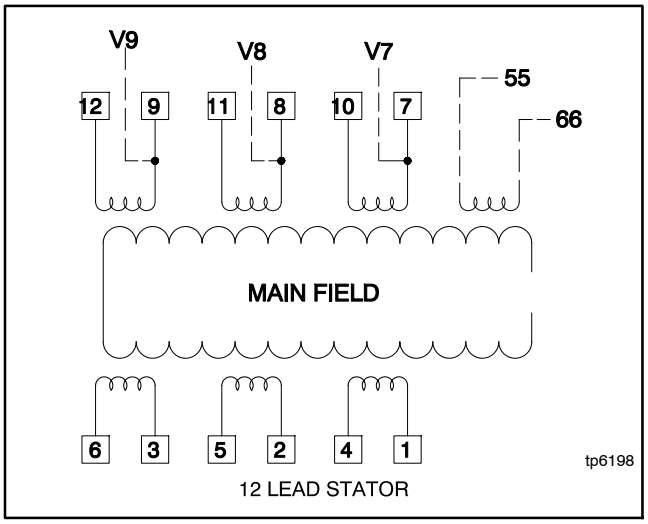


Figure 6-6 Three-Phase Alternator Stator Leads (14/20RESA, 20RESC)

6. Contact the ohmmeter leads and readjust the ohmmeter to read zero ohms.

7. Check the cold resistance of the stator windings by connecting the meter leads to stator lead pairs shown in Figure 6-7 (single-phase) or Figure 6-8 (14/20RESA and 20RESC three-phase). See Section 1.6, Alternator Specifications, for stator winding resistances. Most ohmmeters do not provide accurate readings below 1 ohm. Low resistance readings (continuity) and no evidence of shorted windings (heat discoloration) indicate a stator in good condition.

Leads	Continuity
1 and 2	Yes
1 and 11	
2 and 11	
3 and 4	
3 and 44	
4 and 44	
55 and 66	
1 and 3, 4, 44, 55, or 66	No
2 and 3, 4, 44, 55, or 66	
3 and 1, 2, 11, 55, or 66	
4 and 1, 2, 11, 55, or 66	
Any stator lead and ground on stator housing or frame laminations	

Figure 6-7 Continuity Test Results on a Good Stator, Single-Phase

Leads	Continuity
1 and 4	Yes
2 and 5	
3 and 6	
7 and 10	
8 and 11	
9 and 12	
55 and 66	
1 and 2, 3, 7, 8, or 9	No
1 and 55	
Any stator lead and ground	

Figure 6-8 Continuity Test Results on a Good Stator, Three-Phase (14/20RESA, 20RESC)

8. If the resistance test proves inconclusive, use a megohmmeter to test the stator as described in the next step.

   Note: Because ohmmeter accuracy varies, resistance readings are approximate readings. Take readings of the rotor and stator at room temperature.

   Note: Make sure that all stator leads are disconnected before running the megohmmeter test.

9. Use a megohmmeter to determine whether the stator is shorted to ground.

   a. Apply 500 volts DC to any stator lead and the stator frame. Perform the megohmmeter test following the instructions of the megohmmeter manufacturer.

   b. Repeat the test on the other stator leads until each coil is tested.

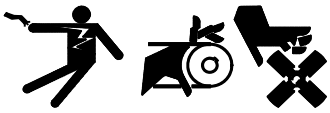
      Note: A reading of approximately 500 kOhms (1/2 megohm) and higher indicates a good stator.

   c. Repair or replace the stator if any reading is less than approximately 500 kOhms. A reading of less than 500 kOhms indicates deterioration of the winding insulation and possible current flow to ground.

6.4 Main Field (Rotor)

The two-pole rotor creates the magnetic field needed to produce alternating current in the stator windings. Before testing, inspect the rotor for visible damage to pole shoes, insulation, exposed coil windings, and slip ring surfaces. Rotate the bearing to check for wear, heat discoloration, or noise.

⚠ 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.

High voltage test. Hazardous voltage can 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.

Grounding electrical equipment. Hazardous voltage can 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.

Rotor Test Procedure

1. Press the OFF button on the controller to turn off the generator set.

2. Disconnect utility power to the generator set.

3. Disconnect the generator set engine starting battery, negative (-) lead first.

4. Check the rotor for continuity and resistance.

   a. Raise and secure the brushes away from the slip rings by removing the two brush holder mounting screws and moving the brush assembly out of the way.

   b. Measure the rotor resistance (ohms) between the two slip rings; see Figure 6-9. See Section 1.6 for rotor resistance readings.

   Note: Because ohmmeter accuracy varies, resistance readings are approximate. Take readings at room temperature.

   c. If the resistance readings are low, perform a megohmmeter test on rotor as described in the next step.

5. Perform a megohmmeter test to determine whether the rotor is shorted to ground.

   a. Raise and secure the brushes away from the slip rings by removing the two brush holder mounting screws and moving the brush assembly out of the way.

   b. Using a megohmmeter, apply 500 volts DC to one rotor slip ring and the rotor poles or shaft. Follow the instructions of the megohmmeter manufacturer when performing this test.

      Note: A reading of approximately 500 kOhms (1/2 megohm) or higher indicates a good rotor.

   c. Repair or replace the rotor if the reading is less than approximately 500 kOhms. A reading of less than 500 kOhms indicates deterioration of the winding insulation and possible current flow to ground.

   d. Following the test, remove the retainer wire from the brush holder and check the brush positions on the slip rings. See Section 6.6, Brushes.

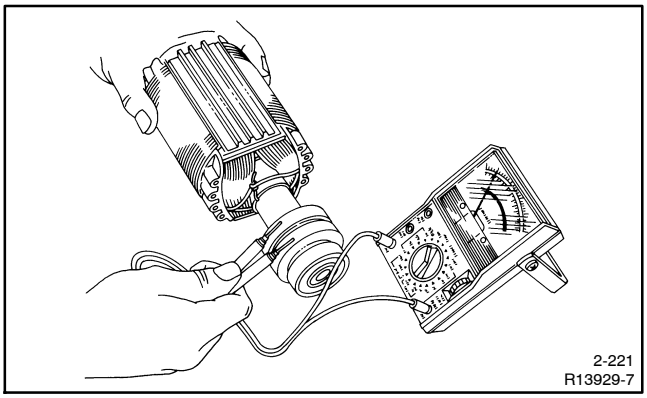


Figure 6-9 Rotor Resistance Check

6.5 Slip Rings

Slip rings acquire a glossy brown finish in normal operation. Do not attempt to maintain a bright, newly-machined appearance on the slip rings. Cleaning with a dry, lint-free cloth is usually sufficient. Use very fine sandpaper (#00) and apply light pressure to remove roughness. Do not use emery or carborundum paper or cloth. Clean all carbon dust from the generator after sanding the slip rings. If the rings are black or pitted, remove the rotor and use a lathe to remove some of the slip ring surface material.

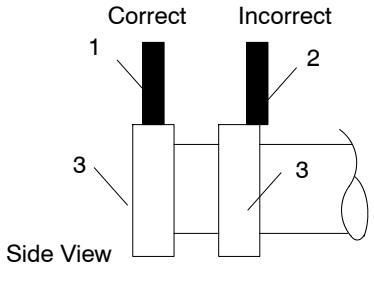
6.6 Brushes

The brushes transfer current to the slip rings. The brushes should last the life of the generator. However, abrasive dust on the slip ring can shorten the life of the brushes.

Excessive arcing at the brushes could damage the controller. Weak springs, damaged slip rings, sticking brushes, a loose brush holder, or poor brush contact causes arcing.

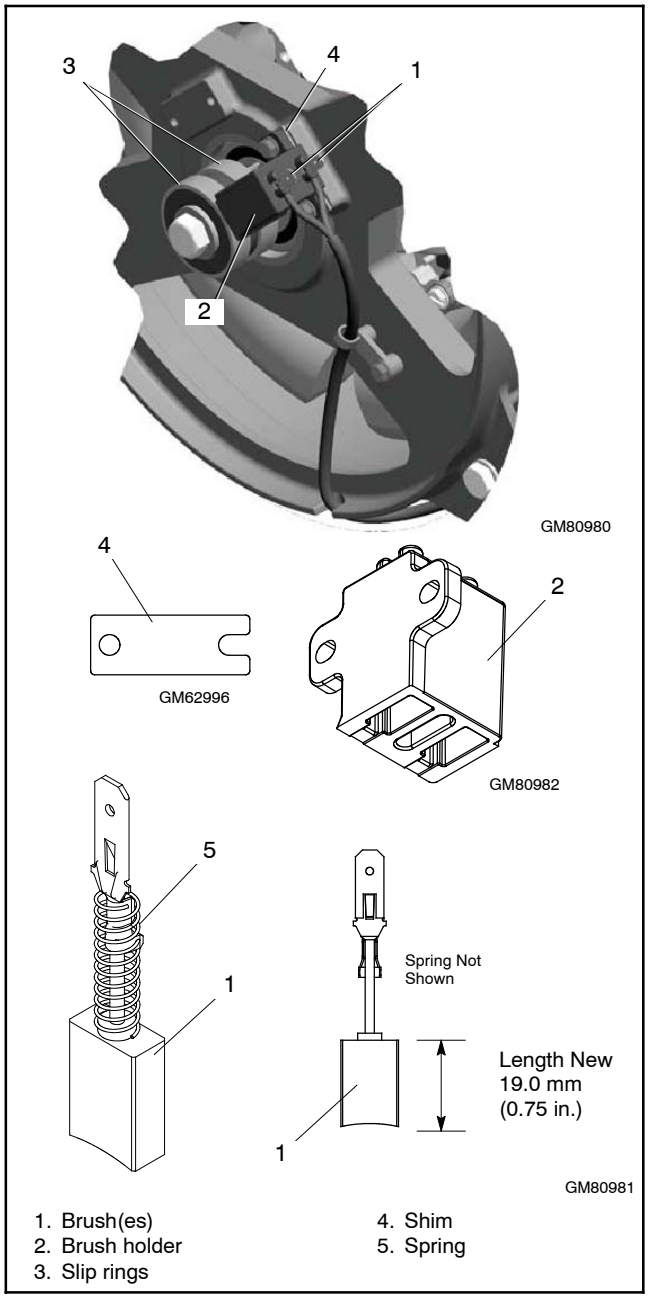
The brush holder assembly is illustrated in Figure 6-11. The brushes must be free to move within the holder and be held in contact with the slip rings by the springs. When correctly positioned, spring pressure on the brush surface causes the brush to wear evenly. The entire brush must ride on the ring or arcing occurs and causes burned rings or voltage regulator failure. Figure 6-10 shows the correct positioning of the brushes. Add or remove shims as necessary to center the brushes on the slip rings. Replace the brushes if they show uneven wear or are worn to one half their original length.

Check the resistance through the brushes. Resistance through the brushes should be low, 0.1–0.2 ohms without meter lead resistance.



1. Correctly positioned brush
2. Incorrectly positioned brush
3. Slip rings

Figure 6-10 Brush Position



1. Brush(es)
2. Brush holder
3. Slip rings
4. Shim
5. Spring

Figure 6-11 Brush Assembly

6.7 Voltage Adjustments

⚠ WARNING

Hazardous voltage. Moving parts. Can cause severe injury or death.

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Testing live electrical circuits. Hazardous voltage or current can 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)

Short circuits. Hazardous voltage/current can 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.

Note: See Section 4.8 for voltage calibration instructions.

Voltage Adjustments Using SiteTech

The SiteTech parameters used to adjust the voltage are shown in Figure 6-12.

SiteTech Group	Parameter
Genset System Configuration	Genset System Voltage
Voltage Regulator	Average Voltage Adjustment
	Volts per Hertz Slope
	Volts per Hertz Cut-in Frequency
	Voltage Regulator Gain

Figure 6-12 SiteTech Parameters for Voltage

6.7.1 Voltage Regulator Average Voltage Adjustment

Voltage regulation is performed by the controller. The controller monitors generator output voltage and adjusts the excitation current to the rotor.

Excitation current control is performed by the patented Kohler Hybrid Voltage Regulator. This regulator consists of a fast-reacting analog inner loop and a slower digital outer loop. The inner loop regulates the average output voltage to a setpoint which is controlled by the outer loop, allowing the voltage to recover very quickly during transient conditions. The outer loop measures the RMS magnitude of the voltage and adjusts the setpoint for the inner loop until the RMS voltage amplitude matches the Voltage Regulator Average Voltage Adjustment setpoint.

The hybrid regulator should require no voltage adjustment, as it regulates the RMS output voltage to the configured output voltage. The Voltage Regulator Average Voltage Adjustment setpoint may require alteration to more closely match the utility voltage at a particular location or to compensate for voltage drop on wiring between the generator and the ATS.

The Voltage Regulator Average Voltage Adjustment can be adjusted from the Voltage Regulator menu on the RDC2 controller, or adjusted using SiteTech. See Figure 6-12 and Figure 6-13.

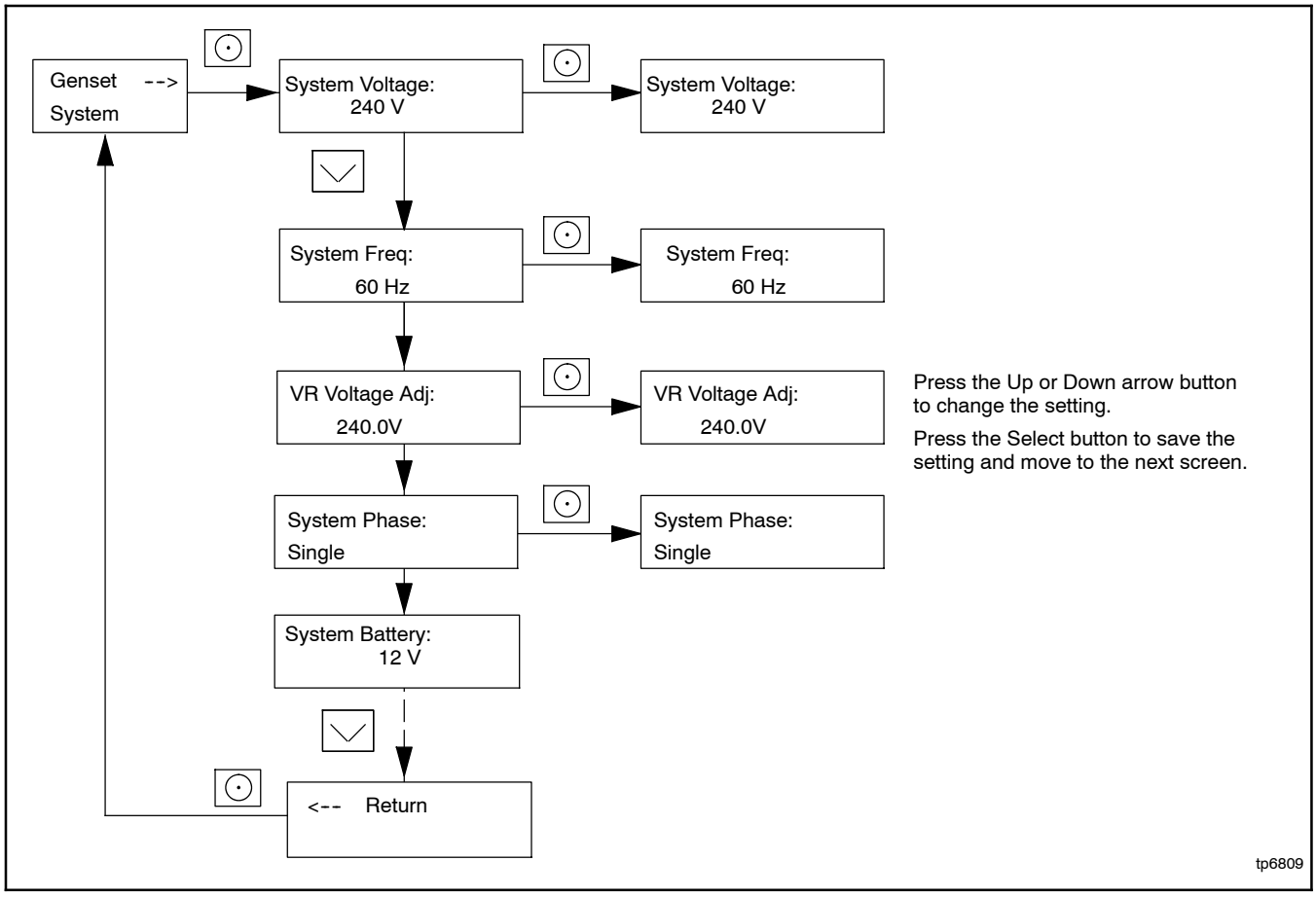


Figure 6-13 Voltage Regulator Voltage Adjustment Using RDC2 Controller Menus and Keypad

6.7.2 Volts/Hz Slope and Cut-In Frequency

The Volts/Hz setting for the voltage regulator performs the following functions on the generator:

- Serves as a method for unloading the engine to allow recovery during a sharp increase in load
- Serves as a means of protection for the alternator to avoid saturating the field (rotor heating) at low frequencies

The slope and cut-in frequency of the volts/Hz curve are set at the factory to allow the generator to meet factory performance standards. They should not be adjusted except under unique circumstances and under direction from a Kohler factory representative.

If the slope of the Volts/Hz curve is set too low, the engine will not be unloaded quickly enough to recover from a quick load increase. If the slope is set too high, the voltage will dip dramatically with a quick load increase, which will cause temporary brownouts.

The cut-in frequency is typically set to 1 Hz below system frequency so that normally small frequency variations do not cause the voltage to vary. Setting the cut-in frequency further from rated frequency may adversely affect the generator's ability to recover frequency after a sharp load increase.

See Figure 6-14 for an illustration of the volts/Hz curves for 50 and 60 Hz.

6.7.3 Voltage Regulator Gain

The gain of the inner loop of the hybrid regulator is set at the factory and is not adjustable in the field. The Voltage Regulator Gain listed in SiteTech is for the outer loop. The outer loop is responsible for correcting the setpoint to the inner loop to ensure that the generator output is regulated to the RMS regulator setpoint. The outer loop thus corrects for wave-shape distortion, temperature variations in the inner loop circuitry, inter-board metering variations, etc. Typically the outer loop only adjusts the setpoint to the inner loop on initial startup (battery is first plugged in) and after calibration has changed.

At a gain setting of 1, it will take 128 seconds to adjust the voltage output 1%. At a gain setting of 255, the voltage adjustment rate is related to the difference between the target voltage and the measured voltage, but could vary up to 3.1% per second.

At lower gains, the voltage may reach the target value very slowly, but the chance of overshoot from the two controller loops fighting is minimal. At higher gains, there is a chance that the outer loop will change the setpoint faster than the inner loop can accommodate, resulting in unstable output voltage. This may show up as slight flicker on a light bulb.

Note: The RMS correction outer loop is not active when the controller is in Volts/Hz mode; the last known correction factor, or inner loop setpoint, is used.

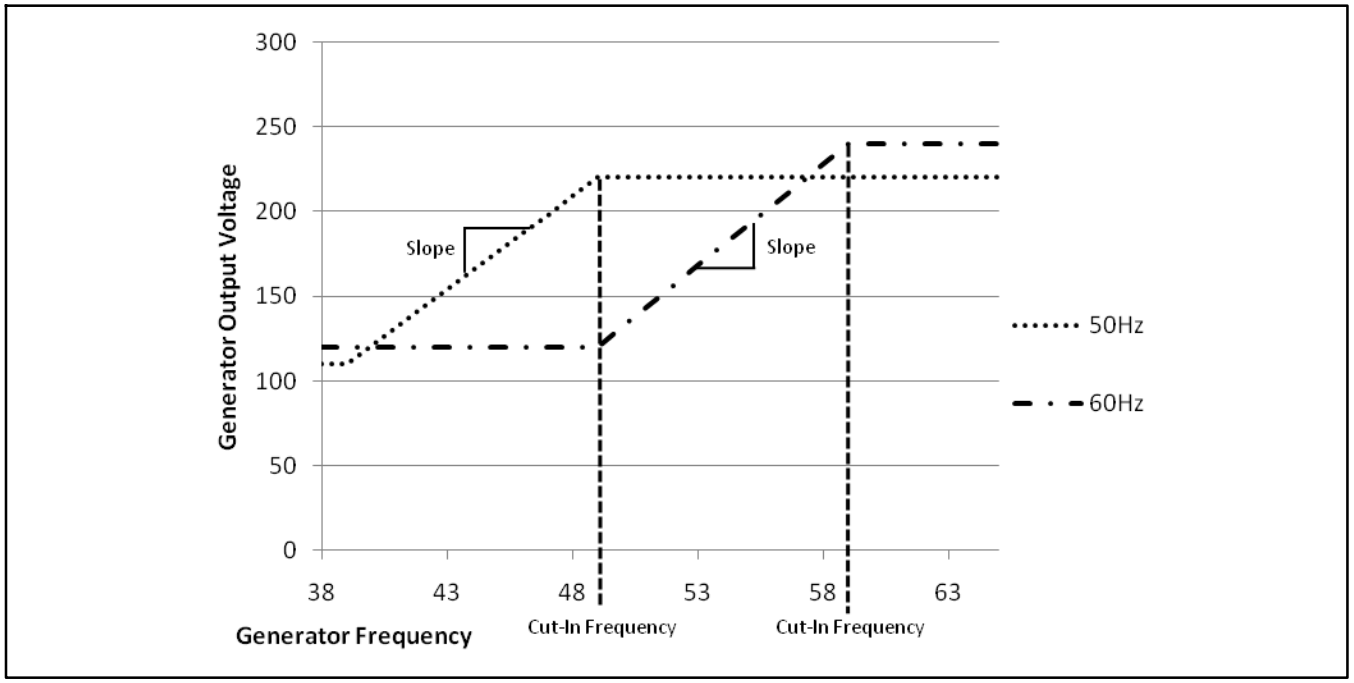


Figure 6-14 Volts/Hz Curves

6.8 Governor System

The governor system consists of an electromechanical stepper motor (actuator) and an engine speed detection/feedback circuit. The RDC2 or DC2 controller controls the governor system operation. See Section 8, Wiring Diagrams, for the governor connections.

6.8.1 Operation

The frequency of the alternator output is determined by the speed of the engine. A two-pole alternator is driven at 3600 rpm to provide 60 Hertz. (A 50 Hz model is driven at 3000 rpm.) The engine speed is maintained by an electronic governor system that consists of an embedded controller and electric actuator (stepper motor).

The governor system is controlled by the generator set controller. The controller provides regulated power to the bidirectional stepper motor actuator, which is linked to the carburetor throttle arm.

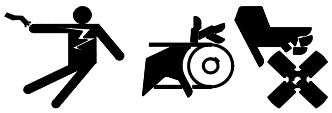
The engine runs at a reduced speed during the warmup and cooldown idle period of the cycle exercise. During this time, the rotor field is not energized and the generator will not produce voltage. When not producing voltage, the generator will not be subject to large changes in engine loading, so the governor response is dramatically slowed to decrease throttle linkage wear and fuel consumption. The response is also slowed during cooldown and fault cooldown for the same reason.

The engine speed adjustment setting in SiteTech allows adjustment of the engine speed for testing purposes. See Section 6.9.2. If the engine is hunting or surging, do not adjust the engine speed. Test the governor operation as described in Sections 6.8.3 and 6.8.4. Then adjust the governor gain to stabilize the engine operation if necessary before adjusting the speed. See Section 6.9.1.

6.8.2 Initial Checks

The factory sets the electronic governor. Under normal circumstances the electronic governor requires no further adjustment. Verify that the governor stepper motor moves smoothly and steadily during operation. If the engine operates erratically, check the following connections and conditions *before* adjusting the governor.

⚠ 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.

- Verify that the electrical connections are clean and tight.
- Verify that the battery connections are clean and tight.
- Check for a loose or worn stepper motor/throttle shaft coupling. Replace the shaft and bushing every 500 hours of engine operation.
- Check the carburetor for dirt, grime, or misadjustment. Check for a loose mixer assembly.

- Check the idle-adjustment screw. The screw should not prevent the throttle plate from closing completely.
- Check the throttle linkage for any binding, dirt, damage, or other visible problems.
- Check the fuel supply pressure and the fuel supply system for leaks, blockages, and/or failed system components (regulators, valves, etc.). See Section 6.11, Fuel Systems.

⚠ WARNING

Hazardous voltage. Moving parts. Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

- Observe the stepper motor operation. The stepper motor should open the throttle while cranking, and pull back after speed feedback is detected.
- Check for electronic governor faults. The fuel shutoff solenoid deenergizes and the generator set shuts down under the following conditions:
  - Closed throttle
  - Engine overspeed
  - Broken fuel shutoff solenoid lead
  - Broken stepper motor leads (erratic performance)
  - Failed actuator linkage (erratic performance)

6.8.3 Hunting/Surging

Hunting/surging problems thought to be caused by the governor system are more likely to be caused by fuel supply, engine, or carburetor problems. Check engine speed stability using the following procedure before testing the governor.

Also see Section 5.10, Troubleshooting Engine Hunting, 20 kW Models.

⚠ WARNING

Hazardous voltage. Moving parts. Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

⚠ 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.

1. Open the generator set line circuit breaker.
2. Start the generator set.
3. Hold the throttle linkage steady while the engine is running. See Figure 6-15. If the engine runs at a steady speed with no hunting or surging when the throttle is held steady, then the hunting/surging problems during operation are probably caused by the governor. Proceed to Section 6.8.4.
4. Check the linkage between the stepper motor and the carburetor. Replace any worn or damaged components.
5. Verify that the speed control parameters have not been modified. Reset the parameters to the default settings if they have been modified. See Figure 6-18, Controller Settings.

6. If the engine speed hunts or surges while the throttle is held steady, check the carburetor and engine operation. Refer to the engine service manual for engine diagnostic and service information.

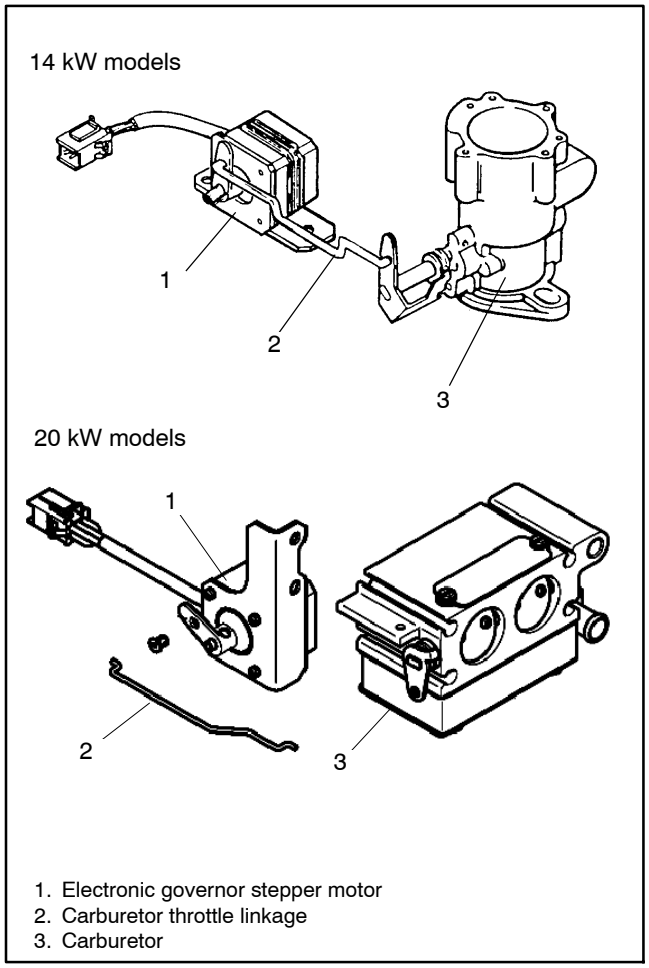


Figure 6-15 Stepper Motor and Carburetor

6.8.4 Governor System Operation Test

If the engine continues to operate erratically after the previous checks, test the governor system operation using the following procedure. The procedure is summarized in the flowchart in Figure 6-16.

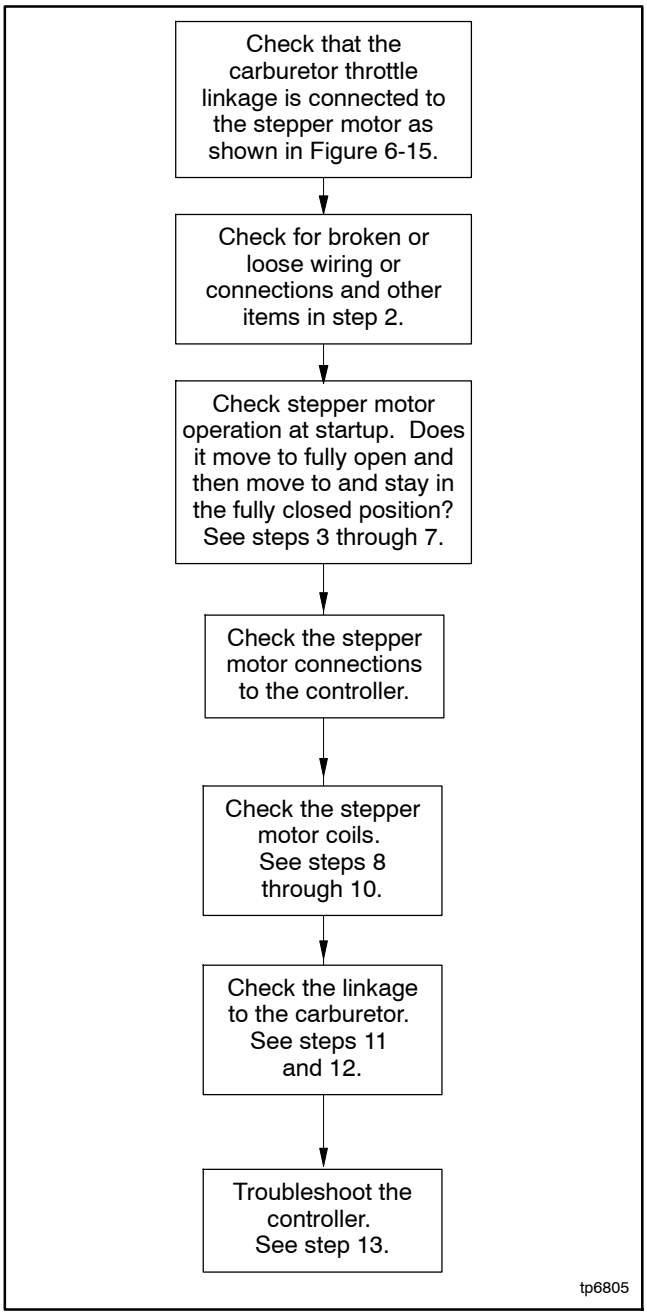


Figure 6-16 Governor System Operation Test Procedure Summary

Governor System Operation Test Procedure

⚠ WARNING

Hazardous voltage. Moving parts. Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

1. Verify that the carburetor throttle linkage is connected to the stepper motor as shown in Figure 6-15.

2. Look for broken or loose wiring or plug connections if the stepper motor moves erratically. Check the condition of the throttle linkage, and verify that the throttle plate closes completely.

Check the operation of the stepper motor at startup.

3. Before starting the generator, move the throttle to the fully closed position. Press the RUN button to initiate the start sequence.

4. If the throttle stays in the fully closed position, and the controller shows a Locked Rotor fault, verify that the generator set model is set to 14 kW or 20 kW. Then check and verify the alternator connections, functionality, and operation. See the wiring diagrams and Sections 6.2 through 6.6 of this document.

5. If the throttle moves to the fully open position and remains fully open, and the controller shuts down the generator for an overspeed or overfrequency fault, verify that the generator set model is set to 14 kW or 20 kW. Then check the throttle linkage and stepper motor connections and operation. Go to step 8 of this procedure.

6. If the throttle moves to the fully open position and remains fully open, the engine goes to a high speed condition, and the controller does not shut down the generator, verify that the generator set model is set to 14 kW or 20 kW. Then check and verify the alternator connections, functionality, and operation. See the wiring diagrams and Sections 6.2 through 6.6 of this document.

7. If the throttle moves to the fully open position and then moves toward the closed position, but the engine speed is erratic or behaves poorly, check the throttle linkage and stepper motor connections and operation. See stepper motor troubleshooting starting with step 8 of this procedure. Also check that the engine speed control parameters are set to the default settings (Engine Speed Governor and Advanced Speed Control parameters in SiteTech).

Check the stepper motor, carburetor, and linkage.

8. To test controller's governing function, open the generator set circuit breaker, disconnect the engine starting battery, and shut off the fuel supply.

9. Disconnect the stepper motor plug P6 to access the stepper motor terminals.

10. Check the stepper motor coil resistance across pins 2 and 3 and across pins 1 and 4. Only two stepper motor leads of each coil group are used (BLK-YEL and RED-WHT). See Figure 6-17. The resistance per half coil is 38.5 ohms. If one of the coils has a significantly higher resistance or is shorted, replace the stepper motor.

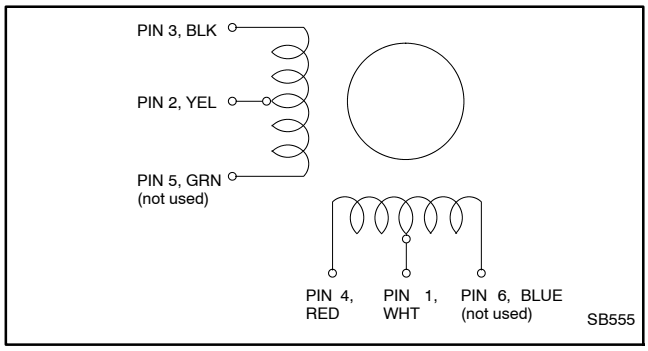


Figure 6-17 Actuator Coil Group

11. Inspect the linkage and the bushings between the stepper motor and the carburetor for damage. Replace as necessary.

12. Disconnect the linkage between the stepper motor and the carburetor. Verify free, full range of motion for the stepper motor and the carburetor throttle plate. Replace as necessary.

13. If there is power and a good ground connection to the controller and the stepper motor, and the carburetor and linkage pass the checks of steps 10 through 12, the problem is with the controller. Check controller connections, wiring, and settings. Refer to the troubleshooting procedures in Section 5.

6.9 Frequency Adjustment

The engine speed determines the generator output frequency; 60 Hz units operate at 3600 RPM and 50 Hz units run at 3000 RPM. When the system frequency setting on the controller is changed, the engine run speed will automatically update.

Set the system frequency to 50 or 60 Hz before adjusting the engine speed. The system frequency can be adjusted using the controller keypad on the RDC2 controller or using a personal computer running Kohler® SiteTech™ software. The DC2 controller must be adjusted using SiteTech™ software.

Frequency Adjustment Procedure

1. Use the RDC2 controller's Genset System menu or use SiteTech to set the system frequency to 50 or 60 Hz.

   Note: Although the RDC2 System Frequency menu scrolls through numbers from 51-59, the only available settings are 50 and 60 Hz.

2. Open the generator set line circuit breaker.

3. Attach a frequency meter to the AC output leads.

4. Start and run the generator set. Verify that the output frequency matches the desired system frequency.

5. Check stability with the generator set running and with no load applied. If the generator set speed is unstable, hunts, or surges, use SiteTech to verify that the engine speed control parameters are set to the default settings (Engine Speed Governor settings in SiteTech).

   Note: Hunting/surging problems thought to be caused by the governor are more likely to be caused by fuel supply, engine or carburetor problems. If the generator set speed is unstable, hunts, or surges, check for the cause using the procedure in Section 5.10.3 before proceeding.

6. Apply rated load to the generator set and observe the frequency reading. The no load and full load frequency should not vary more than 0.4 Hz from the rated generator frequency.

   a. If the frequency varies significantly more than 0.4 Hz from the system frequency, check that the carburetor throttle plate opens completely without sticking and check the carburetor adjustment.

   b. If the frequency is steady but running below rated frequency, verify that the throttle is completely open. If so, reduce the load on the engine until the frequency recovers.

7. Check for hunting and surging at full load. If the generator speed is unstable, hunts, or surges, the governor gain may require adjustment. See Section 6.9.1, Engine Speed Gain adjustment, for instructions to change the governor gain.

8. Remove the load and observe the frequency. The frequency should return to the rated level within a few seconds. If the speed does not recover or the generator controller shuts down for over frequency or overspeed, it may be necessary to adjust the governor gain. See Section 6.9.1.

6.9.1 Engine Speed Gain Adjustment for the Governor

Note: Adjusting the governor gain may cause the generator to operate incorrectly.

Note: Typical governor gain settings are between 35 and 65. Settings outside this range are not recommended for extended use (troubleshooting only).

The governor gain controls how much throttle movement is tied to a given change in the generator speed. Higher gains make the throttle move more aggressively on a speed change, lower gains make the throttle move more slowly.

Using Kohler SiteTech, adjust the Engine Speed Gain Adjustment setting in the Engine Speed Governor group. Change the governor gain setting in small steps (5 or less).

- If the engine is hunting slowly (changes from maximum to minimum speed in more than a second), increase the governor gain.
- If the generator is hunting quickly (maximum to minimum speed several times per second), decrease the gain.
- If changing the gain makes the hunting worse, try changing the gain in the other direction.

6.9.2 Engine Speed Adjustment for Governor

The Engine Speed Adjustment parameter in the Engine Speed Governor group in SiteTech can be adjusted while the generator set is running.

Note: The Engine Speed Adjustment parameter must be left at the default value (50) for the generator to operate at the correct frequency. If this parameter is changed during troubleshooting and testing, make sure to return it to the default setting before disconnecting SiteTech from the generator controller.

The Engine Speed Adjustment setting can be adjusted from 0 to 99 for test purposes. Setting the Engine Speed Adjustment to 0 will make the governor regulate speed to 100 RPM slower than the rated speed. Setting the Engine Speed Adjustment to 99 will make the governor regulate speed to 98 RPM faster than the rated speed setting.

Changing the Engine Speed Adjustment setting will change the engine speed according to the following formula:

(System Frequency x 60) + ((Setting – 50) x 2) = RPM

Examples:

System frequency of 60 Hz, changing the setting to 40:

(60 x 60) + ((40 – 50) x 2) = 3580 RPM

System frequency of 50 Hz, changing the setting to 99:

(50 x 60) + ((99 – 50) x 2) = 3098 RPM

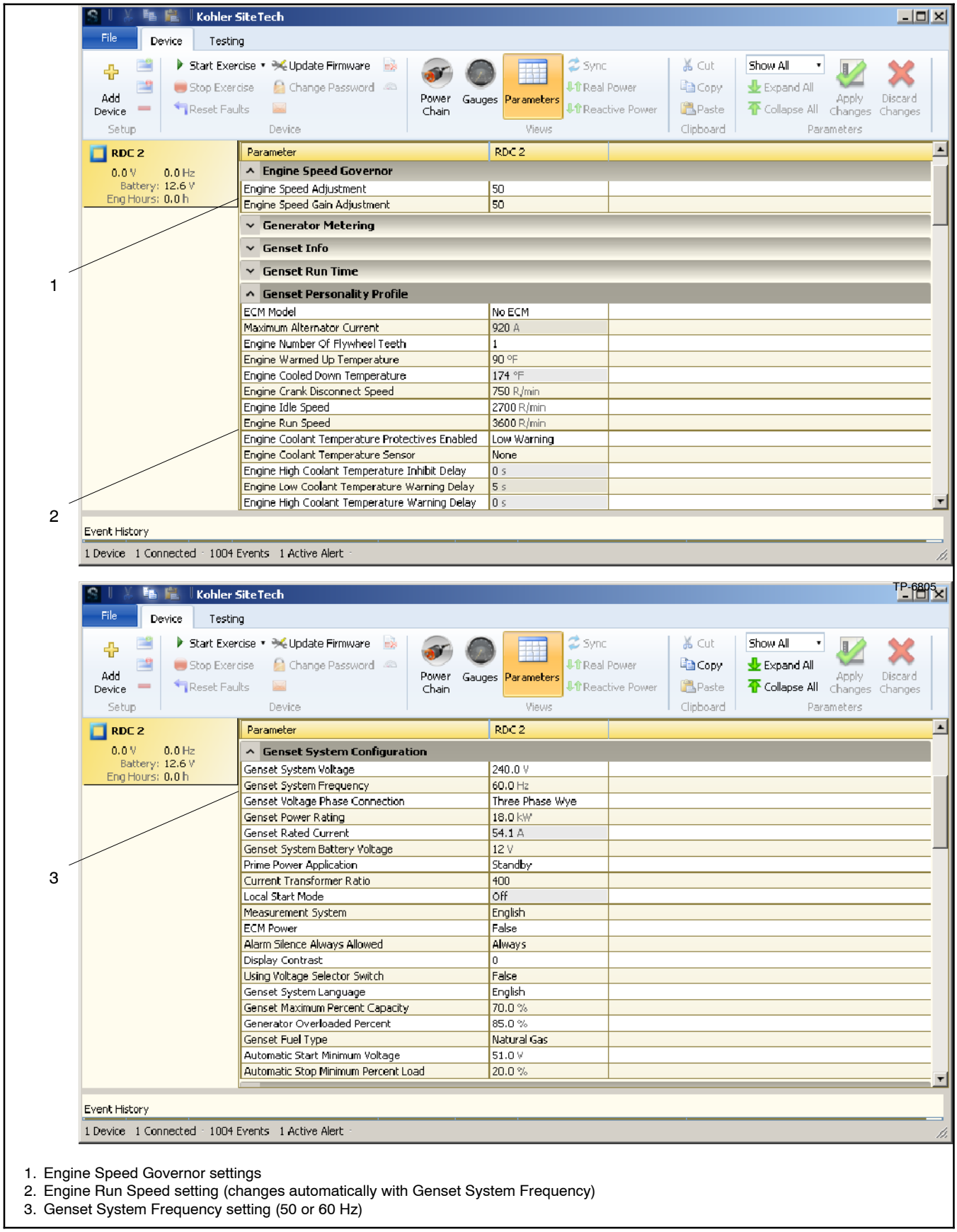
6.9.3 Advanced Speed Control

Note: Do not adjust the Advanced Speed Control settings unless instructed to do so by the Kohler Generator Service Department.

The four parameters under Advanced Speed Control also permit adjustment of the governor function, but have the potential of dramatically affecting the load transient performance of the generator. They are set in the factory and are tested to comply with factory performance standards. They should never be changed from the factory settings except under the direction of factory personnel.

SiteTech Group	Parameter	Units	Adjustment Range	Default Setting
Engine Speed Governor	Engine Speed Adjustment		0 – 99	50
Engine Speed Governor	Engine Speed Gain Adjustment		35–65	50
Genset Personality Profile	Engine Run Speed †	RPM	1000 – 3900	3600
Genset System configuration	Genset System Frequency	Hz	50/60	60.0
† Engine Run Speed is set automatically when the System Frequency is set.				

Figure 6-18 Engine Speed and Frequency Parameters in SiteTech



1. Engine Speed Governor settings
2. Engine Run Speed setting (changes automatically with Genset System Frequency)
3. Genset System Frequency setting (50 or 60 Hz)

Figure 6-19 Engine Speed and Frequency Parameters in SiteTech

6.10 Fault Shutdown Tests

Verify the operation of the generator set overspeed, overcrank, and low oil pressure shutdowns by performing the tests in Section 6.10.1. If these tests are inconclusive, test individual shutdown circuit components (wiring harness, switch, etc.) as described in Section 6.10.2.

⚠ WARNING

Hazardous voltage. Moving parts. Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

Short circuits. Hazardous voltage/current can 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.

⚠ 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.

6.10.1 Controller Fault Shutdown Functions

Check the operation of the fault functions programmed in the controller by performing the following tests. If the controller does not operate as described, check the controller settings. Also check the controller wiring and connections.

Verify that the controller parameters shown in Figure 6-20 are set correctly for your unit.

Open the generator set output circuit breaker before beginning the test. (See Figure 1-1 for the circuit breaker location.)

Parameter	Setting
Genset Model Number*	14 kW 20 kW
Genset Serial Number*	From nameplate; see Figure 4-7.
Fuel Type†	Natural Gas or Liquid Propane (LPG)
Phase Connection†	Single Phase
Genset System Voltage†	From nameplate; see Figure 4-7.
Genset System Frequency†	50 or 60 Hz

* In the Generator Set Information menu.

† In the Genset System menu.
Fuel Type is available with firmware version 4.5 or higher.

Figure 6-20 Controller Settings

Overspeed Shutdown

Connect a digital voltmeter (DVM) to measure the output frequency. Start the generator set and manually adjust the engine speed by moving the throttle linkage.

Note: Be careful not to touch the hot silencer when reaching in to adjust the throttle linkage.

Increase the engine speed to at least 115% of the rated engine speed, 69 Hz on 60 Hz models or 58 Hz on 50 Hz models. Verify that the generator set shuts down on an overspeed fault. If the overspeed shutdown does not operate, the generator set should shut down on an overfrequency fault after approximately 5 seconds.

Low Oil Pressure (LOP) Shutdown

Connect a jumper wire from the LOP switch (lead 13) to the generator set ground. Start the generator set. Verify that the generator set shuts down after approximately 25–35 seconds of operation. Remove the jumper wire from the LOP switch and ground. Start the generator set and run it for at least 25–35 seconds to verify that the generator set does not shut down.

Overcrank Shutdown

Disconnect the fuel solenoid valve. Press the RUN button on the controller. Observe that the generator set cranks for 15 seconds and then rests for 15 seconds. Check that the generator set shuts down after the third crank/rest cycle.

Underspeed and Underfrequency Shutdowns

Close the throttle while the generator is running. The engine speed should decrease until the generator set shuts down and the controller indicates an Engine Speed Low Shutdown.

To check the underfrequency shutdown, use very small movements over a longer period of time to close the throttle. The genset may need to run at reduced

frequency for about a minute before the Frequency Low Shutdown is triggered.

Locked Rotor Shutdown

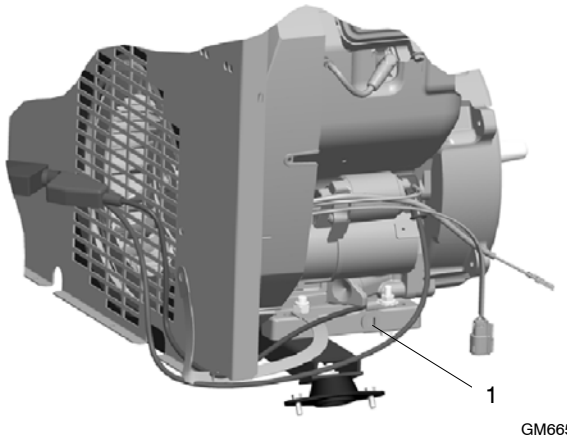
Remove the connector from the starter relay (see Figure 6-38). Press RUN. Verify that the engine does not turn and the controller indicates a Locked Rotor fault.

High Engine Temperature Shutdown

Note: Testing the high engine temperature shutdown requires connecting a jumper wire across the temperature sensor connections. Because the temperature sensor can be difficult to reach, the jumper can be placed across pins 9 and 10 on connector P1 at the generator set controller, if desired.

Disconnect the harness (connector P7) at the oil temperature sensor (OTS). See Figure 6-21 for the temperature sensor location, or see the note above. Connect a jumper wire across the temperature sensor connections in connector P7 or connections P1-9 and P1-10 on the controller. See Figure 6-22. Press RUN to start the generator set. After 5 seconds, verify that the controller displays a high lube oil temperature fault. If the oil temperature remains high (jumper connected) without increasing, the generator set will run for 5 minutes in engine cooldown mode.

Press the OFF button on the controller and remove the jumper wire. Start the generator set and verify that the generator set does not enter the engine cooldown cycle or shut down on a high temperature fault. Reconnect P7 to the temperature sensor.



1. Temperature sensor location

Figure 6-21 Temperature Sensor (OTS) Location

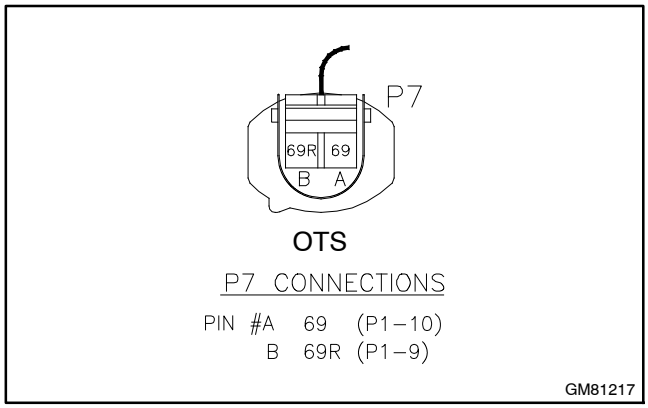


Figure 6-22 Temperature Sensor (OTS) Connector P7

6.10.2 Fault Shutdown Switches

Check the low oil pressure and high engine temperature shutdown switches on the engine by performing the following tests. If the sensor does not function as described, replace it.

⚠ WARNING

Hazardous voltage. Moving parts. Can 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 can 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.

Short circuits. Hazardous voltage/current can 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.

Temperature Sensor (OTS)

The temperature sensor (labelled OTS on the wiring diagram and schematic drawing) is used to monitor engine temperature for the high engine temperature fault shutdown. See Figure 6-21 for the temperature sensor location. Press the OFF button on the controller to stop the generator set and allow the generator set to cool. Disconnect the temperature sensor (or see the note, below) and use an ohmmeter to measure the resistance across the sensor. The sensor resistance varies with temperature and should be within the values

shown in Figure 6-23. If the resistance is very low (indicating a short circuit) or very high (indicating an open circuit), replace the CTS.

Note: Because the temperature sensor can be difficult to reach, the resistance can be measured across pins 9 and 10 on connector P1 at the generator set controller, if desired. Disconnect P1 from the controller before checking the resistance across P1-9 and P1-10.

Note: The temperature sensor is located in the engine oil pan. Drain the engine oil before removing the switch.

Temperature, °C (°F)	Resistance, Ohms
30 (86)	2100–2400
100 (212)	180–200

Figure 6-23 Temperature Sensor OTS Resistance Readings

Low Oil Pressure (LOP) Switch

The low oil pressure (LOP) switch is located under the engine air cleaner. See Figure 6-24. The oil pressure switch should be grounded when the engine is stopped (no oil pressure) and open when the engine is running.

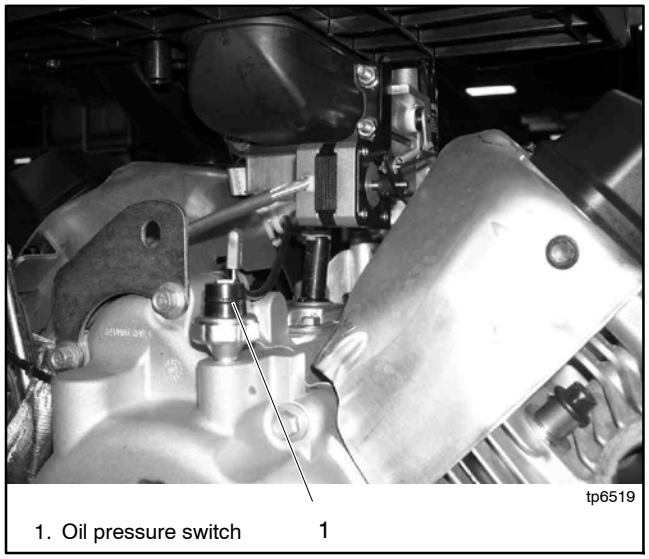


Figure 6-24 Oil Pressure Switch Location (under the air cleaner)

Before testing the LOP switch, check the oil level and add oil if necessary. Inspect the generator set engine for evidence of oil leaks.

To test the LOP switch:

1. Press the OFF button to stop the engine.
2. Disconnect lead 13 from the switch.
3. Use an ohmmeter or continuity tester to verify that the switch is closed (connected to the engine block).
4. Start the engine and verify that the switch opens after a few seconds.

If the LOP switch does not operate as described above, use a gauge to check the oil pressure:

1. Press the OFF button to stop the engine.
2. Remove the LOP switch and install an oil pressure gauge.
3. Start and run the generator set.
4. Verify that the engine oil pressure is within the range specified in Section 1, Specifications, before replacing the LOP switch.

6.11 Fuel Systems

⚠ WARNING

Risk of fire.
Can cause severe injury or death.

Do not smoke or permit flames or sparks near fuels or the 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.

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.

The fuel supplier provides and maintains manual shut-off valves and the primary regulator. See the generator set installation manual for fuel pipe size recommendations. Verify that the fuel system capacity is adequate to supply the generator set plus all other gas appliances.

A factory-installed secondary regulator and 12 VDC solenoid valve are located in the front air intake compartment. See Figure 6-26.

The controller energizes the fuel solenoid valve to open at startup and deenergizes the valve to close at shutdown. The secondary fuel regulator reduces fuel pressure for delivery to the fuel block. The fuel flows from the fuel block to the carburetor in a gaseous state. The carburetor mixes the fuel with intake air for consumption by the engine.

Refer to the troubleshooting instructions in Section 5, Troubleshooting, to identify generator set operation problems that may be caused by an inadequate fuel supply, incorrect adjustments, or damaged fuel system components. Then use the instructions in this section to check fuel system components.

6.11.1 Fuel Solenoid Valve

A solenoid valve upstream of the regulator and the flexible fuel connector provides automatic fuel on/off control. See Figure 6-26. The engine starting battery powers the solenoid valve and the engine starting controls open the valve when the engine cranks or runs.

Fuel Valve Operation Test Procedure

1. Disconnect the positive (+) battery lead from the gas valve terminal.
2. Apply 12 VDC to the gas valve terminal and listen for an audible click, indicating that the valve actuates.
3. Replace the gas valve if it does not actuate in step 2.

6.11.2 Ignition Timing

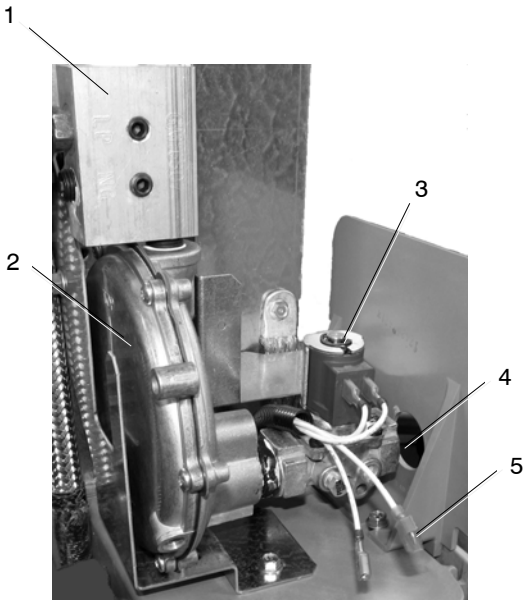
The digital spark advance ignition (DSAI) optimizes the 14 kW generator engine timing for the selected fuel, natural gas or LPG. The ignition timing leads are located near the fuel solenoid valve. See Figure 6-26. Connect the ignition timing leads together for natural gas fuel. Disconnect the leads if LPG is used. See Figure 6-25.

Note: The ignition timing leads have no effect on 20 kW models.

See the engine service manual for ignition system service information.

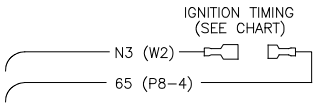
Ignition Timing Lead Connection	
Natural Gas	Connect
LPG	Disconnect

Figure 6-25 Ignition Timing Lead Connection



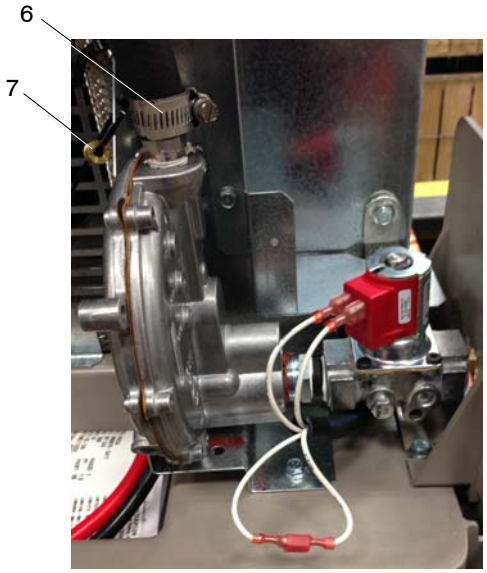
14kW Models before June 26, 2014

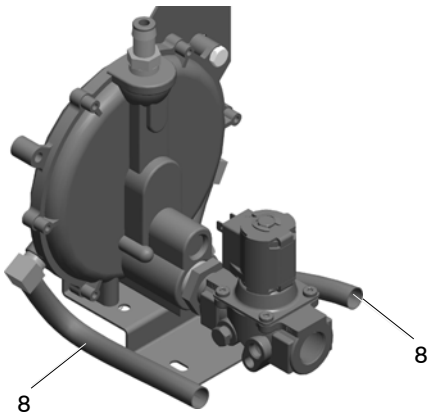
IGNITION TIMING	
FUEL TYPE	
NATURAL GAS	CONNECT 65 TO N
LP GAS	DO NOT CONNECT



Ignition Timing Lead Connection, 14 kW models

1. Fuel block (used on 14 kW models before June 26, 2014)
2. Regulator
3. Fuel solenoid valve
4. Fuel inlet, 1/2 in. NPT female
5. Ignition timing leads





6. Fuel orifice location (see Figure 6-37)
7. LPG fuel orifice is tied here for shipping
8. Regulator vent tubes, used on 20RESA(L) and 20RESC(L) after June 26, 2014

Figure 6-26 Fuel System

6.11.3 Fuel Regulators

The typical gaseous fuel system uses two regulators. The primary regulator reduces the line pressure to an allowable inlet pressure for the secondary regulator. The fuel supplier provides and maintains the primary regulator. The secondary regulator is factory-installed on the generator set and is designed for a maximum inlet pressure of 2.7 kPa (6 oz./in.^{2}) or 280 mm (11 in.) water column.

Note: Do not attempt to adjust the fuel mixture or engine speed by adjusting the regulators.

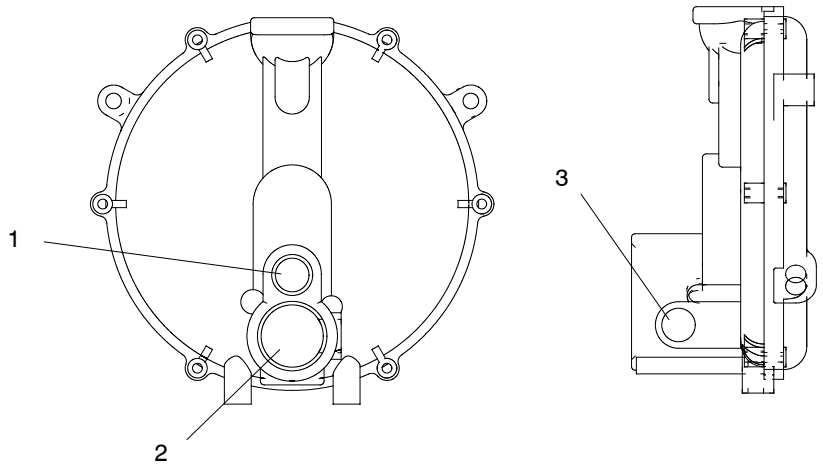
The fuel lockoff prevents fuel flow when the engine is not operating. See Figure 6-28. Do not try to adjust the fuel pressure, fuel mixture, or engine speed using the fuel lockoff.

Checking the Fuel Pressure

Use a gauge or manometer to check the fuel pressure at the secondary regulator inlet. See Figure 6-28. Measure the fuel pressure with the generator set running at rated load. Contact the fuel supplier if the inlet pressure is not within the range shown in Figure 6-27.

Fuel	Fuel Pressure Required	
	14/20RESA(L) 20RESB	**20RESC(L) 20RESD**
Natural Gas	1.2–2.7 kPa (5–11 inches H_2O)	0.9–2.7 kPa (3.5–11 inches H_2O)
LP	1.7–2.7 kPa (7–11 inches H_2O)	

Figure 6-27 Fuel Pressure Requirements



1. Fuel lockoff *(do not adjust)*
2. Fuel inlet, 1/2 in. NPT
3. Inlet pressure check location

Figure 6-28 Fuel Regulator

6.11.4 Fuel Metering Valve Adjustment, 14RESA/RESAL Only

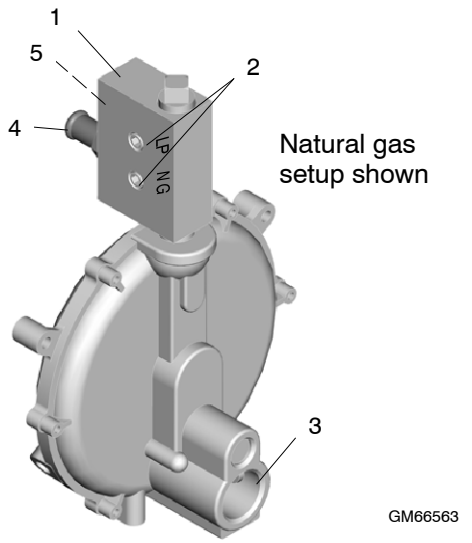
Note: This procedure applies only to units equipped with the fuel block shown in Figure 6-29. The fuel block was used on 14 kW models built before 6/26/2014.

The fuel system is factory-adjusted to comply with applicable emission standards and to provide the best possible hot and cold starting. The fuel metering valves are sealed to prevent field adjustments. If the fuel metering valve requires adjustment, do not break the seals on the factory-installed fuel metering valve. Obtain a new fuel metering valve to replace the factory-installed valve, and adjust the fuel mixture according to the instructions in this section. See Figure 6-29 for the fuel metering valve location. Refer to the generator set Parts Catalog for the fuel metering valve part number.

Note: Adjusting the factory-installed fuel metering valves on emissions-certified generator sets will void the emission certification.

Use an exhaust gas oxygen sensor to check the fuel mixture after replacing the fuel regulator, carburetor, or silencer. Use the following procedure to check the fuel mixture after the engine has reached normal operating temperature.

Only trained, authorized service technicians may adjust the new fuel metering valve. The adjustment procedure requires a digital voltmeter (DVM), oxygen sensor service kit GM58035, and a load bank capable of the rated kW for the fuel being used. Always use an oxygen sensor when adjusting the fuel metering valves.



1. Fuel block
2. Fuel metering valves
3. Fuel inlet, 1/2 in. NPT
4. Hose fitting
5. Plug

Figure 6-29 Fuel Block

Observe the following safety precautions while performing the procedure.

⚠ 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.

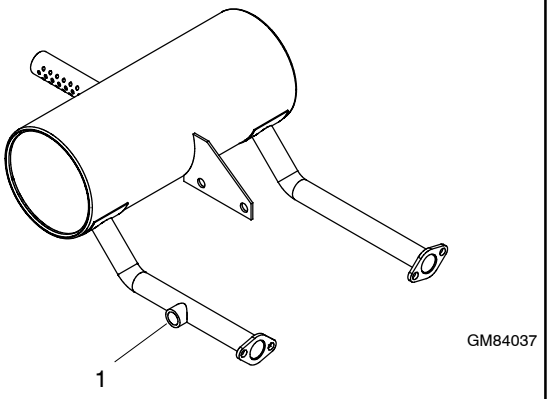
Note: The oxygen sensor gets very hot during operation. DO NOT touch the oxygen sensor, during or after operation, until cool.

Fuel Mixture Check/Fuel Metering Valve Adjustment Procedure

1. Follow the instructions provided with the oxygen sensor kit to perform the initial programming and

setup of the air/fuel (A/F) reader. See SB-675, provided with the oxygen sensor kit.

2. Press the OFF button on the controller.
3. Disconnect utility power to the generator set.
4. Remove the oxygen sensor plug from the silencer and install the oxygen sensor. See Figure 6-30 for location.
5. Follow the instructions provided with the oxygen sensor kit to connect the oxygen sensor to the power supply and A/F reader.



1. Oxygen sensor mounting location

Figure 6-30 Oxygen Sensor Mounting Location on the 14RESA/RESAL Silencer

6. Reconnect utility power to the generator set.
7. Press the RUN button on the controller to start the generator set.
8. Allow the generator set to run until the engine reaches normal operating temperature.
9. With the generator set at normal operating temperature, apply rated load.
10. After several minutes, note the air/fuel ratio meter measurements and compare to the λ (lambda) values in Figure 6-31.

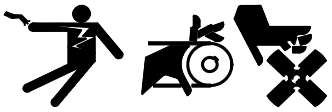
Air/Fuel Mixture λ Values	UEGO Sensor Reading, VDC*
0.923–0.944	2.60 ± 0.05
* UEGO sensor readings shown for reference	

Figure 6-31 Acceptable Oxygen Sensor Readings, 14RESA/RESAL

11. Adjust the fuel metering valve as required to obtain the output from the oxygen sensor specified in Figure 6-31.
12. When the fuel mixture is correct, use thread sealant to seal the metering valve adjustment screws.
13. Remove the load and allow the generator set to run unloaded to cool for at least 5–10 minutes.
14. Stop the generator set by pressing the OFF button on the controller.
15. Disconnect the generator set engine starting battery, negative (–) lead first.
16. Disconnect utility power to the generator set.
17. Allow the generator set exhaust system to cool.
18. Disconnect the DVM leads from the oxygen sensor.
19. After the sensor has cooled, remove the oxygen sensor from exhaust manifold.
20. Apply a small amount of antiseize compound to exhaust plug and reinstall the plug into the exhaust manifold.
21. Reconnect the generator set engine starting battery, negative (–) lead last.
22. Reconnect utility power to the generator set.

6.12 Fuel Conversion

⚠ 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

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.

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.

The multi-fuel system allows conversion from natural gas to LPG (or vice-versa) in the field while maintaining emissions-standard compliance. A trained technician or an authorized distributor/dealer can convert the fuel system.

After converting the fuel system, change the Fuel Type setting on the controller. See the Operation Manual for instructions to change settings at the controller, or use a personal (laptop) computer and Kohler® SiteTech™ software to change the setting.

Rating Change

Converting the fuel will change the generator set rating. See the generator set specification sheet for ratings with natural gas and LP. Order a new nameplate with the updated rating and fuel information from an authorized distributor/dealer, if necessary. Provide the following information from the original nameplate:

- Model Number
- Spec Number
- Serial Number
- Fuel (original and new)
- kW
- kVA
- Amps
- Volts
- Hz

Attach the new nameplate over the old one. Do NOT cover the UL listing information on the old nameplate.

6.12.1 Fuel Conversion, 14RESA/RESAL Equipped with Fuel Block

Two fuel connections on the fuel block allow field-conversion between natural gas and LPG vapor. The fuel metering valves are factory-set and sealed to comply with applicable emission standards and to provide the best possible hot and cold starting.

Note: Do not adjust the factory-sealed fuel-metering adjustments on the fuel block. Changing the fuel-metering adjustments may violate federal or state laws.

Use the following procedure to convert from natural gas (NG) to LPG vapor. See Figure 6-26 for the fuel system component locations.

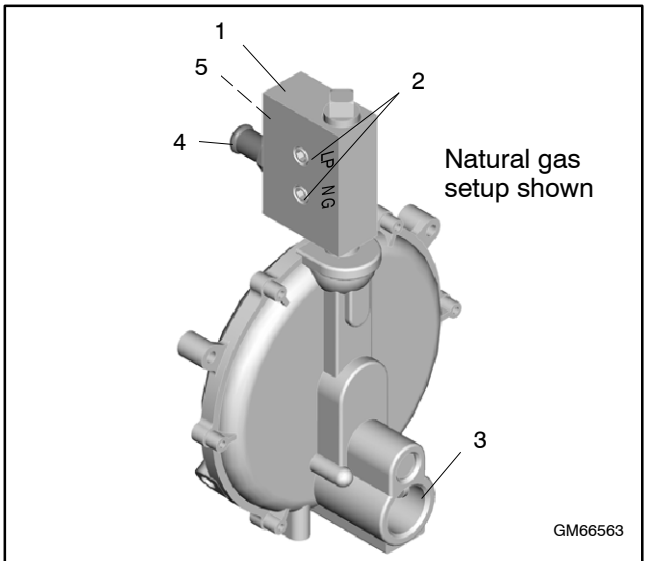
For controllers with firmware version 4.5 or higher, use SiteTech software to change the fuel type setting in the Genset System group. The fuel type setting is important if a Load Control Module (LCM) or load shed kit is connected to the generator controller.

Procedure to convert from NG to LPG, 14RESA/RESAL with Fuel Block

1. Press the OFF button on the generator set controller.
2. Disconnect the utility power to the generator set.
3. Disconnect the generator set engine starting battery, negative (–) lead first.
4. Turn off the fuel supply.
5. Remove the hose clamp and fuel hose from the hose fitting in the fuel block. See Figure 6-32.
6. Remove the hose fitting from the natural gas outlet port in the fuel block. See Figure 6-32.
7. Remove the plug from the LPG port in the fuel block. See Figure 6-32.
8. Clean the plug with a dry cloth or brush, apply fresh pipe sealant, and install the plug into the natural gas outlet port.
9. Clean the hose fitting with a dry cloth or brush, apply fresh pipe sealant to the threads, and install the fitting into the LPG port.

   Note: Do not adjust the fuel metering valves.
10. Slide the hose onto the hose fitting and secure it with the clamp.
11. Disconnect the ignition timing leads for LPG. See Figure 6-26 for the location of the ignition timing leads.
12. Connect and turn on the new fuel supply.
13. Reconnect the generator set engine starting battery leads, negative (–) lead last.
14. Reconnect utility power to the generator set.
15. Start the generator set by pressing the RUN button on the generator set controller.
16. Check for leaks using a gas leak detector.
17. Press the OFF button to shut down the generator set.
18. For controllers with firmware version 4.5 or higher, use SiteTech software to change the fuel type setting on the controller.

To convert from LPG vapor to natural gas, follow the same fuel conversion procedure, moving the hose fitting to the natural gas port and plugging the LPG port. Connect the ignition timing leads for natural gas. See Figure 6-33.



1. Fuel block
2. Fuel metering valves—*factory-sealed, do not adjust*
3. Fuel inlet, 1/2 in. NPT
4. Hose fitting
5. Plug

Figure 6-32 Fuel Block, 14RESA/RESAL

Fuel	Ignition Timing Leads 65 and N3
Natural Gas	Connect lead 65 to N3
LPG	Disconnect

Figure 6-33 Ignition Timing Lead Connection

6.12.2 Fuel Conversion, 14RESA/RESAL Equipped with Fuel Orifice Fittings

Note: Model 14RESA/RESAL generator sets built before June 26, 2014, use a fuel block for the fuel type selection. Use the instructions in Section 6.12.1 for fuel conversion.

Model 14RESA/RESAL generators built June 26, 2014, or later are not equipped with the fuel block. These units use fuel orifice fittings installed in the hose fitting at the fuel regulator. See Figure 6-35 and use the instructions in this section for fuel conversion.

For natural gas and LPG fuel, orifice fittings are used in the fuel line. See Figure 6-34. The natural gas orifice fitting is silver in color and stamped NG. The LPG fitting is gold in color and stamped LPG. The fittings are threaded. A straight-blade screwdriver is required to remove and replace the fittings.

The unit is typically shipped set up for natural gas, with the LPG fitting tied near the fuel solenoid valve. To convert to LPG, remove the NG fitting and install the LPG fitting as described below. See Figure 6-35 for the fuel system component locations.

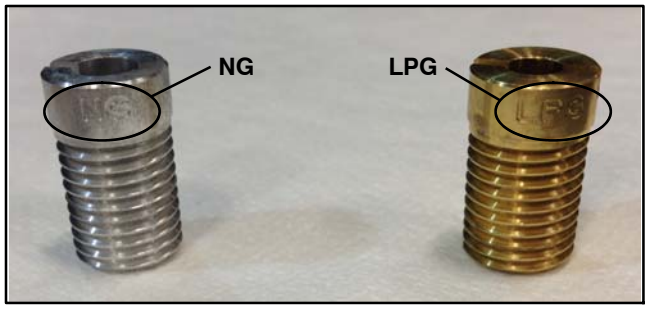


Figure 6-34 NG and LPG Fuel Orifice Fittings

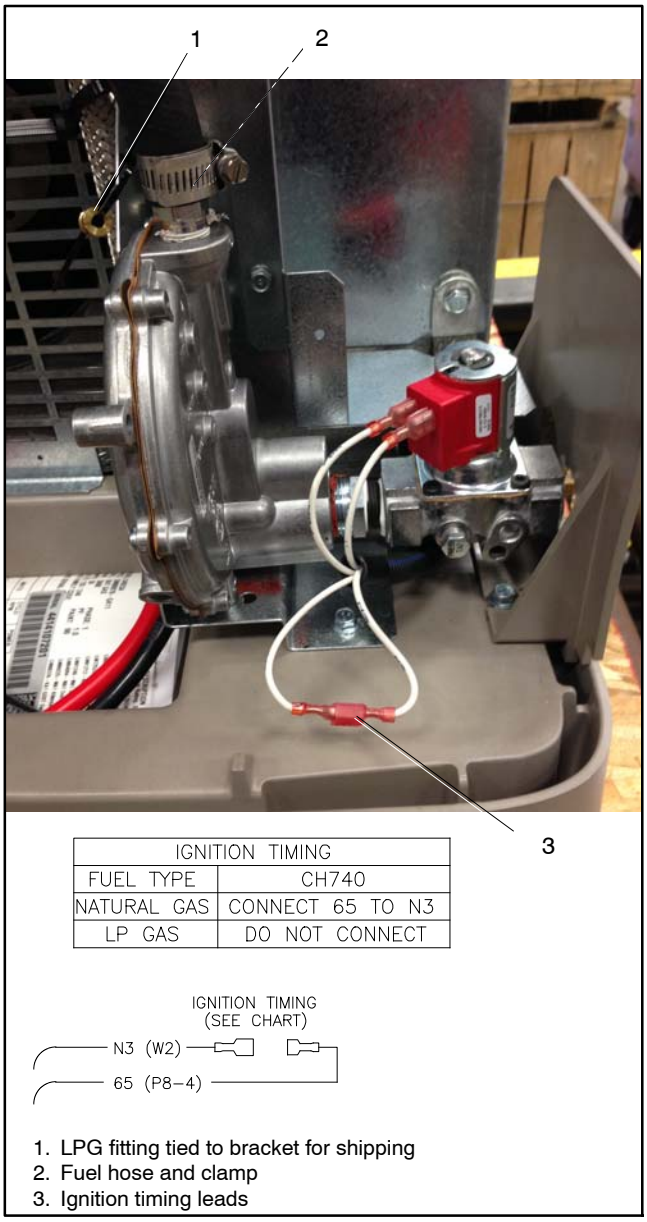


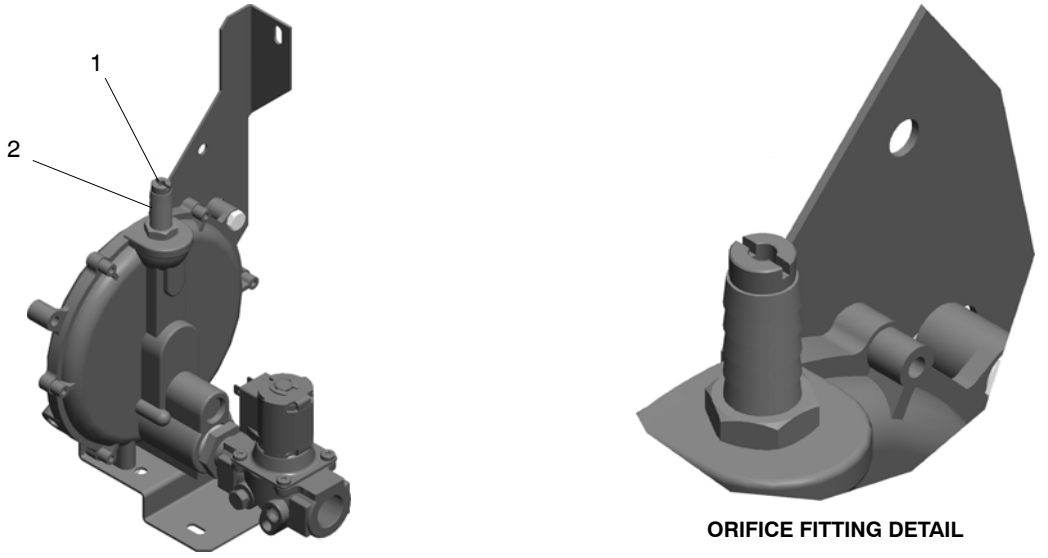
Figure 6-35 Fuel System, As Shipped (Model 14RESA/RESAL built after June 26, 2014)

Procedure to Convert from NG to LPG, 14RESA/RESAL with Fuel Orifice Fittings

1. Press the OFF button on the generator set controller.
2. Disconnect the utility power to the generator.
3. Disconnect the generator set engine starting battery, negative (–) lead first.
4. Turn off and disconnect the fuel supply.
5. Remove the hose clamp and fuel hose from the hose fitting. See Figure 6-35.
6. Use a straight-blade screwdriver to remove the NG orifice from the hose fitting. See Figure 6-36.
7. Insert the LPG orifice into the hose fitting. Use a straight-blade screwdriver to tighten the fitting until it is snug.
8. Slide the hose onto the hose fitting and secure it with the clamp.
9. Disconnect ignition timing leads 65 and N3 for LPG. The ignition timing leads are located near the fuel solenoid valve. See Figure 6-35.
10. Connect and turn on the new fuel supply.
11. Reconnect the generator set engine starting battery leads, negative (–) lead last.
12. Reconnect the utility power to the generator.
13. Start the generator set by pressing the RUN button on the generator set controller.
14. Check for leaks using a gas leak detector.
15. Run the generator set and check the operation.
16. Press the OFF button to shut down the generator set.

Conversion from LPG to Natural Gas

To convert from LPG to natural gas, repeat the steps above, removing the LPG fuel orifice and installing the NG fitting. Connect ignition timing leads 65 and N3 together for natural gas.



1. Orifice fitting (see detail)
2. Hose barb fitting

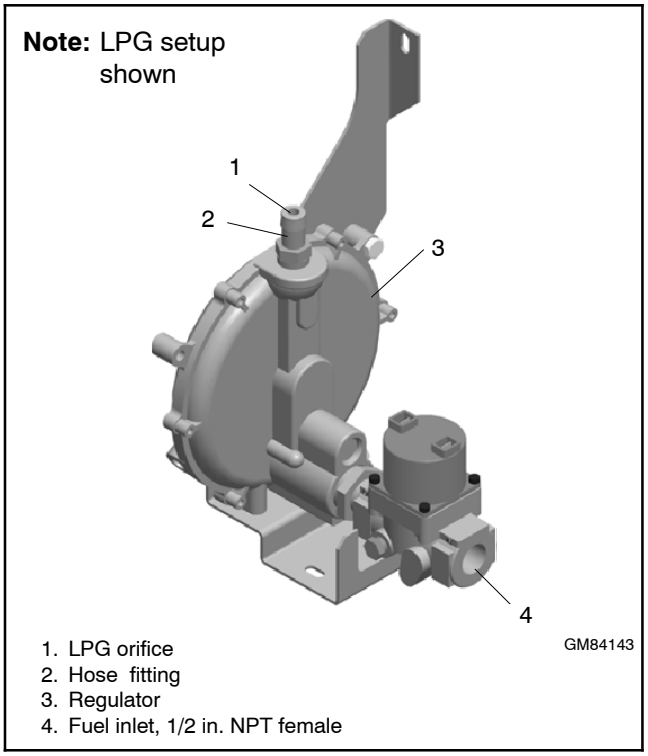
Figure 6-36 14RESA/RESAL Fuel System Showing Orifice Fittings (generators built after June 26, 2014)

6.12.3 Fuel Conversion, 20 kW Models

For LPG vapor fuel, an orifice is used in the fuel line. The unit is typically shipped set up for natural gas, with the loose orifice tied near the fuel solenoid valve. To convert to LPG vapor, install the orifice as described below. See Figure 6-26 for the fuel system component locations.

For controllers with firmware version 4.5 or higher, use SiteTech software to change the fuel type setting in the Genset System group. The fuel type setting is important if a Load Control Module (LCM) or load shed kit is connected to the generator controller.

Note: The generator set harness may contain a pair of leads labelled 65 and N near the fuel solenoid valve. These leads are used on the 14RESA/RESAL generator sets. Connecting or disconnecting these leads has no effect on the operation of 20 kW generator sets.



1. LPG orifice
2. Hose fitting
3. Regulator
4. Fuel inlet, 1/2 in. NPT female

Figure 6-37 Fuel Regulator and LPG Orifice, 20 kW Models

Procedure to Convert from NG to LPG, 20 kW Models

1. Press the OFF button on the generator set controller.
2. Disconnect the utility power to the generator set.
3. Disconnect the generator set engine starting battery, negative (–) lead first.
4. Turn off the fuel supply.
5. Remove the hose clamp and fuel hose from the hose fitting. See Figure 6-37.
6. Insert the orifice into the hose fitting. See Figure 6-37.
7. Slide the hose onto the hose fitting and secure it with the clamp.
8. Connect and turn on the new fuel supply.
9. Reconnect the generator set engine starting battery leads, negative (–) lead last.
10. Reconnect utility power to the generator set.
11. Start the generator set by pressing the RUN button on the generator set controller.
12. Check for leaks using a gas leak detector.
13. Press the OFF button to shut down the generator set.
14. For controllers with firmware version 4.5 or higher, use SiteTech software to change the fuel type setting on the controller.

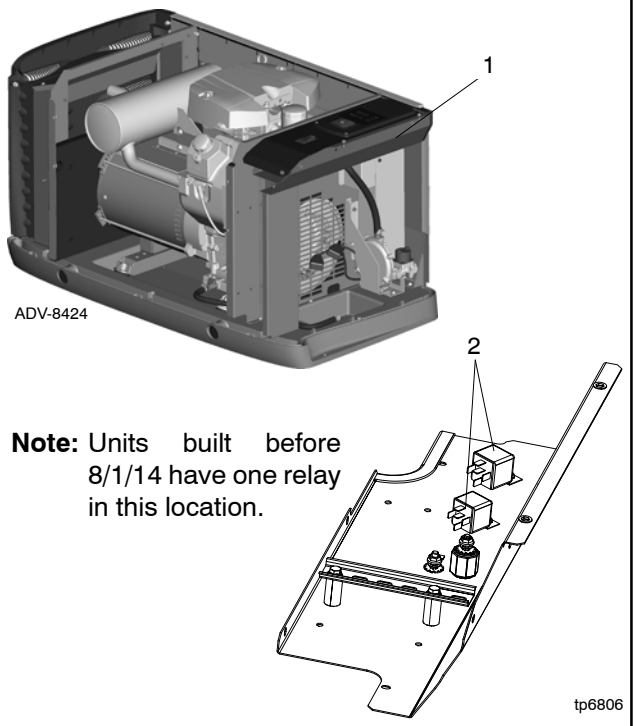
To convert from LPG vapor to natural gas, remove the fuel orifice.

6.13 Start (Crank) and Run Relays

The start (crank) relay is located under the controller. See Figure 6-38. Generator sets built before August 1, 2014, have one start relay in this location. Generator sets built on or after August 1, 2014, have two relays (start and run). Identify the relays by the connected leads shown in Figure 6-39. The start relay is connected to lead 71 from the controller (P1–14). The run relay, if equipped, is connected to lead 70 from the controller (P1–13).

The start and run relays are energized during the engine start sequence as described in Section 5.2.

The relay contains an internal diode across the relay coil. See Figure 6-40. Continuity checks across the coil terminals will show continuity (low resistance) in one direction and an open circuit in the other.



Relay location detail

1. Start relay is located under controller; see detail.
2. Start and run relays; check connections to identify

Figure 6-38 Relay Location, 14/20RESA shown

Relay Terminal	Start Relay Lead	Run Relay Lead
30 (1)	14P	P1
85 (2)	N7	N5
86 (3)	71	70
87A (4)	NC	N/C
87 (5)	14S	70C

Figure 6-39 Relay Connections

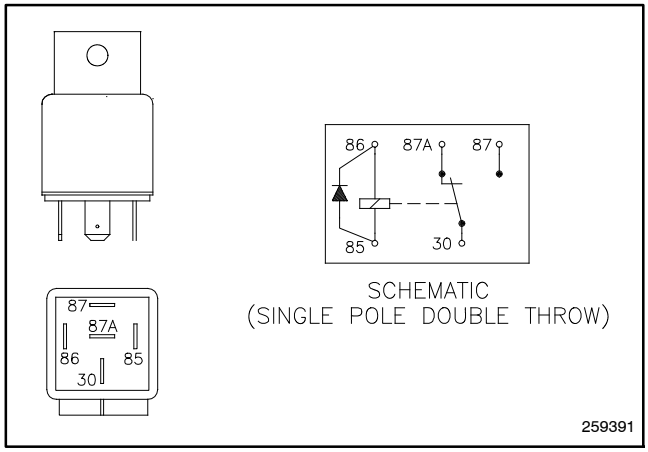


Figure 6-40 Start (Crank) or Run Relay

6.14 Continuity Checks

⚠ WARNING

Hazardous voltage. Moving parts. Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

Short circuits. Hazardous voltage/current can 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.

To further check generator set components, disconnect the battery and remove wiring harness plugs from the controller circuit board. Use an ohmmeter to check the continuity of the components listed in Figure 6-41. Also see Section 8, Wiring Diagrams.

Figure 6-41 gives resistance readings for functional components. A zero reading on the ohmmeter indicates continuity. No ohmmeter reading indicates very high resistance or an open circuit. A measurement that varies significantly from the value shown in the table indicates a faulty component; replace faulty components.

Note: Disconnect the generator set battery before performing continuity checks to prevent damage to the ohmmeter.

For rotor and stator resistance and continuity checks, see Section 6.3, Stator, and Section 6.4, Main Field (Rotor).

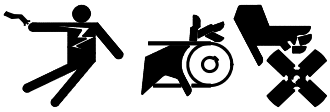
Component	Ohmmeter Connections	Ohmmeter Scale	Generator Set State	Ohmmeter Readings for Operative Components
P1 wiring harness	P1-2 and ground	R x 1	OFF	Less than 1 ohm (continuity) Any other reading indicates a poor ground connection.
	P2-6 and P2-7 (stator leads 11 and 44)	R x 1	OFF	Less than 1 ohm (continuity). If no continuity, check wiring.
	P2-3 and P2-4 (stator leads 55 and 66)	R x 1	OFF	Less than 1 ohm (continuity). If no continuity, check wiring.
Controller wiring	P1-1 and battery positive (+)	R x 100	OFF	Less than 1 ohm (continuity). If no continuity is found, check wiring.
Auxiliary winding breaker (20-amps)	55F (P2-3) and stator lead 55	R x 100	OFF	Less than 1 ohm (continuity). If no continuity is found, check for an open circuit.
Low oil pressure (LOP) switch *	Lead 13 and ground (engine block)	R x 100	OFF	Less than 1 ohm (continuity). No continuity indicates a faulty switch and/or wiring.
Temperature sensor (OTS) *	69R and 69 (P1-9 and P1-10)	R x 1000	OFF	180–2500 ohms, depending on engine temperature. See Section 6.10.2. Less than 1 ohm or an open circuit indicates faulty wiring or a faulty sensor.

* See Section 6.10.2, Fault Shutdown Switches

Figure 6-41 Continuity Checks

This section provides instructions for the disassembly and reassembly of the generator set alternator. Before beginning the generator disassembly or reassembly procedure, carefully read all safety precautions at the beginning of this manual.

⚠ 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 connected equipment, 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.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

⚠ WARNING

Hot engine and exhaust system.
Can cause severe injury or death.

Do not work on the generator set until it cools.

⚠ 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.

⚠ 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.

The engine and generator set may use both American Standard and metric hardware. Use the correct size tools to prevent rounding of the bolt heads and nuts.

7.1 Initial Steps

Perform the following steps before disassembling the generator set.

1. Disconnect AC power to the generator set by opening the upstream circuit breaker. (AC power is connected to the generator set for battery charging and AC-powered accessories.)

2. Shut off the fuel supply. Disconnect the fuel system if necessary to tilt the generator set. Ventilate the area to clear fumes.

3. Allow the generator set and engine to cool.

4. Verify that any hoists or lifting devices used in the disassembly or reassembly procedure are rated for the weight of the generator set, which is shown below.

Model	Weight, kg (lb)
14RESA(L)	227 (500)
20RESA(L)	227 (500)
20RESB	240 (530)
20RESC(L)	227 (500)
20RESD	240 (530)

7.2 Disassembly

The disassembly procedure explains how to disassemble the generator set enclosure and other parts in order to access the alternator for service. The procedure provides important information to minimize disassembly time and indicates where special configurations exist which may require taking notes.

7.2.1 Remove Enclosure, 14/20RESA(L) and 20RESC(L)

See Section 7.2.2 for 20RESB/RESD procedure.

Remove the generator set enclosure as described in the following steps. See Figure 7-1.

1. Open the enclosure roof.

2. Press the OFF button on the controller.

3. Remove 6 nuts and remove the roof. See Figure 7-2.

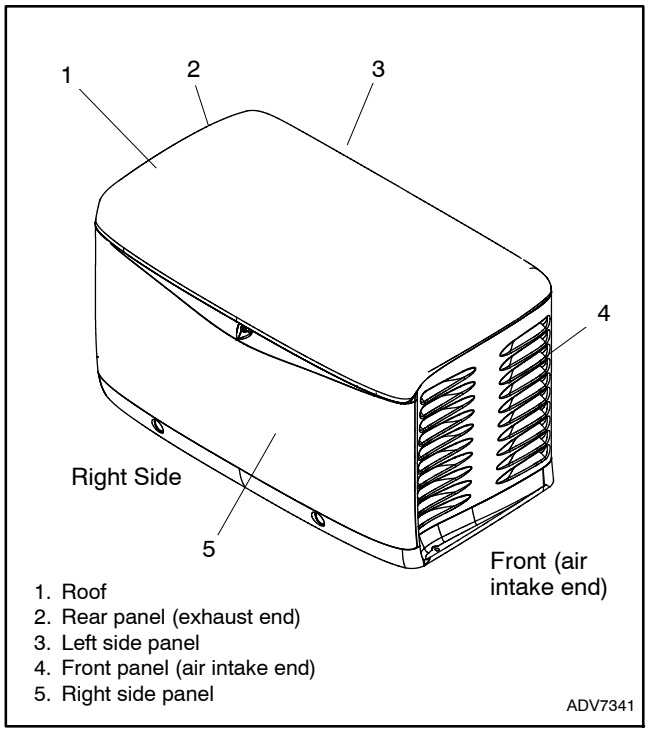
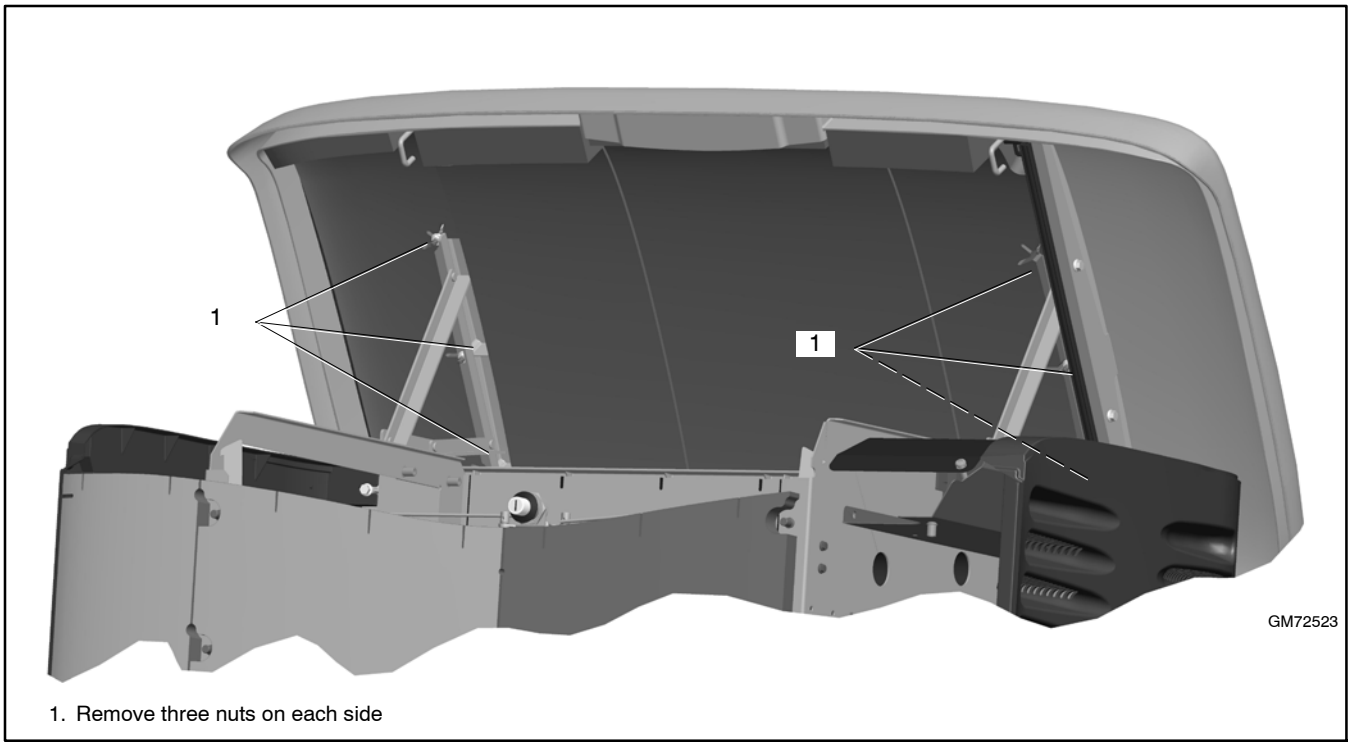


Figure 7-1 Enclosure



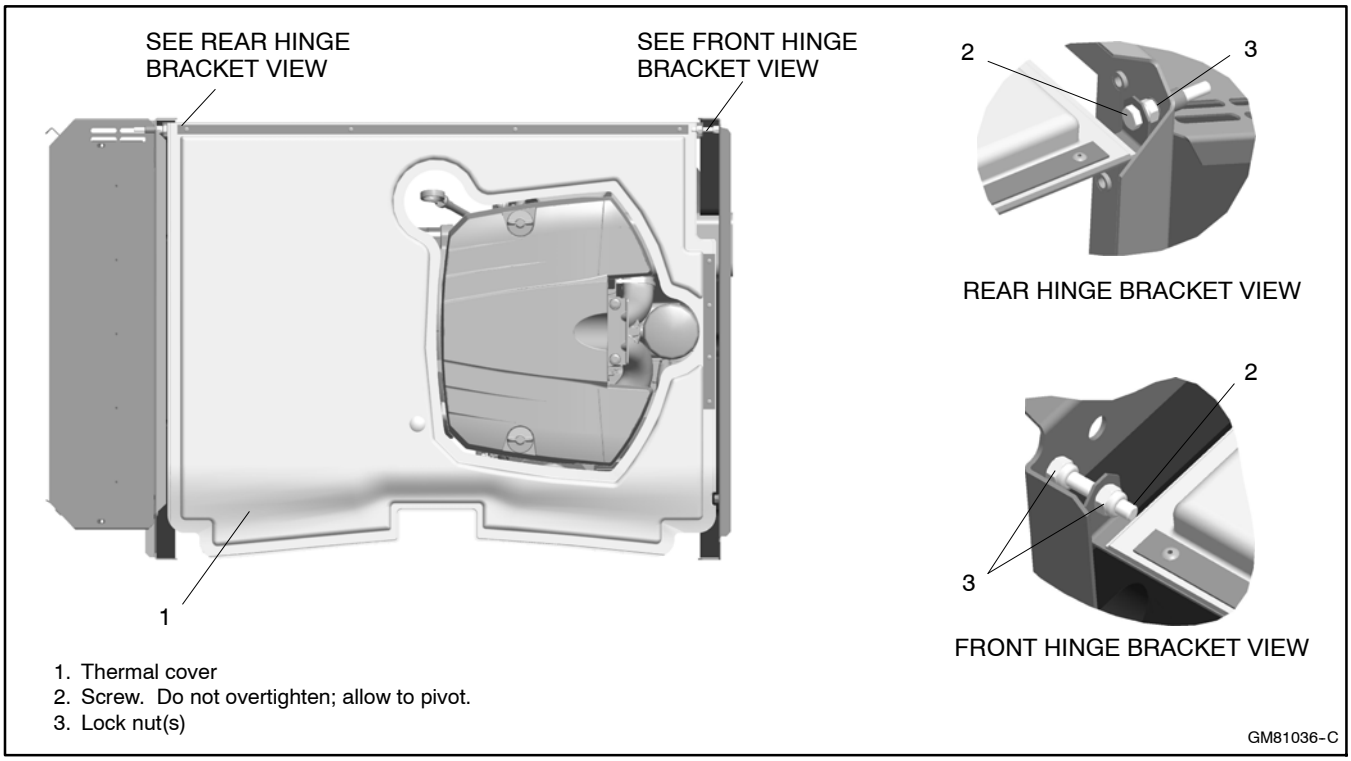
1. Remove three nuts on each side

Figure 7-2 Roof Removal

4. Remove the thermal cover:

   a. Loosen and remove the lock nuts from the front and rear hinge brackets. See Figure 7-3.

   b. Remove the thermal cover.



1. Thermal cover
2. Screw. Do not overtighten; allow to pivot.
3. Lock nut(s)

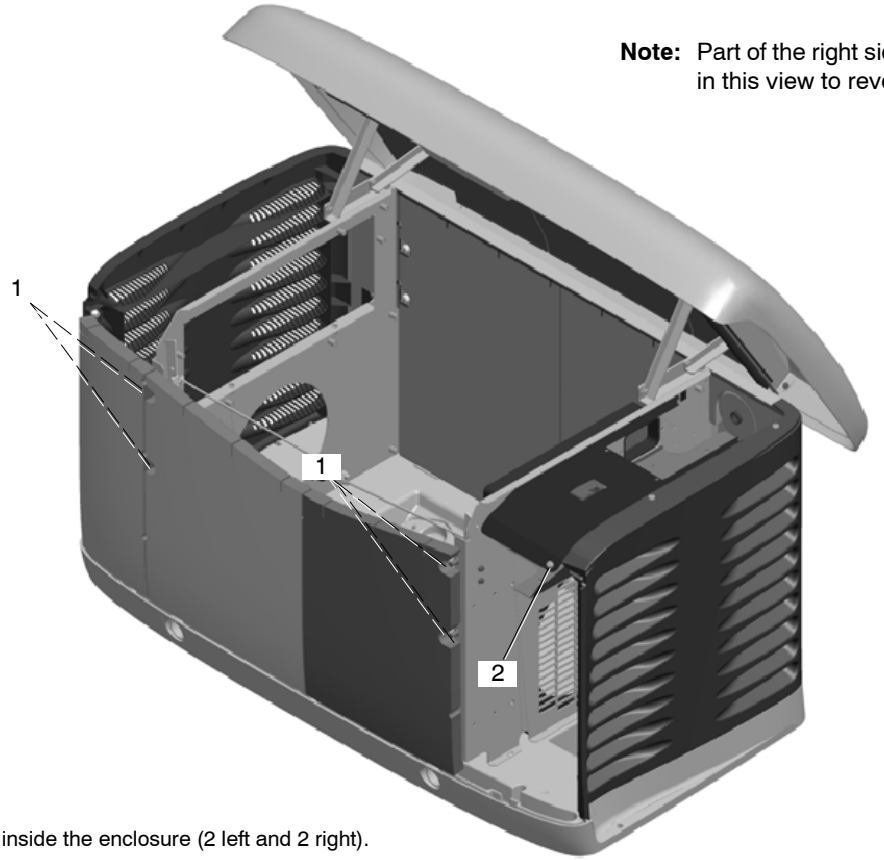
Figure 7-3 Thermal Cover

5. Remove the right-side panel:

   a. Remove two nuts on each side (total of four nuts). See Figure 7-4.

   b. Remove one screw near the controller area.

   c. Pull the right-side panel up and off.



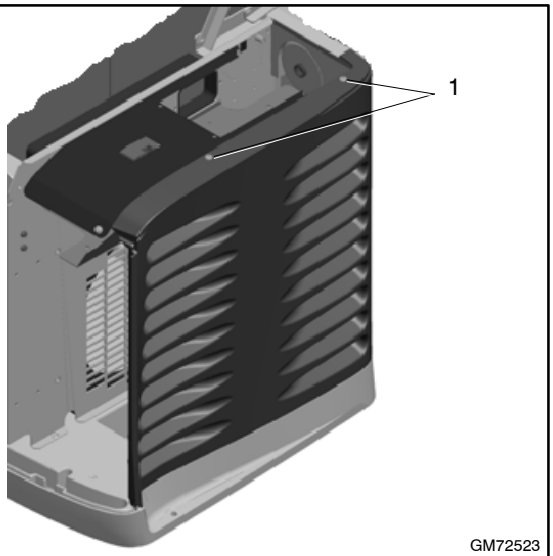
Note: Part of the right side panel is cut away in this view to reveal the fasteners.

1. Remove 4 nuts inside the enclosure (2 left and 2 right).
2. Remove screw.

GM72523

Figure 7-4 Right Side Panel

6. Remove two screws and remove the front panel. See Figure 7-5.



1. Remove 2 screws

Figure 7-5 Front Panel (air intake end panel)

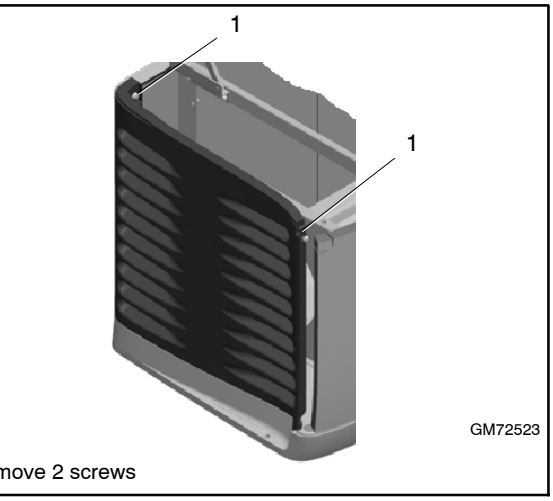
7. Unplug the carburetor heater (if equipped) from the 120 VAC receptacle.

8. Verify that utility power to the generator set terminal block has been disconnected.

9. Disconnect the generator set engine starting battery, negative (-) lead first.

10. Disconnect output leads or load circuit cables at the field-connection terminal block.

11. Remove two nuts and lift off the exhaust end panel. See Figure 7-6.

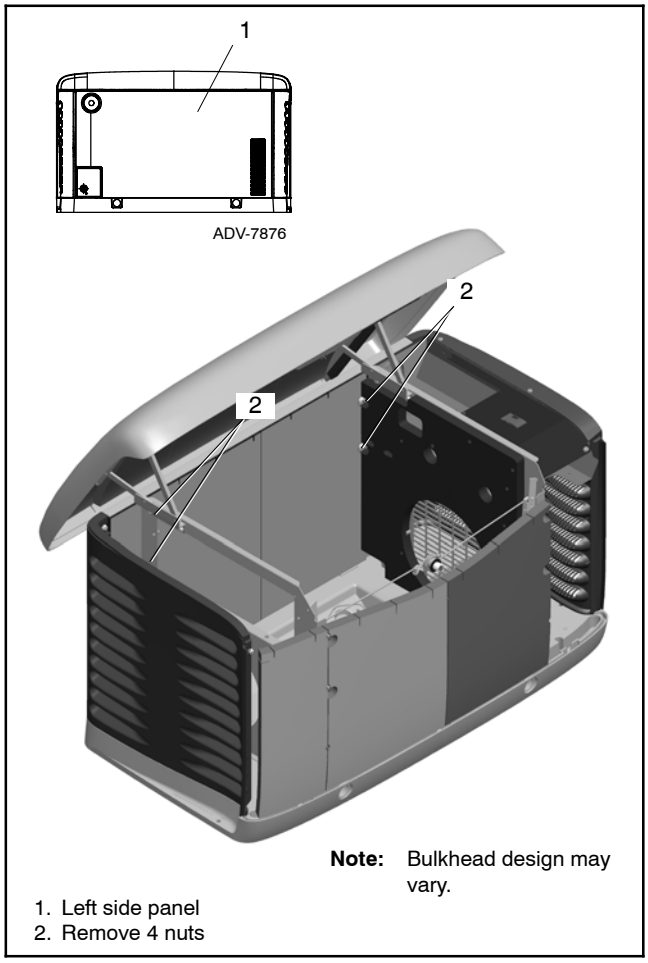


1. Remove 2 screws

Figure 7-6 Rear Panel (exhaust end panel)

12. From the inside of the enclosure, remove four nuts securing the left side panel. See Figure 7-7.

13. Pull the panel up and off.

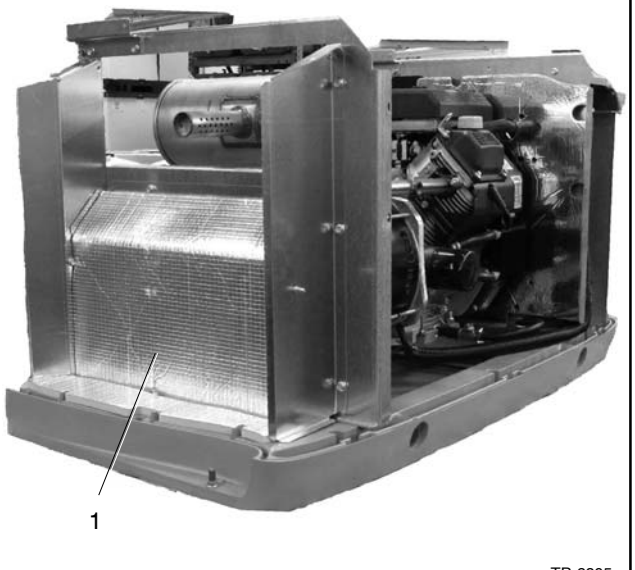


Note: Bulkhead design may vary.

1. Left side panel
2. Remove 4 nuts

Figure 7-7 Left Side Panel

14. Remove the alternator air inlet duct. See Figure 7-8.

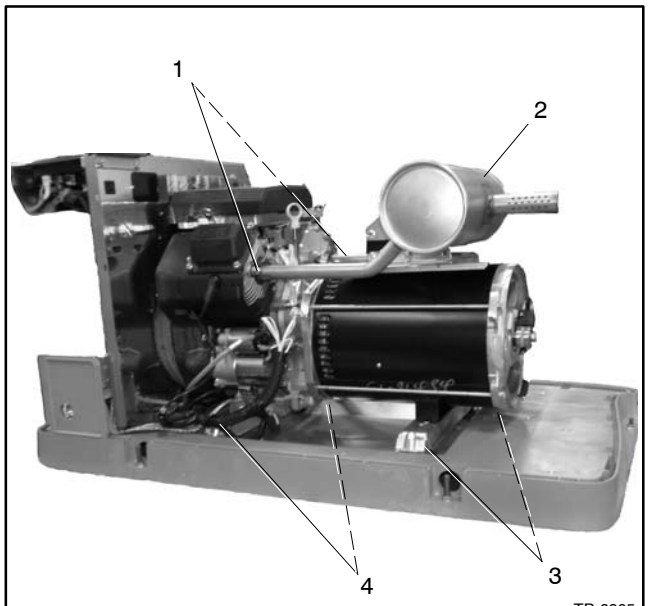


1. Alternator duct

Figure 7-8 Alternator Duct

15. Disconnect the muffler from the engine at the two flange connections and remove the muffler. See Figure 7-9.

Note: Use new exhaust gaskets when re-installing the muffler.



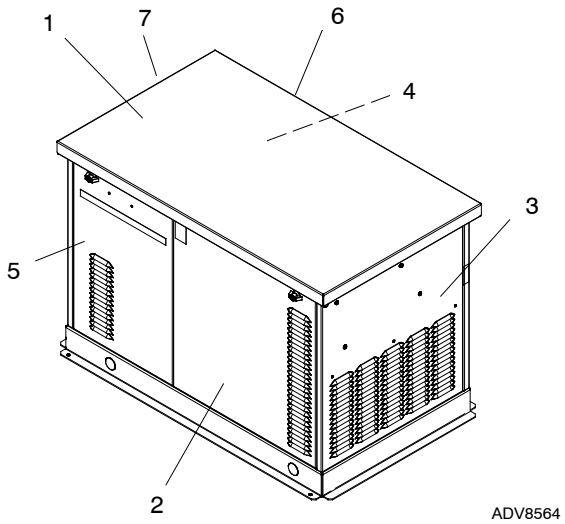
1. Exhaust flanges (qty. 2)
2. Muffler
3. Alternator vibromounts (qty. 2)
4. Engine vibromounts (qty. 2)

Figure 7-9 Muffler and Vibromounts

7.2.2 Remove Enclosure, 20RESB and 20RESD

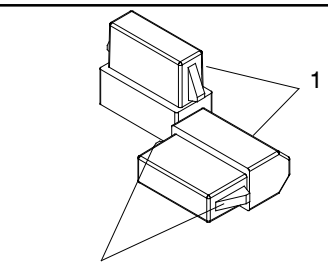
Remove the generator set enclosure as described in the following steps. See Figure 7-10.

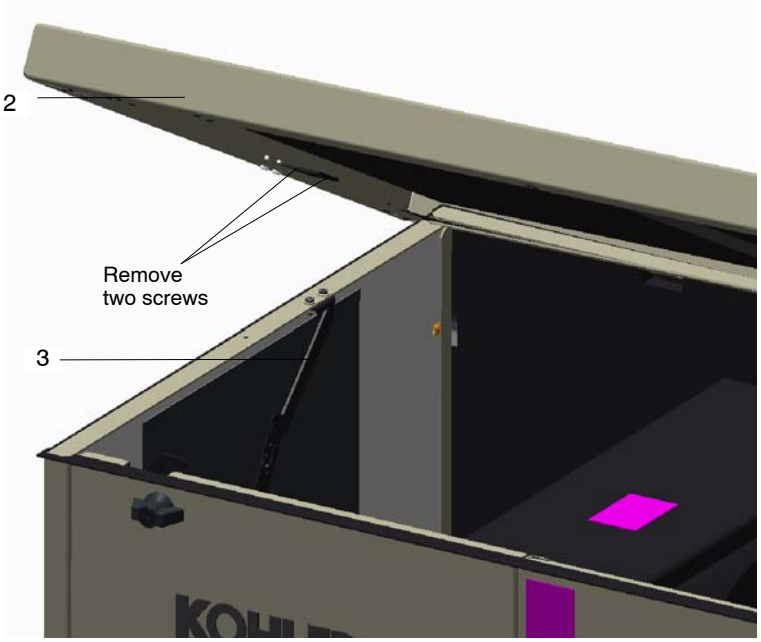
1. Open the enclosure roof.
2. Press the OFF button on the controller.
3. Remove the screws on one end of the roof stay to disconnect the roof stay. See Figure 7-11.
4. Remove one roof hinge: Use two screwdrivers to compress the hinge springs. See Figure 7-11.
5. Remove the roof.



1. Roof
2. Service door
3. Air intake (front) panel
4. Heat shield (inside, not shown)
5. Panel
6. Non-service side panel
7. Exhaust end (rear) panel

Figure 7-10 Enclosure Parts, Order of Disassembly

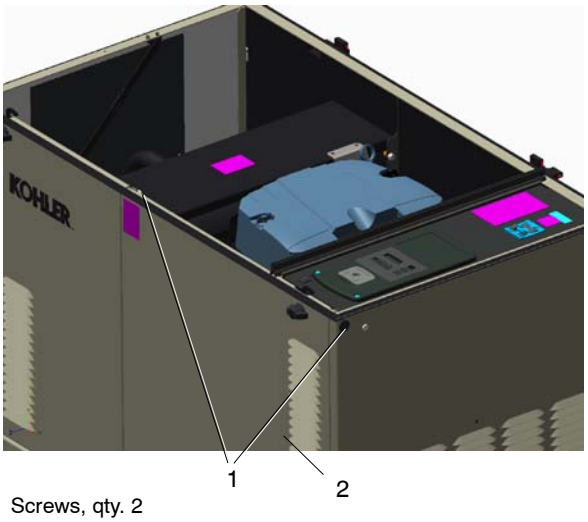




1. Hinges
2. Roof
3. Door stay (GM51973)

Figure 7-11 Roof Stay and Hinges

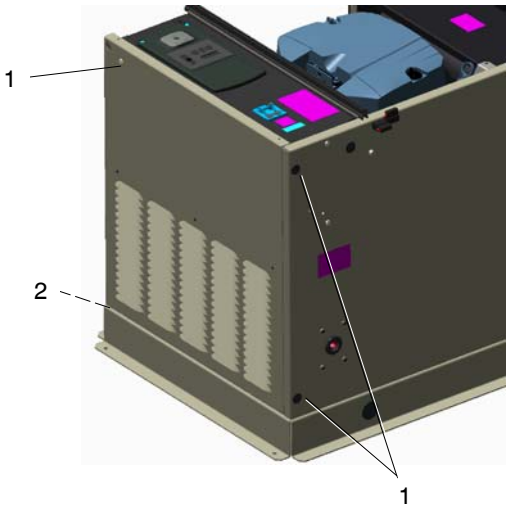
6. Remove the plug and two door screws. See Figure 7-12. Lift the service-side door up and off.



1. Screws, qty. 2
2. Right side door

Figure 7-12 Right Side Door

7. Remove the front panel. See Figure 7-13.



1. Screws, qty. 3 (outside)
2. Screws, qty. 1 (inside)

Figure 7-13 Front Panel Mounting Screw Locations

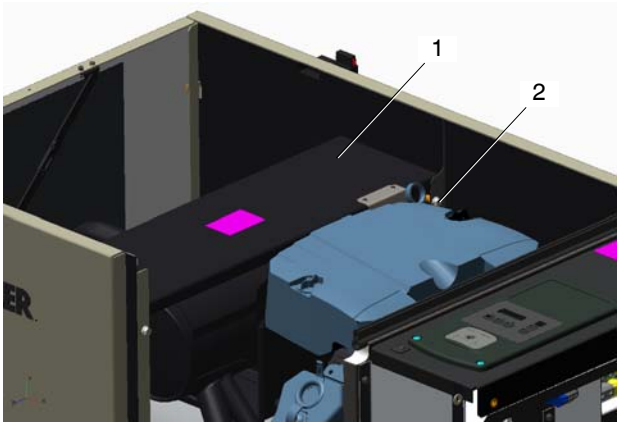
8. Unplug the carburetor heater (if equipped) from the 120VAC receptacle.

9. Unplug the battery charger from the 120VAC receptacle.

10. Disconnect the generator set engine starting battery, negative (-) lead first.

11. Disconnect output leads or load circuit cables at the field-connection terminal block.

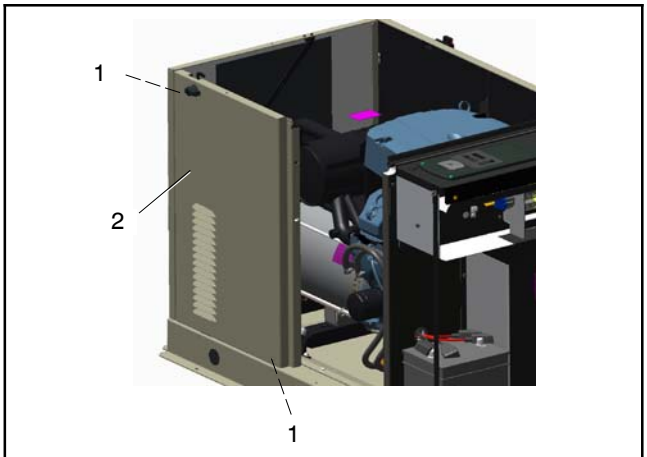
12. Remove the heat shield over the silencer by removing four screws. See Figure 7-14.



1. Remove silencer heat shield
2. Screws, qty. 4

Figure 7-14 Heat Shield Removal

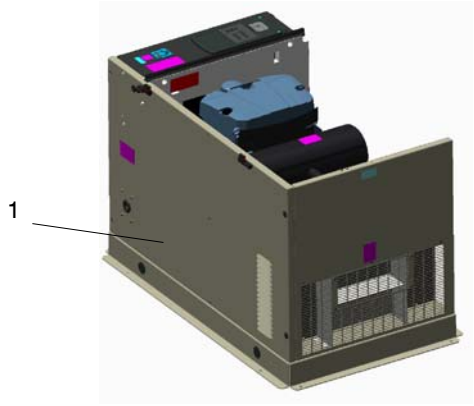
13. From the inside of the enclosure, remove the screws to remove the left side panel. See Figure 7-15.



1. Screws (inside)
2. Left side panel

Figure 7-15 Left Side Panel Removal

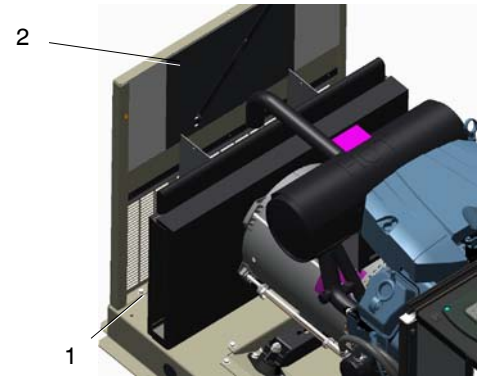
14. Remove the remaining plugs and screws to remove the non-service side housing panel. See Figure 7-16.



1. Non-service side panel

Figure 7-16 Non-Service Side Panel Location

15. From the inside of the enclosure, remove the screws to remove the rear (exhaust end) panel. See Figure 7-17.



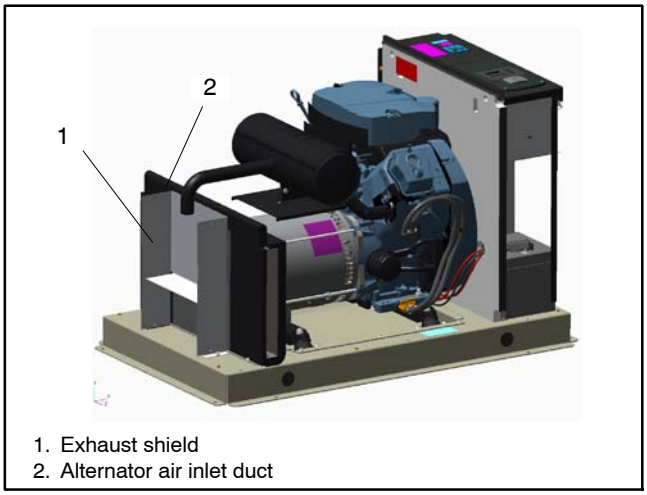
1. Screw
2. Rear Panel

Figure 7-17 Rear Panel

16. Remove the exhaust shield and alternator air inlet duct. See Figure 7-18.

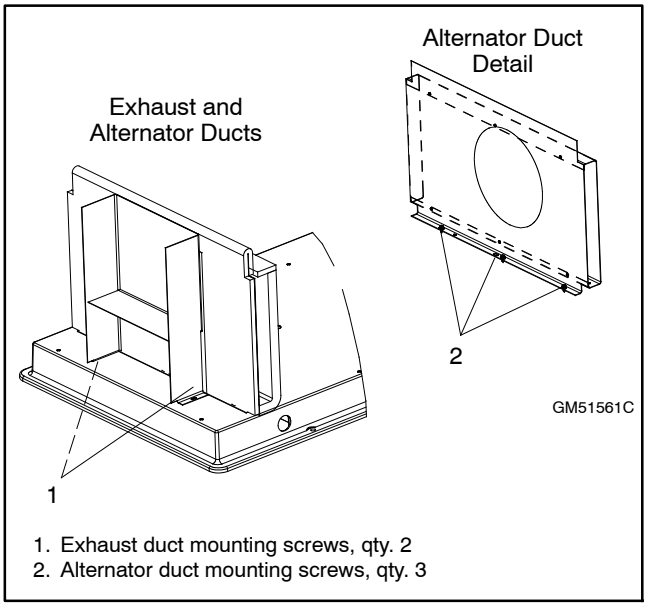
    a. Remove two bolts securing the exhaust shield at the exhaust end and remove the shield. See Figure 7-19.

    b. Remove three bolts securing the alternator air inlet duct to the base and remove the duct. See Figure 7-19.



1. Exhaust shield
2. Alternator air inlet duct

Figure 7-18 Shield and Alternator Air Inlet Duct

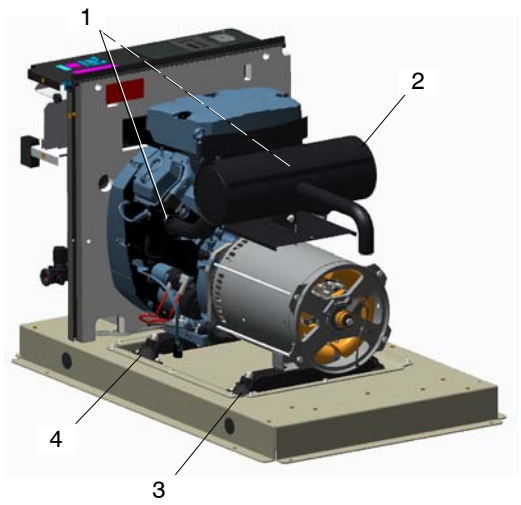


1. Exhaust duct mounting screws, qty. 2
2. Alternator duct mounting screws, qty. 3

Figure 7-19 Exhaust and Alternator Ducts

Note: Obtain new exhaust gaskets before removing the muffler.

17. Disconnect the muffler from the engine at the two flange connections and remove the muffler. See Figure 7-20.



1. Exhaust flanges (qty. 2)
2. Muffler
3. Alternator vibromounts (qty. 2)
4. Engine vibromounts (qty. 2)

Figure 7-20 Muffler and Vibromounts

7.2.3 Generator Disassembly

18. Disconnect the following alternator wiring inside the controller junction box. See the wiring diagrams in Section 8.

    a. Disconnect lead 55 from the mini-breaker on the controller.

    b. Disconnect P2 from the controller.

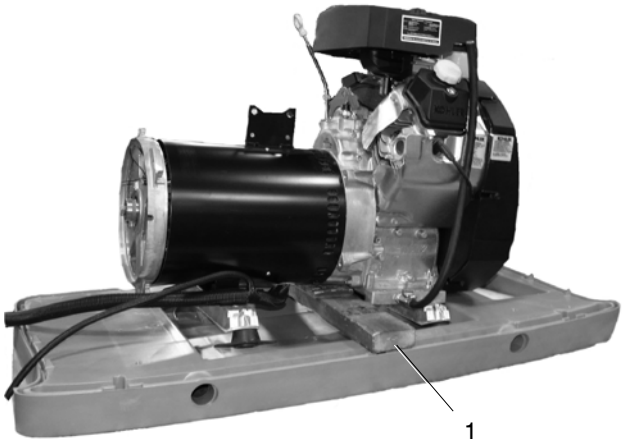
    c. Disconnect leads 2 and 3 from neutral stud L0.

    d. Disconnect leads 1 and 4 from the circuit breaker.

19. Remove the bolts securing the two alternator end vibromounts to the skid. Loosen the two engine vibromounts. See Figure 7-20.

20. Raise the alternator end of the generator set enough to place a wood support beneath the rear of the engine. The wood support must be long enough to span the opening in the base. See Figure 7-21.

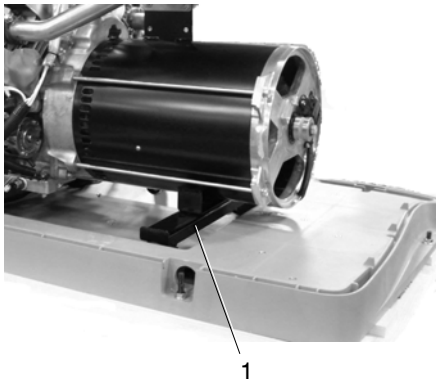
    Note: Use a hoist or lifting device that is rated for the weight of the generator set. See Section 7.1.



1. Engine support

Figure 7-21 Wood Support for Engine (RESA shown)

21. Remove the alternator support bracket from the alternator shell. See Figure 7-22.



1. Alternator support bracket

Figure 7-22 Alternator Support Bracket (RESA shown)

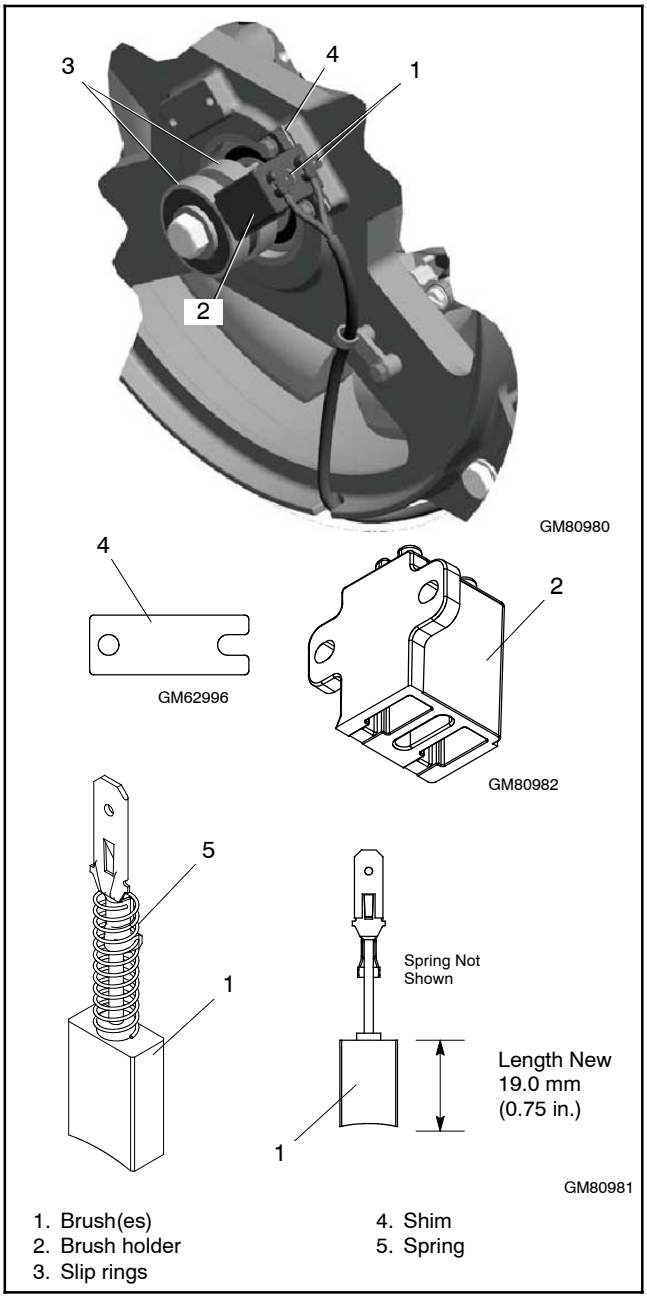
22. Remove the cable tie that attaches the brush leads to the end bracket. See Figure 7-23.

23. Check the brushes. See Figure 7-23.

    Note: The brushes are spring-loaded and captured in the brush holder.

    a. Remove the brush holder from the end bracket by removing two mounting screws.

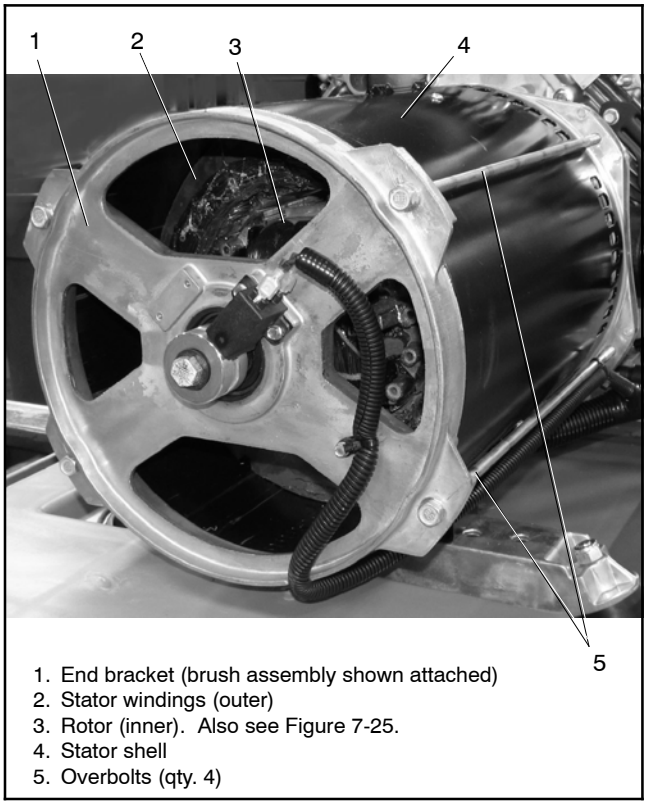
    b. Inspect the brushes. Replace brushes if they show uneven wear or when they are worn to half of their original size. See Section 6.6, Brushes.



1. Brush(es)
2. Brush holder
3. Slip rings
4. Shim
5. Spring

Figure 7-23 Brush Assembly

24. Remove the alternator overbolts and centering washers. See Figure 7-24.



1. End bracket (brush assembly shown attached)
2. Stator windings (outer)
3. Rotor (inner). Also see Figure 7-25.
4. Stator shell
5. Overbolts (qty. 4)

Figure 7-24 Alternator Assembly

25. Using a soft-faced hammer, strike the sides of the end bracket with medium-force blows to remove the end bracket from the stator or remove the end bracket from the stator using a puller. Set the end bracket assembly aside.

26. The stator leads are routed through the bulkhead and into the controller junction box. Carefully pull the leads out of the junction box. Pull the leads and conduit out through the bulkhead to free the alternator for removal.

27. Carefully pull the stator from the rotor. See Figure 7-24.

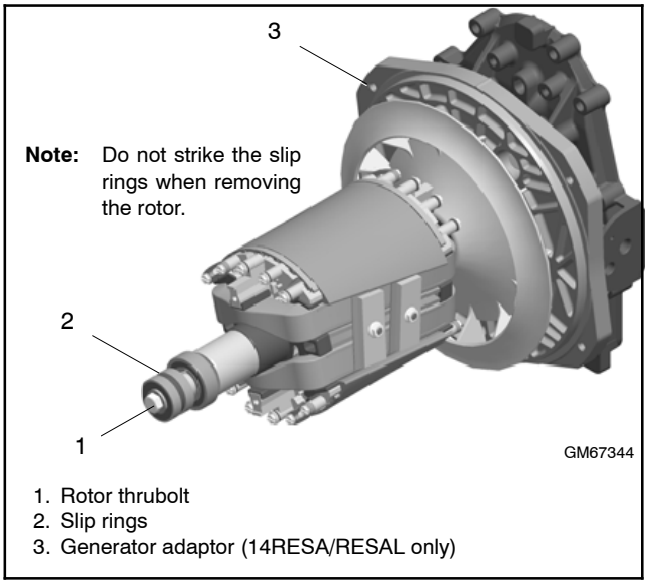
28. Remove the rotor as follows:

    a. Loosen but do not remove the rotor thrubolt. Use a strap wrench on the rotor to keep the rotor from turning during loosening, if necessary. See Figure 7-25.

    b. Loosen the rotor assembly by striking the side of the rotor with a soft-faced hammer to loosen it from the tapered crankshaft fitting. See Figure 7-25. Rotate the rotor and strike it on alternate sides until it can be rocked slightly back and forth.

    Note: Do not strike the slip rings.

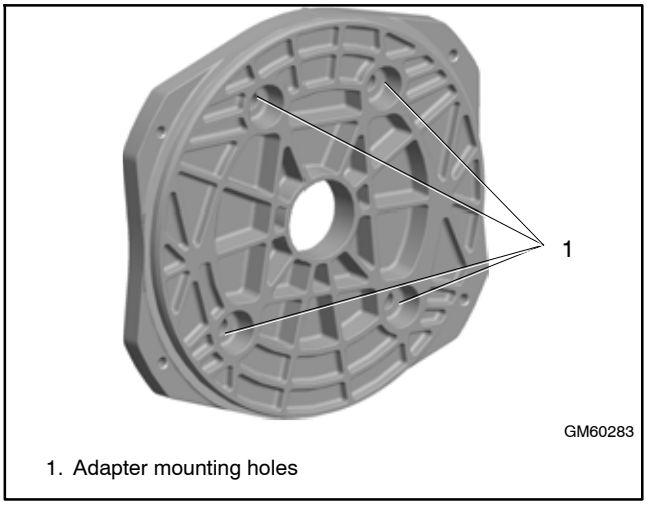
    c. Remove the thrubolt and the rotor. Set the rotor assembly aside.



1. Rotor thrubolt
2. Slip rings
3. Generator adaptor (14RESA/RESAL only)

Figure 7-25 Rotor Assembly with Thrubolt

29. 14RESA/RESAL only: Remove the four generator adapter mounting bolts to remove the generator adapter, if necessary. See Figure 7-26.



1. Adapter mounting holes

Figure 7-26 Generator Adapter (14RESA/RESAL)

7.3 Reassembly

7.3.1 Reassemble Alternator

1. 14RESA/RESAL only: Reinstall the generator adapter onto the engine, if necessary.

   a. Attach the generator adapter to the engine using four 7/16-14 x 1.0 in. hex cap bolts and washers. See Figure 7-26.

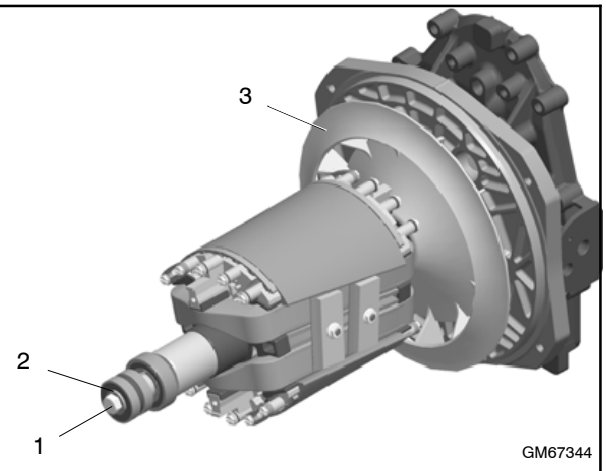
   b. Torque the bolts to 40 Nm (28 ft. lb.).

2. Install the rotor. See Figure 7-27.

   a. Clean the crankshaft stub and mating surface on the fan hub. Do not use antiseize compound when reassembling the rotor.

   b. Install the rotor onto the engine crankshaft.

   c. Thread the thrubolt with hardened washer through the actuator and rotor into the crankshaft. Do not tighten the thrubolt at this time.

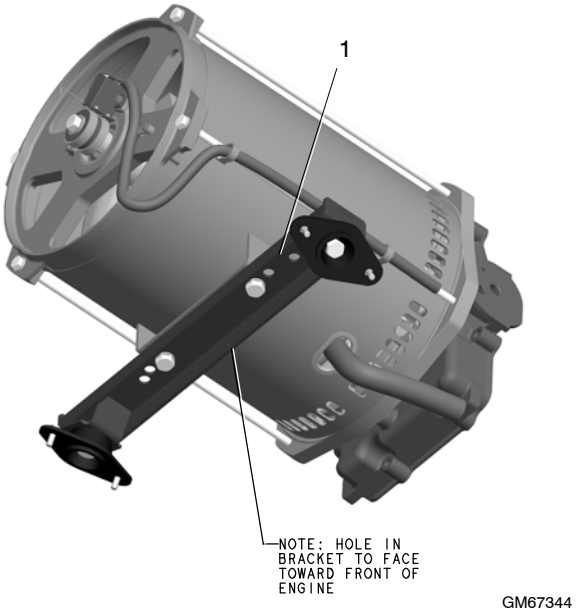


1. Rotor thrubolt
2. Hardened washer
3. Fan

Figure 7-27 Rotor Assembly

3. Install the stator and end bracket.

   a. Re-attach the alternator support bracket to the alternator shell. The hole in the bracket must face the engine. See Figure 7-28.



1. Alternator support bracket

Figure 7-28 Alternator Support Bracket

   b. Align the stator so that the alternator support bracket is at the bottom. Install the stator assembly around the rotor.

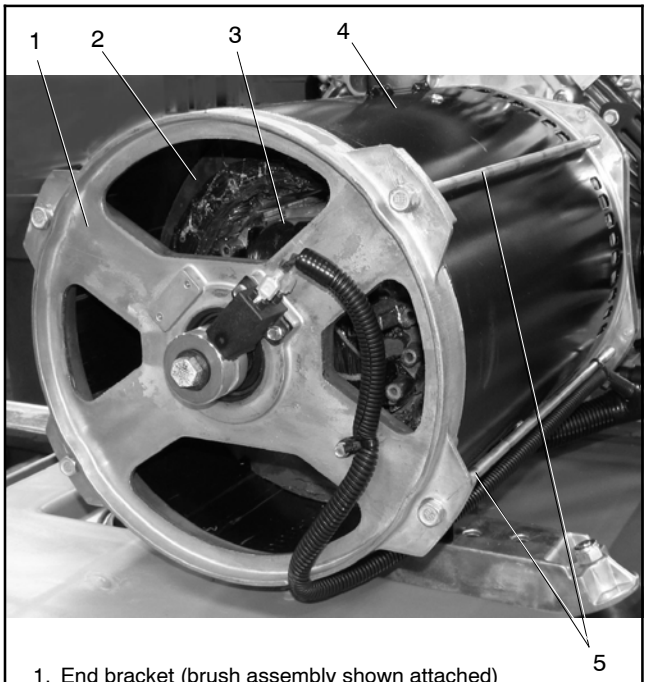
   c. Align the alignment mark on the top of the stator with the center of the slot in the generator adapter.

   d. Route the leads connected to the alternator end bracket through the opening in the base of the alternator frame.

e. Place the end bracket onto the stator assembly, lining up the alignment marks on the top of the stator and end bracket. See Figure 7-29.

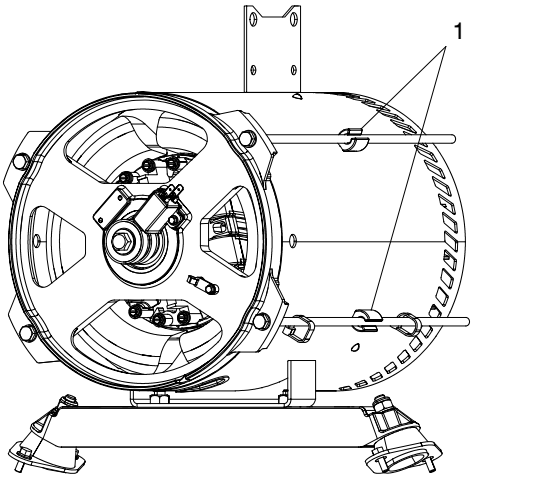
f. Thread the four overbolts with locating washers through the end bracket and into the generator adapter, sliding one damper onto each overbolt, if equipped. See Figure 7-29 and Figure 7-30.

g. Position the locating tab of each washer to the outer edge of the oblong (OBROUND) hole on the end bracket. The overbolts should be parallel to the outside of the alternator. If the overbolts are slanted, rotate the locating washer 1/2 turn. Do not final tighten the overbolts at this time.



1. End bracket (brush assembly shown attached)
2. Stator windings (outer)
3. Rotor (inner). Also see Figure 7-25.
4. Stator shell
5. Overbolts (qty. 4)

Figure 7-29 End Bracket and Overbolt Assembly



1. Dampers GM93481, qty. 4

Figure 7-30 Overbolt Dampers (if equipped)

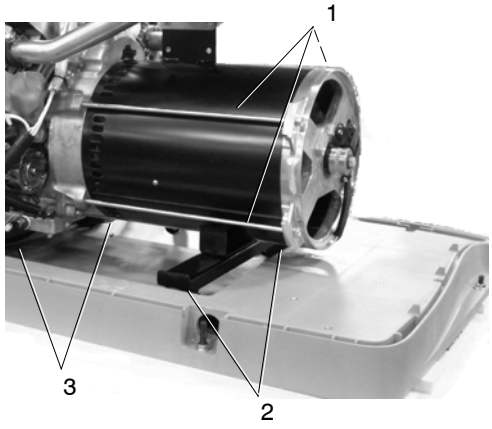
4. Secure the generator set to the skid.

   a. Raise the alternator end of the generator set and remove the wood support block(s).

   b. Lower the end of the generator set and reinstall the screws and washers that secure the vibromounts to the skid. Tighten all four vibromounts (for the alternator and engine) to 5.4 Nm (4 ft. lbs.). Do not overtighten. See Figure 7-31.

5. Tighten the four alternator assembly overbolts to 14.9 Nm (11 ft. lb.). See Figure 7-31.

6. Tighten the rotor thrubolt to 85 Nm (63 ft. lb.). It may be necessary to keep the engine flywheel from turning while torquing the rotor thrubolt.



1. Alternator overbolts (qty. 4)
2. Alternator vibromounts (qty. 2)
3. Engine vibromounts (qty. 2)

Figure 7-31 Vibromounts and Overbolts (RESA shown)

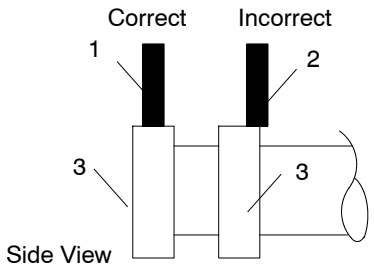
7. Reinstall the end bracket components.

   a. Inspect the brushes. If brushes show uneven wear or are worn to less than half their original length, replace them. See Section 6.6.

   b. Install the brush holder with shim onto the end bracket. Verify that the brushes are not sticking in the holder.

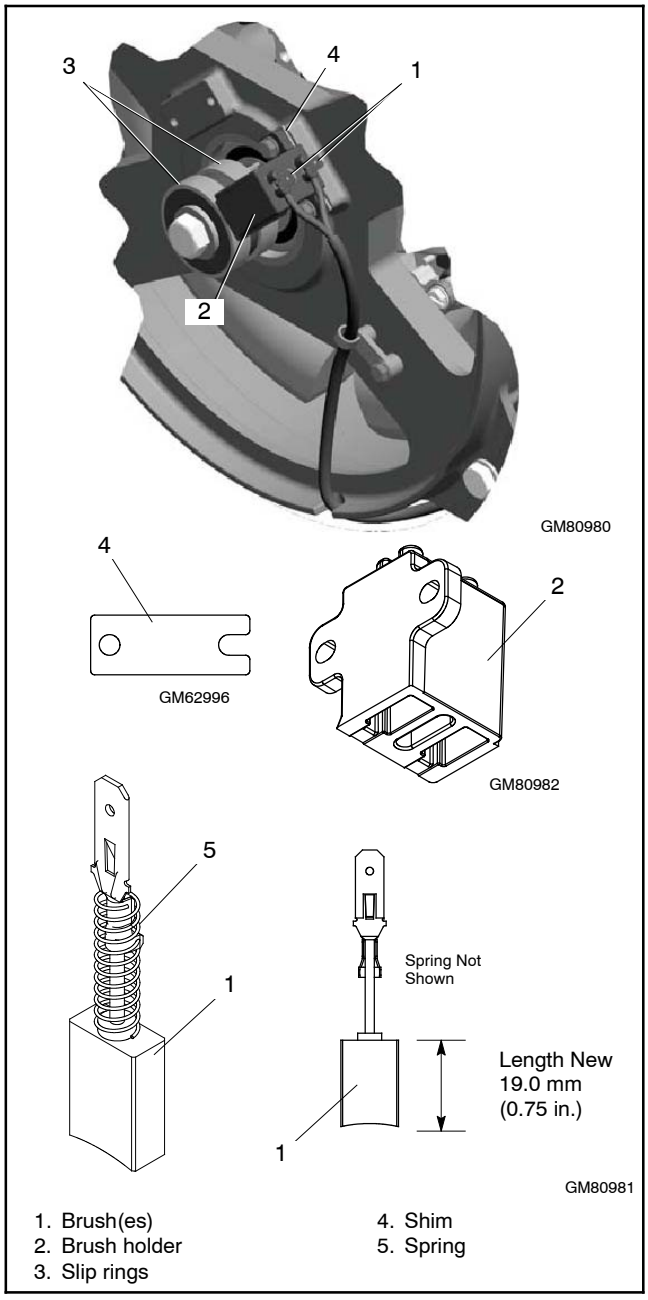
   c. Verify that the brushes are centered on the slip rings. If required, insert spacers between the mounting surface and brush holder to center the brushes on the slip rings. See Figure 7-33. See Section 6.6, Brushes, for more information.

   d. Use the cable tie to secure the brush leads to the end bracket.



1. Correctly positioned brush
2. Incorrectly positioned brush
3. Slip rings

Figure 7-32 Brush Position



1. Brush(es)
2. Brush holder
3. Slip rings
4. Shim
5. Spring

Figure 7-33 Brush Assembly (revised)

7.3.2 Reassemble Exhaust System

8. Install the exhaust system. See Figure 7-34.

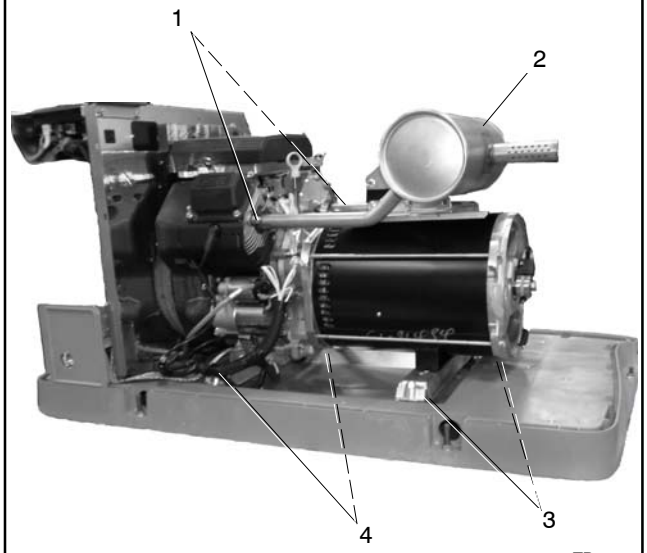
   Note: Use new exhaust gaskets when re-installing the muffler.

   a. Install the heat shield onto the alternator exhaust support.

   b. Using new gaskets, connect the engine exhaust muffler to the engine at the flanges. Do not final tighten the mounting hardware.

   c. Secure the muffler mounting tab to the heat shield.

   d. Torque the nuts securing the engine muffler flange to the engine to 24 Nm (17.7 ft. lb.).



1. Exhaust flanges (qty. 2)
2. Muffler
3. Alternator vibromounts (qty. 2)
4. Engine vibromounts (qty. 2)

Figure 7-34 Exhaust System (RESA shown)

7.3.3 Reinstall Enclosure, 14/20RESA(L) and 20RESC(L)

9. Reinstall the alternator duct panels shown in Figure 7-35.

10. Reconnect the following alternator wiring inside the controller junction box. See the wiring diagrams in Section 8.

    a. Reconnect lead 55 to the mini-breaker on the controller.

    b. Reconnect P2 to the controller.

    c. Reconnect leads 2 and 3 to neutral stud L0.

    d. Reconnect leads 1 and 4 to the circuit breaker.

    e. Reconnect any other controller connections that were removed during disassembly.

11. Press the OFF button on the generator set controller.

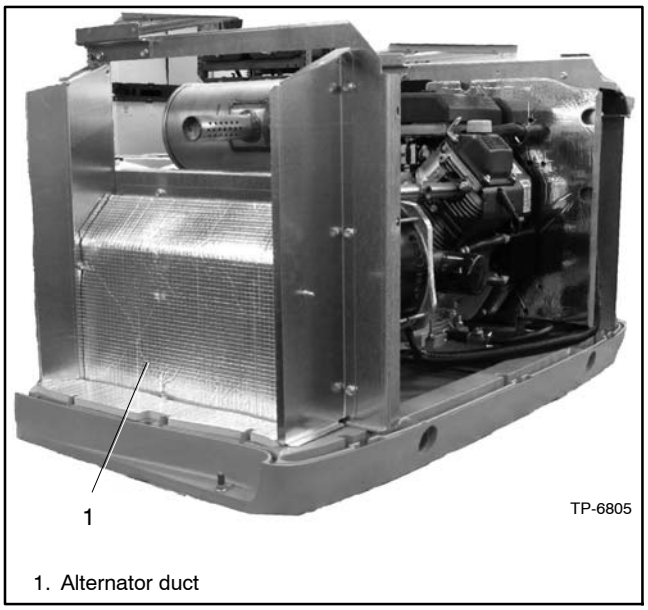
Connecting the battery and the battery charger. Hazardous voltage can cause severe injury or death. Reconnect the battery correctly, positive to positive and negative to negative, to avoid electrical shock and damage to the battery charger and battery(ies). Have a qualified electrician install the battery(ies).

12. Reconnect the generator set engine starting battery, negative (–) lead last.

13. Reconnect the carburetor heater (if equipped) to the 120VAC receptacle.

14. Reconnect the utility power to the generator set.

15. Reconnect output leads or load circuit cables at the field-connection terminal block.



1. Alternator duct

Figure 7-35 Alternator Duct, RESA(L)/RESC(L)

16. Reinstall the enclosure panels in reverse order of removal. See Figure 7-36 and refer to the disassembly instructions, if necessary.

    a. Install the left side panel.

    b. Install the exhaust end panel.

    c. Install the front panel.

    d. Install the right side panel.

    e. Install the thermal cover shown in Figure 7-37.

    Note: Do not overtighten the lock nuts. Verify that the hinge bracket is allowed to pivot.

    f. Install the front panel.

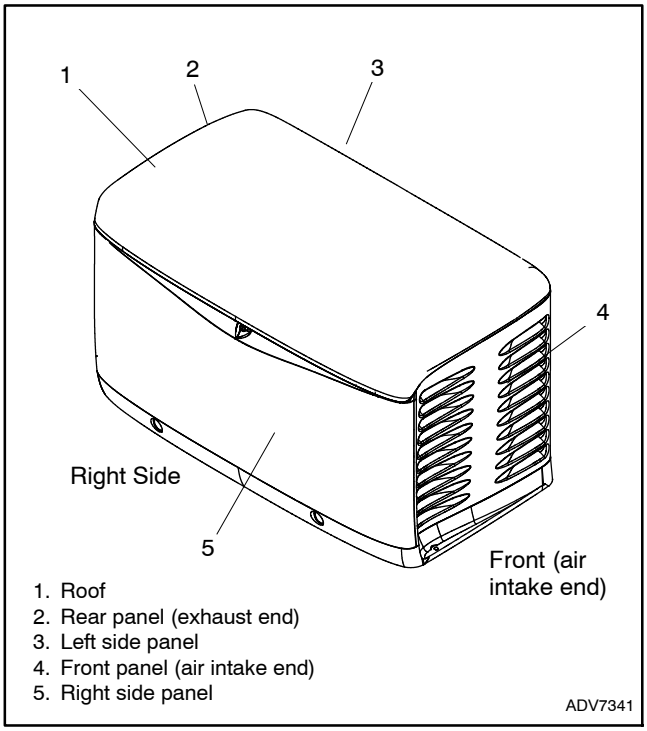
    g. Install the generator set housing roof.

17. Re-apply the 120VAC power supply to the generator set by closing the upstream circuit breaker.

18. Turn on the fuel supply. Press RUN to start the generator set and check for leaks with the engine running.

19. Press OFF to turn off the generator set. Then press AUTO if an automatic transfer switch or remote start/stop switch is used.

20. Lower and secure the roof.



1. Roof
2. Rear panel (exhaust end)
3. Left side panel
4. Front panel (air intake end)
5. Right side panel

Figure 7-36 Generator Set Enclosure, 14/20RESA(L) or 20RESC(L)

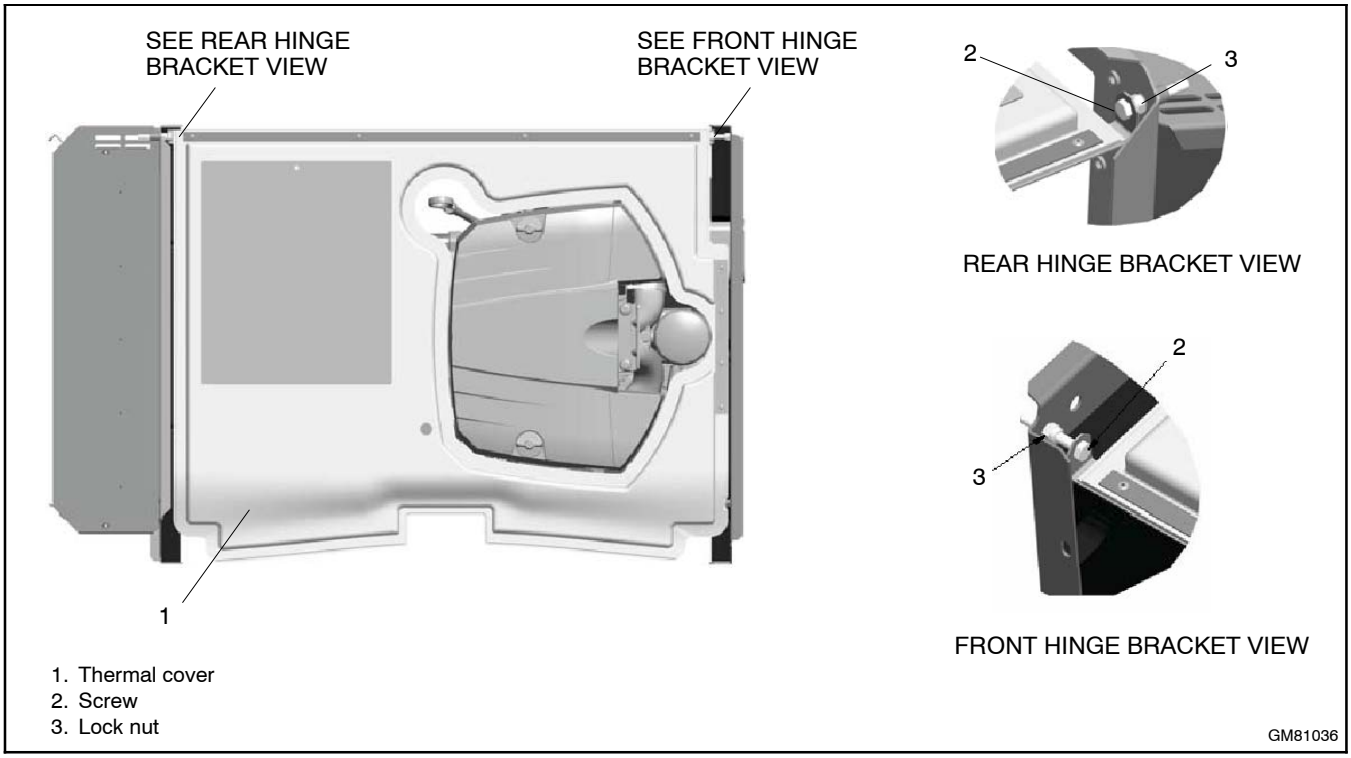


Figure 7-37 Thermal Cover

7.3.4 Reinstall Enclosure, 20RESB and 20RESD

21. Reinstall the alternator air inlet duct. Orient the duct as shown in Figure 7-38.

22. Install the exhaust duct. See Figure 7-38.

23. Reconnect the following alternator wiring inside the controller junction box. See the wiring diagrams in Section 8.

    a. Reconnect lead 55 to the mini-breaker on the controller.

    b. Reconnect P2 to the controller.

    c. Reconnect leads 2 and 3 to neutral stud L0.

    d. Reconnect leads 1 and 4 to the circuit breaker.

    e. Reconnect any other controller connections that were removed during disassembly.

24. Press the OFF button on the generator set controller.

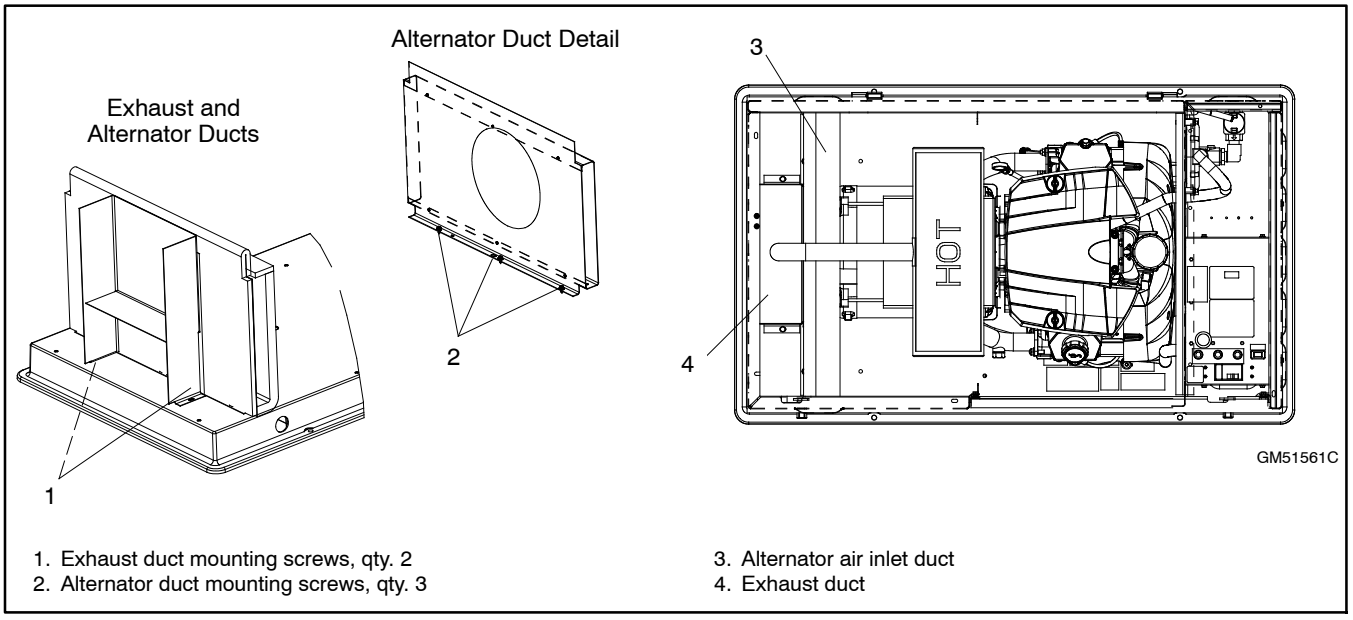
Connecting the battery and the battery charger. Hazardous voltage can cause severe injury or death. Reconnect the battery correctly, positive to positive and negative to negative, to avoid electrical shock and damage to the battery charger and battery(ies). Have a qualified electrician install the battery(ies).

25. Reconnect the generator set engine starting battery, negative (–) lead last.

26. Reconnect the carburetor heater (if equipped) to the 120VAC receptacle.

27. Reconnect the utility power to the generator set.

28. Reconnect output leads or load circuit cables at the field-connection terminal block.



1. Exhaust duct mounting screws, qty. 2
2. Alternator duct mounting screws, qty. 3
3. Alternator air inlet duct
4. Exhaust duct

Figure 7-38 Alternator Air Inlet Duct, 20RESB and 20RESD

29. Reinstall the enclosure panels in reverse order of removal. See Figure 7-39 and refer to the disassembly instructions, if necessary.

    a. Install the rear (alternator end) housing panel.

    b. Install the non-service side housing panel.

    c. Install the left side panel.

    d. Install the heat shield over the muffler.

    e. Install the front panel.

    f. Install the generator set housing service side door.

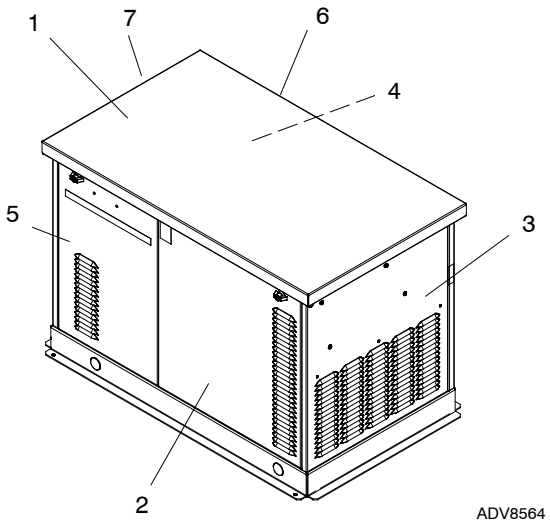
    g. Install the generator set housing roof.

30. Re-apply the 120VAC power supply to the generator set by closing the upstream circuit breaker.

31. Turn on the fuel supply. Press RUN to start the generator set and check for leaks with the engine running.

32. Press OFF to turn off the generator set. Then press AUTO if an automatic transfer switch or remote start/stop switch is used.

33. Lower and secure the roof.



1. Roof
2. Right (service) side door
3. Front panel
4. Heat shield (inside, not shown)
5. Left side panel
6. Non-service side panel
7. Rear panel

Figure 7-39 Generator Set Enclosure, 20RESB and 20RESD

Section 8 Wiring Diagrams

This section contains wiring diagrams and schematics for the generator sets. Figure 8-1 lists the drawing numbers and page numbers.

For RESA, RESAL, and RESB models, note that there are different drawings for generator sets equipped with original and revised controllers. Compare your controller to the illustrations in Section 4.2 to determine which controller is installed on the generator set, then find the applicable drawings in Figure 8-1, below.

All RESC, RESCL, and RESD models are equipped with revised controllers.

Drawing Description	Drawing Number	Page
14/20RESA/RESAL with original controller		
Schematic Diagram	ADV-8164-D	146
Point-to-Point Wiring Diagram	GM81217-D	147
20RESB with original controller		
Schematic Diagram	ADV-8563-A	148
Wiring Diagram	GM89939-A	149
14/20RESA/RESAL and 20RESB with revised controller		
Schematic Diagram	ADV-8706-C	
1 phase, 2 pole circuit breaker	Sheet 1	150
1 phase, 1 pole circuit breaker	Sheet 2	151
3 phase, 3 pole circuit breaker	Sheet 3	152
Wiring Diagram	GM93298-C	
1 phase, 2 pole circuit breaker	Sheet 1	153
1 phase, 1 pole circuit breaker	Sheet 2	154
3 phase, 3 pole circuit breaker	Sheet 3	155
20RESC/RESCL and 20RESD		
Schematic Diagram	ADV-8771	
1 phase, 2 pole circuit breaker	Sheet 1	156
1 phase, 1 pole circuit breaker	Sheet 2	157
3 phase, 3 pole circuit breaker	Sheet 3	158
Wiring Diagram	GM96293	
1 phase, 2 pole circuit breaker	Sheet 1	159
1 phase, 1 pole circuit breaker	Sheet 2	160
3 phase, 3 pole circuit breaker	Sheet 3	161

Figure 8-1 Drawings and Diagrams

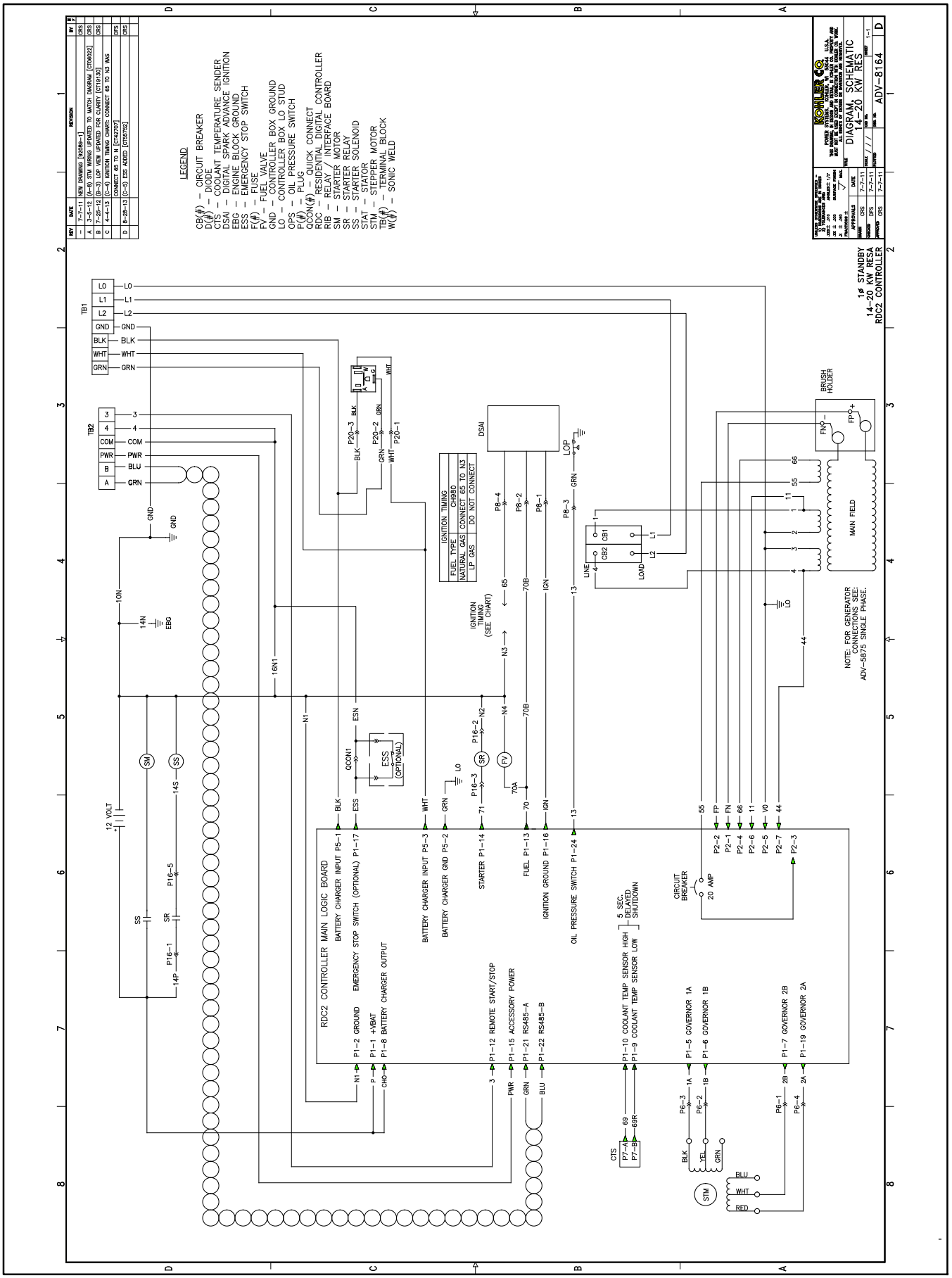


Figure 8-2 Schematic Diagram, ADV-8164-D

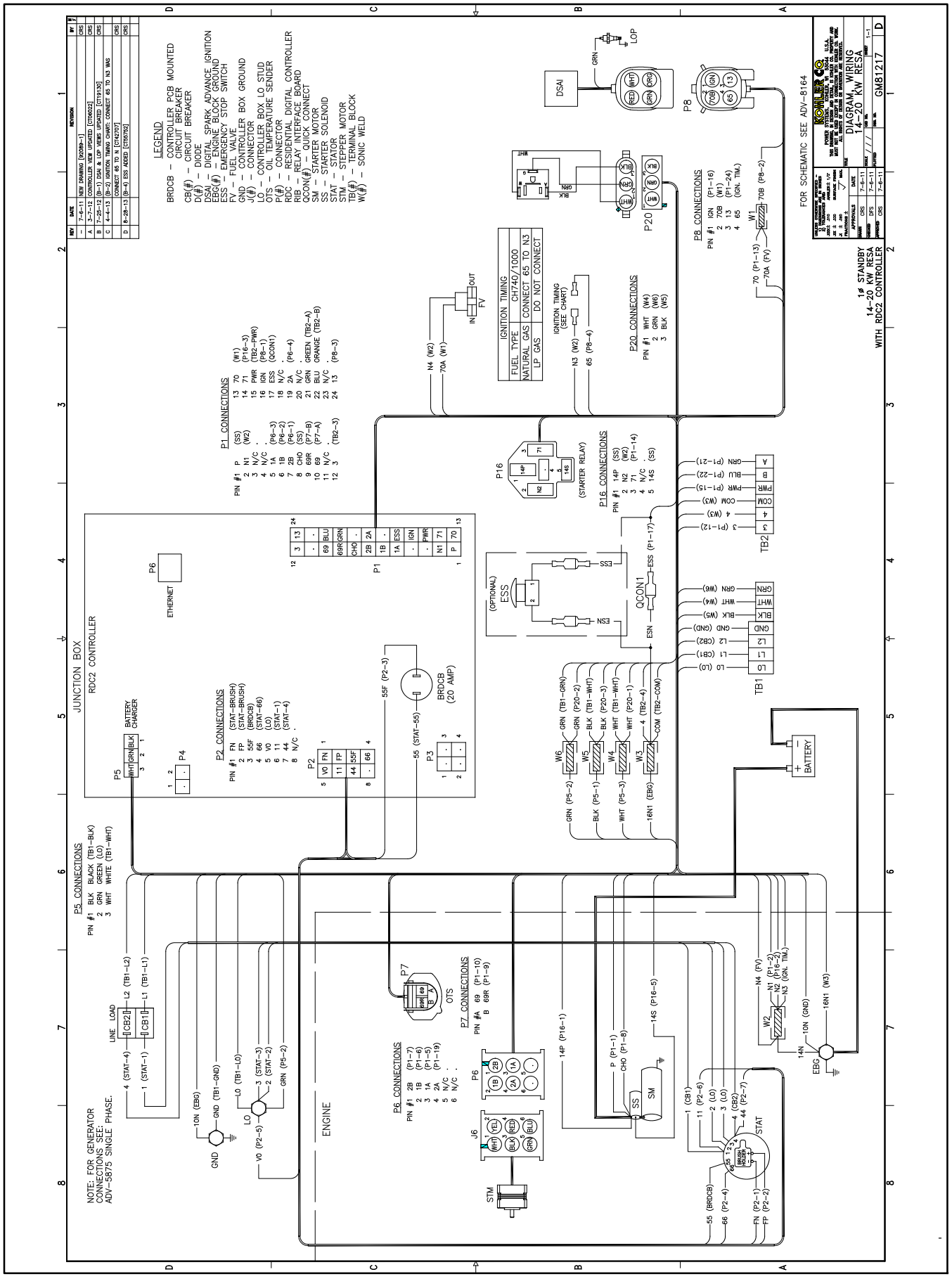


Figure 8-3 Point-to-Point Wiring Diagram, GM81217-D

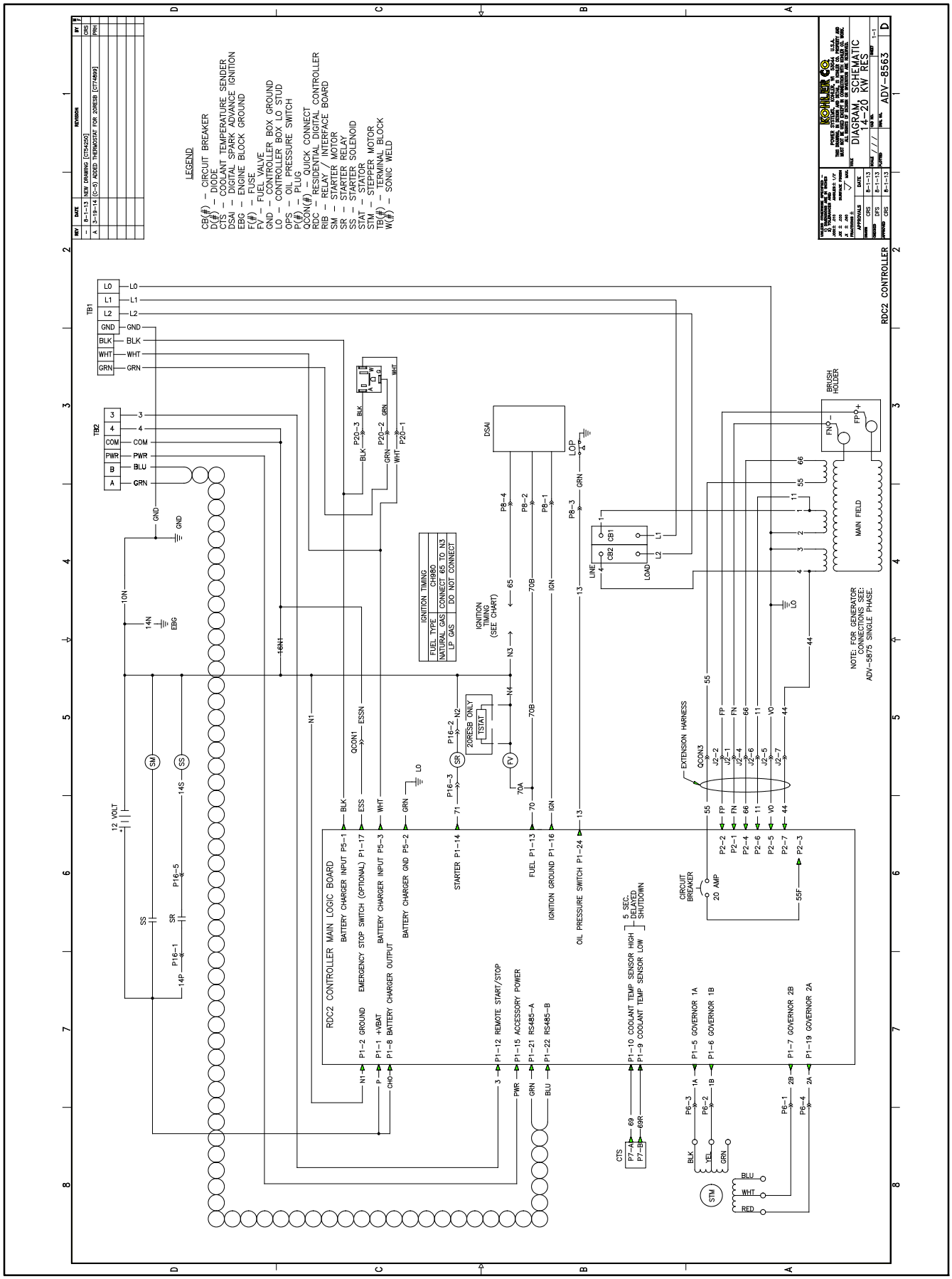


Figure 8-4 Schematic Diagram, ADV-8563

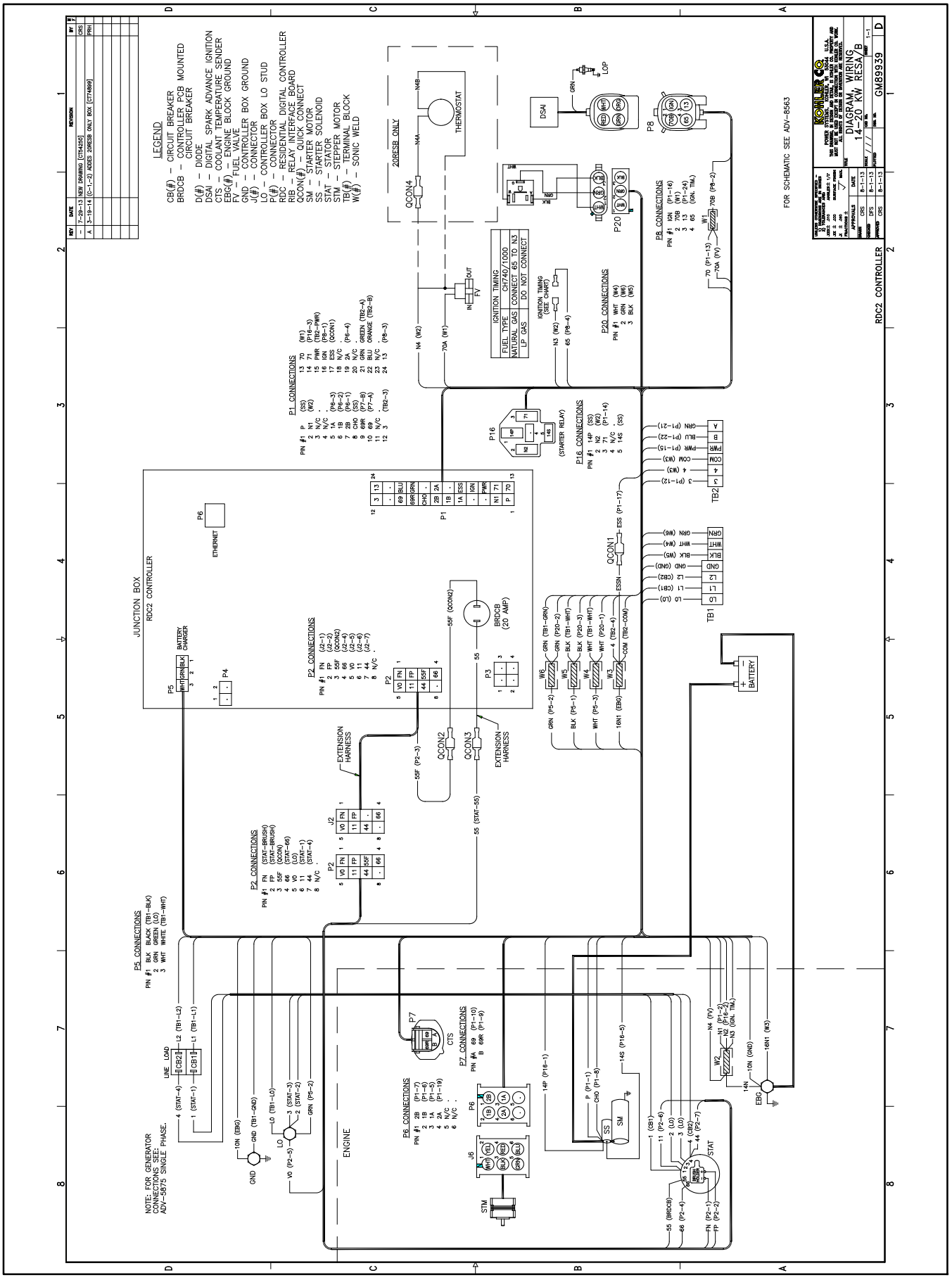


Figure 8-5 Point-to-Point Wiring Diagram, GM89939

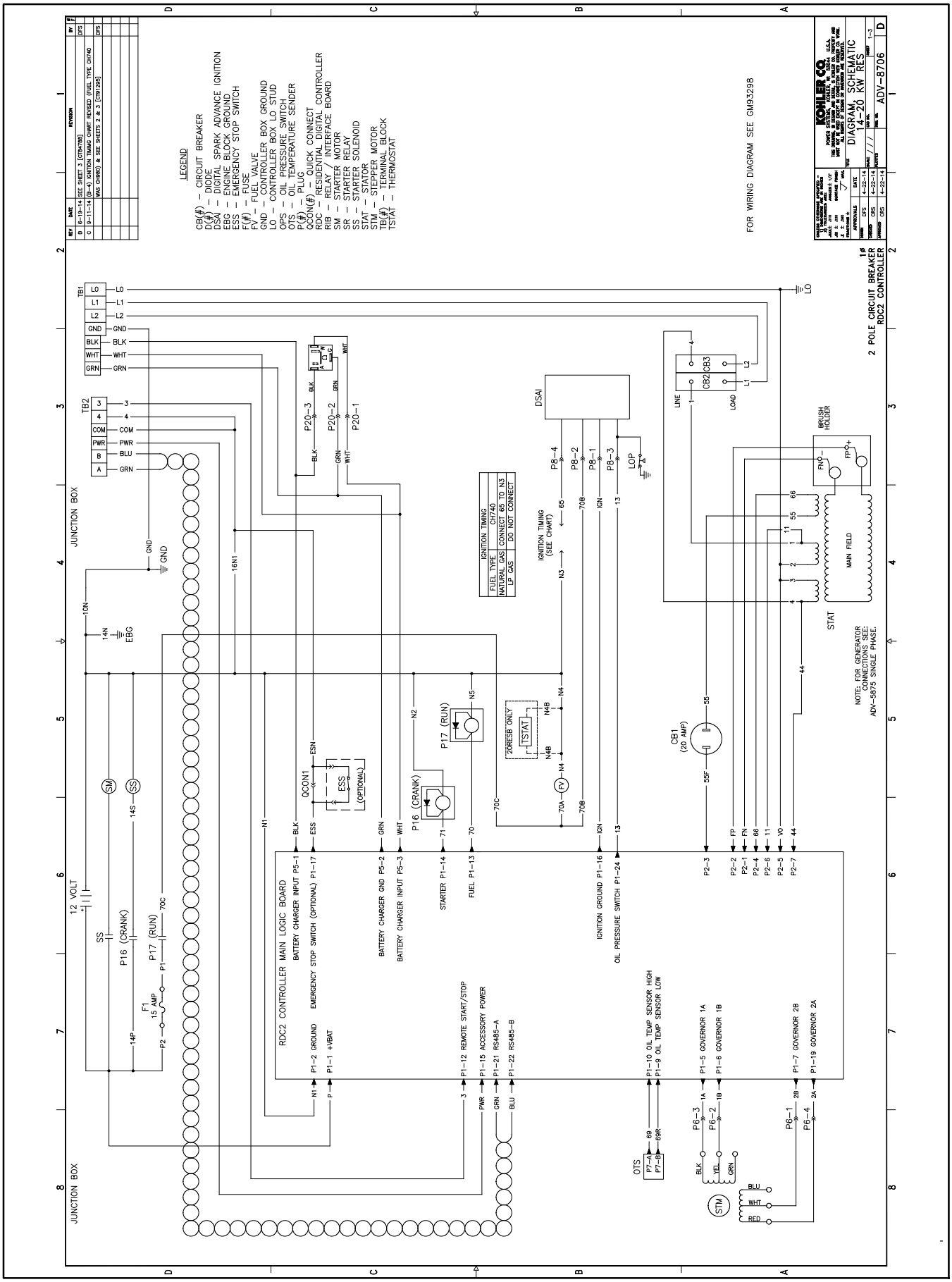


Figure 8-6 Schematic Diagram, 14/20RESA/RESAL, ADV-8706, Sheet 1 of 3

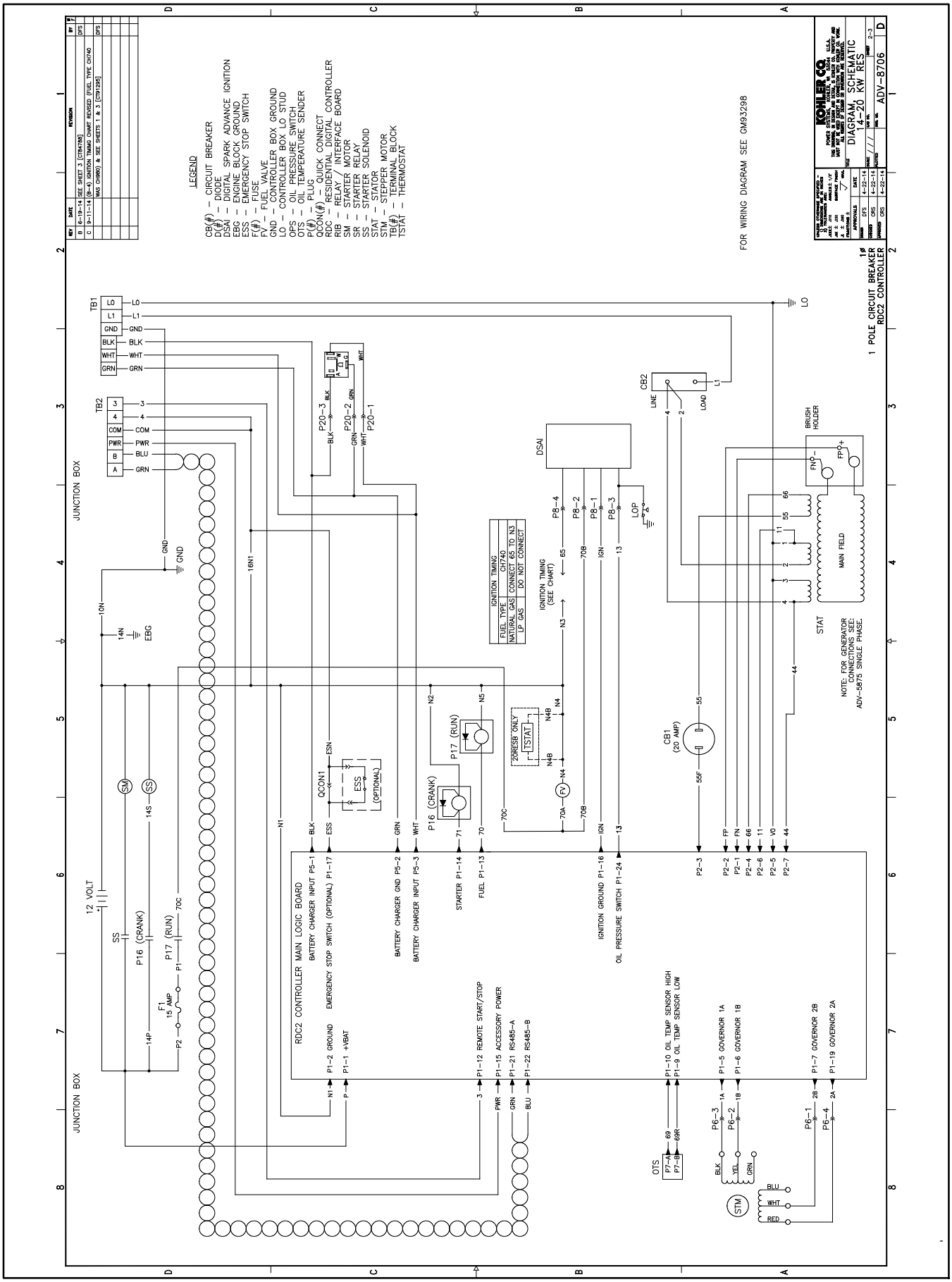


Figure 8-7 Schematic Diagram, 14/20RESA/RESAL, ADV-8706, Sheet 2 of 3

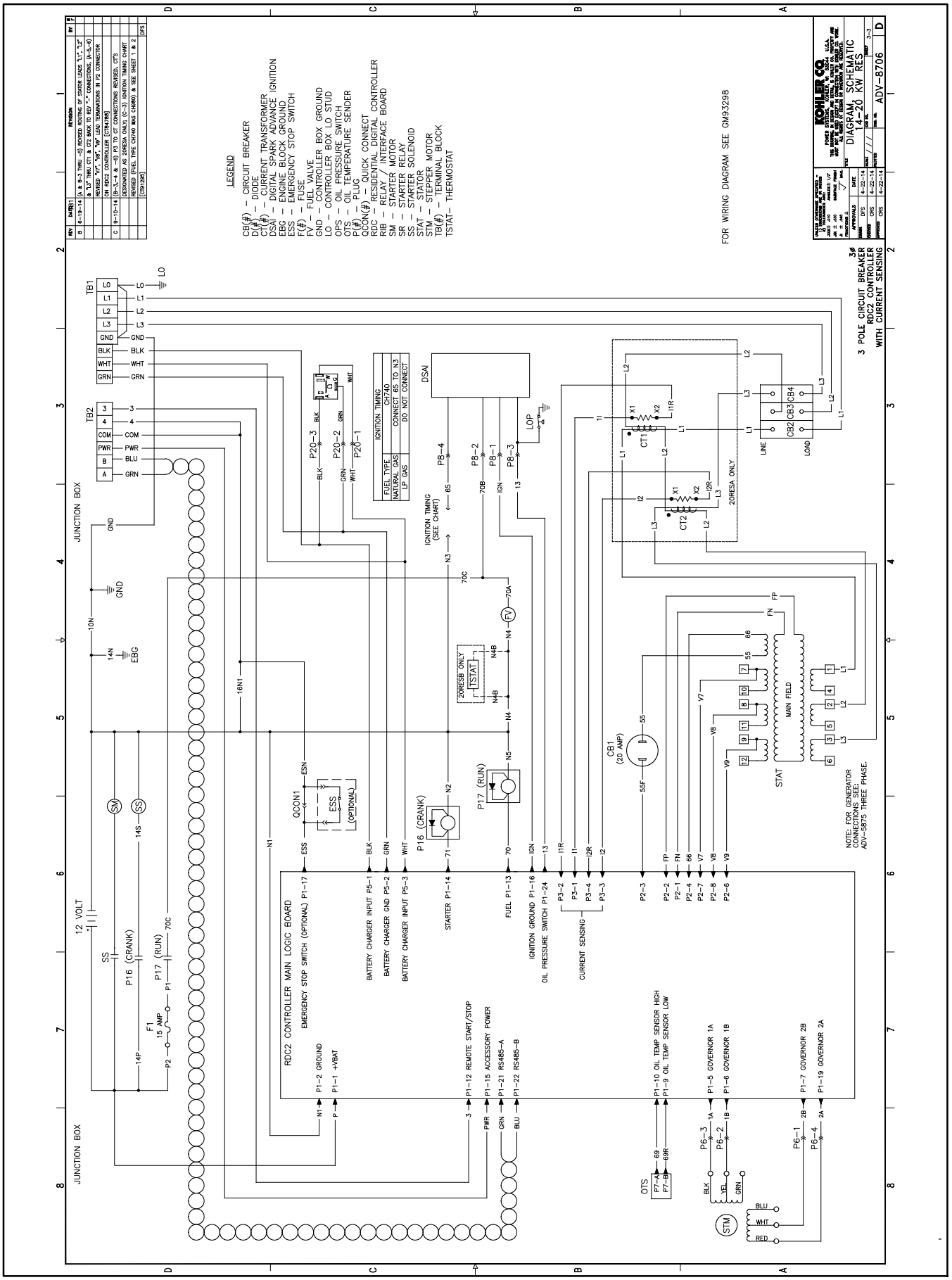


Figure 8-8 Schematic Diagram, 14/20RESA/RESAL, ADV-8706, Sheet 3 of 3

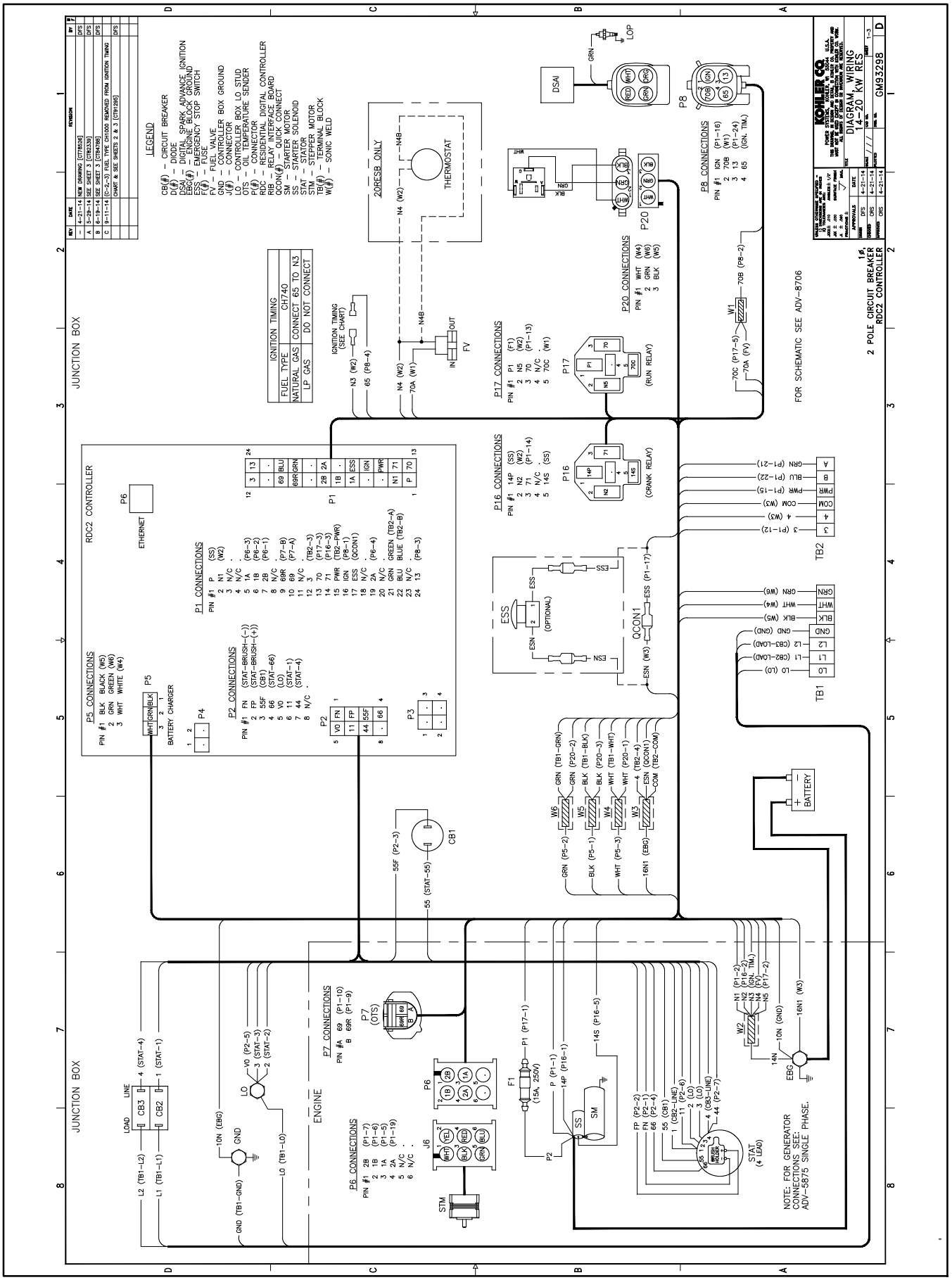


Figure 8-9 Point-to-Point Wiring Diagram, 14/20RESA/RESAL, GM93298, Sheet 1 of 3

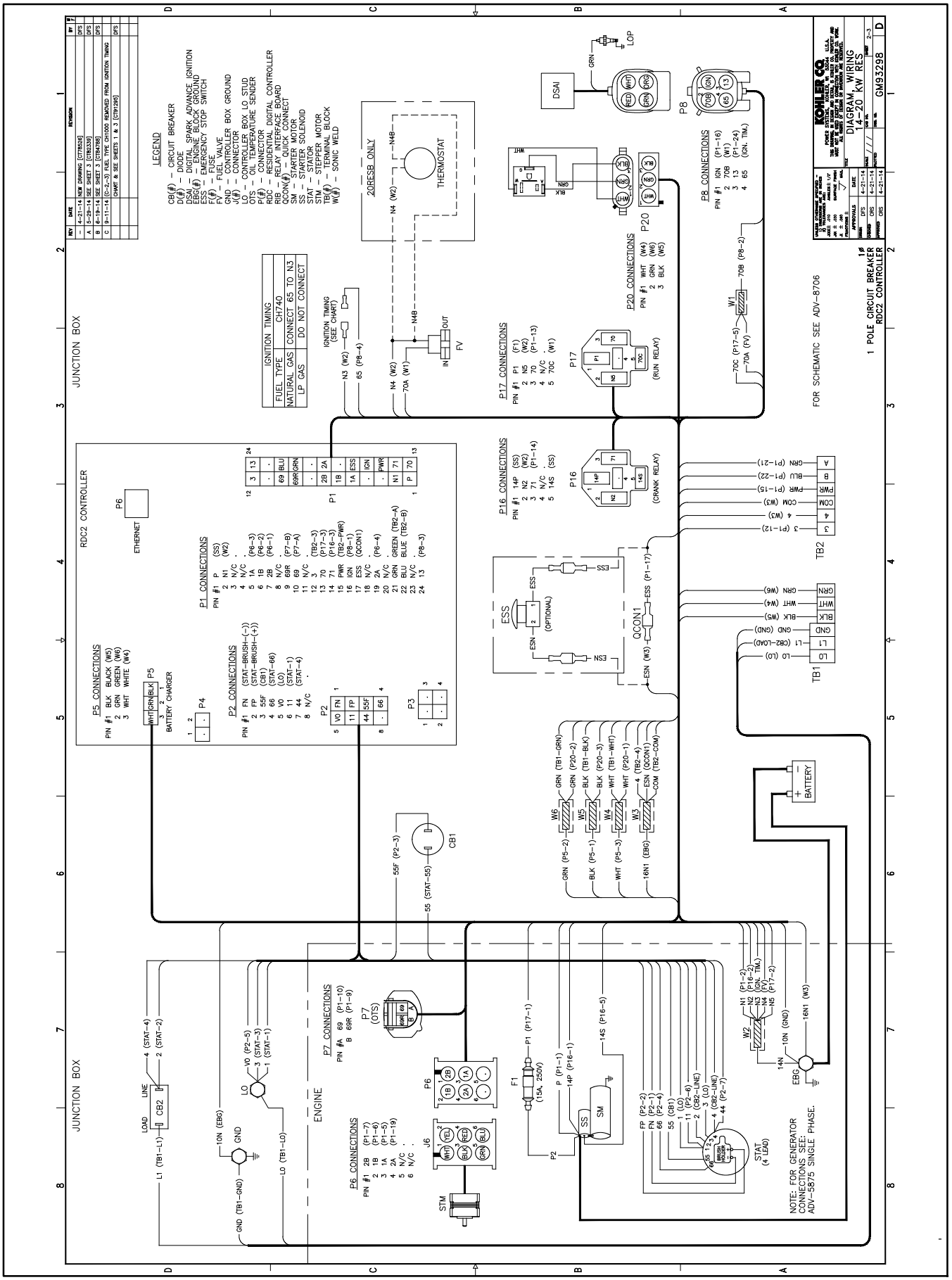


Figure 8-10 Point-to-Point Wiring Diagram, 14/20RESA/RESAL, GM93298, Sheet 2 of 3

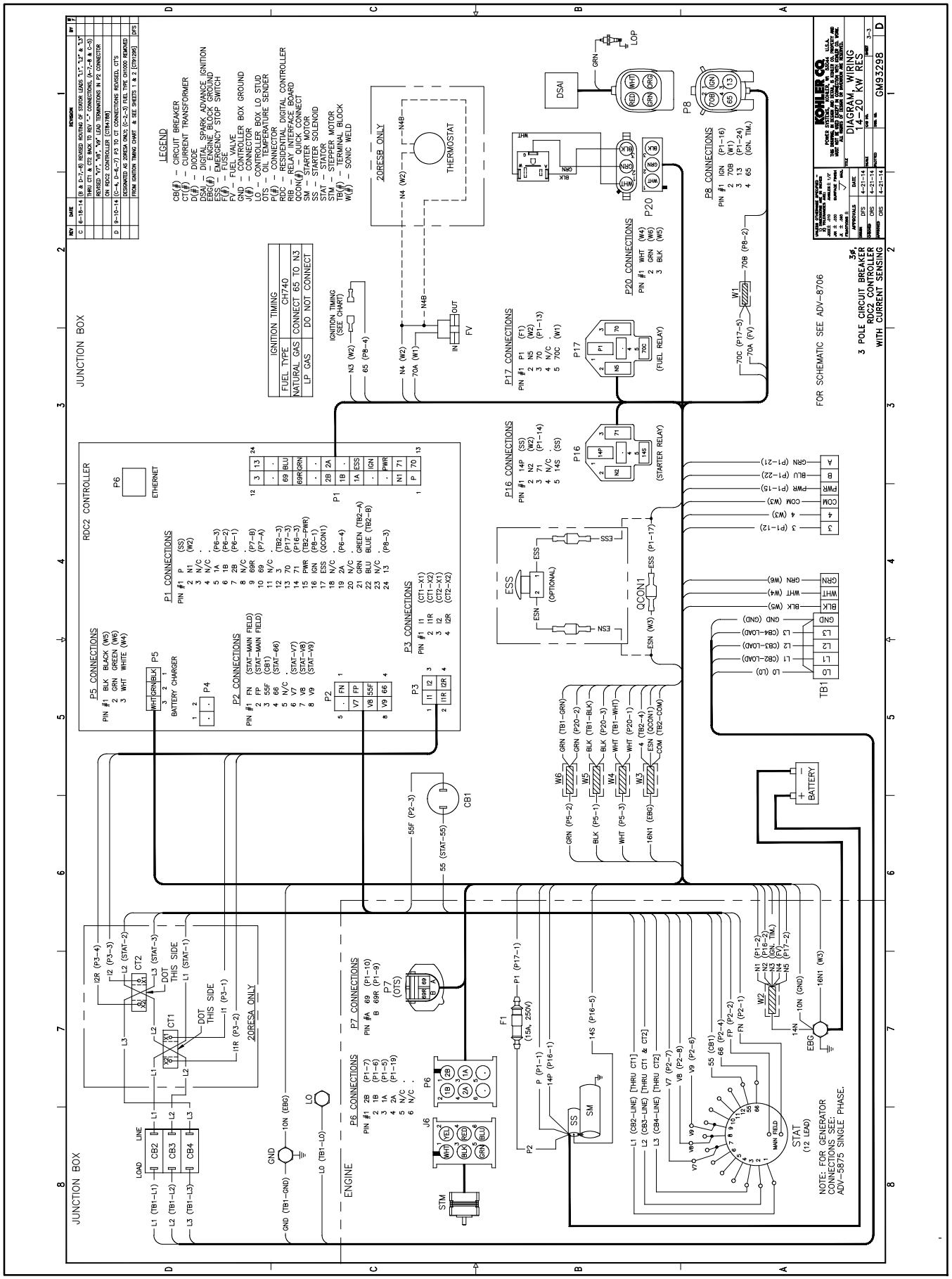


Figure 8-11 Point-to-Point Wiring Diagram, 14/20RESA/RESAL, GM93298, Sheet 3 of 3

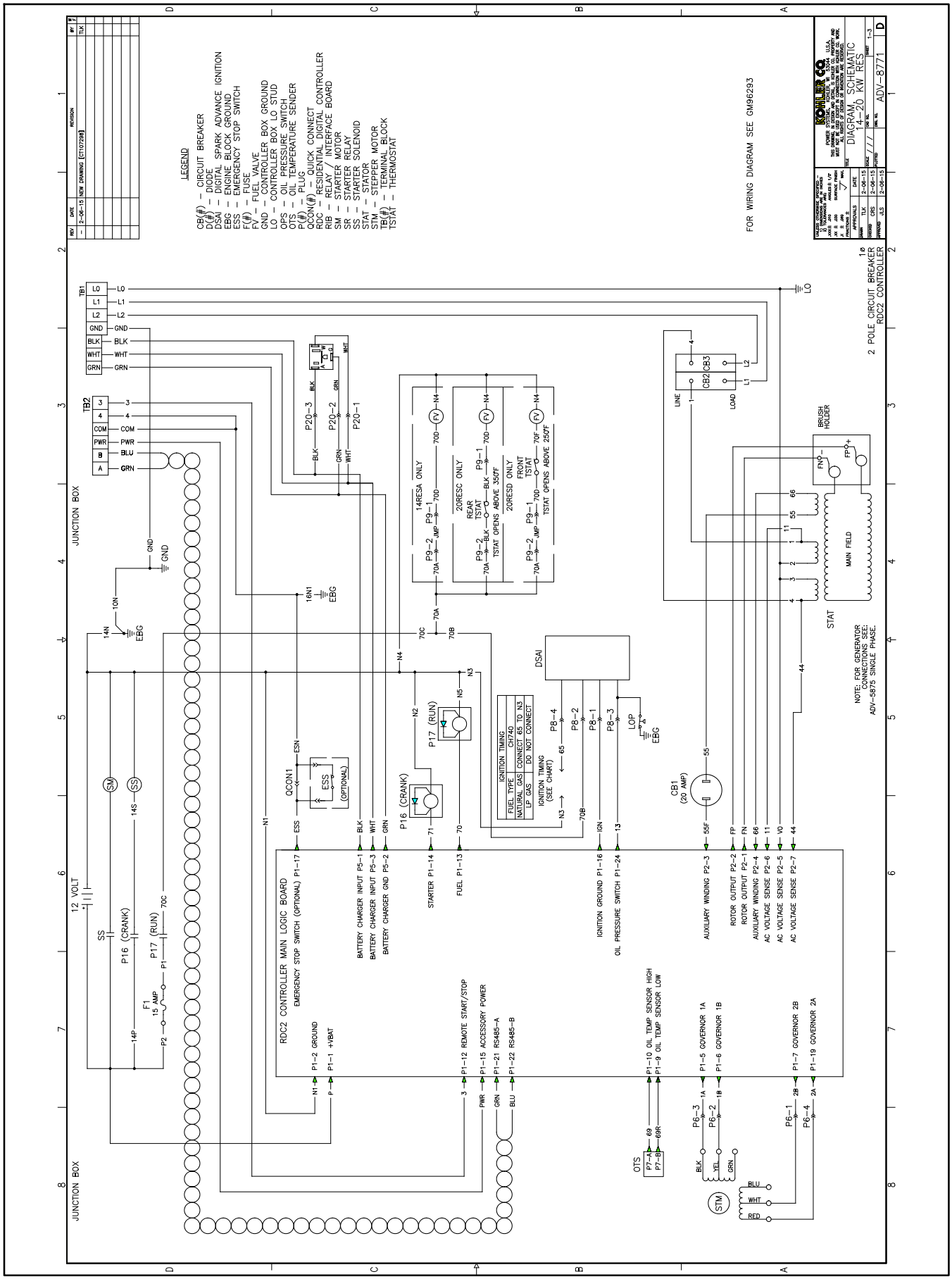


Figure 8-12 Schematic Diagram, Model 20RESC/20RESCL, ADV-8771, Sheet 1 of 3

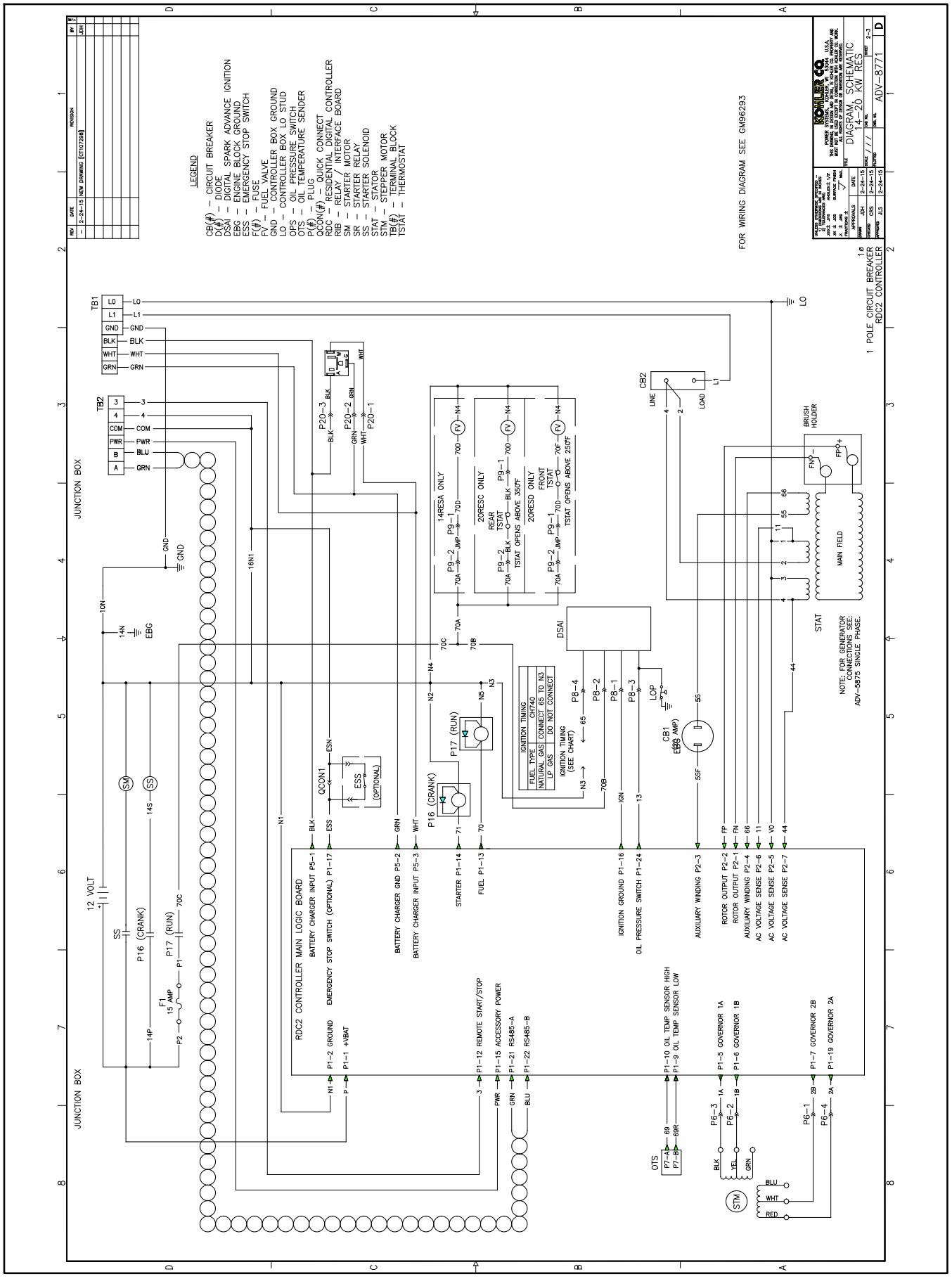


Figure 8-13 Schematic Diagram, Model 20RESC/20RESCL, ADV-8771, Sheet 2 of 3

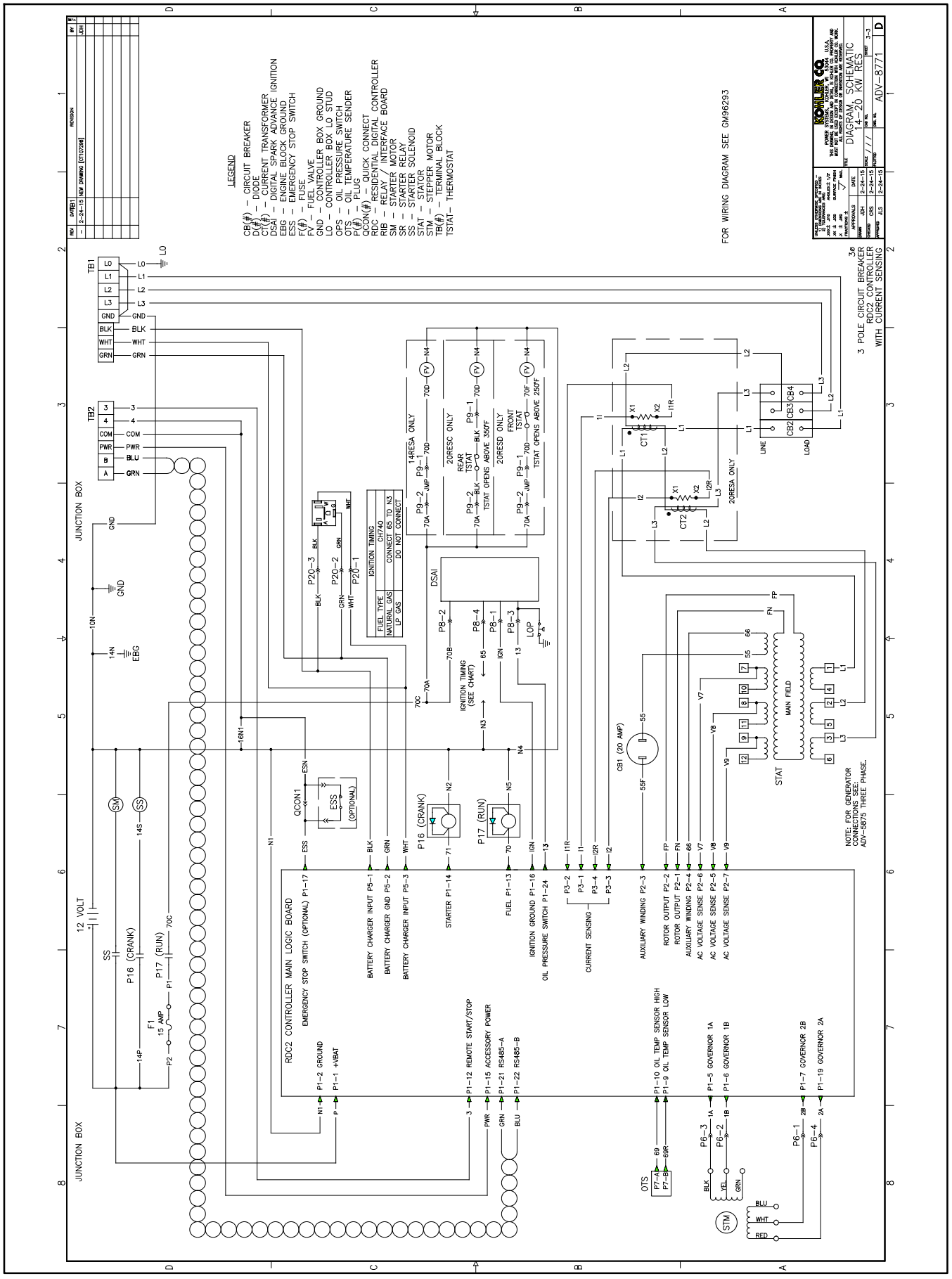


Figure 8-14 Schematic Diagram, Model 20RESC/20RESCL, ADV-8771, Sheet 3 of 3

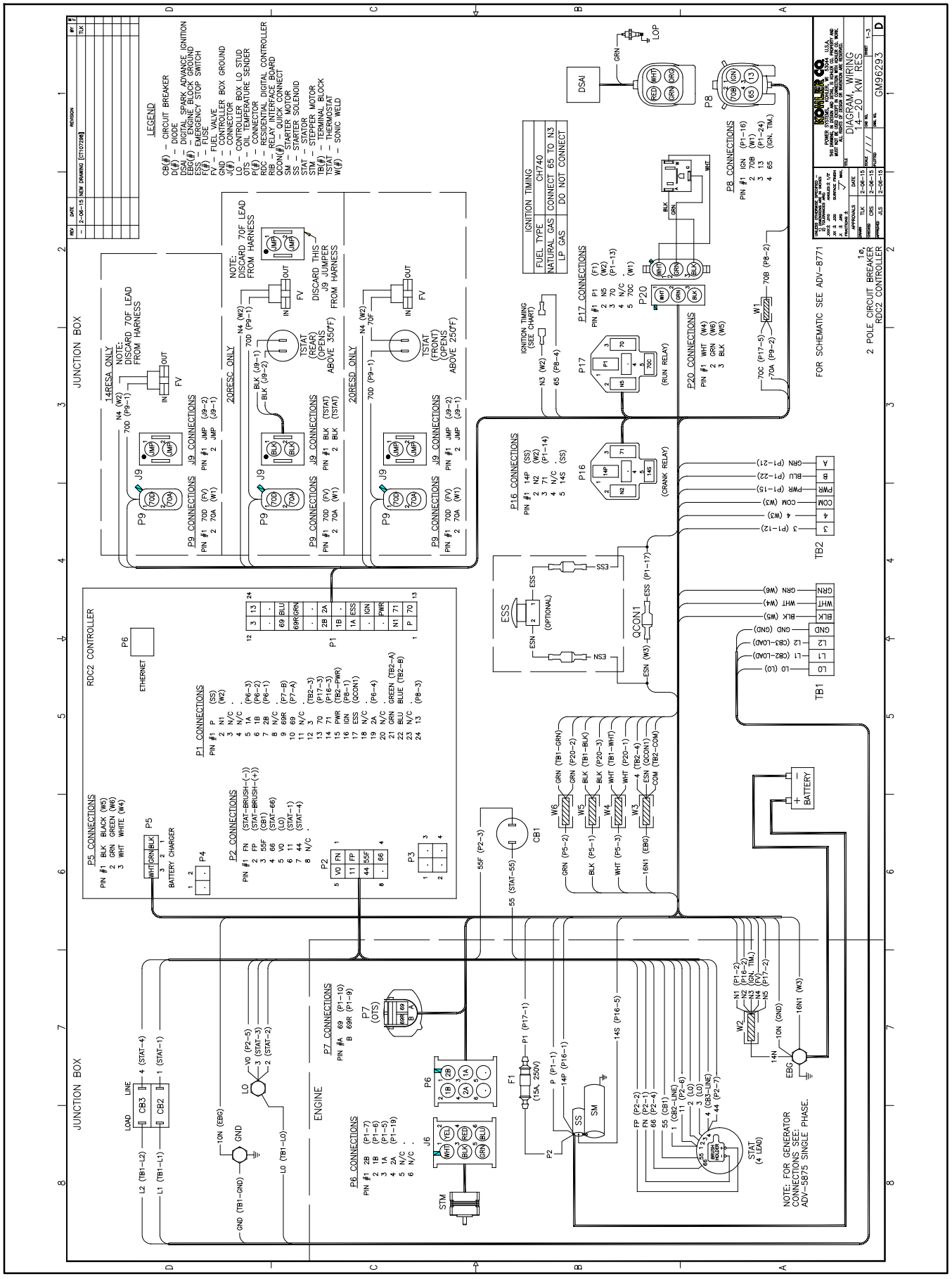


Figure 8-15 Wiring Diagram, Model 20RESC/20RESCL, GM96293, Sheet 1 of 3

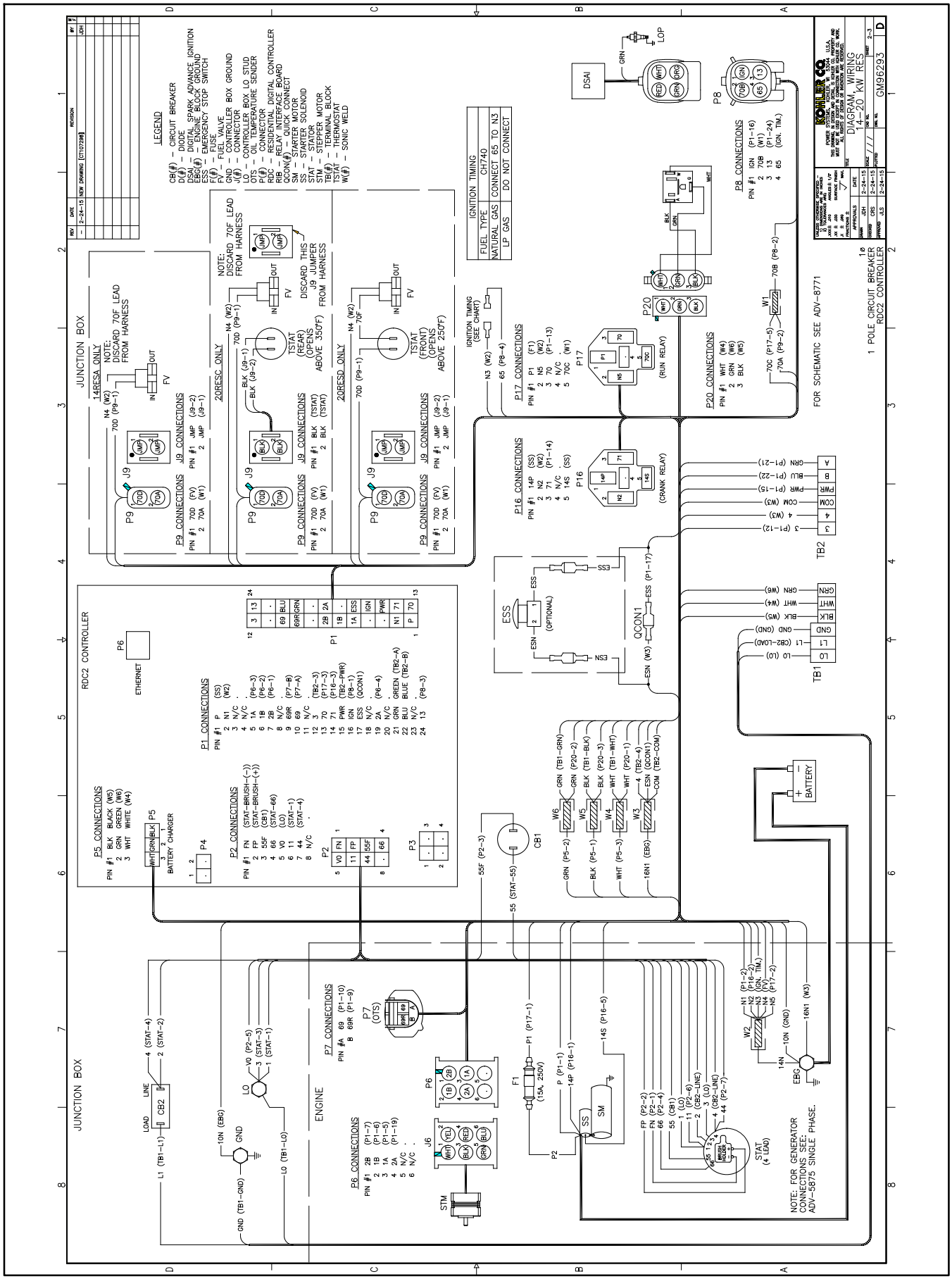


Figure 8-16 Wiring Diagram, Model 20RESC/20RESCL, GM96293, Sheet 2 of 3

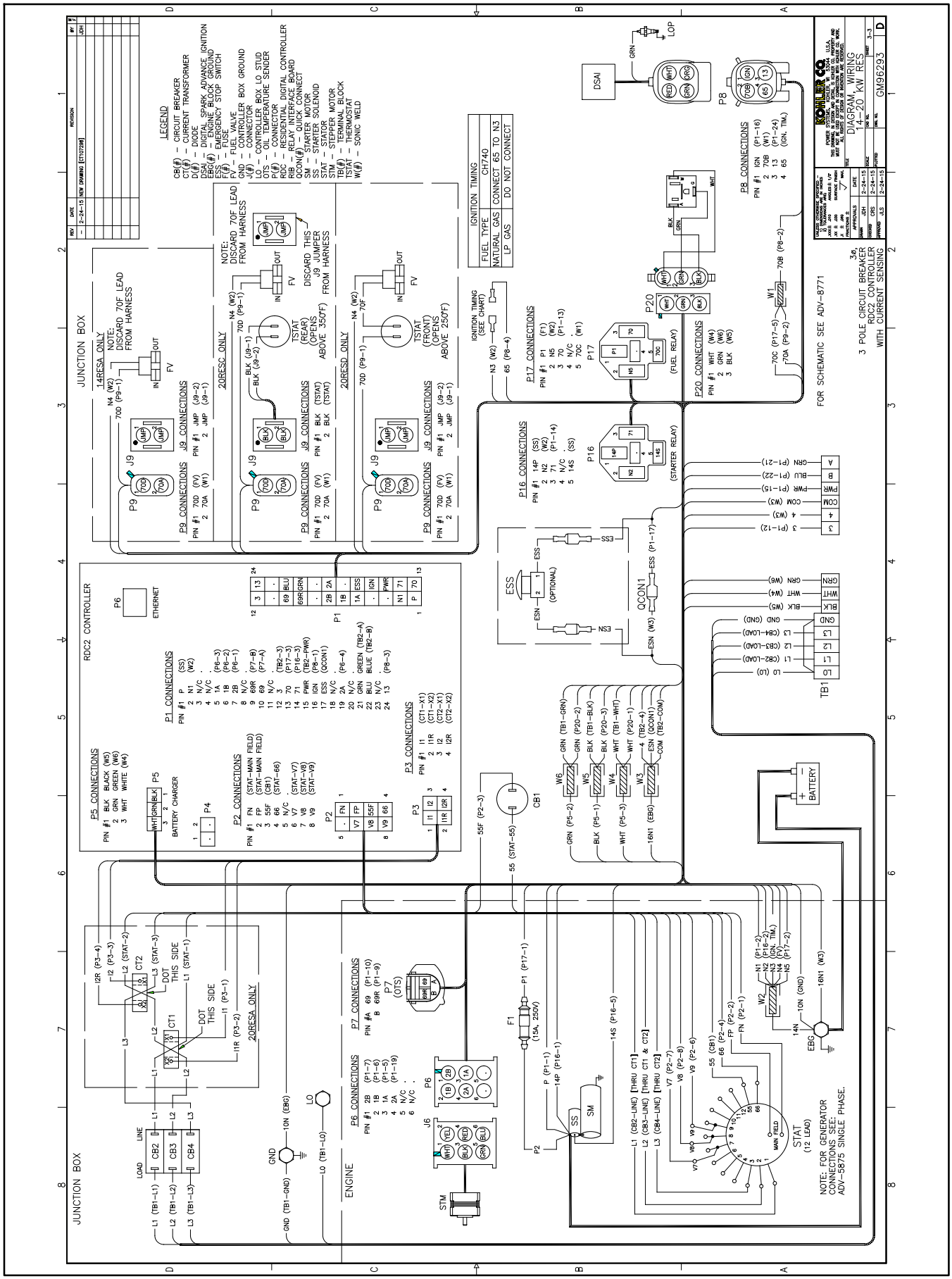


Figure 8-17 Wiring Diagram, Model 20RESC/20RESCL, GM96293, Sheet 3 of 3

Notes

Appendix A Abbreviations

The following list contains abbreviations that may appear in this publication.

A, amp	ampere
ABDC	after bottom dead center
AC	alternating current
A/D	analog to digital
ADC	advanced digital control; analog to digital converter
adj.	adjust, adjustment
ADV	advertising dimensional drawing
Ah	amp-hour
AHWT	anticipatory high water temperature
AISI	American Iron and Steel Institute
ALOP	anticipatory low oil pressure
alt.	alternator
Al	aluminum
ANSI	American National Standards Institute (formerly American Standards Association, ASA)
AO	anticipatory only
APDC	Air Pollution Control District
API	American Petroleum Institute
approx.	approximate, approximately
AQMD	Air Quality Management District
AR	as required, as requested
AS	as supplied, as stated, as suggested
ASE	American Society of Engineers
ASME	American Society of Mechanical Engineers
assy.	assembly
ASTM	American Society for Testing Materials
ATDC	after top dead center
ATS	automatic transfer switch
auto.	automatic
aux.	auxiliary
avg.	average
AVR	automatic voltage regulator
AWG	American Wire Gauge
AWM	appliance wiring material
bat.	battery
BBDC	before bottom dead center
BC	battery charger, battery charging
BCA	battery charging alternator
BCI	Battery Council International
BDC	before dead center
BHP	brake horsepower
blk.	black (paint color), block (engine)
blk. htr.	block heater
BMEP	brake mean effective pressure
bps	bits per second
br.	brass
BTDC	before top dead center
Btu	British thermal unit
Btu/min.	British thermal units per minute
C	Celsius, centigrade
cal.	calorie
CAN	controller area network
CARB	California Air Resources Board
CB	circuit breaker
cc	cubic centimeter
CCA	cold cranking amps
ccw.	counterclockwise
CEC	Canadian Electrical Code
cert.	certificate, certification, certified
cfh	cubic feet per hour
cfm	cubic feet per minute
CG	center of gravity
CID	cubic inch displacement
CL	centerline
cm	centimeter
CMOS	complementary metal oxide substrate (semiconductor)
cogen.	cogeneration
com	communications (port)
coml	commercial
Coml/Rec	Commercial/Recreational
conn.	connection
cont.	continued
CPVC	chlorinated polyvinyl chloride
crit.	critical
CRT	cathode ray tube
CSA	Canadian Standards Association
CT	current transformer
Cu	copper
cUL	Canadian Underwriter's Laboratories
CUL	Canadian Underwriter's Laboratories
cu. in.	cubic inch
cw.	clockwise
CWC	city water-cooled
cyl.	cylinder
D/A	digital to analog
DAC	digital to analog converter
dB	decibel
dB(A)	decibel (A weighted)
DC	direct current
DCR	direct current resistance
deg., °	degree
dept.	department
DFMEA	Design Failure Mode and Effects Analysis
dia.	diameter
DI/EO	dual inlet/end outlet
DIN	Deutsches Institut fur Normung e. V. (also Deutsche Industrie Normenausschuss)
DIP	dual inline package
DPDT	double-pole, double-throw
DPST	double-pole, single-throw
DS	disconnect switch
DVR	digital voltage regulator
E, emer.	emergency (power source)
ECM	electronic control module, engine control module
EDI	electronic data interchange
EFR	emergency frequency relay
e.g.	for example (*exempli gratia)*
EG	electronic governor
EGSA	Electrical Generating Systems Association
EIA	Electronic Industries Association
EI/EO	end inlet/end outlet
EMI	electromagnetic interference
emiss.	emission
eng.	engine
EPA	Environmental Protection Agency
EPS	emergency power system
ER	emergency relay
ES	engineering special, engineered special
ESD	electrostatic discharge
est.	estimated
E-Stop	emergency stop
etc.	et cetera (and so forth)
exh.	exhaust
ext.	external
F	Fahrenheit, female
fglass.	fiberglass
FHM	flat head machine (screw)
fl. oz.	fluid ounce
flex.	flexible
freq.	frequency
FS	full scale
ft.	foot, feet
ft. lb.	foot pounds (torque)
ft./min.	feet per minute
ftp	file transfer protocol
g	gram
ga.	gauge (meters, wire size)
gal.	gallon
gen.	generator
genset	generator set
GFI	ground fault interrupter
GND, ⏚	ground
gov.	governor
gph	gallons per hour
gpm	gallons per minute
gr.	grade, gross
GRD	equipment ground
gr. wt.	gross weight
H x W x D	height by width by depth
HC	hex cap
HCHT	high cylinder head temperature
HD	heavy duty
HET	high exhaust temp., high engine temp.
hex	hexagon
Hg	mercury (element)
HH	hex head
HHC	hex head cap
HP	horsepower
hr.	hour
HS	heat shrink
hsg.	housing
HVAC	heating, ventilation, and air conditioning
HWT	high water temperature
Hz	hertz (cycles per second)
IC	integrated circuit
ID	inside diameter, identification
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IMS	improved motor starting
in.	inch
in. H_2O	inches of water
in. Hg	inches of mercury
in. lb.	inch pounds
Inc.	incorporated
ind.	industrial
int.	internal
int./ext.	internal/external
I/O	input/output
IP	iron pipe
ISO	International Organization for Standardization
J	joule
JIS	Japanese Industry Standard

k	kilo (1000)
K	kelvin
kA	kiloampere
KB	kilobyte (2^{10} bytes)
KBus	Kohler communication protocol
kg	kilogram
kg/cm^2	kilograms per square centimeter
kgm	kilogram-meter
kg/m^3	kilograms per cubic meter
kHz	kilohertz
kJ	kilojoule
km	kilometer
kOhm, kΩ	kilo-ohm
kPa	kilopascal
kph	kilometers per hour
kV	kilovolt
kVA	kilovolt ampere
kVAR	kilovolt ampere reactive
kW	kilowatt
kWh	kilowatt-hour
kWm	kilowatt mechanical
kWth	kilowatt-thermal
L	liter
LAN	local area network
L x W x H	length by width by height
lb.	pound, pounds
lbm/ft^3	pounds mass per cubic feet
LCB	line circuit breaker
LCD	liquid crystal display
ld. shd.	load shed
LED	light emitting diode
Lph	liters per hour
Lpm	liters per minute
LOP	low oil pressure
LP	liquefied petroleum
LPG	liquefied petroleum gas
LS	left side
L_{wa}	sound power level, A weighted
LWL	low water level
LWT	low water temperature
m	meter, milli (1/1000)
M	mega (10^6 when used with SI units), male
m^3	cubic meter
m^3/hr.	cubic meters per hour
m^3/min.	cubic meters per minute
mA	milliampere
man.	manual
max.	maximum
MB	megabyte (2^{20} bytes)
MCCB	molded-case circuit breaker
MCM	one thousand circular mils
meggar	megohmmeter
MHz	megahertz
mi.	mile
mil	one one-thousandth of an inch
min.	minimum, minute
misc.	miscellaneous
MJ	megajoule
mJ	millijoule
mm	millimeter
mOhm, mΩ	milliohm
MOhm, MΩ	megohm
MOV	metal oxide varistor
MPa	megapascal
mpg	miles per gallon
mph	miles per hour
MS	military standard
ms	millisecond
m/sec.	meters per second
MTBF	mean time between failure
MTBO	mean time between overhauls
mtg.	mounting
MTU	Motoren-und Turbinen-Union
MW	megawatt
mW	milliwatt
μF	microfarad
N, norm.	normal (power source)
NA	not available, not applicable
nat. gas	natural gas
NBS	National Bureau of Standards
NC	normally closed
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
Nm	newton meter
NO	normally open
no., nos.	number, numbers
NPS	National Pipe, Straight
NPSC	National Pipe, Straight-coupling
NPT	National Standard taper pipe thread per general use
NPTF	National Pipe, Taper-Fine
NR	not required, normal relay
ns	nanosecond
OC	overcrank
OD	outside diameter
OEM	original equipment manufacturer
OF	overfrequency
opt.	option, optional
OS	oversize, overspeed
OSHA	Occupational Safety and Health Administration
OV	overvoltage
oz.	ounce
p., pp.	page, pages
PC	personal computer
PCB	printed circuit board
pF	picofarad
PF	power factor
ph., ∅	phase
PHC	Phillips® head Crimptite® (screw)
PHH	Phillips® hex head (screw)
PHM	pan head machine (screw)
PLC	programmable logic control
PMG	permanent magnet generator
pot	potentiometer, potential
ppm	parts per million
PROM	programmable read-only memory
psi	pounds per square inch
psig	pounds per square inch gauge
pt.	pint
PTC	positive temperature coefficient
PTO	power takeoff
PVC	polyvinyl chloride
qt.	quart, quarts
qty.	quantity
R	replacement (emergency) power source
rad.	radiator, radius
RAM	random access memory
RDO	relay driver output
ref.	reference
rem.	remote
Res/Coml	Residential/Commercial
RFI	radio frequency interference
RH	round head
RHM	round head machine (screw)
rly.	relay
rms	root mean square
rnd.	round
ROM	read only memory
rot.	rotate, rotating
rpm	revolutions per minute
RS	right side
RTU	remote terminal unit
RTV	room temperature vulcanization
RW	read/write
SAE	Society of Automotive Engineers
scfm	standard cubic feet per minute
SCR	silicon controlled rectifier
s, sec.	second
SI	*Systeme international d'unites,* International System of Units
SI/EO	side in/end out
sil.	silencer
SN	serial number
SNMP	simple network management protocol
SPDT	single-pole, double-throw
SPST	single-pole, single-throw
spec	specification
specs	specification(s)
sq.	square
sq. cm	square centimeter
sq. in.	square inch
SS	stainless steel
std.	standard
stl.	steel
tach.	tachometer
TD	time delay
TDC	top dead center
TDEC	time delay engine cooldown
TDEN	time delay emergency to normal
TDES	time delay engine start
TDNE	time delay normal to emergency
TDOE	time delay off to emergency
TDON	time delay off to normal
temp.	temperature
term.	terminal
THD	total harmonic distortion
TIF	telephone influence factor
TIR	total indicator reading
tol.	tolerance
turbo.	turbocharger
typ.	typical (same in multiple locations)
UF	underfrequency
UHF	ultrahigh frequency
UL	Underwriter's Laboratories, Inc.
UNC	unified coarse thread (was NC)
UNF	unified fine thread (was NF)
univ.	universal
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
w/o	without
wt.	weight
xfmr	transformer

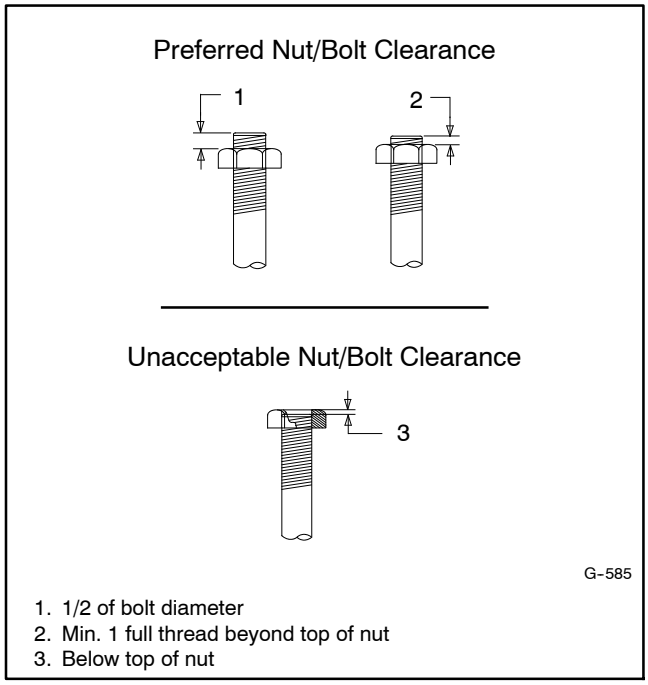
Appendix B Common Hardware Application Guidelines

Use the information below and on the following pages to identify proper fastening techniques when no specific reference for reassembly is made.

Bolt/Screw Length: When bolt/screw length is not given, use Figure 1 as a guide. As a general rule, a minimum length of one thread beyond the nut and a maximum length of 1/2 the bolt/screw diameter beyond the nut is the preferred method.

Washers and Nuts: Use split lock washers as a bolt locking device where specified. Use SAE flat washers with whiz nuts, spiralock nuts, or standard nuts and preloading (torque) of the bolt in all other applications.

See Appendix C, General Torque Specifications, and other torque specifications in the service literature.



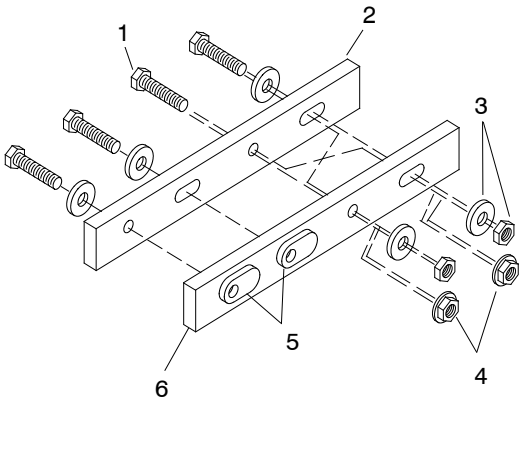
1. 1/2 of bolt diameter
2. Min. 1 full thread beyond top of nut
3. Below top of nut

Figure 1 Acceptable Bolt Lengths

Steps for common hardware application:

1. Determine entry hole type: round or slotted.
2. Determine exit hole type: fixed female thread (weld nut), round, or slotted.

   For round and slotted exit holes, determine if hardware is greater than 1/2 inch in diameter, or 1/2 inch in diameter or less. Hardware that is *greater than 1/2 inch* in diameter takes a standard nut and SAE washer. Hardware *1/2 inch or less* in diameter can take a properly torqued whiz nut or spiralock nut. See Figure 2.
3. Follow these SAE washer rules after determining exit hole type:
   a. Always use a washer between hardware and a slot.
   b. Always use a washer under a nut (see 2 above for exception).
   c. Use a washer under a bolt when the female thread is fixed (weld nut).
4. Refer to Figure 2, which depicts the preceding hardware configuration possibilities.



1. Cap screw
2. Entry hole types
3. Standard nut and SAE washer
4. Whiz nut or spiralock: up to 1/2 in. dia. hardware
5. Weld nuts: above 1/2 in. dia. hardware
6. Exit hole types

Figure 2 Acceptable Hardware Combinations

Appendix C General Torque Specifications

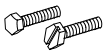
American Standard Fasteners Torque Specifications								
Size	Torque Measurement	Assembled into Cast Iron or Steel						Assembled into Aluminum Grade 2 or 5
		Grade 2		Grade 5		Grade 8		
8-32	Nm (in. lb.)	1.8	(16)	2.3	(20)	–		See Note 3
10-24	Nm (in. lb.)	2.9	(26)	3.6	(32)	–		
10-32	Nm (in. lb.)	2.9	(26)	3.6	(32)	–		
1/4-20	Nm (in. lb.)	6.8	(60)	10.8	(96)	14.9	(132)	
1/4-28	Nm (in. lb.)	8.1	(72)	12.2	(108)	16.3	(144)	
5/16-18	Nm (in. lb.)	13.6	(120)	21.7	(192)	29.8	(264)	
5/16-24	Nm (in. lb.)	14.9	(132)	23.1	(204)	32.5	(288)	
3/8-16	Nm (ft. lb.)	24.0	(18)	38.0	(28)	53.0	(39)	
3/8-24	Nm (ft. lb.)	27.0	(20)	42.0	(31)	60.0	(44)	
7/16-14	Nm (ft. lb.)	39.0	(29)	60.0	(44)	85.0	(63)	
7/16-20	Nm (ft. lb.)	43.0	(32)	68.0	(50)	95.0	(70)	
1/2-13	Nm (ft. lb.)	60.0	(44)	92.0	(68)	130.0	(96)	
1/2-20	Nm (ft. lb.)	66.0	(49)	103.0	(76)	146.0	(108)	
9/16-12	Nm (ft. lb.)	81.0	(60)	133.0	(98)	187.0	(138)	
9/16-18	Nm (ft. lb.)	91.0	(67)	148.0	(109)	209.0	(154)	
5/8-11	Nm (ft. lb.)	113.0	(83)	183.0	(135)	259.0	(191)	
5/8-18	Nm (ft. lb.)	128.0	(94)	208.0	(153)	293.0	(216)	
3/4-10	Nm (ft. lb.)	199.0	(147)	325.0	(240)	458.0	(338)	
3/4-16	Nm (ft. lb.)	222.0	(164)	363.0	(268)	513.0	(378)	
1-8	Nm (ft. lb.)	259.0	(191)	721.0	(532)	1109.0	(818)	
1-12	Nm (ft. lb.)	283.0	(209)	789.0	(582)	1214.0	(895)	

Metric Fasteners Torque Specifications, Measured in Nm (ft. lb.)								
Size (mm)	Assembled into Cast Iron or Steel						Assembled into Aluminum Grade 5.8 or 8.8	
	Grade 5.8		Grade 8.8		Grade 10.9			
M6 x 1.00	6.2	(4.6)	9.5	(7)	13.6	(10)	See Note 3	
M8 x 1.25	15.0	(11)	23.0	(17)	33.0	(24)		
M8 x 1.00	16.0	(11)	24.0	(18)	34.0	(25)		
M10 x 1.50	30.0	(22)	45.0	(34)	65.0	(48)		
M10 x 1.25	31.0	(23)	47.0	(35)	68.0	(50)		
M12 x 1.75	53.0	(39)	80.0	(59)	115.0	(85)		
M12 x 1.50	56.0	(41)	85.0	(63)	122.0	(90)		
M14 x 2.00	83.0	(61)	126.0	(93)	180.0	(133)		
M14 x 1.50	87.0	(64)	133.0	(98)	190.0	(140)		
M16 x 2.00	127.0	(94)	194.0	(143)	278.0	(205)		
M16 x 1.50	132.0	(97)	201.0	(148)	287.0	(212)		
M18 x 2.50	179.0	(132)	273.0	(201)	390.0	(288)		
M18 x 1.50	189.0	(140)	289.0	(213)	413.0	(305)		

Notes:

1. The torque values above are general guidelines. Always use the torque values specified in the service manuals and/or assembly drawings when they differ from the above torque values.
2. The torque values above are based on new plated threads. Increase torque values by 15% if non-plated threads are used.
3. Hardware threaded into aluminum must have either two diameters of thread engagement or a 30% or more reduction in the torque to prevent stripped threads.
4. Torque values are calculated as equivalent stress loading on American hardware with an approximate preload of 90% of the yield strength and a friction coefficient of 0.125.

Appendix D Common Hardware Identification

Screw/Bolts/Studs	
Head Styles	
Hex Head or Machine Head	
Hex Head or Machine Head with Washer	
Flat Head (FHM)	
Round Head (RHM)	
Pan Head	
Hex Socket Head Cap or Allen™ Head Cap	
Hex Socket Head or Allen™ Head Shoulder Bolt	
Sheet Metal Screw	
Stud	
Drive Styles	
Hex	
Hex and Slotted	
Phillips®	
Slotted	
Hex Socket	

Nuts	
Nut Styles	
Hex Head	
Lock or Elastic	
Square	
Cap or Acorn	
Wing	
Washers	
Washer Styles	
Plain	
Split Lock or Spring	
Spring or Wave	
External Tooth Lock	
Internal Tooth Lock	
Internal-External Tooth Lock	

Hardness Grades	
American Standard	
Grade 2	
Grade 5	
Grade 8	
Grade 8/9 (Hex Socket Head)	
Metric	
Number stamped on hardware; 5.8 shown	

Allen™ head screw is a trademark of Holo-Krome Co.

Phillips® screw is a registered trademark of Phillips Screw Company.

Sample Dimensions

American Standard (Screws, Bolts, Studs, and Nuts)

1/4-20 x 1

- 1 — Length In Inches (Screws and Bolts)
- 20 — Threads Per Inch
- 1/4 — Major Thread Diameter In Fractional Inches Or Screw Number Size

Metric (Screws, Bolts, Studs, and Nuts)

M8-1.25 x 20

- 20 — Length In Millimeters (Screws and Bolts)
- 1.25 — Distance Between Threads In Millimeters
- M8 — Major Thread Diameter In Millimeters

Plain Washers

9/32 x 5/8 x 1/16

- 1/16 — Thickness
- 5/8 — External Dimension
- 9/32 — Internal Dimension

Lock Washers

5/8

- 5/8 — Internal Dimension

Appendix E Common Hardware List

The Common Hardware List lists part numbers and dimensions for common hardware items.

American Standard

Part No.	Dimensions
Hex Head Bolts (Grade 5)	
X-465-17	1/4-20 x .38
X-465-6	1/4-20 x .50
X-465-2	1/4-20 x .62
X-465-16	1/4-20 x .75
X-465-18	1/4-20 x .88
X-465-7	1/4-20 x 1.00
X-465-8	1/4-20 x 1.25
X-465-9	1/4-20 x 1.50
X-465-10	1/4-20 x 1.75
X-465-11	1/4-20 x 2.00
X-465-12	1/4-20 x 2.25
X-465-14	1/4-20 x 2.75
X-465-21	1/4-20 x 5.00
X-465-25	1/4-28 x .38
X-465-20	1/4-28 x 1.00
X-125-33	5/16-18 x .50
X-125-23	5/16-18 x .62
X-125-3	5/16-18 x .75
X-125-31	5/16-18 x .88
X-125-5	5/16-18 x 1.00
X-125-24	5/16-18 x 1.25
X-125-34	5/16-18 x 1.50
X-125-25	5/16-18 x 1.75
X-125-26	5/16-18 x 2.00
230578	5/16-18 x 2.25
X-125-29	5/16-18 x 2.50
X-125-27	5/16-18 x 2.75
X-125-28	5/16-18 x 3.00
X-125-22	5/16-18 x 4.50
X-125-32	5/16-18 x 5.00
X-125-35	5/16-18 x 5.50
X-125-36	5/16-18 x 6.00
X-125-40	5/16-18 x 6.50
X-125-43	5/16-24 x 1.75
X-125-44	5/16-24 x 2.50
X-125-30	5/16-24 x .75
X-125-39	5/16-24 x 2.00
X-125-38	5/16-24 x 2.75
X-6238-2	3/8-16 x .62
X-6238-10	3/8-16 x .75
X-6238-3	3/8-16 x .88
X-6238-11	3/8-16 x 1.00
X-6238-4	3/8-16 x 1.25
X-6238-5	3/8-16 x 1.50
X-6238-1	3/8-16 x 1.75
X-6238-6	3/8-16 x 2.00
X-6238-17	3/8-16 x 2.25
X-6238-7	3/8-16 x 2.50
X-6238-8	3/8-16 x 2.75
X-6238-9	3/8-16 x 3.00
X-6238-19	3/8-16 x 3.25
X-6238-12	3/8-16 x 3.50
X-6238-20	3/8-16 x 3.75
X-6238-13	3/8-16 x 4.50
X-6238-18	3/8-16 x 5.50
X-6238-25	3/8-16 x 6.50

Part No.	Dimensions
Hex Head Bolts, cont.	
X-6238-14	3/8-24 x .75
X-6238-16	3/8-24 x 1.25
X-6238-21	3/8-24 x 4.00
X-6238-22	3/8-24 x 4.50
X-6024-5	7/16-14 x .75
X-6024-2	7/16-14 x 1.00
X-6024-8	7/16-14 x 1.25
X-6024-3	7/16-14 x 1.50
X-6024-4	7/16-14 x 2.00
X-6024-11	7/16-14 x 2.75
X-6024-12	7/16-14 x 6.50
X-129-15	1/2-13 x .75
X-129-17	1/2-13 x 1.00
X-129-18	1/2-13 x 1.25
X-129-19	1/2-13 x 1.50
X-129-20	1/2-13 x 1.75
X-129-21	1/2-13 x 2.00
X-129-22	1/2-13 x 2.25
X-129-23	1/2-13 x 2.50
X-129-24	1/2-13 x 2.75
X-129-25	1/2-13 x 3.00
X-129-27	1/2-13 x 3.50
X-129-29	1/2-13 x 4.00
X-129-30	1/2-13 x 4.50
X-463-9	1/2-13 x 5.50
X-129-44	1/2-13 x 6.00
X-129-51	1/2-20 x .75
X-129-45	1/2-20 x 1.25
X-129-52	1/2-20 x 1.50
X-6021-3	5/8-11 x 1.00
X-6021-4	5/8-11 x 1.25
X-6021-2	5/8-11 x 1.50
X-6021-1	5/8-11 x 1.75
273049	5/8-11 x 2.00
X-6021-5	5/8-11 x 2.25
X-6021-6	5/8-11 x 2.50
X-6021-7	5/8-11 x 2.75
X-6021-12	5/8-11 x 3.75
X-6021-11	5/8-11 x 4.50
X-6021-10	5/8-11 x 6.00
X-6021-9	5/8-18 x 2.50
X-6239-1	3/4-10 x 1.00
X-6239-8	3/4-10 x 1.25
X-6239-2	3/4-10 x 1.50
X-6239-3	3/4-10 x 2.00
X-6239-4	3/4-10 x 2.50
X-6239-5	3/4-10 x 3.00
X-6239-6	3/4-10 x 3.50
X-792-1	1-8 x 2.25
X-792-5	1-8 x 3.00
X-792-8	1-8 x 5.00

Part No.	Dimensions	Type
Hex Nuts		
X-6009-1	1-8	Standard
X-6210-3	6-32	Whiz
X-6210-4	8-32	Whiz
X-6210-5	10-24	Whiz
X-6210-1	10-32	Whiz
X-6210-2	1/4-20	Spiralock
X-6210-6	1/4-28	Spiralock
X-6210-7	5/16-18	Spiralock
X-6210-8	5/16-24	Spiralock
X-6210-9	3/8-16	Spiralock
X-6210-10	3/8-24	Spiralock
X-6210-11	7/16-14	Spiralock
X-6210-12	1/2-13	Spiralock
X-6210-15	7/16-20	Spiralock
X-6210-14	1/2-20	Spiralock
X-85-3	5/8-11	Standard
X-88-12	3/4-10	Standard
X-89-2	1/2-20	Standard

Washers

Part No.	ID	OD	Thick.	Bolt/ Screw
X-25-46	.125	.250	.022	#4
X-25-9	.156	.375	.049	#6
X-25-48	.188	.438	.049	#8
X-25-36	.219	.500	.049	#10
X-25-40	.281	.625	.065	1/4
X-25-85	.344	.687	.065	5/16
X-25-37	.406	.812	.065	3/8
X-25-34	.469	.922	.065	7/16
X-25-26	.531	1.062	.095	1/2
X-25-15	.656	1.312	.095	5/8
X-25-29	.812	1.469	.134	3/4
X-25-127	1.062	2.000	.134	1

Metric

Hex head bolts are hardness grade 8.8 unless noted.

Hex Head Bolts (Partial Thread)

Part No.	Dimensions
M931-05055-60	M5-0.80 x 55
M931-06040-60	M6-1.00 x 40
M931-06055-60	M6-1.00 x 55
M931-06060-60	M6-1.00 x 60
M931-06060-SS	M6-1.00 x 60
M931-06070-60	M6-1.00 x 70
M931-06070-SS	M6-1.00 x 70
M931-06075-60	M6-1.00 x 75
M931-06090-60	M6-1.00 x 90
M931-06145-60	M6-1.00 x 145
M931-06150-60	M6-1.00 x 150
M931-08035-60	M8-1.25 x 35
M931-08040-60	M8-1.25 x 40
M931-08045-60	M8-1.25 x 45
M931-08050-60	M8-1.25 x 50
M931-08055-60	M8-1.25 x 55
M931-08055-82	M8-1.25 x 55*
M931-08060-60	M8-1.25 x 60
M931-08070-60	M8-1.25 x 70
M931-08070-82	M8-1.25 x 70*
M931-08075-60	M8-1.25 x 75
M931-08080-60	M8-1.25 x 80
M931-08090-60	M8-1.25 x 90
M931-08095-60	M8-1.25 x 95
M931-08100-60	M8-1.25 x 100
M931-08110-60	M8-1.25 x 110
M931-08120-60	M8-1.25 x 120
M931-08130-60	M8-1.25 x 130
M931-08140-60	M8-1.25 x 140
M931-08150-60	M8-1.25 x 150
M931-08200-60	M8-1.25 x 200
M931-10040-82	M10-1.25 x 40*
M931-10040-60	M10-1.50 x 40
M931-10045-60	M10-1.50 x 45
M931-10050-60	M10-1.50 x 50
M931-10050-82	M10-1.25 x 50*
M931-10055-60	M10-1.50 x 55
M931-10060-60	M10-1.50 x 60
M931-10065-60	M10-1.50 x 65
M931-10070-60	M10-1.50 x 70
M931-10080-60	M10-1.50 x 80
M931-10080-82	M10-1.25 x 80*
M931-10090-60	M10-1.50 x 90
M931-10090-82	M10-1.50 x 90*
M931-10100-60	M10-1.50 x 100
M931-10110-60	M10-1.50 x 110
M931-10120-60	M10-1.50 x 120
M931-10130-60	M10-1.50 x 130
M931-10140-60	M10-1.50 x 140
M931-10180-60	M10-1.50 x 180
M931-10235-60	M10-1.50 x 235
M931-10260-60	M10-1.50 x 260
M960-10330-60	M10-1.25 x 330
M931-12045-60	M12-1.75 x 45
M960-12050-60	M12-1.25 x 50
M960-12050-82	M12-1.25 x 50*
M931-12050-60	M12-1.75 x 50
M931-12050-82	M12-1.75 x 50*
M931-12055-60	M12-1.75 x 55
M931-12060-60	M12-1.75 x 60
M931-12060-82	M12-1.75 x 60*
M931-12065-60	M12-1.75 x 65
M931-12075-60	M12-1.75 x 75
M931-12080-60	M12-1.75 x 80
M931-12090-60	M12-1.75 x 90
M931-12100-60	M12-1.75 x 100
M931-12110-60	M12-1.75 x 110

Hex Head Bolts (Partial Thread), continued

Part No.	Dimensions
M960-16090-60	M16-1.50 x 90
M931-16090-60	M16-2.00 x 90
M931-16100-60	M16-2.00 x 100
M931-16100-82	M16-2.00 x 100*
M931-16120-60	M16-2.00 x 120
M931-16150-60	M16-2.00 x 150
M931-20065-60	M20-2.50 x 65
M931-20090-60	M20-2.50 x 90
M931-20100-60	M20-2.50 x 100
M931-20120-60	M20-2.50 x 120
M931-20140-60	M20-2.50 x 140
M931-20160-60	M20-2.50 x 160
M931-22090-60	M22-2.50 x 90
M931-22120-60	M22-2.50 x 120
M931-22160-60	M22-2.50 x 160
M931-24090-60	M24-3.00 x 90
M931-24120-60	M24-3.00 x 120
M931-24160-60	M24-3.00 x 160
M931-24200-60	M24-3.00 x 200

Hex Head Bolts (Full Thread)

M933-04006-60	M4-0.70 x 6
M933-05030-60	M5-0.80 x 30
M933-05035-60	M5-0.80 x 35
M933-05050-60	M5-0.80 x 50
M933-06010-60	M6-1.00 x 10
M933-06012-60	M6-1.00 x 12
M933-06014-60	M6-1.00 x 14
M933-06016-60	M6-1.00 x 16
M933-06020-60	M6-1.00 x 20
M933-06025-60	M6-1.00 x 25
M933-06030-60	M6-1.00 x 30
M933-06040-60	M6-1.00 x 40
M933-06050-60	M6-1.00 x 50
M933-07025-60	M7-1.00 x 25
M933-08010-60	M8-1.25 x 10
M933-08012-60	M8-1.25 x 12
M933-08016-60	M8-1.25 x 16
M933-08020-60	M8-1.25 x 20
M933-08025-60	M8-1.25 x 25
M933-08030-60	M8-1.25 x 30
M933-08030-82	M8-1.25 x 30*
M933-10012-60	M10-1.50 x 12
M961-10020-60	M10-1.25 x 20
M933-10020-60	M10-1.50 x 20
M933-10025-60	M10-1.50 x 25
M961-10025-60	M10-1.25 x 25
M933-10025-82	M10-1.50 x 25*
M961-10030-60	M10-1.25 x 30
M933-10030-60	M10-1.50 x 30
M933-10030-82	M10-1.50 x 30*
M961-10035-60	M10-1.25 x 35
M933-10035-60	M10-1.50 x 35
M933-10035-82	M10-1.50 x 35*
M961-10040-60	M10-1.25 x 40

Hex Head Bolts (Full Thread), continued

Part No.	Dimensions
M933-12016-60	M12-1.75 x 16
M933-12020-60	M12-1.75 x 20
M961-12020-60F	M12-1.50 x 20
M933-12025-60	M12-1.75 x 25
M933-12025-82	M12-1.75 x 25*
M961-12030-60	M12-1.25 x 30
M933-12030-82	M12-1.75 x 30*
M961-12030-82F	M12-1.50 x 30*
M933-12030-60	M12-1.75 x 30
M933-12035-60	M12-1.75 x 35
M961-12040-82	M12-1.25 x 40*
M933-12040-60	M12-1.75 x 40
M933-12040-82	M12-1.75 x 40*
M961-14025-60	M14-1.50 x 25
M933-14025-60	M14-2.00 x 25
M961-14050-82	M14-1.50 x 50*
M961-16025-60	M16-1.50 x 25
M933-16025-60	M16-2.00 x 25
M961-16030-82	M16-1.50 x 30*
M933-16030-82	M16-2.00 x 30*
M933-16035-60	M16-2.00 x 35
M961-16040-60	M16-1.50 x 40
M933-16040-60	M16-2.00 x 40
M961-16045-82	M16-1.50 x 45*
M933-16045-82	M16-2.00 x 45*
M933-16050-60	M16-2.00 x 50
M933-16050-82	M16-2.00 x 50*
M933-16060-60	M16-2.00 x 60
M933-16070-60	M16-2.00 x 70
M933-18035-60	M18-2.50 x 35
M933-18050-60	M18-2.50 x 50
M933-18060-60	M18-2.50 x 60
M933-20050-60	M20-2.50 x 50
M933-20055-60	M20-2.50 x 55
M933-24060-60	M24-3.00 x 60
M933-24065-60	M24-3.00 x 65
M933-24070-60	M24-3.00 x 70

Pan Head Machine Screws

M7985A-03010-20	M3-0.50 x 10
M7985A-03012-20	M3-0.50 x 12
M7985A-04010-20	M4-0.70 x 10
M7985A-04016-20	M4-0.70 x 16
M7985A-04020-20	M4-0.70 x 20
M7985A-04050-20	M4-0.70 x 50
M7985A-04100-20	M4-0.70 x 100
M7985A-05010-20	M5-0.80 x 10
M7985A-05012-20	M5-0.80 x 12
M7985A-05016-20	M5-0.80 x 16
M7985A-05020-20	M5-0.80 x 20
M7985A-05025-20	M5-0.80 x 25
M7985A-05030-20	M5-0.80 x 30
M7985A-05080-20	M5-0.80 x 80
M7985A-05100-20	M5-0.80 x 100
M7985A-06100-20	M6-1.00 x 100

Flat Head Machine Screws

M965A-04012-SS	M4-0.70 x 12
M965A-05012-SS	M5-0.80 x 12
M965A-05016-20	M5-0.80 x 16
M965A-06012-20	M6-1.00 x 12

* This metric hex bolt's hardness is grade 10.9.

Metric, continued

Part No.	Dimensions	Type
Hex Nuts		
M934-03-50	M3-0.50	Standard
M934-04-50	M4-0.70	Standard
M934-04-B	M4-0.70	Brass
M934-05-50	M5-0.80	Standard
M934-06-60	M6-1.00	Standard
M934-06-64	M6-1.00	Std. (green)
M6923-06-80	M6-1.00	Spiralock
M982-06-80	M6-1.00	Elastic Stop
M934-08-60	M8-1.25	Standard
M6923-08-80	M8-1.25	Spiralock
M982-08-80	M8-1.25	Elastic Stop
M934-10-60	M10-1.50	Standard
M934-10-60F	M10-1.25	Standard
M6923-10-80	M10-1.50	Spiralock
M6923-10-62	M10-1.50	Spiralock†
M982-10-80	M10-1.50	Elastic Stop
M934-12-60	M12-1.75	Standard
M934-12-60F	M12-1.25	Standard
M6923-12-80	M12-1.75	Spiralock
M982-12-80	M12-1.75	Elastic Stop
M982-14-60	M14-2.00	Elastic Stop
M6923-16-80	M16-2.00	Spiralock
M982-16-80	M16-2.00	Elastic Stop
M934-18-80	M18-2.5	Standard
M982-18-60	M18-2.50	Elastic Stop
M934-20-80	M20-2.50	Standard
M982-20-80	M20-2.50	Elastic Stop
M934-22-60	M22-2.50	Standard
M934-24-80	M24-3.00	Standard
M982-24-60	M24-3.00	Elastic Stop
M934-30-80	M30-3.50	Standard

Washers

Part No.	ID	OD	Thick.	Bolt/ Screw
M125A-03-80	3.2	7.0	0.5	M3
M125A-04-80	4.3	9.0	0.8	M4
M125A-05-80	5.3	10.0	1.0	M5
M125A-06-80	6.4	12.0	1.6	M6
M125A-08-80	8.4	16.0	1.6	M8
M125A-10-80	10.5	20.0	2.0	M10
M125A-12-80	13.0	24.0	2.5	M12
M125A-14-80	15.0	28.0	2.5	M14
M125A-16-80	17.0	30.0	3.0	M16
M125A-18-80	19.0	34.0	3.0	M18
M125A-20-80	21.0	37.0	3.0	M20
M125A-24-80	25.0	44.0	4.0	M24

† This metric hex nut's hardness is grade 8.

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