# **Operation**

# Residential/Light Commercial Generator Sets



Model: 38RCL 48RCL

Controller: RDC2



KOHLER® POVVER SYSTEMS\_\_\_\_\_

TP-6810 6/12a

## **California Proposition 65**



Engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

## **Product Identification Information**

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

## **Generator Set Identification Numbers**

generator set nameplat	e(s).	engi
Specification Number _		Man Mod Seri
Accessory Number	Accessory Description	

## **Controller Identification**

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

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

## **Engine Identification**

Record the product identification	information	from	the
engine nameplate.			

Manufacturer	
Model Designation	
Serial Number	

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

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



### **DANGER**

Danger indicates 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 Accidental starting can cause severe injury or death. 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**

## A

## 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 eves 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 batterv before generator set installation maintenance. Remove all iewelry 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



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 for electrical fires or as recommended by the local fire code or an authorized agency. Train all extinguisher personnel on fire operation and fire prevention procedures.

## Exhaust System



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. Never operate the generator set where exhaust gas could seep inside or be drawn into a potentially occupied building through windows, air intake vents, or other openings.

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.

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 the according to detectors manufacturer's instructions.

## **Fuel System**



Explosive fuel vapors.
Can cause severe injury or death.

Use extreme care when handling, storing, and using fuels.

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

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

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

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

Gas fuel leaks. **Explosive fuel** vapors can cause severe injury or death. Fuel leakage can cause an explosion. Check the LP vapor gas 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 (10-14 inches water column). Do not use a soap solution containing either ammonia or chlorine because both prevent bubble formation. successful test depends on the ability of the solution to bubble.

## **Hazardous Noise**

**A** CAUTION



Hazardous noise. Can cause hearing loss.

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

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

## Hazardous Voltage/ Moving Parts



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.

## **A** 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 before servicina equipment. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

Disconnecting the electrical load. Hazardous voltage can cause severe injury or death. Disconnect the generator set from the load by turning off the line circuit breaker or by disconnecting the generator set output leads from the transfer switch and heavily taping the ends of the leads. High voltage transferred to the load during testing may cause personal injury and equipment damage. Do not use the safeguard circuit breaker in place of the line circuit breaker. The safeguard circuit breaker does not disconnect the generator set from the load.

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.

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.

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

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





Airborne particles. Can cause severe injury or blindness.

Wear protective goggles and clothing when using power tools, hand tools, or compressed air.

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.

## **Heavy Equipment**



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**



Hot coolant and steam. Can cause severe injury or death.

Before removing the pressure cap, stop the generator set and allow it to cool. Then loosen the pressure cap to relieve pressure.



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

Do not work on the generator set until it cools.

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

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

## **Notice**

### **NOTICE**

**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 operation instructions for Model 38RCL and 48RCL residential/light commercial generator sets equipped with the RDC2 generator set/transfer switch controller.

This generator set is approved for use in stationary applications in locations served by a reliable utility power source. Have the generator set installed by an authorized Kohler distributor/dealer or service technician. Refer to the Installation Manual for installation instructions.

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

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

The equipment maintenance requirements are very important for safe and efficient operation. Inspect the parts often and perform required maintenance at the prescribed intervals. Obtain service from an authorized Kohler distributor/ dealer or service technician to keep equipment in top condition.



Figure 1 Model 48RCL Generator Set

## Nameplate

Figure 2 shows a typical generator set nameplate. Copy the model, serial, and specification numbers from the nameplate into the spaces provided in the product information section on the inside front cover of this manual. See the service view in Section 1 for the nameplate location.

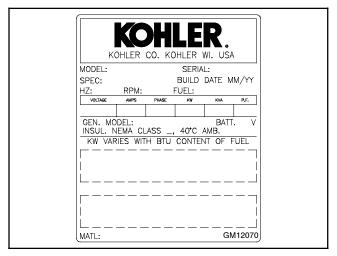


Figure 2 Nameplate, Typical

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## **List of Related Literature**

Figure 3 identifies related literature available for the generator sets covered in this manual. Only trained and qualified personnel should install or service the generator set.

Literature Type	Part Number
Specification Sheet, 38RCL	G4-214
Specification Sheet, 48RCL	G4-211
Installation Manual, Generator Set	TP-6809
Operation Manual, Engine	TP-6101
Service Manual, Generator Set	TP-6811
Service Manual, 38RCL Engine Mechanical	TP-6103
Service Manual, 48RCL Engine Mechanical	TP-6104
Service Manual, Engine ECM Diagnostics	TP-6724
Service Manual, 38RCL Alternator	TP-6353
Service Manual, 48RCL Alternator	TP-6783
Parts Catalog, 38RCL Engine	TP-6730
Parts Catalog, 48RCL Engine	TP-6731
Parts Catalog, Generator Set	TP-6812
Installation Instructions, Load Control Module (LCM)	TT-1574
Installation Instructions, Programmable Interface Module (PIM)	TT-1584
Operation Manual, OnCue™ Software	TP-6796
Operation/Installation Manual, RXT ATS	TP-6807
Operation/Installation Manual, RDT ATS	TP-6345
Installation Manual, RSB Transfer Switch	TP-6486
Operation Manual, RSB Transfer Switch	TP-6487

Figure 3 Related Literature

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## **Service Assistance**

For professional advice on generator set power requirements and conscientious service, please contact your nearest authorized 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 stickers 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

India Regional Office Bangalore, India

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Fax: (91) 80 3315972

## Japan, Korea

North Asia Regional Office

Tokyo, Japan

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### **Latin America**

Latin America Regional Office

Lakeland, Florida, USA Phone: (863) 619-7568 Fax: (863) 701-7131

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## **Notes**

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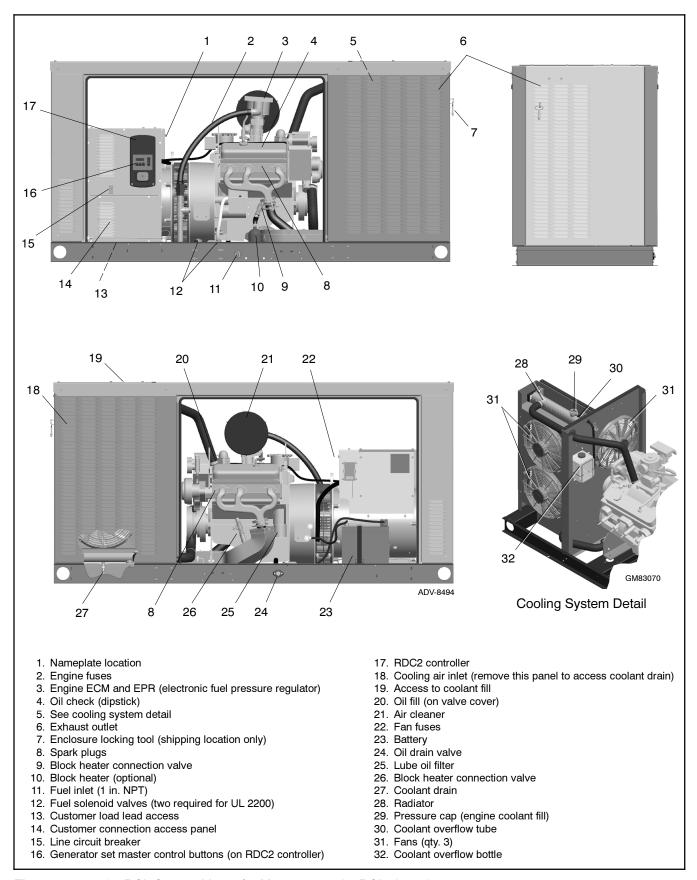


Figure 1-1 38/48RCL Service Views for Maintenance (38RCL shown)

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## **Notes**

14 Section 1 Service Views TP-6810 6/12

## 2.1 Operating Area



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

The exhaust system must be leakproof and routinely inspected.

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 ioints 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.

Keep the generator set area clear. Maintain at least 0.9 m (3 ft.) of clearance on all sides of the generator set. Verify that there are no windows, air vents, or other openings in the building within 1.5 m (5 ft.) of the generator set exhaust outlet in any direction.

### **Notice**

Do not locate patios, decks, play areas, or animal shelters near the generator set. Keep items such as lawn furniture, toys, sports equipment, and all combustible materials away from the generator set exhaust outlet. Remind family members, children, and visitors to use caution near the generator set.

Generator sets connected to automatic transfer switches start automatically during exercise periods and power outages. Some generator set components become hot when the generator set is running and remain hot for a time after the generator set shuts down.

## 2.2 Prestart Checklist

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

Air Cleaner. Check for a clean and installed air cleaner element to prevent unfiltered air from entering the engine.

Air Inlets. Check for obstructions that could block the flow of cooling air. Keep the air intake area clean. Do not leave rags, tools, or debris on or near the generator set.

Battery. Check for tight battery connections. Consult the battery manufacturer's instructions regarding battery care and maintenance.

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

Note: Block heater damage. The block heater will fail if the energized heater element is not immersed in coolant. Fill the cooling system before turning on the block heater. Run the engine until it is warm, and refill the radiator to purge the air from the system before energizing the block heater.

Drive Belt(s). Check the belt condition of the water pump and battery charging alternator belt(s).

Exhaust System. Check for exhaust leaks and blockages. Check the silencer and piping condition and check for tight exhaust system connections.

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

- Check for corroded or broken metal parts and replace them as needed.
- Check that there are no combustible materials near the exhaust outlet.
- Check that the exhaust outlet is unobstructed.

Carbon Monoxide Detectors. Check for the installation and operation of carbon monoxide (CO) detectors on each level of any building near the generator set.

Oil Level. Maintain the oil level at or near, not over, the full mark on the dipstick.

## 2.3 Exercising the Generator Set

Operate the generator set without load every week or every other week for 20 minutes. Perform all of the prestart checks before starting the exercise procedure. See Section 2.5 for instructions to set the automatic exerciser.

#### 2.4 **Generator Set Operation**

#### 2.4.1 **Local Starting and Stopping**

Start: Press the RUN button to immediately start the generator set.

**Stop:** Press the OFF button. The engine stops.

Run the generator set with no load for at least 2 minutes to ensure adequate engine cooldown.

#### 2.4.2 **Automatic Starting and Stopping**

An automatic transfer switch monitors the utility power and signals the generator set to start when utility power is lost. The ATS then transfers the load to the generator

When utility power is restored, the transfer switch transfers the load back to utility, runs the generator set with no load to cool down the engine, and then stops the generator set engine. The electric fans continue to run for two minutes after the engine shuts down to evacuate the engine compartment.

#### 2.4.3 **Remote Starting and Stopping**

A remote switch connected to terminals 3 and 4 can be used to start and stop the generator set. Close the switch to start and run the generator set. Open the switch to stop the generator set.

Run the generator set with no load for at least 2 minutes to ensure adequate engine cooldown.

#### 2.4.4 **Engine Start Crank Cycle**

The controller attempts to start the generator set three times (three crank cycles, 15 seconds crank and 15 seconds off). If the generator set does not start in three attempts, the system shuts down on an overcrank fault. See Section 2.6.

Pressing the OFF button during the crank cycle stops the cranking. No other buttons are acknowledged during the crank cycle.

#### 2.4.5 **Engine Cooldown**

The engine cooldown time delay allows the engine to run after the loads have been removed.

The engine cooldown time delay is set to 5 minutes. The engine stops before the cooldown time delay expires if the temperature drops below the cooled-down temperature level, or if the temperature rises above the high limit during the cooldown cycle.

The electric fans continue to run for two minutes after the engine shuts down to evacuate the engine compartment.

If a transfer switch other than the Model RXT is used, an additional engine cooldown time delay may be programmed on the transfer switch. To allow the smart engine cooldown on the RDC2 controller to operate most efficiently, set the cooldown time on the transfer switch controller to zero or the minimum time allowed. Refer to the instructions provided with the transfer switch for more information.

#### **Automatic Operation with Model** 2.4.6 **RXT Transfer Switch**

The Model RXT transfer switch connects to the RDC2 controller through the ATS interface board on the transfer switch. Also see Section 2.7, Model RXT Transfer Switch Operation.

The RDC2 controller must be in AUTO mode for automatic transfer switch operation.

## **Automatic Start**

The RDC2 controller receives utility source voltage sensing data from the Model RXT transfer switch.

- 1. If the utility source voltage falls below an acceptable level, the controller starts the engine start time delay.
- 2. If the utility source is not restored before the time delay expires, the generator set starts.
- 3. After the Normal-to-Emergency time delay, the ATS is signaled to transfer the load to the emergency source.

### **Automatic Stop**

- 1. When the utility source is restored, the Emergency-to-Normal time delay starts.
- 2. When the Emergency-to-Normal time delay expires, the load is transferred to the utility.
- 3. The generator set stops.

#### 2.4.7 **Automatic Operation with Model RDT or RSB Transfer Switches**

If a Kohler Model RDT or RSB transfer switch is used. the engine start contacts from the ATS must be connected to engine start leads 3 and 4 on the generator set.

The RDC2 generator set controller must be in AUTO mode to respond to remote start/stop signals from an ATS or remote switch. Press the AUTO button on the RDC2 controller to put the generator set into automatic mode.

### **Automatic Start**

The engine start contacts on the ATS close to signal the generator set to start, and remain closed while the generator set is running.

## **Automatic Stop**

The engine start contacts on the ATS open to signal the generator set to stop.

## 2.5 Exercise

The RDC2 controller can be set to automatically run the generator set at the same time and day every week or every other week. Exercising the generator set every week or every two weeks is required in order to keep the engine and alternator in good operating condition.

Three exercise modes are available: unloaded cycle, unloaded full speed, and loaded full speed. See Sections 2.5.1 through 2.5.3 for information about the exercise modes. A loaded exercise can be set at the RDC2 controller only if a Model RXT transfer switch is connected.

Note: With the RDT and RSB transfer switches, it is possible to have two exercise settings (one unloaded exercise set at the generator set controller, and another exercise set at the ATS controller). If the exercise times overlap, the ATS exercise setting takes priority.

If a Model RDT or RSB transfer switch is used, refer to the instructions provided with the transfer switch to set a loaded exercise at the ATS, if desired.

### 2.5.1 **Unloaded Cycle Exercise with Complete System Diagnostics**

An unloaded cycle exercise runs the generator set without signalling the transfer switch to transfer the electrical load from the utility source to the generator set. The Unloaded Cycle exercise with diagnostics is the recommended exercise mode and is the factory-default exercise setting.

The Unloaded Cycle exercise runs the engine for 20 minutes in the cycle shown in Figure 2-1 and described below.

- Runs at reduced speed for 10 minutes to warm up and exercise the engine.
- Ramps up and runs at full speed for 3 minutes. Engine diagnostics are performed during this full-speed portion of the cycle, which provides the best test of engine and alternator power backup capability. Diagnostic tests at full speed can identify potential problems with the power output and alert the operator before an emergency event.
- Ramps down and runs at reduced speed for 5 minutes to cool down the engine before shutting down automatically.

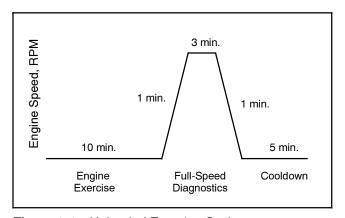


Figure 2-1 Unloaded Exercise Cycle

## **System Diagnostics**

During the unloaded cycle exercise, the controller monitors the following data. The controller display indicates an unloaded exercise run during the diagnostics, unless a fault is detected as described below.

- ATS connection. The controller verifies that the Model RXT ATS interface board is connected.
- Battery voltage. Battery voltage is checked before exercise to verify engine starting capability. Battery voltage provides a measurement of battery health. If the controller detects low battery voltage, low battery or low charging battery is displayed and the exercise does not start.
- Coolant level check. The coolant level is checked.
- Communication integrity tests. J1939, RBUS, Ethernet, and USB are monitored for messages indicating that the controller and wiring are reliable.
- Engine speed. Engine speed is measured at low speed and full speed. An overspeed or underspeed condition will result in a fault condition and shutdown.
- Generator output frequency and voltage. Operating the generator at full speed allows the RDC2 controller to check the output power for correct voltage, frequency, and stability. When the engine is running at full speed, the controller verifies that the voltage and frequency are within acceptable limits. A fault message is displayed if the voltage or frequency is out of range.
- Oil pressure. Oil pressure is verified to ensure proper lubrication of critical engine components. Pressure is monitored at both low and full speeds. If the oil pressure is low, low oil pressure is displayed and the generator set shuts down.

#### 2.5.2 **Unloaded Full-Speed Exercise**

The unloaded full speed exercise runs the generator set at full speed for 20 minutes without transferring the load.

To set an unloaded full speed exercise, follow the procedure in Figure 2-3 and select Exercise Mode: Unloaded Full.

### 2.5.3 **Loaded Full-Speed Exercise (with RXT only)**

A loaded exercise starts the generator set, ramps up to full speed, and then transfers the electrical load from the utility source to the generator set. The load is transferred back to the utility source before the generator set shuts down.

**Note:** With a loaded exercise, power to the building is lost for up to 10 seconds during load transfer.

For a loaded exercise controlled by the RDC2 controller. a Model RXT transfer switch must be connected to the generator set. To set a loaded exercise, follow the procedure in Section 2.5.7 and select Exercise Type: Loaded.

For a loaded exercise with a transfer switch other than a Kohler® Model RXT, program the exercise at the transfer switch controller. Refer to the transfer switch operation manual for instructions.

#### **Power Failure During Exercise** 2.5.4

If the utility power is lost during an unloaded exercise, the ATS transfers to the emergency source, the exercise is ended and the control remains in the AUTO mode.

If the utility power is lost during a loaded exercise, the exercise is ended. The ATS remains in the emergency position and the control goes into the AUTO mode.

The generator set continues to run and supply power to the load for the duration of the utility power outage. When Utility power is restored, the ATS will re-transfer to the utility source through normal timing sequences.

#### 2.5.5 **Exerciser Reset**

To reset the exerciser to run at a different day and/or time or to change the exercise mode, follow the procedure in Section 2.5.6 to change the exerciser settings.

#### 2.5.6 **Setting the Exerciser at Power-up**

When power is connected to the controller, you will be prompted to set the date, time, and exercise schedule.

- 1. At power-up, the date is displayed with the year flashing. Use the up or down arrow key to step to the current year.
- 2. Press Select button to save the year and move to the month.
- 3. Use the arrow and select buttons to set the month and the day.
- 4. The time is displayed with the hour flashing. Use the up or down arrow key to step to the current hour and am or pm setting.

Note: Check the am/pm setting displayed. If pm is displayed and you need to change it to am, use the down arrow button to step down in time until the correct hour and am are displayed.

- 5. Press the Select button to save the hour and move to minutes.
- 6. Use the up or down arrow button to change the minutes.
- 7. Press Select to save the time and move to the next screen.
- 8. Next Exercise is displayed. Use the up, down, and select buttons to set the exercise time and date. Be sure to set a time and date in the future.
- 9. Press Select. The controller exits the exercise menu.
- 10. Press the Auto button and verify that the AUTO LED is lit. The generator set must be in automatic mode for the exercise to run as scheduled.

The exercise will run every 7 days at the same time, starting on the date set. To change the exerciser to run every other week or on a different day and time, use the following procedure.

#### 2.5.7 **Changing the Exercise Setting**

Set the date and time on the controller before setting the exercise schedule. Set the exerciser to automatically run the generator set for 20 minutes every week or every two weeks. Follow the procedure below and see the flowchart in Figure 2-3 to set the exercise time and date, mode, and frequency.

## **Procedure to Change the Exercise Setting**

- 1. Press the AUTO button on the controller.
- 2. Press the Select button to go to the main menu. See Figure 2-2.
- 3. Press the down arrow button to step to the Genset System menu.
- 4. Press the Select button to enter the Genset system menu. See Figure 2-3.

- 5. Use the down arrow button to step to the next Exercise menu.
- 6. Press the Select button. The setting flashes to show that it can be changed. For example, the hour flashes to show that the hour can be changed.
- 7. Press the UP or Down arrow buttons to change the setting.
- 8. Press the Select button to save the setting and move to the next. For example, save the hour setting and move to minutes.
- 9. Repeat steps 5 through 8 to change the next item on the line until the desired settings are displayed.
- 10. Press Select to save after all settings have been selected. Settings will stop flashing.
- 11. If the generator set is connected to a Kohler® Model RXT transfer switch, the exercise can be changed to a loaded exercise. Set the Exercise Mode to loaded full speed, unloaded full speed, or unloaded cycle as shown in Figure 2-3.
- 12. Set the exercise frequency (weekly or every two weeks). Weekly exercises are recommended.
- 13. Press the down arrow button to step to the Return menu. Press the Select button to return to the main menu.
- 14. Check that the AUTO LED is lit. The generator set must be in automatic mode for the exercise to run as scheduled.

After a scheduled exercise run, the next exercise time and date will be updated automatically based on the Exercise Frequency setting.

Other transfer switches: For a loaded exercise with a transfer switch other than a Kohler® Model RXT. program the exercise at the transfer switch controller. Refer to the transfer switch operation manual for instructions.

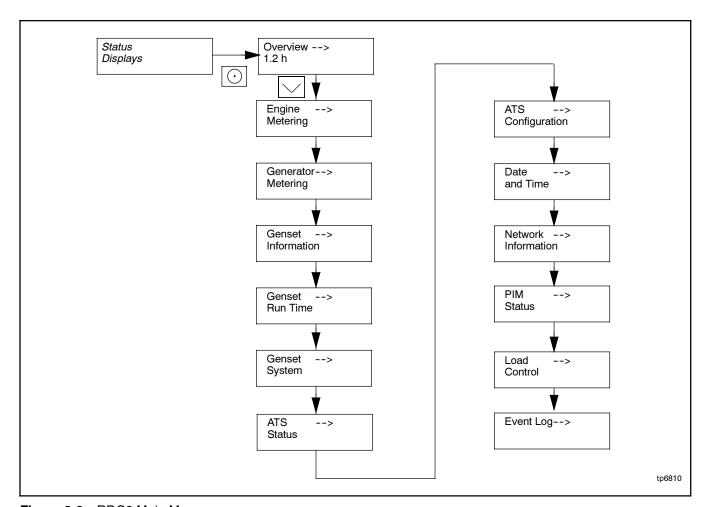


Figure 2-2 RDC2 Main Menu

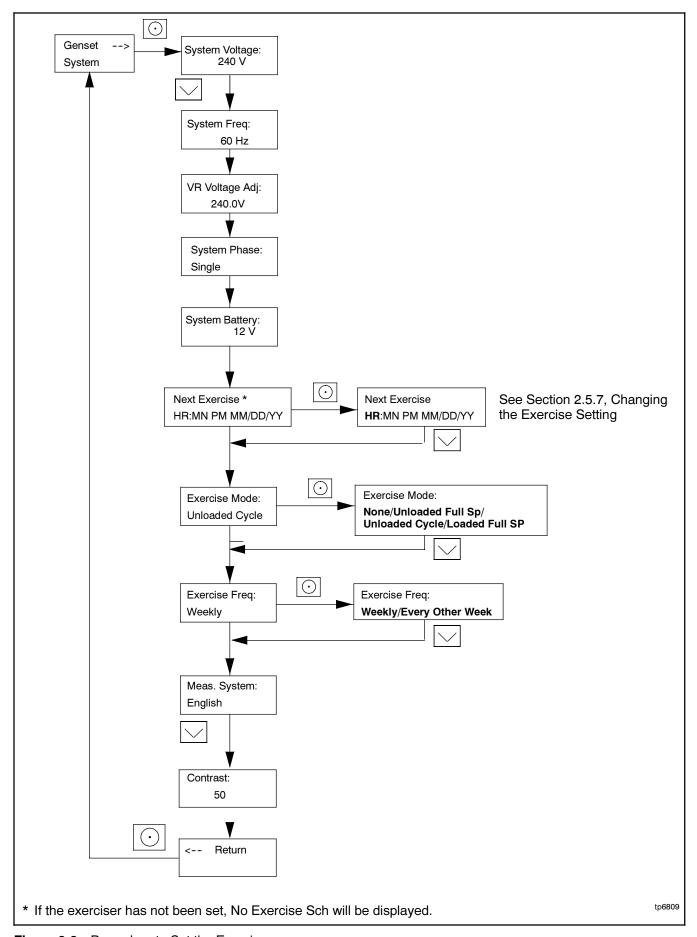


Figure 2-3 Procedure to Set the Exerciser

## 2.6 Faults

Selected fault conditions are shown in Figure 2-5. Fault conditions are classified as warnings or shutdowns. If a fault occurs that is not listed in the table, contact an authorized distributor/dealer for service.

If a programmable interface module (PIM) is connected to the generator set controller, additional faults can be activated by customer-supplied equipment. TT-1584, Installation Instructions for the Programmable Interface Module, for available inputs and outputs.

#### 2.6.1 **Warnings**

The controller displays a fault message but the generator set does not shut down on a warning. The controller resets automatically after a warning condition is corrected.

#### 2.6.2 **Shutdowns**

Under a fault shutdown condition, the generator set shuts down automatically and the controller displays a fault message. The OFF LED flashes. See Figure 2-5.

Shutdown switches (such as the low coolant level switch or high engine temperature switch) on the generator set will automatically reset when the problem is corrected. However, the fault condition at the controller does not clear until the controller is reset.

The generator set cannot be restarted until the fault condition is corrected and the controller is reset. See Section 2.6.4 to reset the controller after a fault shutdown.

#### 2.6.3 **ATS Communication Errors**

When a Model RXT transfer switch is used, an ATS fault indicates that the connection to the interface board on

the transfer switch has been lost. Check the connection to the ATS interface board.

#### 2.6.4 Resetting the Controller after a **Fault Shutdown**

Always identify and correct the cause of a fault shutdown before resetting the controller. Check the fault message displayed on the controller and refer to Figure 2-5 to identify and correct the fault condition before proceeding. Contact an authorized distributor/dealer for service, if necessary.

Press the OFF button to reset the controller, or follow the procedure below. See Figure 2-4.

## Procedure to Reset the Controller after a Fault Shutdown

- 1. Press the Select button to go to the Overview menu.
- 2. Press Select again. The active fault is displayed.
- 3. Press Select. Confirm Clear Fault: NO is displayed.
- 4. Press the Up arrow button. Confirm Clear Fault: YES is displayed.
- 5. Press the Select button to enter YES and clear the fault
- 6. Press the Select Button to return to the overview menu.
- 7. Press AUTO to put the generator set into automatic

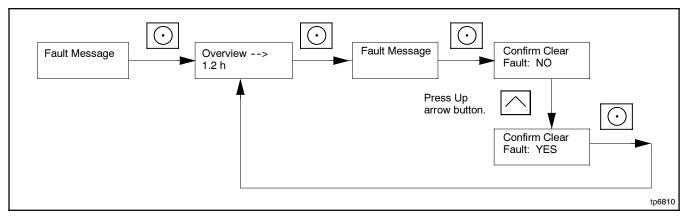


Figure 2-4 Clearing a Fault

Fault	Warning (W) or Shutdown (SD)	Condition	Check
AC Sens Lost	W (1 sec.) SD (3 sec.)	AC Sensing Lost. In Auto mode, generator output AC sensing is lost. Starts 10 seconds after crank disconnect.	Contact an authorized distributor/dealer for service.
		Warning: after 1 second if no output detected after crank disconnect.	
		Shutdown: after 3 seconds if voltage was present and then lost.	
Accy PwrOver Warning	W	Accessory Power Overload. An over current fault (short circuit) on the accessory controller power output.	Contact an authorized distributor/dealer for service.
Alt Protect Shtdwn	SD	High generator current has been detected. The generator set shuts down to protect the alternator from damage caused by overheating the windings. (38RCL only)	Reduce the load.
ATS Com Error	W	Ats Communication Error. Warning is displayed if RXT interface connection is lost. See Section 2.6.3.	Check communication wiring between transfer switch interface board and generator set.
ATS PhaseRot	W	ATS Phase Rotation Mismatch. Transfer switch phase rotation does not match. ATS will not transfer.	Correct the ATS connection. Refer to the ATS Installation manual, wiring diagrams, and labels on the transfer switch.
Aux Input	SD	Auxiliary Input. An optional customer-connected input is closed. (Digital input from optional PIM.)	Check customer-supplied equipment.
Batt Chg Flt	W	Battery charger fault. Input to PIM from an external battery charger (not the built-in battery charger).	Check external battery charger.
Battery Voltage High	W	Engine starting battery voltage rises above 125% of the battery voltage setting for more than 10 seconds. Inhibited during the engine crank cycle.	Check the battery rating and condition. Check the battery charger operation.
		Clears when the battery voltage returns to an acceptable level.	
Battery Voltage Low	W	Engine starting battery voltage falls below the battery voltage setting (typically 12.5 volts) for	Check the battery rating and condition.
		more than 90 seconds when the engine is not running. Inhibited during the engine crank cycle.	Check the battery charger operation.
		Clears when the battery voltage returns to an acceptable level.	Charge or replace the battery.
CAN comm	SD	Engine CAN communications fault.	Check wiring to ECM.
fault			Check power to ECM.
Engine Coolant Temperature High	SD	Engine coolant temperature exceeds the maximum temperature for more than 5 seconds. Function becomes active after crank disconnect.	Check for blocked air inlets and exhaust outlets.
Engine Oil Pressure Low	SD	The engine ECM indicates low oil pressure for more than 5 seconds. Function becomes active	Check for leaks in the lubrication system.
		30 seconds after crank disconnect (30 second inhibit).	Check the oil level and add oil if the level is low.
		<b>Note:</b> The low oil pressure shutdown does not protect against low oil level. Check the engine oil level regularly as recommended in Section 4.	
EngineSpeed High	SD	Engine speed exceeds 115% of the normal running speed for more than 0.3 seconds.	Contact an authorized distributor/dealer for service.
EngineSpeed	SD	Engine speed drops below 85% of the normal	Reduce the load.
Low		running speed for more than 3 seconds.	Contact an authorized distributor/dealer for service.

Fault	Warning (W) or Shutdown (SD)	Condition	Check
Exer Not Sch	W	Exercise Not Scheduled. No exercise has been scheduled on the RDC2 controller.	See Section 2.5 for instructions to set the exerciser.
Generator Frequency High	SD	Governed frequency exceeds 110% of the system's frequency setpoint for more than 10 seconds. Function becomes active 10 seconds after engine start (10 second inhibit).	Contact an authorized distributor/dealer for service.
Generator Frequency Low	SD	Governed frequency falls below 90% of the system frequency setting for more than 10 seconds, or 1 Hz below the system frequency setting for more than 60 seconds.	Reduce the load and restart the generator set.  Contact an authorized distributor/dealer for service.
		Function becomes active 10 seconds after engine start (10 second inhibit).	
Generator VoltageL1-L2 High	SD	Generator Voltage High. Output voltage exceeds 120% of the system nominal voltage for more than 2 seconds.	Contact an authorized distributor/dealer for service.
Generator VoltageL1-L2	SD	Generator Voltage Low. Output voltage falls below 80% of the nominal system voltage for	Reduce the load and restart the generator set.
Low		more than 10 seconds.	Contact an authorized distributor/dealer for service.
Lo Crank VIt	W	Low cranking voltage. Battery voltage falls below 60% of system battery voltage for more than 6 seconds while the starter is engaged.	Charge or replace the battery.
Locked Rotor	SD	No engine rotation is sensed during cranking. Shuts down 3 seconds after the fault is	Check the battery.
		detected.	Check for loose connections.
			Contact an authorized distributor/dealer for service.
MainPwrOverL Shutdown	SD	Main power overload. An over current fault on the 70 controller power output (short circuit).	Contact an authorized distributor/dealer for service.
Not in Auto	W	The generator set is not in Automatic (standby) mode. Remote start and stop commands from a transfer switch or remote switch will be ignored.	Press AUTO to place the generator set in Automatic mode, when appropriate.
Over Crank	SD	Three unsuccessful starting attempts.	Check the fuel supply, spark plug, and battery.
		Check for loose connections.	
			Contact an authorized distributor/dealer for service.
Speed Sensor Fault	SD	Engine speed sensor has failed or engine stalled.	Contact an authorized distributor/dealer for service.
Total Power High ShtDwn	SD	Measured load is greater than 102% of the generator set power rating for more than 1 minute. (38RCL only)	Reduce the load.

Figure 2-5 Controller Fault Messages

#### 2.6.5 **Event Log**

The event log displays up to 1000 controller faults and notices, starting with the most recent event. Events are numbered 1-1000, with 1 being the most recent. Each event is displayed with the date and time of the event. the number of the event, a code to indicate whether the event was a warning (W), shutdown (S), or informational notice (I), the engine hours at the time of the event, and the event description.

### **Procedure to View Event History**

- 1. Press Select to enter the main menu.
- 2. Press the down arrow to step down to the event log.
- 3. Press Select to display the most recent event.
- 4. Press the down arrow to step to the next event.
- 5. Use the up and down arrow buttons to view events.
- 6. Press the Select button to exit the event log.

To stop viewing the event history before the last event, press the select button to return to the main menu.

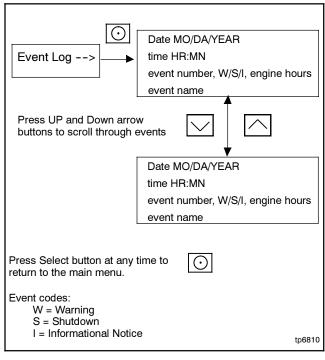


Figure 2-6 Event Log

## 2.7 Model RXT Transfer Switch Operation

The RDC2 generator set/transfer switch controller manages automatic transfer switch (ATS) functions when connected to a Kohler® Model RXT transfer switch through the ATS interface board. Refer to the Model RXT Operation/Installation Manual for information about the transfer switch operation.

#### 2.7.1 **Source Availability**

The Model RXT transfer switch supplies voltage sensing data to the RDC2 controller through the ATS interface board. If the source voltage falls below the undervoltage dropout setting, the source is considered to have failed. See Figure 2-7.

Item	Setting
Accuracy	± 5%
Undervoltage Dropout	90% of Pickup
Undervoltage Pickup	90% of Nominal

Figure 2-7 Voltage Sensing Parameters

The RDC2 controller also has a set of power system LEDs below the pushbuttons. The power system LEDs indicate which power sources are available and which source is supplying power to the building. Figure 3-2.

Note: The power system LEDs operate only if a Model RXT transfer switch is connected. They will not operate if a Model RDT or RSB transfer switch is used.

### **ATS Control Sequence of** 2.7.2 Operation

See Figure 2-8 for time delay settings.

### **Preferred Source Fails:**

- 1. The load control contact opens.
- 2. The engine start time delay times out.
- 3. The generator set is signaled to start.
- 4. The generator starts and the emergency source becomes available.
- 5. The normal-to-emergency time delay times out.
- 6. The transfer switch transfers to the emergency source.
- 7. The load control contact time delay times out.
- 8. The load control contact closes.

### **Normal Source Returns:**

- 1. The emergency-to-normal time delay times out.
- 2. The contactor transfers to the normal source.
- 3. The engine cooldown time delay times out.
- 4. The generator is signaled to stop.

#### 2.7.3 **Time Delays**

Time delays are factory-set to the values shown in Figure 2-8. An authorized distributor/dealer can adjust time delays using a personal computer and Kohler® SiteTech™ software.

Time delays described in this section operate only when the controller is connected to a Kohler® Model RXT transfer switch.

The engine start and load transfer time delays prevent engine start and load transfer caused by brief variations in the utility power source.

#### 2.7.4 **ATS Load Control Relay Time** Delay

The load control time delay allows delayed starting of large motor loads (such as air conditioners), preventing simultaneous starting of large motors after transfer to the generator set. The load control time delay is fixed at 5 minutes. It is not adjustable.

The load must be connected to the load control output on the interface board of the Model RXT transfer switch. See the transfer switch operation and installation manual for connection instructions.

Time Delay	Setting	Description
Engine Start	3 seconds	Time delay after utility source is lost until the engine start cycle begins. Guards against starting the generator set because of a brief change in the utility source.
Transfer, Normal to Emergency	3 seconds	Time delay after emergency source becomes available until transfer to emergency source.
Transfer, Emergency to Normal	2 minutes	Time delay after the utility source returns until transfer back to normal. Ensures that the the utility source is stable before transferring from the emergency source.
Load Control	5 minutes	See Section 2.7.4. Allows delayed connection of selected loads to the generator set to prevent simultaneous starting of large motors after transfer to the emergency source. Recommended for delayed starting of air conditioners.

Figure 2-8 Time Delays

### **RDC2 Generator Set/ Transfer** 3.1 **Switch Controller**

Model 38 RCL and 48RCL generator sets are equipped with the RDC2 generator set/transfer switch controller. The RDC2 controls the following power system components:

- Model 38RCL or 48RCL generator set
- Model RXT automatic transfer switch (ATS)
- Load Control Module (LCM)
- Programmable Interface Module (PIM)

RDC2 Controller features include:

- Two-line x 16 character backlit LCD display with adjustable contrast
- OFF, AUTO, and RUN generator set master control buttons
- Generator set status indicating LEDs (OFF, AUTO, RUN)
- Up, Down, and Select buttons for navigation through menus and adjustments
- Power system indicator LEDs to show utility and generator source status, and to show which source (utility or generator) is supplying power to the building

#### **Controls and Indicators** 3.2

Figure 3-1 illustrates the RDC2 controller. Figure 3-2 shows the keypad, display, and indicators on the controller's user interface.

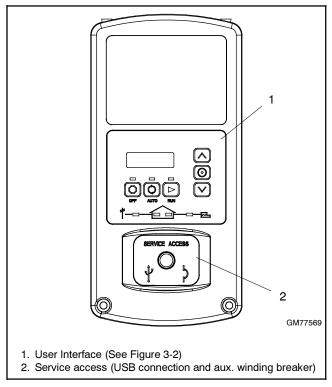


Figure 3-1 RDC2 Controller

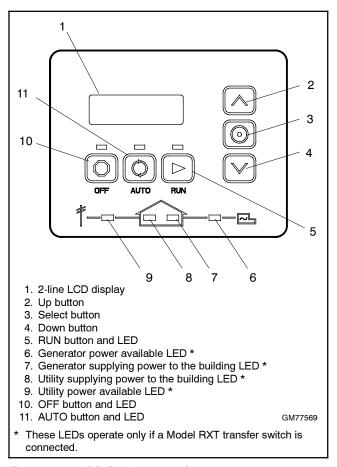


Figure 3-2 RDC2 User Interface

#### 3.2.1 **Controller Keypad**

The Run, Off, and Auto buttons control the generator set as described in Figure 3-3. Use the Select, Up arrow, and Down arrow buttons to navigate through the menus and change settings, if necessary. See Section 2.4 for operation instructions.

#### 3.2.2 **LED Indicators**

LEDs above the RUN, OFF, and AUTO buttons indicate the mode of operation as shown in Figure 3-3.

The RDC2 controller also has a set of power system LEDs below the pushbuttons. The power system LEDs indicate which power sources are available and which source is supplying power to the building (based on the position of the Model RXT transfer switch). See Figure 3-2.

Note: The power system LEDs operate only if a Model RXT transfer switch is connected. They will not operate if a Model RDT or RSB transfer switch is used.

Button	Button Function	
RUN	Starts the generator set. The engine start time delay is ignored.	
OFF	Stops the generator set. The cooldown time delay is ignored.	
	During the engine crank cycle, pressing OFF will stop the crank cycle.	
	Press OFF to clear faults and reset the controller.	
AUTO	Places the generator set in Automatic (standby) mode.	
Down arrow		
Select	Use to navigate through menus and change settings. This manual contains instructions to navigate the controller menus and adjust settings on the RDC2 controller.	
Up arrow	- Some of the had and adjust seeings on the Fib-ob some.	

Figure 3-3 Pushbutton Operation

LED	LED Operation		
RUN	Lights when the generator set has been started locally by pressing the RUN button. Remote start and stop commands are ignored.		
OFF	Lights for 2 seconds, then flashes every 2 seconds when the generator set and controller are off. Remote start/stop commands have no effect. The exercise cycle will not run.		
	In Auto mode, OFF LED flashes quickly to indicate a fault shutdown. Attention required. Identify and correct the fault condition before resetting the controller.		
AUTO	Lights when the generator is in automatic (standby) mode. Generator set will respond to engine start and stop commands from the controller (for example, exercise start and stop commands), an ATS, or OnCue®. Time delays operate as described in Section 2.4.		
Utility Power Available *	Lights when utility power is available.		
Building on Utility Power *	Lights when the building load is connected to utility power through the RXT transfer switch.		
Generator Power Available *	Lights when generator power is available.		
Building on Generator Power *	Lights when the building load is connected to generator power through the RXT transfer switch.		
* These LEDs operate only if a Model RXT transfer switch is connected.			

Figure 3-4 RDC2 Controller LED Operation

#### 3.2.3 LCD Display

The controller is equipped with a two-line x 16 character backlit liquid crystal diode (LCD) display with adjustable contrast. When the generator is running, the controller automatically scrolls through the displays shown in Figure 3-5. When the system is in AUTO, the LCD display scrolls through the status messages shown in Figure 3-6.

When a fault or warning condition exists, the controller will show the corresponding message. See Section 2.6 for more information on fault and warning messages.

Controller menus display power system information, including status information for the engine, generator, and optional RBUS accessories, exercise settings, and event history. Some menus allow changes to the controller settings. See Sections 3.6 through 3.19 for menu diagrams.

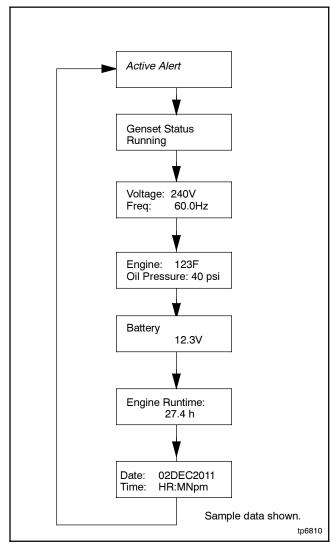


Figure 3-5 Autopaging Displays, Generator Running

The display contrast is adjustable. Navigate to the Genset System menu and step down to the Contrast screen. Press the Select button, and then use the up and down arrow buttons to adjust the contrast. See Section 3.5, Changing Settings, and Section 3.11, Generator Set System Menu.

The display backlight turns off after about a minute of no activity. The backlight turns on when a button is pressed or when the generator set starts.

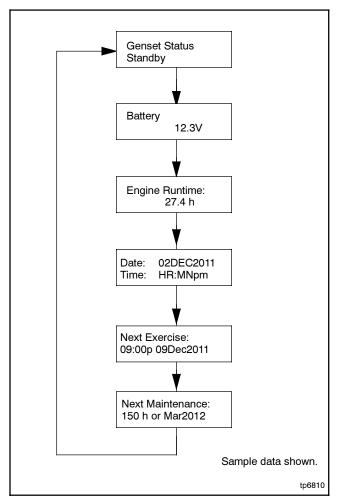


Figure 3-6 Autopaging Displays, Automatic Mode

## 3.3 Controller Power

The RDC2 controller is powered by the generator set engine starting battery and the built-in battery charger.

Note: To disconnect controller power, disconnect the battery and the utility power to the generator set.

If controller power is disconnected and reconnected, you will be prompted to set the time, date, and exerciser. The first setting will flash. Press the Up and Down arrow buttons to change the setting. Press Select to save the setting and move on to the next. Repeat until all settings are saved and the controller returns to the main menu. See Section 3.5 for more detailed instructions to change settings on the RDC2. See Section 2.5 for more detailed instructions to set the exerciser or change the exercise settings.

#### **Battery Charging** 3.4

The controller includes a built-in battery charger to maintain the engine starting battery. The RDC2 controller monitors the battery voltage and provides a constant 14  $\pm$  2% VDC voltage and maximum 2.5 amps to charge the battery.

The installer must connect 120 VAC/60Hz utility power provided from the building on a breaker-protected circuit for the built-in battery charger. See the Installation Manual for instructions to connect the utility power for the battery charger.

#### **Changing Settings** 3.5

Some settings can be changed from the controller keypad. The controller settings and generator set output are factory-set and should not require field adjustment under normal circumstances. Check and adjust the settings and/or output when:

- The controller has been replaced.
- The voltage requires adjustment for a particular application.
- Troubleshooting generator set problems.

Have controller setup and adjustment performed only by an authorized Kohler distributor/dealer or authorized representative.

The following procedure explains how to change settings. See Figure 3-7 for an example using the Date and Time settings.

Note: Use caution when navigating the controller menus and changing the settings. In some menus, pressing the Select button can enable editing of the controller settings. Changing some settings to incorrect values can adversely affect generator set operation or render the unit inoperable.

### **Procedure to Change Settings**

- 1. Press the Select button to enter the main menu.
- 2. Press the down arrow button until the desired menu is displayed. The Date and Time menu is used for the example in Figure 3-7.
- 3. Press the Select button to enter the selected menu. See Figure 3-7.
- 4. Press the down arrow button to step through the parameters in the selected menu.
- 5. To change a setting, press the Select button. The selected setting flashes.
- 6. Press the up or down arrow buttons to increase or decrease the setting.
- 7. When the desired setting is shown, press Select. The value stops flashing. If there are additional adjustable settings on the screen, the next setting flashes. For example, in the date menu, the year, month, and day can be adjusted.
- 8. Repeat steps 5 through 7 for each setting on the screen.
- 9. Press the down arrow to step to the next screen.
- 10. To exit, press the down arrow button until Return is displayed. Press the Select button to exit the menu.
- 11. Press the AUTO or OFF button to exit the main menu.

Note: If no buttons are pushed, the controller exits the menus and returns to the generator set status display after 5 minutes.

Changing Settings on the RDC2 Controller			
Press the Select button to example 1. Press the Select button to example 1.	8. When the correct button. The save		
Press: Display:	Overview> 1.2 h	Press: D	
Press the down arrow but menu is displayed. See Figu are used for this example.	9. Press the down a menu.		
Press: Display:	Date> and Time	Press:	
Press the Select button to e menu.	10. Repeat steps 5 a buttons to set an		
Press: Display:	Date: 05Dec2011	Note: To change from key to increase and pm is displ	
		11. Repeat to set the	
To change the date and tin Select button again. The y	12. Press the dow displayed.		
Press: Display:	Date: 05Dec <b>2011</b>	Press:	
<ol><li>Press the up or down arrow year.</li></ol>	13. Press Select to menu.		
, a		Press:	
Press: OR Display:	Date: 05Dec <b>2012</b>		

6. When the correct year is shown, press the Select button. The year is saved and the next setting

Date: Press: Display: 05**Dec**2012

7. Repeat steps 5 and 6, using the arrow and select buttons to set the month and the date.

8. When the correct date is shown, press the Select button. The saved date is shown.

Date: Press: Display: 03Jan2012

9. Press the down arrow button to step to the next menu.

Time: Press: Display: 01:49pm

10. Repeat steps 5 and 6, using the arrow and select buttons to set and save the time.

**Note:** To change from am to pm, press the up arrow key to increase the hour until the correct hour and pm is displayed.

- 11. Repeat to set the time format to 12 hr. or 24 hr.
- 12. Press the down arrow button. Return is displayed.

<-- Return Press: Display:

13. Press Select to return to the Date and Time menu.

Date --> Display: Press: and Time

- 14. Press the Up or Down arrow buttons to step to a different menu.
- 15. Press Auto to signal the controller to exit the menus and return to the generator set status display.

Genset State Press: Display: Standby **AUTO** 

**Note:** If no buttons are pressed, the controller returns to the status display after 5 minutes.

Figure 3-7 Changing Settings

(month) flashes.

## 3.6 Controller Menus

The following sections show the RDC2 controller menus and submenus. Use the Select button and the up and down arrow buttons to navigate the menus as shown in the diagrams.

Note: Use caution when navigating the controller menus. In some menus, pressing the Select button can enable editing of the controller settings. Changing the settings to incorrect values can adversely affect generator set operation or render the unit inoperable.

If a setting on the controller display is flashing, edit mode has been enabled. Press the OFF or AUTO button to exit the edit mode.

#### 3.7 Main Menu

Press the Select button once to bring up the main menu. Overview is displayed. See Figure 3-8. Press the down arrow button to step to the next menu, Engine Metering. Use the UP and DOWN arrow buttons to step up and down through the menus shown in Figure 3-8.

The controller will exit the main menu after 5 minutes if no buttons are pressed. To exit the main menu immediately, press the controller's OFF or AUTO button.

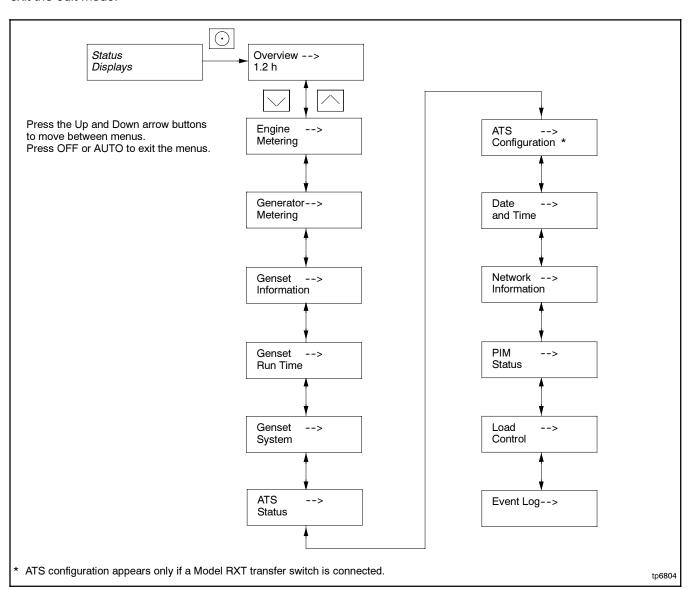


Figure 3-8 RDC2 Main Menu

## 3.8 Overview Menu

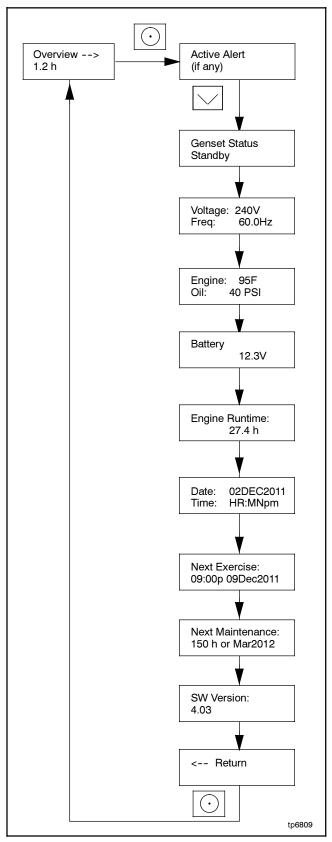


Figure 3-9 Overview Menu

## 3.9 Engine Metering Menu

The engine metering menu displays engine status information as shown in Figure 3-10. displays status information only. No settings can be changed from this menu.

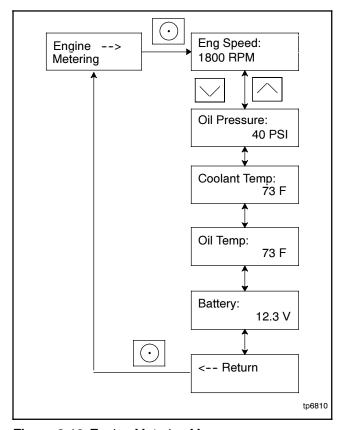


Figure 3-10 Engine Metering Menu

## 3.10 Generator Metering Menu

The generator metering menu displays the generator voltage and frequency. See Figure 3-11.

The voltage calibration mode can be entered from the generator metering menu.

## **Voltage Calibration**

personnel.

distributor/dealer for service.



The voltage calibration mode can be entered from the Generator Metering menu. Contact a Kohler-authorized

The Reset Calibration menu allows you to set the voltage reading back to the original value after calibration, if necessary. See Figure 3-11.

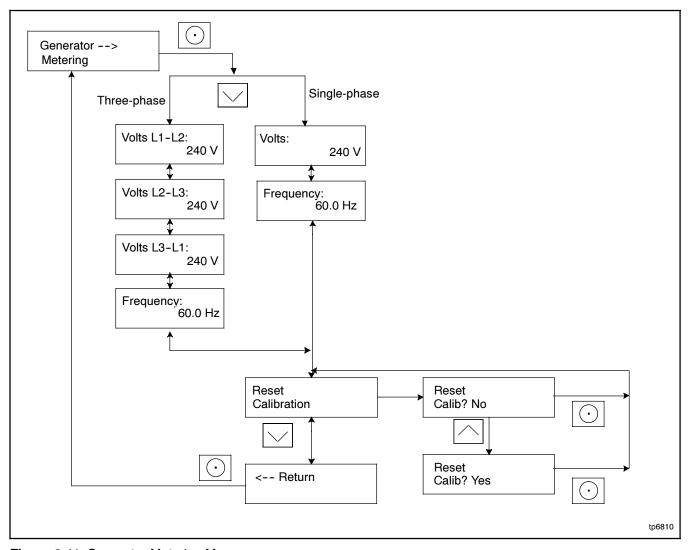


Figure 3-11 Generator Metering Menu

# 3.11 Generator Set Information Menu

The generator set model number and serial numbers are displayed. No changes are allowed from this menu.

Model and serial numbers are factory set and should not require changes in the field, except in the event that the controller is being replaced. A personal computer running Kohler® SiteTech  $^{\text{\tiny M}}$  software is required to enter the generator set model number and serial numbers on a replacement controller. Contact an authorized Kohler distributor/dealer for service.

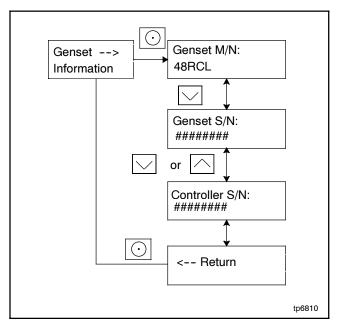


Figure 3-12 Generator Set Information Menu

## 3.12 Genset Run Time Menu

The data shown in Figure 3-13 are displayed. No changes are allowed from this menu.

The Next Maintenance menu shows the number of hours of generator set operation until maintenance is required. The estimated date for the next scheduled maintenance is also displayed. The maintenance reminder intervals are based on the engine manufacturer's recommendation for changing the oil. Refer to Section 4, Scheduled Maintenance, for maintenance instructions.

After changing the oil and performing other recommended maintenance, go to the Overview menu to reset the maintenance timer. See Section 4.3.4 for instructions to reset the maintenance timer.

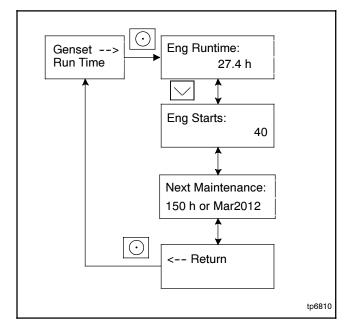


Figure 3-13 Generator Set Run Time Menu

## 3.13 Genset System Menu

The genset system menu displays the system information shown in Figure 3-14. Generator sets are factory set and should not require changes to the system settings in the field.

A Kohler authorized distributor or dealer can adjust these settings, if necessary. If the generator set is reconnected to a different voltage or the system settings require adjustment for some other reason, see Section 3.5 for instructions to enable editing and change the system settings.

Note: Use caution when navigating the controller menus. In some menus, pressing the Select button can enable editing of the controller settings. Changing the settings to incorrect values can adversely affect generator set operation or render the unit inoperable.

## Voltage Regulator (VR) Voltage Adjust

The generator set voltage is factory set and typically does not require adjustment in the field. If voltage adjustment is required, contact a Kohler authorized distributor or dealer for service. Refer to the generator set Installation Manual for instructions to adjust the voltage.

## **Setting the Exerciser**

Use the Genset System menus to set the generator set exerciser. Refer to Section 2.5 for instructions to set the exerciser and for more information about exercising the generator set.

After a scheduled exercise run, the Next Exercise time and date will be updated automatically based on the Exercise Frequency setting.

## **Adjusting the Display Contrast**

To adjust the display contrast, use the down arrow button to step to the Contrast menu. Press the Select button, and then use the up and down arrow buttons to adjust the contrast. Press the Select button to save the contrast setting.

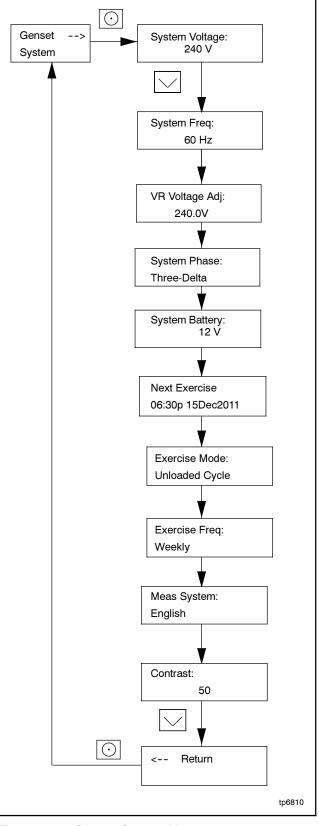


Figure 3-14 Genset System Menu

### 3.14 ATS Status Menu

ATS menus appear if a Model RXT transfer switch is connected to the generator set. If no transfer switch is connected, or another model ATS is connected to the engine start connections, Remote ATS is displayed on the ATS Status screen.

The ATS Status menu displays Model RXT transfer switch and source information.

The voltage shown in these menus can be calibrated. Contact an authorized distributor or dealer for service if calibration is required.

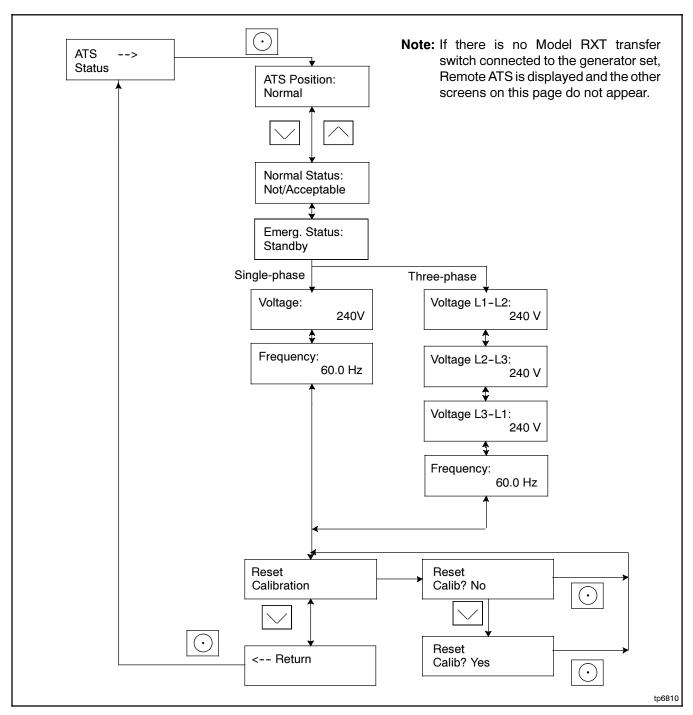


Figure 3-15 ATS Status Menu, with Calibration

### 3.15 ATS Configuration Menu

Note: The ATS Configuration menu appears only if a Model RXT transfer switch is connected.

Use the ATS Configuration submenu to check the Model RXT transfer switch system settings and time delays, and change the settings, if necessary.

#### **Changing ATS Configuration Settings**

To enable editing, press the select button. The value flashes to indicate that it can be changed. Press the up and down arrow buttons to change the value. Press the Select button to save the value shown.

Use the up and down arrow buttons to move to the next value to be changed. Repeat the adjustment process until all values are correct.

Press the down arrow until Return is displayed. Press the select button to return to the main menu.

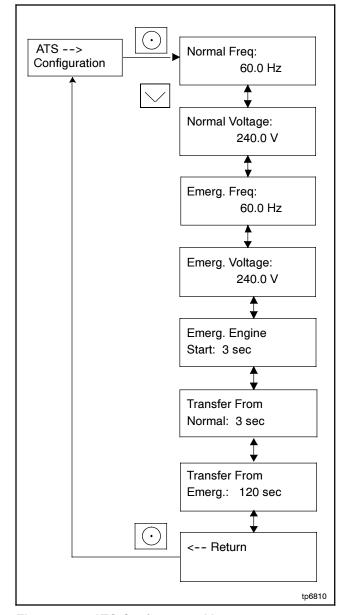


Figure 3-16 ATS Configuration Menu

### 3.16 Date and Time Menu

The date and time will typically be set at controller power-up. To change the date, time, or time format (12 hour or 24 hour), use the Date and Time menu. See Figure 3-17.

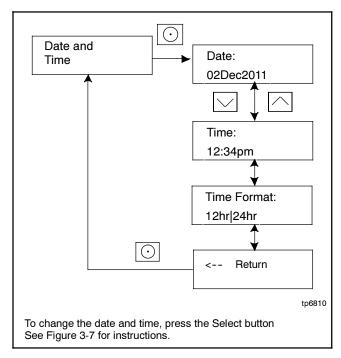


Figure 3-17 Date and Time Menu

### 3.17 Networking Information Menus

Use the networking menus to view and adjust communication settings for systems with remote RBUS devices such as a PIM or LCM, and for systems that use the Kohler® OnCue® Home Generator Management

System. RBUS is a proprietary RS-485 communication protocol.

The Networking Information menu leads to submenus for network and RBUS communication settings.

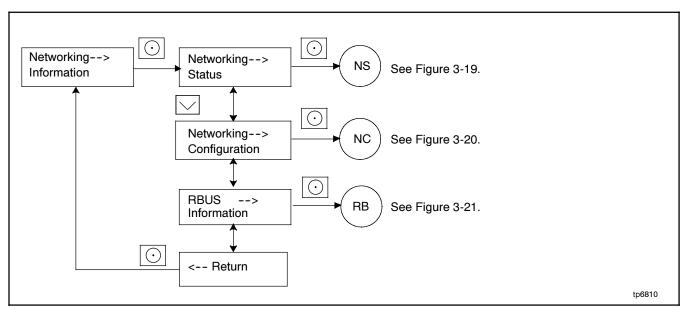


Figure 3-18 Networking Information Menu

### 3.17.1 Networking Status Submenu

The Networking Status submenu contains settings for OnCue®. See the OnCue Software Operation Manual for information about the appropriate network settings for OnCue.

If DHCP is enabled, IP parameters are not displayed. If DHCP is disabled (i.e., if a static IP address is used), the IP parameters are displayed.

To enable or disable DHCP and change the IP settings, go to the Networking Configuration menu. See Section 3.17.2.

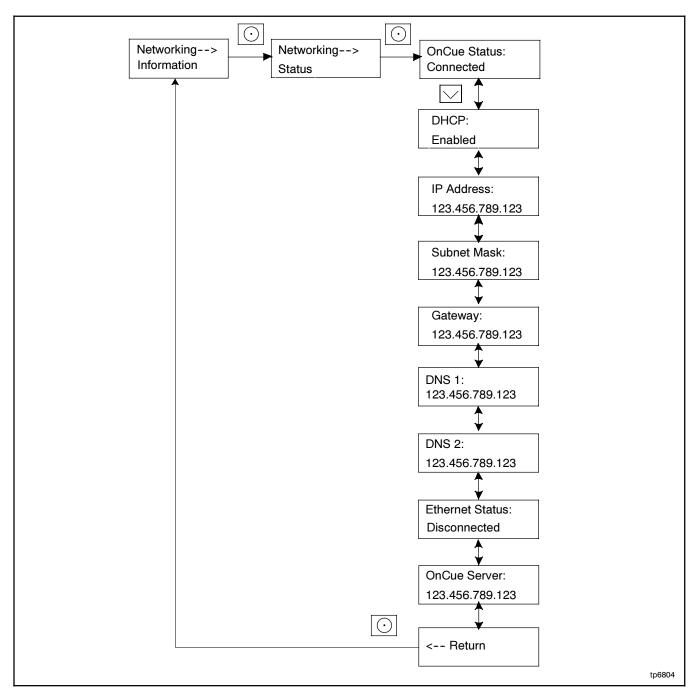


Figure 3-19 Network Status Submenu

### 3.17.2 Networking Configuration Submenu (OnCue Password)

The networking Configuration menu includes settings used for communication with the Kohler® OnCue® Home Generator Management System.

For most applications, DHCP is enabled and the IP settings cannot be changed from the controller keypad. If DHCP is enabled, IP parameters are not displayed.

If DHCP is disabled (i.e., if a static IP address is required), then the IP parameters can be modified. For applications that require static IP addresses, press and hold the select button to enable editing, disable DHCP, and then step to the next parameters and enter the information.

If an error occurs while setting a parameter, an error message is displayed and then the controller exits the edit mode. Previous settings are preserved.

#### **OnCue Password**

For the initial OnCue setup, you will be required to reset the OnCue password on the RDC2 controller, and then enter it into the OnCue software. To reset the password, follow the instructions in Figure 3-20.

**Note:** The password is displayed for only 10 seconds. Be sure to write down the password and serial number.

A new password is generated each time the reset password procedure is performed. If the password is reset after the OnCue system has been set up, the connection will be lost. Enter the new password in OnCue to reconnect.

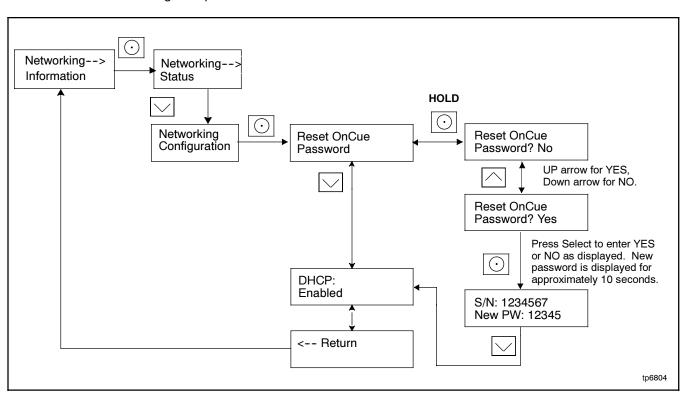


Figure 3-20 Network Configuration Submenu

#### 3.17.3 RBUS Information Submenu

The RBUS Information menu contains settings for remote modules that communicate with the RDC2 controller using RBUS protocol. This includes the following optional modules:

- Model RXT transfer switch
- Programmable Interface Module (PIM)
- Load Control Module (LCM)

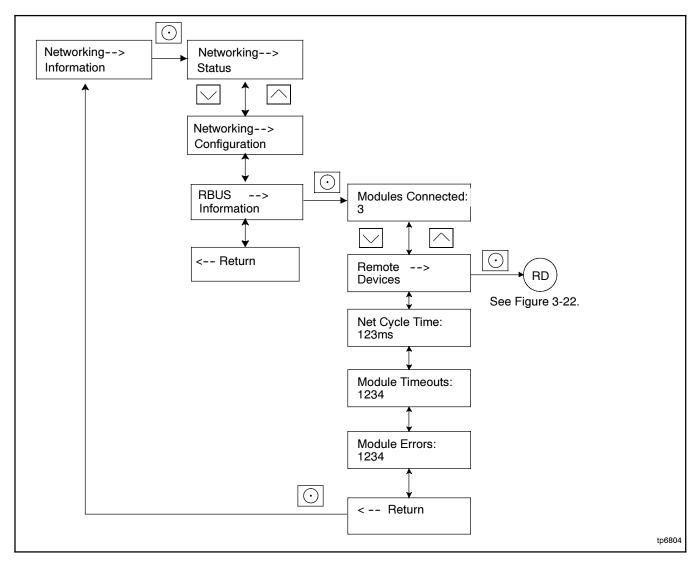


Figure 3-21 RBUS Information Submenu

#### 3.17.4 Remote Devices Submenu

Check the status of remote devices communicating through RBUS. Device types can include:

- Model RXT ATS
- Programmable interface module (PIM)
- Load control module (LCM)

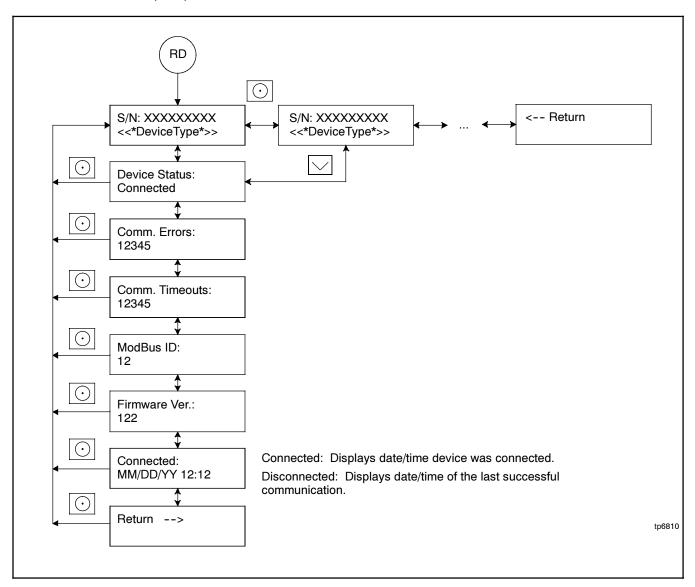


Figure 3-22 Remote Devices Submenu

### 3.18 Programmable Interface Module (PIM) Menus

The PIM status menu displays the status of inputs and outputs connected to the programmable interface module (PIM). This is a status display menu only. Input and output settings cannot be changed from the RDC2 controller's user interface.

A personal computer running Kohler® SiteTech™ software is required to change the input and output settings. Contact an authorized distributor or dealer for service.

The Kohler® OnCue® Home Management System can be used to turn outputs on and off. See the OnCue Software Operation Manual for instructions.

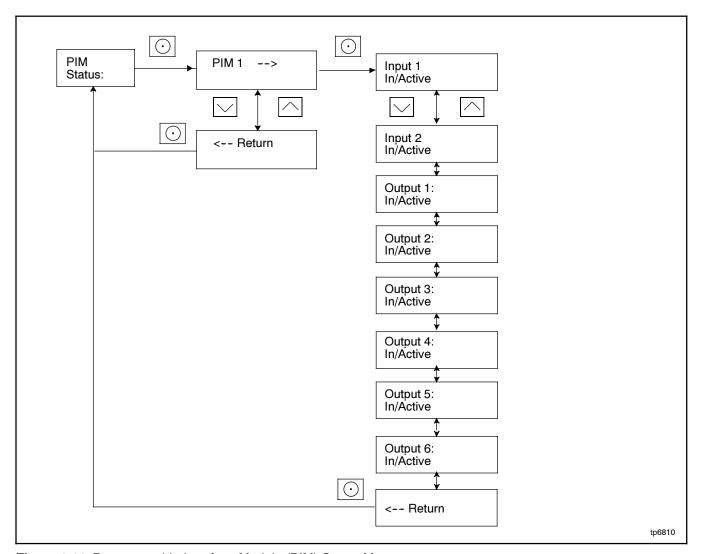


Figure 3-23 Programmable Interface Module (PIM) Status Menu

### 3.19 Load Control Module (LCM) Menus

The Load Control menu displays the status of the Load Control Module (LCM) inputs and outputs, and allows a test of the LCM output relays.

Generator current is displayed as a percent of the maximum generator capacity. The load control module adds and sheds loads based on the generator current.

The test function cycles the relays in the order of their For detailed information about the LCM operation, refer to TT-1574, provided with the LCM kit.

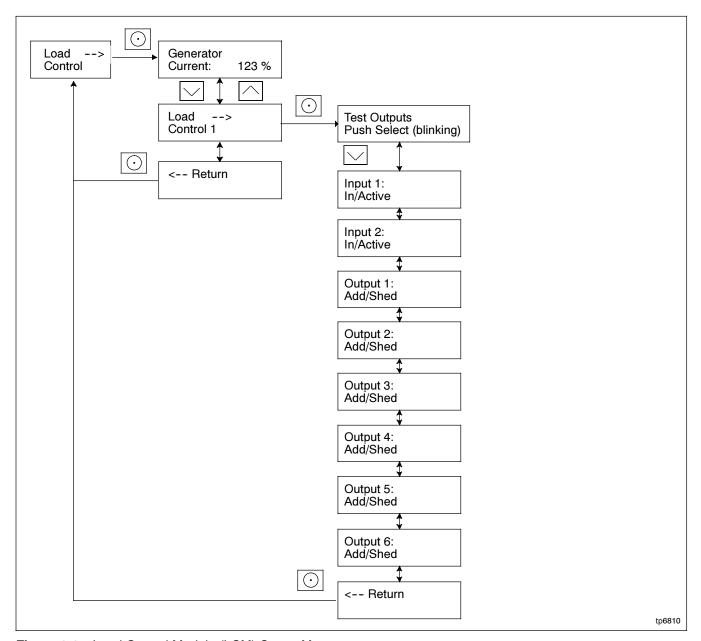


Figure 3-24 Load Control Module (LCM) Status Menu

#### 4.1 General Maintenance



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.

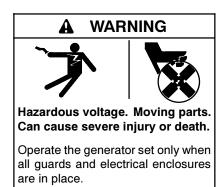
Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or connected equipment, disable the generator set as follows: (1) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove 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.



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 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 quards, screens, and covers before operating the generator

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.

See the Safety Precautions and Instructions at the beginning of this manual before attempting to service, repair, or operate the generator set. Have an authorized Kohler distributor/dealer perform generator set service.

**Engine Service.** Perform generator set engine service at the intervals specified by the engine operation manual.

**Generator Set Service.** Perform generator set service at the intervals specified by the generator set operation manual.

Routine Maintenance. Refer to the following generator set service schedule, the engine service schedule, and the runtime hours shown on the RDC2 controller to determine when to schedule routine maintenance. Service generator sets that are subject to extreme weather or dusty or dirty conditions more frequently.

**Maintenance and Service Parts.** Obtain maintenance and service parts from an authorized Kohler distributor/dealer.

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### 4.2 Service Schedule

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

Operation	Initial Startup Sequence Check	Daily	Every 100 Hr.	Every 150 Hr.	Every 400 Hr.	Every 800 Hr.	Every 1000 Hr.	Every 2000 Hr.	As Reg'd
GENERAL MAINTENANCE	CHOCK	Duny		100 1		300 1	1000		11040
Check for fluid leaks	3	Х							
Check all bolts and nuts for tightness ‡	6	X						Х	Х
Check PCV valve, hose, and fittings ‡					Х				X
Replace PCV valve, if equipped ‡						Х			
Check belts and belt tension	5					, ,	X		
Inspect vacuum lines and fittings								X	
LUBRICATION SYSTEM									
Check engine oil level	1	X							
Change engine oil and filter †				Х					
AIR INTAKE SYSTEM				Λ					
Inspect and clean air cleaner element †				Х					Х
Replace air cleaner element †				^	X				X
Check air induction for leaks					Α		X		
Check intake manifold for vacuum leaks							X		
COOLING SYSTEM									
Check coolant level *	2	Х							
Inspect and clean radiator exterior ‡	_		Х						Х
Replace engine coolant ‡*							X		
Inspect coolant hoses							X		
ELECTRICAL SYSTEM							Α		
Check battery charge and fluid level ‡	4		Х						Х
Inspect electrical system	4		^					X	^
								^	Х
Clean battery cables :  EXHAUST SYSTEM									
Inspect exhaust manifold for leaks	I							X	
Inspect exhaust piping for leaks								X	
								X	
Inspect catalyst inlet and outlet (if equipped) Check HEGO (oxygen) sensor connections								X	
FUEL SYSTEM									
Replace fuel filter §  Check fuel shutoff valve for leaks and function							X		X
Check fuel regulator pressure							^	~	
Test fuel lines for leaks								X	
								X	
Inspect/drain vaporizer for oil buildup								X	
IGNITION SYSTEM							V		
Check spark plug wires							X		
Clean secondary ignition coil wires							Х		
Replace distributor cap and rotor (3.0-5.7 L)					V			Х	
Replace spark plugs Replace spark plug wires					Х			X	

<sup>\*</sup> Check engine coolant condition and protection, hoses, and clamps annually (prior to cold weather).

<sup>†</sup> More frequent intervals may be required in dusty or dirty operating conditions. ‡ Seasonal or as required.

<sup>§</sup> More frequent intervals may be required with dirt in fuel system.

### 4.3 Lubrication System

### 4.3.1 Oil Specifications

Use oil that displays the American Petroleum Institute (API) Starburst certification mark FOR GASOLINE ENGINES on the container. Do not use straight-weight oils recommended for industrial or stationary engines. CC or CD classification oils, even when labeled Heavy Duty or For Natural Gas Engines are not acceptable.

Multi-viscosity oils are recommended. Figure 4-1 shows the recommended Society of Automotive Engineers (SAE) viscosity designation for a given operating temperature.

Ambient Temperature	Engine Oil Type		
-18°C (0°F) and above	SAE 10W-30		
Below -18°C (0°F)	SAE 5W-30		

Figure 4-1 Engine Oil Selection

#### 4.3.2 Oil Check

Check the oil level in the crankcase every 24 hours of operation or before the engine is started each day. Do not check the oil level while operating the unit. Stop the generator set and keep the generator set level to get an accurate reading. To check the oil level, remove the dipstick and wipe the end clean. Reinsert the dipstick and wait at least 30 seconds. Remove the dipstick and check the level. Maintain the oil level between the Full and Add marks on the dipstick, as shown in Figure 4-2. See Section 1, Service Views for the dipstick location.

**Note:** Do not operate the set if the oil level is below the Add mark or above the Full mark on the dipstick.

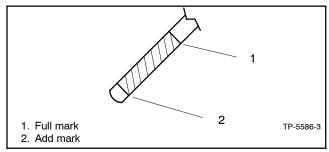


Figure 4-2 Oil Level Check

#### 4.3.3 Oil Additions

Adding some oil between oil changes is normal. The amount varies with generator set usage. Open the oil fill cap and pour in a small amount of oil using a funnel or other suitable pouring device. See Section 1, Service Views, for the oil check and oil fill locations.

### 4.3.4 Oil and Filter Change

Change the oil according to the service schedule or before generator set storage. Change the oil more frequently if the generator set operates under dirty, dusty conditions. Change the oil while the engine is still warm. See Section 1, Service Views, for oil fill, oil check, and oil filter locations.

Dispose of all waste materials (engine oil, fuel, filter, etc.) in an environmentally safe manner.

**Note:** Reset the maintenance timer on the RDC2 controller after changing the oil.

### Oil Change Procedure

Whenever possible, drain the oil while it is still warm.

#### 1. Drain the oil.

- a. Press the OFF button on the RDC2 generator set controller.
- b. Disconnect the power for the battery charger.
- c. Disconnect the generator set engine starting battery, negative (-) lead first.
- d. Remove the housing side panel.
- e. Remove the plug from the oil drain fitting and install a drain hose.
- f. Open the oil drain valve on the engine.
- g. Allow time for the engine oil to drain completely.
- h. Close the oil drain valve.
- i. Replace the oil drain plug.

#### 2. Replace the oil filter.

- a. Remove the oil filter by rotating it counterclockwise with an oil filter wrench.
- b. Clean the contact surface of the oil filter adapter.
- 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. See Figure 4-1 for oil selection and Figure 4-3 for oil capacity.

Model	Oil Capacity, L (qt.)
38RCL and 48RCL	4.7 (5.0)

Figure 4-3 Oil Capacity

#### 4. Check for leaks.

- a. Press the OFF button on the RDC2 generator set controller.
- b. Reconnect the generator set engine starting battery, negative (-) lead last.
- c. Reconnect the power for the battery charger.
- d. Start the generator set and check for leaks around the oil filter.
- e. Stop the generator set and tighten the oil filter to stop any leaks.
- f. Reinstall the housing side panel.
- 5. Stop the generator set. Check the oil level. Add oil, as necessary, to bring the level up to the Full mark.

Note: Too high an oil level causes high oil consumption and engine carbonizing. Too low a level damages the engine.

#### 6. Reset the maintenance timer on the RDC2.

- a. In the Overview menu, step down to the Next Maintenance screen.
- b. Press the Select button.
- c. Press the Up arrow button so that Reset Maint Timer? Yes is displayed.
- d. Press the Select button. The next maintenance interval and date will be displayed.

### 4.4 Air Cleaner

At the interval specified in the service schedule, inspect and clean or replace the air cleaner element. Clean the element more frequently in dirty, dusty conditions. Check the element for accumulated oil or dirt that could cause poor performance. Replace a damaged air cleaner element. Follow the procedure described helow

#### Air Cleaner Service Procedure

A dry-type air cleaner silences and filters the intake air. The air intake silencer assembly connects to the intake manifold via a rubber hose. Refer to Figure 4-4 during this procedure.

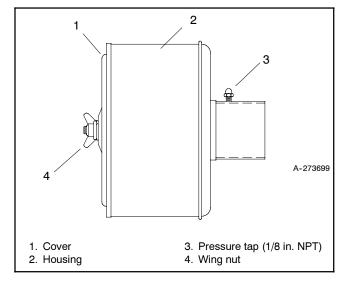


Figure 4-4 Air Cleaner

- 1. Remove the wing nuts to open the housing and remove the air silencer element.
- 2. Tap the element lightly against a flat surface to dislodge loose surface dirt. Do not clean the element in any liquid or use compressed air as these will damage the filter element.
- 3. Examine the element and housing for damage. Replace the element or housing if necessary.
- 4. Wipe the cover and housing with a clean rag to remove dirt. Make sure the sealing surfaces fit correctly.
- 5. Replace the cover and secure using the wing nut.

### 4.5 Exhaust System



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

The exhaust system must be leakproof and routinely inspected.

Carbon monoxide detectors. Carbon monoxide can cause severe nausea, fainting, or death. Install carbon monoxide detectors on each level of the building. 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.

At the interval specified in the service schedule, inspect the exhaust system components (exhaust manifold, exhaust outlet, exhaust line, exhaust clamps, and muffler) for cracks, leaks, and corrosion.

#### **Exhaust System Inspection Points**

- Check for corroded or broken metal parts and replace them as needed.
- Check that the exhaust outlet is unobstructed.
- Check the exhaust gas color. If the exhaust is blue or black, contact your local authorized Kohler distributor/ dealer.
- Visually inspect for exhaust leaks (blowby). Check for carbon or soot residue on exhaust components. Carbon and soot residue indicates an exhaust leak. Seal leaks as needed.
- Check that all covers and doors are undamaged, in place, and locked.
- Check for the installation and operation of carbon monoxide (CO) detectors on each level of any building near the generator set.

### 4.6 Cooling System



Hot coolant and steam. Can cause severe injury or death.

Before removing the pressure cap, stop the generator set and allow it to cool. Then loosen the pressure cap to relieve pressure.

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

Note: Block heater damage. The block heater will fail if the energized heater element is not immersed in coolant. Fill the cooling system before turning on the block heater. Run the engine until it is warm and refill the radiator to purge the air from the system before energizing the block heater.

#### 4.6.1 **Checking and Filling Coolant**

Maintain the coolant level in the coolant overflow bottle between the High and Low markings. See Section 1, Service Views, for the coolant overflow bottle location.

Note: Periodically check the coolant level by removing the radiator's pressure cap. Do not rely solely on the level in the coolant overflow bottle.

Add fresh coolant until the level is just below the overflow tube opening. Use a coolant mixture of 50% ethylene glycol and 50% clean, softened water to inhibit rust/corrosion and prevent freezing.

A coolant solution of 50% ethylene glycol provides freezing protection to -37°C (-34°F) and overheating protection to 129°C (265°F). A coolant solution with less than 50% ethylene glycol may not provide adequate freezing and overheating protection. A coolant solution with more than 50% ethylene glycol can cause engine or component damage. Do not use alcohol or methanol antifreeze or mix them with the specified coolant.

### 4.6.2 Cooling System Inspection

To prevent generator shutdown or damage because of overheating:

- Keep the cooling air inlets clean and unobstructed
- Inspect the radiator's exterior for obstructions and remove dirt and foreign material with a soft brush or cloth to avoid damaging the radiator fins.
- Check the hoses and connections for leaks and replace any cracked, frayed, or spongy hoses.
- Check the condition and tension of the radiator water pump belt(s).
- Check the rubber seal of the radiator's pressure cap and replace a cracked or deteriorated cap. Remove dirt and other debris from the pressure cap and filler neck. The pressure cap raises the boiling point of the coolant, enabling higher operating temperatures. If the cap leaks, replace it with the same rating type of cap. Find the pressure cap rating in Figure 4-5.

Item	Rating
Pressure cap	97 kPa (14 psi)
Thermostat	71°C (160°F)

Figure 4-5 Pressure Cap and Thermostat Rating

### 4.6.3 Draining Cooling System

The radiator contains a coolant drain valve to drain the cooling system. When draining the coolant, remove the radiator's pressure cap, which will allow the entire system to drain and will prevent air pockets from forming and restricting coolant passage to the block.

- 1. De-energize the block heater, if equipped.
- 2. Remove the pressure cap to allow the entire system to drain and prevent air pockets from restricting coolant flow through the engine block.
- 3. Open the coolant drain valve and allow the system to drain.
- 4. If the inside of the radiator has mineral deposits or the used coolant contains dirt or grease, go to Section 4.6.4, Flushing and Cleaning. If the cooling system does not have mineral deposits, refill the cooling system as instructed in Section 4.6.5, Filling Cooling System.

#### 4.6.4 Flushing and Cleaning

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

### Flushing and Cleaning Procedure

- 1. Flush the system with clean water.
- 2. Drain, clean, and flush the coolant overflow bottle.
- Refill the cooling system as instructed in Section 4.6.5.

### 4.6.5 Filling Cooling System

	Coolant Capacity, L (qts)					
Model	Generator Set	With Block Heater				
38RCL	15 (16)	16.5 (17.5)				
48RCL	17.5 (18.5)	19 (20)				

Figure 4-6 Coolant Capacity

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

- 1. Close the radiator's coolant drain valve and tighten the hose clamps.
- Fill the radiator with the recommended coolant mixture of 50% ethylene glycol and 50% clean, softened water to inhibit rust/corrosion and prevent freezing. The coolant capacity is shown in Figure 4-6.
- Operate the engine with the radiator cap removed until the thermostat opens and the upper radiator hose becomes hot.
- 4. Stop the engine and allow it to cool.
- Add coolant to the radiator to just below the overflow tube on the filler neck. See Section 1, Service Views, for the overflow tube location.
- 6. Replace the radiator's pressure cap.
- Maintain the coolant level in the coolant overflow bottle between the High and Low markings. See Section 1, Service Views, for the coolant overflow bottle location.
- 8. Re-energize the block heater, if equipped.

### 4.7 Ignition System

Service the spark plugs at the interval specified in the service schedule using the following procedure.

- 1. Press the OFF button on the RDC2 controller.
- 2. Disconnect the power to the battery charger.
- 3. Disconnect the generator set engine starting battery, negative (-) lead first.
- 4. Remove spark plug wires by grasping the spark plug boot and turning slightly while pulling. Do not pull the wire. Pulling on the wire rather than the boot may damage the wire or terminal.
- 5. Loosen the spark plug with a ratchet and 5/8-in. spark plug socket with a rubber insert to prevent spark plug damage.
- 6. Use compressed air to remove dirt from around each spark plug to prevent dirt particles from falling into the combustion chamber.
- 7. Remove spark plugs, one at a time, and examine. Identify a normal spark plug in good operating condition by observing a light tan or gray deposit on firing tip. See Figure 4-9 to evaluate engine condition by color/condition of a problem spark plug.
- 8. Clean spark plugs by wiping them with a rag. File the center electrode to keep it parallel to the side electrode.

**Note:** Do not sandblast, wire brush, scrape, or otherwise service spark plugs in poor condition. Obtain a new plug for best results.

 Check the spark plug gap before installing any spark plug. See Figure 4-7 and Figure 4-8. Attain a correct gap when the feeler (or wire) passes between the spark plug electrode. It should pass easily but with some resistance or drag; otherwise adjust as necessary.

Model	Spark plug gap
38 RCL and 48RCL	0.9 mm (0.035 in.)

Figure 4-7 Recommended Spark Plug Gap

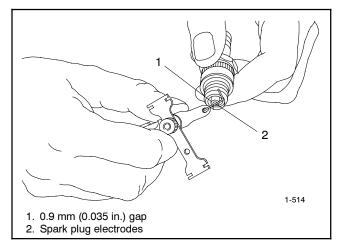


Figure 4-8 Spark Plug Gap Inspection

Problem/Condition	Means of Identification	Possible Cause/Solution
Gap-bridged spark plug	Built-up deposits and gap between electrodes closing.	Oil or carbon fouling. Clean and regap the spark plug.
Oil-fouled spark plug	Wet, black deposits on the insulator shell, bore, and electrodes.	Excessive oil entering combustion chamber through worn rings and pistons, excessive clearance between valve guides and stems, or worn or loose bearings. Replace the spark plug.
Carbon-fouled spark plug	Black, dry, fluffy carbon deposits on insulator tips, exposed shell surfaces and electrodes.	Incorrect spark plug, weak ignition, clogged air intake, overrich fuel mixture, or excessive no-load operation. Clean and regap the spark plug.
Lead-fouled spark plug	Dark gray, black, yellow, or tan deposits; or a glazed coating on the insulator tip.	Caused by highly leaded fuel. Replace the spark plug.
Pre-ignition damaged spark plug	Melted electrodes and possibly blistered insulator. Metallic deposits on insulator suggest internal engine damage.	Wrong type of fuel, incorrect timing or advance, too hot a plug, burned valves, or engine overheating. Replace the spark plug.
Overheated spark plug	White or light gray insulator with small black or gray/brown spots with bluish (burned) appearance on electrodes.	Engine overheating, wrong type of fuel, loose spark plugs, too hot a plug, low fuel pressure or incorrect ignition timing. Replace the spark plug.
Worn spark plug	Severely eroded or worn electrodes.	Caused by normal wear and failure to replace spark plug at prescribed interval. Replace the spark plug.

Figure 4-9 Engine Evaluation Using Spark Plug Condition

10. Use a gapping tool to gently bend the side electrode closer to or farther from the center electrode to set the correct gap. See Figure 4-10. Position the side electrode directly over the center electrode.

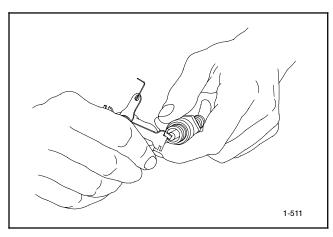


Figure 4-10 Spark Plug Gap Adjustment

- 11. Reinstall the spark plug. Do not bump the electrode against the cylinder head. Rotate the spark plug clockwise until you feel resistance.
- 12. Use a torque wrench to torque each spark plug to 25 Nm (18 ft. lbs.). Otherwise, hand-tighten the spark plug until you feel resistance.
- 13. Use a ratchet wrench to final tighten an additional 1/4 turn. Do not overtighten, as doing so may strip the threads or alter the electrode gap setting.
- 14. Check the spark plug wire connector in the boot for accumulated dirt, grease, and other debris, and clean as necessary.
- 15. Firmly push the spark plug boot onto the spark
- 16. Reconnect the generator set engine starting battery, negative (-) lead last.
- 17. Reconnect the power for the battery charger.

### 4.8 Battery

Consult the battery manufacturer's instructions regarding battery care and maintenance.

### WARNING



Sulfuric acid in batteries. Can cause severe injury or death.

protective goggles 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 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.

#### **Storage Procedure** 4.9

Follow the procedure below when storing your generator set for a long period (3 months or more).

- 1. Start and run the generator set until it reaches operating temperature or about 15 minutes.
- 2. Stop the generator set.
- 3. Change the oil and oil filter; see Section 4.3.4, Oil and Filter Change.
- 4. Check the engine coolant protection; see Section 4.6.

Note: Use antifreeze capable of withstanding the lowest possible temperatures.

- 5. Keep spark plugs in their holes or seal spark plug holes with suitable threaded metal plugs.
- 6. Clean the exterior of the generator set and spread a light film of oil or silicon spray over any exposed surfaces that may be subject to rust or corrosion.
- 7. Seal the air inlet, exhaust pipe, and fuel tank cap with tape.
- 8. Disconnect and remove the battery. Place the battery in a warm, dry location for the storage period. Recharge the battery once a month to maintain a full charge.
- 9. Select a well-ventilated (not humid or dusty) location to store the generator.
- 10. Cover the entire unit with a dust cover.

Note: Run the generator set once a month whenever possible.

### **Notes**

### **Section 5 Troubleshooting**

### 5.1 Introduction

Use the troubleshooting charts in this section to diagnose and correct common problems. First check for simple causes such as a dead engine starting battery, loose connections, or an open circuit breaker. The charts include a list of common problems, possible causes of the problem, and recommended corrective actions.

If the procedures in this manual do not explain how to correct the problem, contact an authorized Kohler distributor/dealer. Maintain a record of repairs and adjustments performed on the equipment. Use the record to help describe the problem and repairs or adjustments made to equipment.

### 5.2 Controller Service Access

A USB port is located in the controller's service access area. Some controller settings can be adjusted using a laptop computer with Kohler® SiteTech™ software. See TP-6701, SiteTech™ Software Operation Manual, for more information.

Use a USB cable with a mini-B connector to connect the controller to your PC. Remove the service access door to access the USB port. See Figure 5-1.

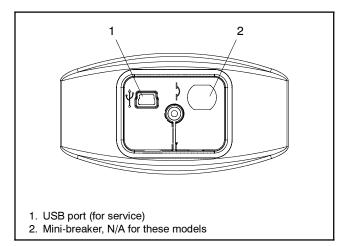


Figure 5-1 Controller Service Access (cover removed)

### 5.3 Fault Messages

The RDC2 controller displays fault messages to aid in troubleshooting. Fault messages, descriptions, and recommended checks are listed in Figure 2-5.

Identify and correct the cause of the fault condition. Then reset the controller after a fault shutdown. See Section 2.6.4.

#### 5.4 Circuit Protection

If the generator set circuit breaker trips or the fuses blow repeatedly, contact an authorized Kohler distributor/dealer for service.

#### 5.4.1 Line Circuit Breaker

The line circuit breaker interrupts the generator output in the event of a fault in the wiring between the generator and the load. If the circuit breaker trips, reduce the load and switch the breaker back to the ON position.

#### **5.4.2 Fuses**

Always identify and correct the cause of a blown fuse before restarting the generator set. Refer to Figure 5-2, Troubleshooting Chart, for conditions that may indicate a blown fuse. Obtain replacement parts and service from an authorized Kohler distributor/dealer.

**Fan Fuses.** Three 30 amp fan fuses are located in the fan fuse and relay box. See Section 1, Service Views, for location.

**Engine Fuses.** Engine fuses are located in the engine fuse box. See the service views in Section 1 for the fuse box location.

- Fuse F1, 5 amps
- Fuse F2, ECM 10 amps
- Fuse M3, battery charging alternator, 70 amps
- Fuse F4, ignition,15 amps.
- Fuse F6, starter, 20 amps.

# 5.4.3 Controller Internal Circuit Protection

The controller is equipped with internal circuit protection. Press OFF to reset.

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## 5.5 Generator Set Troubleshooting

Figure 5-2 contains generator set troubleshooting, diagnostic, and repair information. Check for loose connections before replacing parts.

Problem	Possible Cause	Corrective Action		
The generator	Battery weak or dead.	Recharge or replace the battery.		
set does not crank.	Battery connections reversed or poor.	Check the connections.		
стапк.	Blown fuse(s).	Replace the fuse. Contact an authorized Kohler distributor/dealer for service if fuse blows repeatedly.		
	Generator set is OFF.	Press the RUN button to start the engine or press AUTO to allow remote starting.		
The generator	Air cleaner clogged.	Clean and/or replace the air cleaner.		
set cranks but does not start.	Battery weak or dead.	Recharge or replace the battery.		
starts hard,	Battery connection poor.	Clean and tighten the battery connections.		
lacks power, or	Spark plug wire connection loose.	Check the spark plug wires.		
operates erratically.	Low oil pressure shutdown.	Check for oil leaks. Check the oil level and add oil if necessary.		
	Fuel pressure insufficient.	Check the fuel supply and valves.		
	Engine fuse blown.	Replace the fuse. If the fuse blows again, contact an authorized Kohler distributor/dealer.		
	Engine malfunction.	Contact an authorized Kohler distributor/dealer.		
No AC output.	AC circuit breaker in the OFF position.	Place the circuit breaker in the ON position.		
	AC circuit breaker tripping because of overload.	Reduce the load on the generator set.		
	AC circuit breaker tripping because of short circuit.	Contact an authorized Kohler distributor/dealer for service.		
	Engine fuse blown.	Replace the fuse. Contact an authorized Kohler distributor/dealer for service if fuse blows repeatedly.		
Low output or excessive drop in voltage.	Generator set overloaded.	Reduce the load.		
Generator set stops suddenly.	Low oil pressure shutdown.	Check for oil leaks. Check the oil level and add oil if necessary.		
	Out of fuel.	Check fuel supply.		
	Overcrank shutdown.	Reset the controller. If the overcrank fault occurs again, contact an authorized Kohler distributor/dealer.		
	Blown fuse(s).	Replace the fuse. If the fuse blows again, contact an authorized Kohler distributor/dealer.		
	Overspeed shutdown.	Reset the controller. If the overspeed fault occurs again, contact an authorized Kohler distributor/dealer.		
	Generator set is OFF.	Press the RUN button to start the engine or press AUTO to allow remote starting.		
	Remote stop command received from a remote switch, ATS, or OnCue®.	Check the remote switch position.		
	Engine malfunction.	Contact an authorized Kohler distributor/dealer.		
Fans run after engine shuts down.	The fans continue to run for 2 minutes after the engine shuts down to evacuate the engine compartment.	None.		

Figure 5-2 General Troubleshooting Chart

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## 5.6 Controller Troubleshooting

Figure 5-3 contains basic troubleshooting information for the RDC2 controller.

Problem	Possible Cause	Corrective Action		
Controller LCD display is off.	Low or no battery voltage.	Check connections. Check generator set battery. See Figure 5-2.		
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.		
	Low or no battery voltage.	Check battery connections. Check generator set battery. See Figure 5-2.		
LCM relays do not operate.	Bad connections.	Check wiring and connections. Verify that cable size and length of run comply with the instructions in the Installation manual.		
	Low or no battery voltage.	Check battery connections. Check generator set battery. See Figure 5-2.		
Date is flashing.	Controller power was disconnected and then	Check battery connections. See Figure 5-2.		
	reconnected.	Check utility power connection for the built-in battery charger.		
		Reset the time, date, and exercise schedule. See Section 2.5.6, Setting the Exerciser at Power-Up.		

Figure 5-3 RDC2 Troubleshooting Chart

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## **Notes**

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# **Appendix A Abbreviations**

The following list contains abbreviations that may appear in this publication.

	•	•	, , ,		
A, amp	ampere	cfm	cubic feet per minute	exh.	exhaust
ABDC	after bottom dead center	CG	center of gravity	ext.	external
AC	alternating current	CID	cubic inch displacement	F	Fahrenheit, female
A/D	analog to digital	CL	centerline	FHM	flat head machine (screw)
ADC			centimeter	fl. oz.	fluid ounce
ADC	advanced digital control;	cm			
	analog to digital converter	CMOS	complementary metal oxide	flex.	flexible
adj.	adjust, adjustment		substrate (semiconductor)	freq.	frequency
ADV	advertising dimensional	com	communications (port)	FS	full scale
	drawing	coml	commercial	ft.	foot, feet
Ah	amp-hour	Coml/Rec	Commercial/Recreational	ft. lb.	foot pounds (torque)
AHWT	anticipatory high water	conn.	connection	ft./min.	feet per minute
,	temperature			. '	•
AISI	American Iron and Steel	cont.	continued	ftp	file transfer protocol
AlSi	Institute	CPVC	chlorinated polyvinyl chloride	g	gram
A1 OD		crit.	critical	ga.	gauge (meters, wire size)
ALOP	anticipatory low oil pressure	CSA	Canadian Standards	gal.	gallon
alt.	alternator		Association	gen.	generator
Al	aluminum	CT	current transformer	-	Š .
ANSI	American National Standards	Cu	copper	genset	generator set
	Institute (formerly American	cUL	• •	GFI	ground fault interrupter
	Standards Association, ASA)	COL	Canadian Underwriter's	GND, 😃	ground
AO	anticipatory only	01.11	Laboratories	gov.	governor
APDC	Air Pollution Control District	CUL	Canadian Underwriter's		
			Laboratories	gph	gallons per hour
API	American Petroleum Institute	cu. in.	cubic inch	gpm	gallons per minute
approx.	approximate, approximately	CW.	clockwise	gr.	grade, gross
APU	Auxiliary Power Unit	CWC	city water-cooled	GRD	equipment ground
AQMD	Air Quality Management District		•	gr. wt.	gross weight
AR	as required, as requested	cyl.	cylinder		height by width by depth
AS	as supplied, as stated, as	D/A	digital to analog		
AS		DAC	digital to analog converter	HC	hex cap
	suggested	dB	decibel	HCHT	high cylinder head temperature
ASE	American Society of Engineers	dB(A)	decibel (A weighted)	HD	heavy duty
ASME	American Society of	DC ´	direct current	HET	high exhaust temp., high
	Mechanical Engineers	DCR	direct current resistance		engine temp.
assy.	assembly			hex	hexagon
ASŤM	American Society for Testing	deg., °	degree	Hg	mercury (element)
7101111	Materials	dept.	department		- '
ATDC	after top dead center	dia.	diameter	HH	hex head
	•	DI/EO	dual inlet/end outlet	HHC	hex head cap
ATS	automatic transfer switch	DIN	Deutsches Institut fur Normung	HP	horsepower
auto.	automatic	Diii	e. V. (also Deutsche Industrie	hr.	hour
aux.	auxiliary		Normenausschuss)	HS	heat shrink
avg.	average	DID			housing
AVR	automatic voltage regulator	DIP	dual inline package	hsg.	
AWG	0 0	DPDT	double-pole, double-throw	HVAC	heating, ventilation, and air
	American Wire Gauge	DPST	double-pole, single-throw		conditioning
AWM	appliance wiring material	DS	disconnect switch	HWT	high water temperature
bat.	battery	DVR	digital voltage regulator	Hz	hertz (cycles per second)
BBDC	before bottom dead center	E <sup>2</sup> PROM,		IBC	International Building Code
BC	battery charger, battery	L I I OIVI,	electrically-erasable	IC	integrated circuit
	charging		programmable read-only	ID	inside diameter, identification
BCA	battery charging alternator				,
	, , ,		memory	IEC	International Electrotechnical
BCI	Battery Council International	E, emer.	emergency (power source)		Commission
BDC	before dead center	ECM	electronic control module,	IEEE	Institute of Electrical and
BHP	brake horsepower		engine control module		Electronics Engineers
blk.	black (paint color), block	EDI	electronic data interchange	IMS	improved motor starting
	(enginë)	EFR	emergency frequency relay	in.	inch
blk. htr.	block heater	e.g.	for example (exempli gratia)	in. H <sub>2</sub> O	inches of water
BMEP	brake mean effective pressure			_	
	•	EG	electronic governor	in. Hg	inches of mercury
bps	bits per second	EGSA	Electrical Generating Systems	in. lb.	inch pounds
br.	brass		Association	Inc.	incorporated
BTDC	before top dead center	EIA	Electronic Industries	ind.	industrial
Btu	British thermal unit		Association	int.	internal
Btu/min.	British thermal units per minute	EI/EO	end inlet/end outlet	int./ext.	internal/external
C	Celsius, centigrade	EMI	electromagnetic interference		
	, 0	emiss.	emission	I/O	input/output
cal.	calorie			IP	internet protocol
CAN	controller area network	eng.	engine	ISO	International Organization for
CARB	California Air Resources Board	EPA	Environmental Protection		Standardization
CAT5	Category 5 (network cable)		Agency	J	ioule
CB	circuit breaker	EPS	emergency power system	JIS	Japanese Industry Standard
CC		ER	emergency relay		
	crank cycle	ES	engineering special,	k	kilo (1000)
CC	cubic centimeter	_0	engineered special	K	kelvin
CCA	cold cranking amps	ECD	•	kA	kiloampere
CCW.	counterclockwise	ESD	electrostatic discharge	KB	kilobyte (2 <sup>10</sup> bytes)
CEC	Canadian Electrical Code	est.	estimated	KBus	Kohler communication protocol
cert.	certificate, certification, certified	E-Stop	emergency stop	kg	kilogram
cfh	cubic feet per hour	etc.	et cetera (and so forth)	9	mogram
GILL	capic leet het tiout		,		

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kg/cm <sup>2</sup>	kilograms per square centimeter	NC NEC	normally closed National Electrical Code	RTU RTV	remote terminal unit room temperature vulcanizatio
kgm	kilogram-meter	NEMA	National Electrical	RW	read/write
kg/m <sup>3</sup>	kilograms per cubic meter		Manufacturers Association	SAE	Society of Automotive
kHz	kilohertz	NFPA	National Fire Protection	٠, ١.=	Engineers
 (J	kilojoule		Association	scfm	standard cubic feet per minute
(m	kilometer	Nm	newton meter	SCR	silicon controlled rectifier
		NO	normally open	s, sec.	second
Ohm, kΩ		no., nos.	number, numbers		
:Pa	kilopascal		•	SI	Systeme international d'unites
ph	kilometers per hour	NPS	National Pipe, Straight	01/50	International System of Units
V	kilovolt	NPSC	National Pipe, Straight-coupling	SI/EO	side in/end out
(VA	kilovolt ampere	NPT	National Standard taper pipe	sil.	silencer
VAR	kilovolt ampere reactive		thread per general use	SMTP	simple mail transfer protocol
:W	kilowatt	NPTF	National Pipe, Taper-Fine	SN	serial number
Wh	kilowatt-hour	NR	not required, normal relay	SNMP	simple network management
:Wm	kilowatt mechanical	ns	nanosecond		protocol
Wth	kilowatt-thermal	OC	overcrank	SPDT	single-pole, double-throw
	liter	OD	outside diameter	SPST	single-pole, single-throw
_ AN	local area network	OEM	original equipment	spec	specification
		O L IVI	manufacturer	specs	specification(s)
	length by width by height	OF	overfrequency		• • • • • • • • • • • • • • • • • • • •
b.	pound, pounds	opt.	option, optional	sq.	square
om/ft <sup>3</sup>	pounds mass per cubic feet	OS.		sq. cm	square centimeter
.CB	line circuit breaker		oversize, overspeed	sq. in.	square inch
_CD	liquid crystal display	OSHA	Occupational Safety and Health	SMS	short message service
.ED	light emitting diode	0)/	Administration	SS	stainless steel
_ph	liters per hour	OV	overvoltage	std.	standard
.pm	liters per minute	OZ.	ounce	stl.	steel
.OP	low oil pressure	p., pp.	page, pages	tach.	tachometer
_Oi _P	liquefied petroleum	PC	personal computer	TB	terminal block
_ı _PG	liquefied petroleum gas	PCB	printed circuit board	TCP	transmission control protocol
		pF	picofarad	TD	time delay
.S	left side	PF	power factor	TDC	top dead center
-wa	sound power level, A weighted	ph., ∅	phase	TDEC	•
_WL	low water level	PHC	Phillips® head Crimptite®		time delay engine cooldown
_WT	low water temperature	1110	(screw)	TDEN	time delay emergency to
n	meter, milli (1/1000)	PHH	Phillips® hex head (screw)	TDEC	normal
И	mega (10 <sup>6</sup> when used with SI	PHM	pan head machine (screw)	TDES	time delay engine start
	units), male		. , ,	TDNE	time delay normal to
n <sup>3</sup>	cubic meter	PLC	programmable logic control		emergency
n <sup>3</sup> /hr.	cubic meters per hour	PMG	permanent magnet generator	TDOE	time delay off to emergency
n <sup>3</sup> /min.	cubic meters per minute	pot	potentiometer, potential	TDON	time delay off to normal
nÁ	milliampere	ppm	parts per million	temp.	temperature
nan.	manual	PROM	programmable read-only	term.	terminal
nax.	maximum		memory	THD	total harmonic distortion
	megabyte (2 <sup>20</sup> bytes)	psi	pounds per square inch	TIF	telephone influence factor
/IB		psig	pounds per square inch gauge	tol.	tolerance
/ICCB	molded-case circuit breaker	pt.	pint	turbo.	turbocharger
/ICM	one thousand circular mils	PTC	positive temperature coefficient	typ.	typical (same in multiple
neggar	megohmmeter	PTO	power takeoff	ιyρ.	locations)
ИHz	megahertz	PVC	polyvinyl chloride	UF	underfrequency
ni.	mile		quart, quarts	UHF	
nil	one one-thousandth of an inch	qt.			ultrahigh frequency
nin.	minimum, minute	qty.	quantity	UIF	user interface
nisc.	miscellaneous	R	replacement (emergency)	UL	Underwriter's Laboratories, In
/IJ	megajoule	rod	power source	UNC	unified coarse thread (was NC)
	millijoule	rad.	radiator, radius	UNF	unified fine thread (was NF)
n.l		RAM	random access memory	univ.	universal
	•				and the second s
nm	millimeter	RBUS	RS-485 proprietary	URL	uniform resource locator
nm nOhm, mΩ	millimeter ⊵milliohm	RBUS	communications	URL	uniform resource locator (web address)
mm mOhm, mΩ MOhm, MΩ	millimeter ⊇milliohm ⊇megohm	RBUS RDO	communications relay driver output	URL US	
mm mOhm, mΩ MOhm, MΩ MOV	millimeter ⊇milliohm Ωmegohm metal oxide varistor	RBUS	communications	US	(web address) undersize, underspeed
nm nOhm, mΩ MOhm, MΩ MOV	millimeter ⊇milliohm Ωmegohm metal oxide varistor megapascal	RBUS RDO	communications relay driver output	US UV	(web address) undersize, underspeed ultraviolet, undervoltage
mm nOhm, mΩ MOhm, MΩ MOV MPa	millimeter ⊇milliohm Ωmegohm metal oxide varistor	RBUS RDO ref.	communications relay driver output reference	US UV V	(web address) undersize, underspeed ultraviolet, undervoltage volt
mm nOhm, mΩ MOhm, MΩ MOV MPa npg	millimeter ⊇milliohm Ωmegohm metal oxide varistor megapascal	RBUS  RDO ref. rem. Res/Coml	communications relay driver output reference remote Residential/Commercial	US UV V VAC	(web address) undersize, underspeed ultraviolet, undervoltage volt volts alternating current
mm nOhm, mΩ MOhm, M9 MOV MPa npg nph	millimeter amilliohm amegohm metal oxide varistor megapascal miles per gallon miles per hour	RBUS  RDO ref. rem. Res/Coml RFI	communications relay driver output reference remote Residential/Commercial radio frequency interference	US UV V VAC VAR	(web address) undersize, underspeed ultraviolet, undervoltage volt volts alternating current voltampere reactive
nm mOhm, mΩ MOhm, MΩ MOV MPa npg nph MS	millimeter  millimeter milliohm megohm metal oxide varistor megapascal miles per gallon miles per hour military standard	RBUS  RDO ref. rem. Res/Coml RFI RH	communications relay driver output reference remote Residential/Commercial radio frequency interference round head	US UV V VAC VAR VDC	(web address) undersize, underspeed ultraviolet, undervoltage volt volts alternating current voltampere reactive volts direct current
mm mOhm, m MOhm, M MOV MPa mpg mph MS ms	millimeter  millimeter  millimeter  megohm metal oxide varistor megapascal miles per gallon miles per hour military standard millisecond	RBUS RDO ref. rem. Res/Coml RFI RH RHM	communications relay driver output reference remote Residential/Commercial radio frequency interference round head round head machine (screw)	US UV V VAC VAR VDC VFD	(web address) undersize, underspeed ultraviolet, undervoltage volt volts alternating current voltampere reactive volts direct current vacuum fluorescent display
nm nOhm, mΩ MOhm, MΩ MOV MPa npg nph MS ns n/sec.	millimeter  millimeter  milliohm  metal oxide varistor megapascal miles per gallon miles per hour military standard millisecond meters per second	RBUS RDO ref. rem. Res/Coml RFI RH RHM rly.	communications relay driver output reference remote Residential/Commercial radio frequency interference round head round head machine (screw) relay	US UV V VAC VAR VDC VFD VGA	(web address) undersize, underspeed ultraviolet, undervoltage volt volts alternating current voltampere reactive volts direct current vacuum fluorescent display video graphics adapter
mm mOhm, mΩ MOhm, MΩ MOV MPa mpg mph MS ms m/sec. mtg.	millimeter 2 milliohm 2 megohm metal oxide varistor megapascal miles per gallon miles per hour military standard millisecond meters per second mounting	RBUS  RDO ref. rem. Res/Coml RFI RH RHM rly. rms	communications relay driver output reference remote Residential/Commercial radio frequency interference round head round head machine (screw) relay root mean square	US UV V VAC VAR VDC VFD VGA VHF	(web address) undersize, underspeed ultraviolet, undervoltage volt volts alternating current voltampere reactive volts direct current vacuum fluorescent display video graphics adapter very high frequency
mm mOhm, mΩ MOhm, MΩ MOV MPa mpg mph MS ms m/sec. mtg. MTU	millimeter 2 millimeter 2 milliohm 2 megohm metal oxide varistor megapascal miles per gallon miles per hour military standard millisecond meters per second mounting Motoren-und Turbinen-Union	RBUS  RDO ref. rem. Res/Coml RFI RH RHM rly. rms rnd.	communications relay driver output reference remote Residential/Commercial radio frequency interference round head round head machine (screw) relay root mean square round	US UV V VAC VAR VDC VFD VGA	(web address) undersize, underspeed ultraviolet, undervoltage volt volts alternating current voltampere reactive volts direct current vacuum fluorescent display video graphics adapter
mm mOhm, mΩ MOhm, MΩ MOV MPa mpg mph MS ms m/sec. mtg. MTU MW	millimeter 2 milliohm 2 megohm metal oxide varistor megapascal miles per gallon miles per hour military standard millisecond meters per second mounting Motoren-und Turbinen-Union megawatt	RBUS  RDO ref. rem. Res/Coml RFI RH RHM rly. rms rnd. RO	communications relay driver output reference remote Residential/Commercial radio frequency interference round head round head machine (screw) relay root mean square round read only	US UV V VAC VAR VDC VFD VGA VHF	(web address) undersize, underspeed ultraviolet, undervoltage volt volts alternating current voltampere reactive volts direct current vacuum fluorescent display video graphics adapter very high frequency watt
mm mOhm, mΩ MOhm, MΩ MOV MPa mpg mph MS ms m/sec. mtg. MTU MW mW	millimeter 2 milliohm 2 megohm metal oxide varistor megapascal miles per gallon miles per hour military standard millisecond meters per second mounting Motoren-und Turbinen-Union megawatt milliwatt	RBUS  RDO ref. rem. Res/Coml RFI RH RHM rly. rms rnd.	communications relay driver output reference remote Residential/Commercial radio frequency interference round head round head machine (screw) relay root mean square round	US UV V VAC VAR VDC VFD VGA VHF W WCR	(web address) undersize, underspeed ultraviolet, undervoltage volt volts alternating current voltampere reactive volts direct current vacuum fluorescent display video graphics adapter very high frequency watt withstand and closing rating
mm mOhm, mΩ MOhm, MΩ MOV MPa mpg mph MS ms m/sec. mtg. MTU MW mW	millimeter 2 milliohm 2 megohm metal oxide varistor megapascal miles per gallon miles per hour military standard millisecond meters per second mounting Motoren-und Turbinen-Union megawatt	RBUS  RDO ref. rem. Res/Coml RFI RH RHM rly. rms rnd. RO	communications relay driver output reference remote Residential/Commercial radio frequency interference round head round head machine (screw) relay root mean square round read only	US UV V VAC VAR VDC VFD VGA VHF W WCR w/	(web address) undersize, underspeed ultraviolet, undervoltage volt volts alternating current voltampere reactive volts direct current vacuum fluorescent display video graphics adapter very high frequency watt withstand and closing rating with
mm mOhm, mΩ MOhm, MΩ MOV MPa mpg mph MS ms m/sec. mtg. MTU MW mW	millimeter 2 milliohm 2 megohm metal oxide varistor megapascal miles per gallon miles per hour military standard millisecond meters per second mounting Motoren-und Turbinen-Union megawatt milliwatt	RBUS  RDO ref. rem. Res/Coml RFI RH RHM rly. rms rnd. RO ROM rot.	communications relay driver output reference remote Residential/Commercial radio frequency interference round head round head machine (screw) relay root mean square round read only read only memory rotate, rotating	US UV V VAC VAR VDC VFD VGA VHF W WCR W/ WO	(web address) undersize, underspeed ultraviolet, undervoltage volt volts alternating current voltampere reactive volts direct current vacuum fluorescent display video graphics adapter very high frequency watt withstand and closing rating with write only
mm mOhm, mΩ MOhm, MΩ MOV MPa mpg mph MS ms m/sec. mtg. MTU MW mW uF N, norm.	millimeter 2 milliohm 2 megohm metal oxide varistor megapascal miles per gallon miles per hour military standard millisecond meters per second mounting Motoren-und Turbinen-Union megawatt milliwatt microfarad	RBUS  RDO ref. rem. Res/Coml RFI RH RHM rly. rms rnd. RO ROM rot. rpm	communications relay driver output reference remote Residential/Commercial radio frequency interference round head round head machine (screw) relay root mean square round read only read only memory rotate, rotating revolutions per minute	US UV V VAC VAR VDC VFD VGA VHF W WCR W/ WO W/o	(web address) undersize, underspeed ultraviolet, undervoltage volt volts alternating current voltampere reactive volts direct current vacuum fluorescent display video graphics adapter very high frequency watt withstand and closing rating with write only without
mJ mm mOhm, m MOhm, m MOV MPa mpg mph MS ms m/sec. mtg. MTU MW mW u F N, norm. NA nat. gas	millimeter 2 milliohm 2 megohm metal oxide varistor megapascal miles per gallon miles per hour military standard millisecond meters per second mounting Motoren-und Turbinen-Union megawatt milliwatt microfarad normal (power source)	RBUS  RDO ref. rem. Res/Coml RFI RH RHM rly. rms rnd. RO ROM rot.	communications relay driver output reference remote Residential/Commercial radio frequency interference round head round head machine (screw) relay root mean square round read only read only memory rotate, rotating	US UV V VAC VAR VDC VFD VGA VHF W WCR W/ WO	(web address) undersize, underspeed ultraviolet, undervoltage volt volts alternating current voltampere reactive volts direct current vacuum fluorescent display video graphics adapter very high frequency watt withstand and closing rating with write only

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