Installation

Residential/Commercial Generator Sets

Model:

20RESB
20RESD

Controller:

RDC2

ISO 9001 KOHLER POWER SYSTEMS NATIONALLY REGISTERED

KOHLER® Power Systems

TP-6925 6/15b

California Proposition 65

⚠ WARNING

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

Generator Set Identification Numbers

Record the product identification numbers from the generator set nameplate(s).

Model Designation _____

Specification Number _____

Serial Number _____

Accessory Number	Accessory Description

Engine Identification

Record the product identification information from the engine nameplate.

Manufacturer _____

Model Designation _____

Serial Number _____

Controller Identification

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

Controller Description _____

Table of Contents

Notes

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

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

DANGER

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

WARNING

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

CAUTION

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

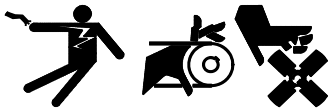
NOTICE

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

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

Accidental Starting

WARNING



Accidental starting.
Can cause severe injury or death.

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

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

Battery

WARNING

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

Wear protective goggles and clothing. Battery acid may cause blindness and burn skin.

WARNING

Explosion.
Can cause severe injury or death.
Relays in the battery charger cause arcs or sparks.

Locate the battery in a well-ventilated area. Isolate the battery charger from explosive fumes.

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

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

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

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

Engine Backfire/Flash Fire

⚠ WARNING

Risk of fire.
Can cause severe injury or death.

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

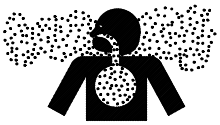
Servicing the air cleaner. A sudden backfire can cause severe injury or death. Do not operate the generator set with the air cleaner removed.

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

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

Exhaust System

⚠ WARNING



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

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

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

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

Fuel System

⚠ WARNING

Explosive fuel vapors.
Can cause severe injury or death.

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

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

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

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

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

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

Hazardous Noise

⚠ CAUTION

Hazardous noise.
Can cause hearing loss.

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

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

Hazardous Voltage/ Moving Parts

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

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

⚠ WARNING

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

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

⚠ WARNING

Hazardous voltage.
Backfeed to the utility system can cause property damage, severe injury, or death.

If the generator set is used for standby power, install an automatic transfer switch to prevent inadvertent interconnection of standby and normal sources of supply.

⚠ CAUTION

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

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

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

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

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

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

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

Heavy Equipment

⚠ WARNING

Unbalanced weight.
Improper lifting can cause severe injury or death and equipment damage.

Do not use lifting eyes.
Lift the generator set using lifting bars inserted through the lifting holes on the skid.

Hot Parts

⚠ WARNING

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

Do not work on the generator set until it cools.

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

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

Notice

NOTICE

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

This manual provides installation instructions for Residential/Commercial Model 20RESB and 20RESD generator sets. See Figure 1. Refer to TP-6926, Operation Manual, for generator set operation and maintenance instructions.

The generator set is approved for use in stationary applications in locations served by a reliable utility power source.

Have a Kohler® authorized distributor/dealer install the generator set **outdoors** according to the instructions in this manual. The generator set installation must comply with the National Electrical Code (NEC) and local code requirements. **Do not install this generator set indoors.**

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.

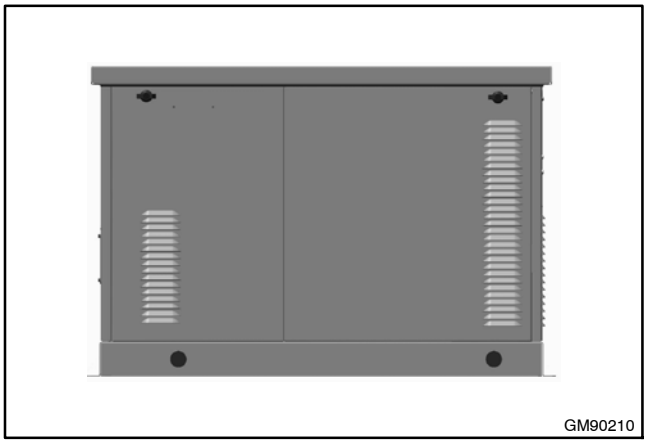


Figure 1 20RESB Generator Set

List of Related Literature

Figure 2 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, 20RESB	G4-244
Specification Sheet, 20RESD	G4-247
Operation Manual, 20RESB/20RESD Generator Set	TP-6926
Service Manual, 14/20RESA/RESAL/ 20RESB/20RESD Generator Set	TP-6805
Operation Manual, OnCue® Plus Generator Management System	TP-6928
Operation/Installation Manual, Model RDT Transfer Switch	TP-6345
Operation/Installation Manual, Model RXT Automatic Transfer Switch	TP-6807
Installation Instructions, Programmable Interface Module (PIM)	TT-1584
Installation Instructions, PowerSync® Automatic Paralleling Module (APM)	TT-1596
Installation Instructions, Load Shed Kit	TT-1609
Installation Instructions, Power Relay Modules	TT-1646

Figure 2 Related Literature

Startup and Registration

When the generator set is installed, complete the startup and installation checklists supplied with the startup notification form. Complete and sign the startup notification form and register the unit using the Kohler online Warranty Processing System.

Service Assistance

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

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

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Phone: (65) 6264-6422
Fax: (65) 6264-6455

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

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

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

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

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

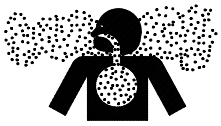
1.1 Introduction

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

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

⚠ WARNING



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

The exhaust system must be leakproof and routinely inspected.

Generator set operation. Carbon monoxide can cause severe nausea, fainting, or death. Carbon monoxide is an odorless, colorless, tasteless, nonirritating gas that can cause death if inhaled for even a short time. Avoid breathing exhaust fumes when working on or near the generator set. Never operate the generator set inside a building. 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 detectors. Carbon monoxide can cause severe nausea, fainting, or death. Install carbon monoxide detectors on each level of any building adjacent to the generator set. Locate the detectors to adequately warn the building's occupants of the presence of carbon monoxide. Keep the detectors operational at all times. Periodically test and replace the carbon monoxide detectors according to the manufacturer's instructions.

Have the generator set installed by an authorized Kohler distributor/dealer or authorized representative. For all locations, ensure that the installation complies with applicable national and local codes. Install the equipment in compliance with the National Electrical Code (NEC) and local codes. For Canadian installations, refer to the Canadian Electrical Code (CEC).

The generator set must be installed outdoors. The exhaust systems on enclosed units are designed for outdoor installation only.

Note: DO NOT install these generator sets inside a building.

Note: Install carbon monoxide (CO) detector(s) on each level of any building adjacent to a generator set. Locate the detectors to adequately warn the building's occupants of the presence of carbon monoxide.

Obtain a building permit and contact your local utility companies to mark the locations of underground pipes and cables.

Read and follow the safety precautions in this manual and observe the decals on the equipment. Refer to the diagrams and drawings in this manual for dimensions and electrical connections during the installation procedure. Read the entire installation procedure and obtain the accessories and tools needed before beginning installation. Perform the steps in the order shown.

To install optional accessories, follow the instructions provided with each kit.

1.2 Lifting

⚠ WARNING

Unbalanced weight.
Improper lifting can cause severe injury or death and equipment damage.

Do not use lifting eyes.
Lift the generator set using lifting bars inserted through the lifting holes on the skid.

The approximate weight of the generator set without packaging is shown in Figure 1-1. Use lifting bars inserted through the holes in the skid to lift the unit. See the dimension drawings in Section 3 for lifting hole locations.

Model	Weight, kg (lb.)
20RESB with aluminum enclosure 20RESD with aluminum enclosure	223 (490)

Figure 1-1 Approximate Weight

1.3 Generator Set Inspection

Complete a thorough inspection of the generator set. Check for the following:

1. Inspect the generator set for loose or damaged parts or wires. Repair or tighten any loose parts before installation.

2. Check the engine oil. Fill, if necessary, with the recommended viscosity and grade of oil. Use synthetic oil, API (American Petroleum Institute) Service Class SG or higher. See the Operation Manual for additional information.

1.4 Location and Mounting

Install the generator set outdoors near the incoming gas service. The required distance from a structure is dependent on state and local codes. See the dimension drawing in Section 3 for the minimum clearance from structures and non-combustible materials.

Locate the generator set so that the hot exhaust does not blow on plants or other combustible materials. No plants, shrubs, or other combustible materials are allowed within 1.2 m (4 ft.) of the exhaust end of the generator set.

Do not install the generator set where exhaust gas could accumulate and seep inside or be drawn into a potentially occupied building. Furnace and other similar intakes must be at least 3 m (10 ft.) from the exhaust end of the generator set.

Notice

DO NOT locate the generator set near patios, decks, play areas, or animal shelters. 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.

1.4.1 Mounting Area

The generator set is shipped on an aluminum skid. Prepare a flat, level mounting area covered with a weed barrier and gravel or a concrete mounting pad. Set the skid directly on the gravel or concrete.

Note: For high-wind installations, see Section 1.4.2.

Do not install the generator set directly on grass, wood, or other combustible materials. Clear all combustible materials, including plants and shrubs, building materials, and lawn furniture, from the area beyond the exhaust end of the generator set as shown on the dimension drawing in Section 3.

1.4.2 High Wind Installation

For high-wind installations (up to 181 mph), use a concrete mounting pad and four mounting bolts. See the dimension drawing in Section 3 for mounting hole locations.

1.4.3 Exhaust Requirements

⚠ WARNING

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

Do not work on the generator set until it cools.

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

Figure 1-2 gives the exhaust temperature at rated load. The engine exhaust mixes with the generator set cooling air at the exhaust end of the enclosure. Mount the generator set so that the hot exhaust does not blow on plants or other combustible materials. Maintain the clearances shown on the dimension drawing in Section 3.

Exhaust	Temperature, °C (°F)
Exhaust gas exiting the enclosure at rated kW, °C (°F)	260 (500)

Figure 1-2 Exhaust Flow and Temperature

The generator set requires correct air flow for cooling and combustion. The inlet and outlet openings in the sound enclosure provide the cooling and combustion air. Figure 1-3 shows the locations of the cooling air intake and exhaust vents. Inspect the air inlet and outlet openings inside and outside the housing to ensure that the air flow is not blocked.

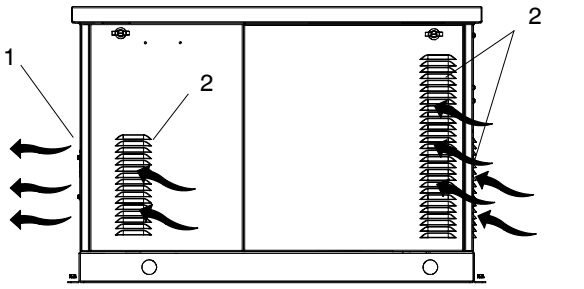


Figure 1-3 Cooling Air Intake and Exhaust

1.5 Dimension Drawings

See the dimension drawings in Section 3 for the generator set dimensions, fuel and electric inlet locations, and recommended clearance.

1.6 Fuel Requirements

⚠ WARNING

Explosive fuel vapors.
Can cause severe injury or death.

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

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

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

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

The generator set operates using natural gas or LPG fuel. The generator set is EPA-certified for both natural gas and LPG fuels.

The fuel system installation must comply with applicable national, state, and local codes.

1.6.1 Fuel Supply

Because of variable climates and geographical considerations, contact the local fuel supplier for fuel system planning and installation. Figure 1-4 lists the recommended fuel ratings and other fuel supply information for natural gas and LPG fuels.

Fuel type	Natural Gas	LPG
Fuel supply inlet	1/2 NPT	
Fuel supply pressure, kPa (in. H_2O):		
20RESB	1.3–2.7 (5–11)	1.7–2.7 (7–11)
20RESD	0.9–2.7 (3.5–11)	
Fuel flow rate, maximum, Btu/hr.:		
20RESB/20RESD	281,000	340,000
Nominal Fuel Rating, Btu/ft.^{3}		
Natural gas	1000	
LPG	2500	

Figure 1-4 Fuel Supply Specifications

Verify that the output pressure from the primary gas utility pressure regulator is within the specifications shown in Figure 1-4 and that the utility gas meter flow rate is sufficient to supply the generator set at rated load plus all other gas-consuming appliances. For LPG tanks, verify that the output pressure is within the specifications shown in Figure 1-4. See Figure 1-6 for fuel consumption. Contact the fuel supplier for flow rate information or a gas meter upgrade, if necessary.

1.6.2 Fuel Pipe Size

Ensure that the fuel pipe size and length meet the specifications in Figure 1-5. Measure the pipe length from the primary gas pressure regulator to the pipe connection on the generator set fuel inlet. Add 2.4 m (8 ft.) to the measured length for each 90 degree elbow. Compare the total pipe length with the chart in Figure 1-5 to find the required pipe size.

Contact local LPG provider for LPG installation information.

Minimum Gas Pipe Size Recommendation, in. NPT			
Pipe Length		20RESB/20RESD	
m	(ft.)	Natural Gas (281,000 Btu/hr.)	LPG (340,000 Btu/hr.)
8	(25)	1	3/4
15	(50)	1	1
30	(100)	1 1/4	1
46	(150)	1 1/4	1 1/4
61	(200)	1 1/4	1 1/4

Figure 1-5 Fuel Pipe Size Recommendations

Fuel Type	% Load	Fuel Consumption, m^3/hr. (cfh) 20RESB/20RESD 60 Hz		50 Hz	
Natural Gas	100%	8.0	(281)	6.4	(225)
	75%	6.9	(243)	5.4	(189)
	50%	4.6	(161)	3.9	(139)
	25%	3.6	(127)	2.9	(103)
LPG	100%	3.9	(136)	2.9	(102)
	75%	3.1	(109)	2.4	(85)
	50%	2.3	(82)	1.8	(63)
	25%	1.7	(59)	1.3	(47)

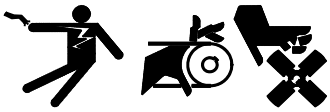
LPG conversion factors:
8.58 ft.^{3} = 1 lb.
0.535 m^3 = 1 kg
36.39 ft.^{3} = 1 gal.

Nominal fuel rating:
Natural gas: 37 MJ/m^3 (1000 Btu/ft.^{3})
LPG: 93 MJ/m^3 (2500 Btu/ft.^{3})

Figure 1-6 Fuel Consumption

1.6.3 Connecting the Fuel Supply

⚠ WARNING

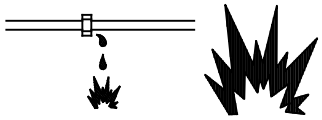


Accidental starting.
Can cause severe injury or death.

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

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

⚠ WARNING



Explosive fuel vapors.
Can cause severe injury or death.

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

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

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

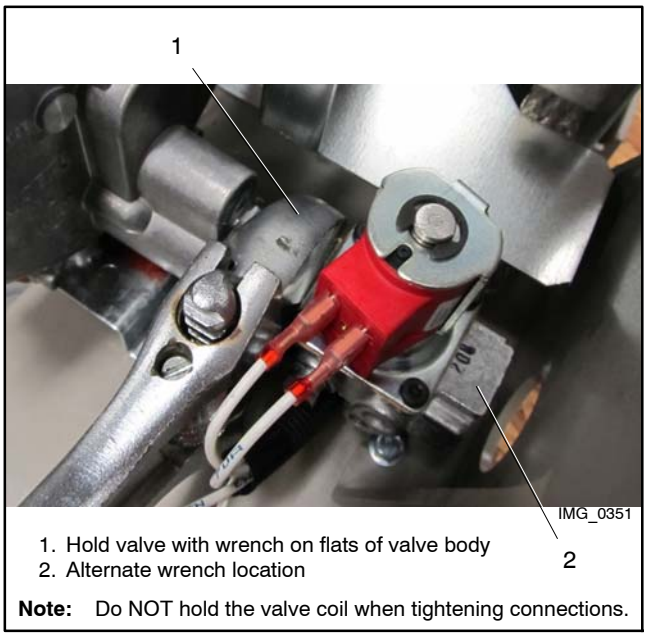
Natural Gas—Adequate ventilation is mandatory. Because natural gas rises, install natural gas detectors high in a room. Inspect the detectors per the manufacturer's instructions.

The dimension drawing in Section 3 shows the location of the fuel inlet connection. Have the fuel supplier install rigid gas piping and a manual fuel shut-off valve. The fuel supply line should line up with the generator set fuel inlet and end about 12 inches away to allow connection with a section of flexible fuel line. Use flexible sections to prevent fuel line breakage caused by vibration.

Note: Do not bend the flexible fuel line to make up for misalignment of the fuel supply line and the generator set fuel inlet.

Apply pipe sealant that is approved for fuel connections. Hold the fuel solenoid valve with a wrench on the flats of the valve when tightening the fuel connections.

Note: Do not hold the fuel solenoid valve coil when tightening the fuel connections. See Figure 1-7 for the recommended wrench locations.



1. Hold valve with wrench on flats of valve body
2. Alternate wrench location

Note: Do NOT hold the valve coil when tightening connections.

Figure 1-7 Holding Fuel Valve to Tighten Fuel Connections

Open the manual fuel valves and test all fuel connections using soapy water. If a leak is found, close the fuel valves, clean the fittings, and apply fresh sealant. Check for fuel leaks again with the generator set running.

Protect all fuel lines from machinery or equipment contact, adverse weather conditions, and environmental damage.

1.7 Fuel Conversion

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

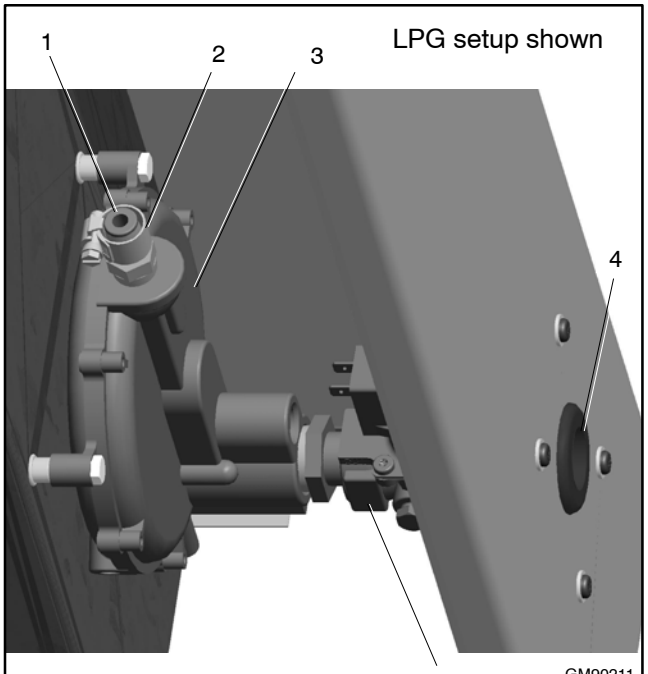
See Figure 1-8 for the fuel system components.

Rating Change

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

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

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



1. Fuel orifice for LPG
2. Hose fitting
3. Fuel regulator
4. Fuel inlet, 1/2 in. NPT
5. Fuel solenoid valve (with coil)

Figure 1-8 Fuel System

1.7.1 Fuel Conversion

For LPG fuel, an orifice is used in the fuel line. The unit is typically shipped set up for natural gas, with the loose orifice tied near the fuel solenoid valve. To convert to LPG, install the orifice as described below. See Figure 1-8 for the fuel system component locations.

Procedure to Convert from NG to LP

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

Conversion from LPG to Natural Gas

To convert from LPG to natural gas, repeat the steps above to remove the fuel orifice.

1.8 Battery

⚠ WARNING

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

Wear protective goggles and clothing. Battery acid may cause blindness and burn skin.

⚠ 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.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

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

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

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

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

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

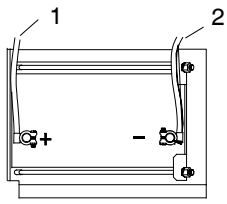
Connecting the battery and the battery charger. Hazardous voltage can cause severe injury or death. Reconnect the battery correctly, positive to positive and negative to negative, to avoid electrical shock and damage to the battery charger and battery(ies). Have a qualified electrician install the battery(ies).

Battery Description

Starting batteries are usually the lead-acid type. Use a 12-volt group 26 battery with a minimum rating of 500 cold cranking amps at 0°F. The generator set uses a negative ground with a 12-volt engine electrical system. See Figure 1-9 for battery connections. Make sure that the battery is correctly connected and the terminals are tight.

Note: The generator set will not start and circuit board damage may occur if the battery is connected in reverse.

See the dimension drawing in Section 3 for the engine starting battery location on the air intake side of the generator set. Standard battery cables provide easy connection to the battery.



EZ-273000-J

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

Figure 1-9 Typical Battery Connection

Use the following procedure to install and connect the battery.

Battery Installation Procedure

1. Ensure that the starting battery is fully charged before placing the battery in service.
2. Clean the battery posts and/or adapters if necessary.
3. Install the battery post adapters, if needed.
4. Place the battery in the housing.
5. Connect the positive (+) lead to the engine starting battery.
6. Connect the negative (–) lead to the engine starting battery.

Refer to the generator set operation manual and the battery manufacturer's instructions for battery maintenance instructions.

When power is applied to the RDC2 controller (that is, when the battery is connected), you will be prompted to set the date and time, and then to set the exerciser. See Section 1.12 and the generator set operation manual for instructions.

If the battery is disconnected for service or replacement, the exercise settings on the RDC2 controller are lost. Set the exerciser after installing and connecting the battery. See Section 1.12, Set Exerciser.

1.9 Electrical Connections

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

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

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

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.

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.

Have an authorized distributor/dealer or a licensed electrician make the following electrical connections. The electrical installation must comply with the National Electrical Code® (NEC) class 1 wire designation and all applicable local codes. Use Class 1 wiring methods for field wiring connections to a Class 2 circuit. Canadian installations must comply with the Canadian Electrical Code (CEC) and applicable local codes.

AC circuit protection. All AC circuits must include circuit breaker or fuse protection. The circuit breaker must be rated for a maximum of 125% of the rated generator set output current. The circuit breaker must open all ungrounded connectors. The generator set is equipped with a factory-installed circuit breaker.

The National Electrical Code® is a registered trademark of the National Fire Protection Association, Inc.

For customer-supplied wiring, select the wire temperature rating in Figure 1-10 based upon the following criteria:

- Select row 1, 2, 3, or 4 if the circuit rating is 110 amperes or less or requires #1 AWG (42.4 mm^2) or smaller conductors.
- Select row 3 or 4 if the circuit rating is greater than 110 amperes or requires #1 AWG (42.4 mm^2) or larger conductors.

Row	Temp. Rating	Copper (Cu) Only	Cu/Aluminum (Al) Combinations	Al Only
1	60°C (140°F) or 75°C (167°F)	Use No. * AWG, 60°C wire or use No. * AWG, 75°C wire	Use 60°C wire, either No. * AWG Cu, or No. * AWG Al or use 75°C wire, either No. * AWG Cu or No. * AWG Al	Use 60°C wire, No. * AWG or use 75°C wire, No. * AWG
2	60°C (140°F)	Use No. * AWG, 60°C wire	Use 60°C wire, either No. * AWG Cu or No. * AWG Al	Use 60°C wire, No. * AWG
3	75°C (167°F)	Use No. *† AWG, 75°C wire	Use 75°C wire, either No. *† AWG Cu or No. *† AWG Al	Use 75°C wire, No.*† AWG
4	90°C (194°F)	Use No. *† AWG, 90°C wire	Use 90°C wire, either No. *† AWG Cu or No. *† AWG Al	Use 90°C wire, No.*† AWG

* The wire size for 60°C (140°F) wire is not required to be included in the marking. If included, the wire size is based on ampacities for the wire given in Table 310-16 of the National Electrical Code®, in ANSI/NFPA 70, and on 115% of the maximum current that the circuit carries under rated conditions. The National Electrical Code® is a registered trademark of the National Fire Protection Association, Inc.

† Use the larger of the following conductors: the same size conductor as that used for the temperature test or one selected using the guidelines in the preceding footnote.

Figure 1-10 Terminal Markings for Various Temperature Ratings and Conductors

1.9.1 Grounding

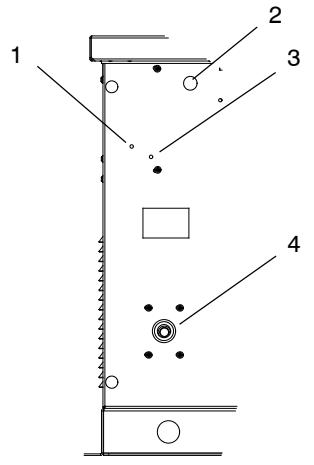
Ground the generator set. The grounding method must comply with NEC and local codes. Connect the ground to the generator set ground lug, terminal GND inside the controller compartment.

Generator sets are shipped with the generator neutral bonded (connected) to the generator ground in the junction box. The requirement for having a bonded (grounded) neutral or ungrounded neutral is determined by the type of installation. At installation, the neutral can be grounded at the generator set or lifted from the ground stud and isolated if the installation requires an ungrounded neutral connection at the generator. The generator set will operate properly with the neutral either bonded to ground or isolated from ground at the generator.

Various regulations and site configurations including the National Electrical Code (NEC), local codes, and the type of transfer switch used in the application determine the grounding of the neutral at the generator. NEC Section 250 is one example that has a very good explanation of the neutral grounding requirements for generators.

1.9.2 Electrical Lead Entry

Drill or punch holes in the enclosure for the electrical conduit in the locations shown in Figure 1-11. Pilot holes are provided at the recommended locations. Do not drill or punch holes in any other locations on the back panel.



1. Utility voltage electrical lead entry point
2. Optional emergency stop switch location. Do not use to route wiring.
3. Low voltage electrical lead entry point
4. 1/2 NPT female fuel inlet

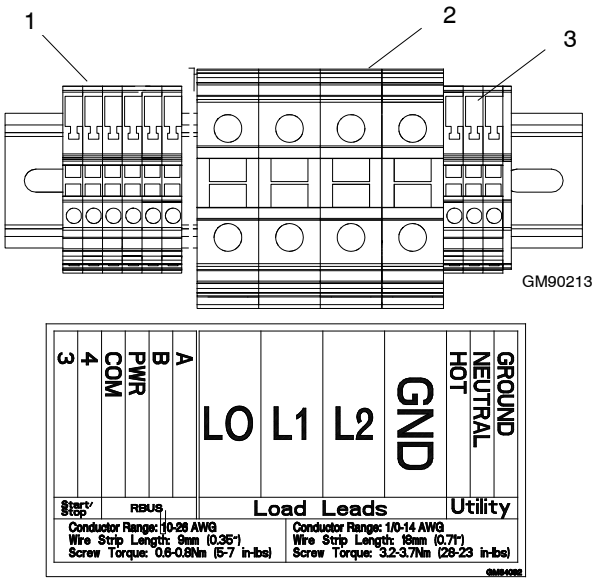
Figure 1-11 Electrical Lead Entry Locations

1.9.3 Field-Connection Terminal Block

The generator set is equipped with a field-connection terminal block located in the air inlet area near the junction box. Leads have been factory-installed from the junction box to the terminal block for easy field wiring.

See the dimension drawing in Section 3 for the terminal block location. See Figure 1-12 for terminal block details. Refer to the terminal block decal for connections and cable sizes. Also see the wiring diagram in Section 3.

Electrical conduits must include flexible sections to isolate vibration and prevent breakage. Ensure that the leads and conduit do not interfere with the operation of the generator set or obstruct the service areas. Route low-voltage communication leads through separate conduit.



1. Low voltage communication and engine start connections
2. AC load connections
3. AC power connections for battery charging and accessories

Figure 1-12 Field Connection Terminal Block

Procedure

1. Drill holes for the conduit fittings. See Figure 1-11 for the recommended electrical inlet locations. Feed the cables through the openings.

2. Connect the leads from the transfer switch emergency source lugs to the L1 and L2 connections on the generator set terminal block.

3. Connect the neutral (L0) and ground (GRD) leads from the ATS and the main panel to the corresponding connection points on the terminal block. See Section 1.9.1, Grounding.

4. Connect AC power source leads to the terminal block connections labeled BLK, WHT, and GRN. Connect the circuit to the load side of the transfer switch. See Section 1.9.4 for more information about the AC power requirement.

   Note: AC power must be connected to maintain the charge on the engine starting battery.

5. For connection of optional transfer switches, the programmable interface module (PIM), and/or a load shed kit, see Section 1.10.

Note: Optional OnCue® Plus and OnCue® Plus Wireless Generator Management System kits are available for remote generator monitoring and control. The OnCue® Plus system requires installation of a network cable from the generator to the owner's computer router. OnCue® Plus Wireless does not require installation of a network cable to the owner's router.

6. If the OnCue® Plus Generator Management System will be used with the generator set, run category 5E network cable from the generator set to the customer's router or modem.

   Note: Installation of the network cable at the time of generator set installation is highly recommended (unless installing OnCue® Plus Wireless). Installing the Ethernet cable now will make connection much easier if you choose to add OnCue® Plus later.

   a. Route the network cable with other low-voltage signal wiring (for example, the RBUS communication leads or engine start leads to the transfer switch), in separate conduit from the AC load leads. If a network cable is longer than 100 meters (328 ft.), use a repeater or switch.

   b. Use an RJ45 inline coupler to connect the Ethernet cable to the cable in the customer connection box. The inline coupler is included with the OnCue® Plus kit.

1.9.4 AC Power Supply

The installer must connect AC power for the battery charger (which is integral to the RDC2 controller) and optional accessories shown in Figure 1-13. The power source must comply with state and local codes. The power to the battery charger and accessories must be backed up by the generator so that power is available at all times.

Be sure to disconnect power at the distribution panel before making the connections. Connect power leads to the AC power connection points labeled BLK, WHT, and GRN on the field-connection terminal block. Connect the circuit to the load side of the transfer switch so that it is backed up by the generator. See Figure 1-12 and the wiring diagrams in Section 3 for connection details.

Equipment	Power Requirement, Max.	
	Watts	Volts @ 50/60 Hz
Battery charger (standard)	50	100–250 VAC
Carburetor heater *	37	120 VAC
Battery heater *	110	
Fuel regulator heater *	60	
* Optional accessory		

Figure 1-13 Power Requirements

1.10 ATS and Accessory Communication Connections

The following sections cover communication connections from the generator set to automatic transfer switches and RBUS accessories, including the programmable interface module (PIM) and the load shed kit.

1.10.1 Transfer Switch Connection

Connect the automatic transfer switch (ATS) or remote start/stop switch. Connect the load leads from the generator set to the Emergency source lugs on the ATS. Connect the RBUS or engine start connections as described below. Route low-voltage communication leads through separate conduit from the AC power and load leads. All connections must comply with applicable state and local codes.

Note: Do not use the Kohler® Model RRT transfer switch with the 20RESB or 20RESD generator set.

RBUS communication connections for a Kohler® Model RXT transfer switch

One Model RXT transfer switch can be connected to the generator set. See Figure 1-14. Use shielded, twisted-pair communication cable to connect P10-1 through P10-4 on the transfer switch interface module to the generator set terminal block TB1 connections A, B, PWR, and COM. See Section 1.10.2 for the communication cable recommendations and maximum cable length.

The Model RXT transfer switch with the combined interface/load management board requires one set of RBUS connections to the generator set. However, the combined board acts as two RBUS modules: one RXT transfer switch and one load managemnt device.

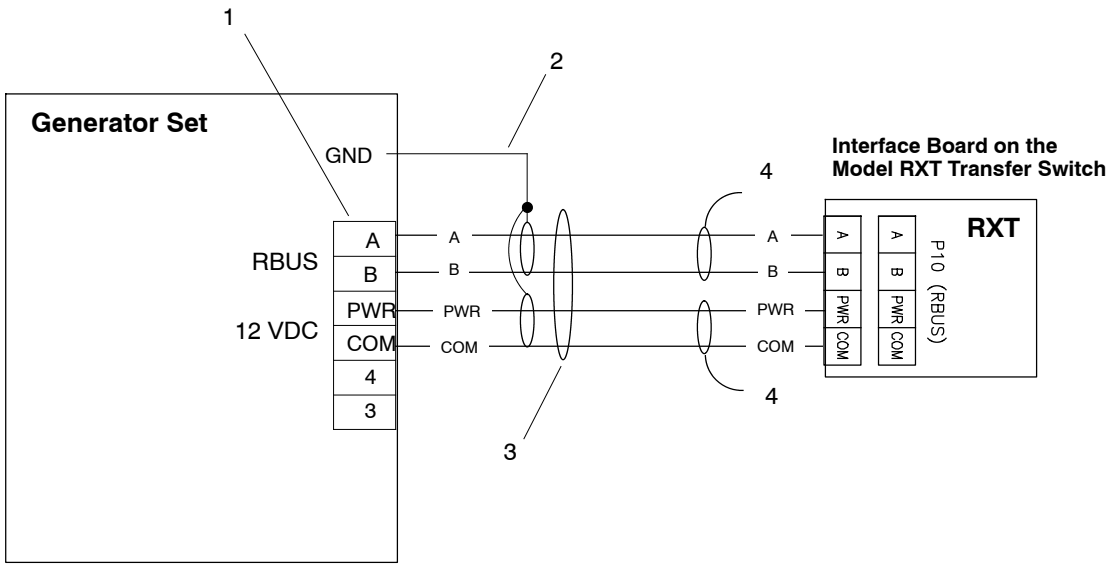
Note: Connections 3 and 4 on the generator set are not used with the Model RXT transfer switch.

Engine start connection for other transfer switches or a remote start/stop switch

These instructions apply to a remote start/stop switch or a transfer switch other than the Kohler Model RXT ATS.

Connect the engine start leads from the transfer switch or remote start switch to terminals 3 and 4 on the terminal block. See Figure 1-15. See the connection decal on the generator set and the transfer switch information for acceptable wire sizes. Route the engine start leads through separate conduit from the AC power and load leads.

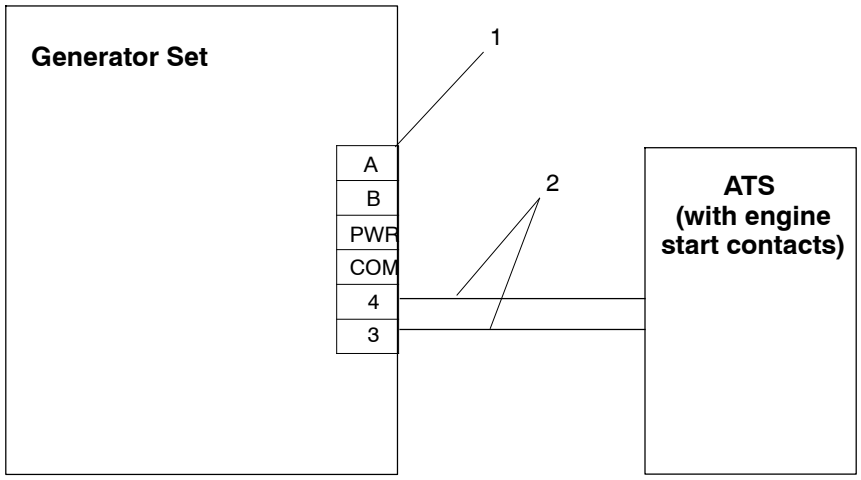
Close the remote start contacts to start and run the generator set. Open the contacts to signal the generator set to stop. The generator set controller must be in AUTO mode for remote start/stop.



Note: Connections 3 and 4 are NOT USED with the Model RXT ATS.

1. Customer connection terminal block. See the dimension drawing in Section 3 for location. Check the decal on the generator set for terminal block connections.
2. Connect one end of each cable shield to GROUND at the generator set.
3. Communication cable Belden #9402 or equivalent 20 AWG shielded, twisted-pair cable. See Section 1.10.2, Cable Specifications, and Figure 1-16.
4. Leave one end of each cable shield disconnected. If accessory modules are connected, see Section 1.10.3.

Figure 1-14 Model RXT Transfer Switch Communication Connection to Generator Set Terminal Block



1. Customer connection terminal block. See the dimension drawing in Section 3 for location. Check the decal on the generator set for terminal block connections.
2. Engine start leads 3 and 4. See the ATS manual for more information.

Figure 1-15 Engine Start Connections with Transfer Switch Models other than Model RXT

1.10.2 Communication Cable Specifications

RBUS Connections A and B

For the RBUS communication connections A and B to the optional RBUS modules, use 20 AWG shielded, twisted-pair communication cable. Belden #9402 (two-pair) or Belden #8762 (single-pair) or equivalent cable is recommended. Optional RBUS modules can include the Model RXT transfer switch, RXT combined interface/load management board, automatic paralleling module (APM), programmable interface module (PIM), and/or the load shed kit for the RDT or RXT transfer switch.

For outdoor installations, including those with buried cables and/or conduit, use outdoor-rated Belden #1075A or equivalent 20 AWG shielded, twisted-pair communication cable.

PWR and COM Connections

For the PWR and COM connections, the cable size and maximum cable length depends on the number of modules connected. See Figure 1-16.

- For short cable runs shown in the first two rows of Figure 1-16, use one pair in the two-pair communication cable for the A and B connections, and use the second pair for the PWR and COM connections.
- For the longer cable runs shown in the last two rows of Figure 1-16, use 12 or 14 AWG cable for PWR and COM, and use the 20 AWG communication cable specified above for the A and B connections only. In this case, single-pair communication cable such as Belden #8762 can be used for the A and B connections.

The maximum cable length depends on the number of optional modules connected. See Figure 1-16 for the maximum cable lengths with 1 to 4 modules per cable run. Note the shield connections shown in Figure 1-17.

Note: A model RXT transfer switch with combined interface/load management board acts as two RBUS modules: one RXT transfer switch and one load management device.

Power relay modules are not RBUS modules and do not add to the number of modules in Figure 1-16.

	Maximum length per run, meters (ft.)			
	Number of Modules (RXT, APM, PIM, and/or load management device) per Run			
Cable (TB1-PWR and COM)	**1 Module**	**2 Modules**	**3 Modules**	**4 Modules**
Belden #9402 or equivalent 20AWG for indoor installations	46 (150)	15 (50)	5 (17)	Do not use 20AWG for PWR and COM
Belden #1075A or equivalent 20AWG for outdoor installations or buried cables	46 (150)	15 (50)	5 (17)	Do not use 20AWG for PWR and COM
14 AWG *	137 (450)	137 (450)	107 (350)	107 (350)
12 AWG *	137 (450)	137 (450)	137 (450)	137 (450)

* Use 12 or 14 AWG cable for PWR and COM connections only. For RBUS connections A and B, use shielded, twisted pair communication cable specified above.

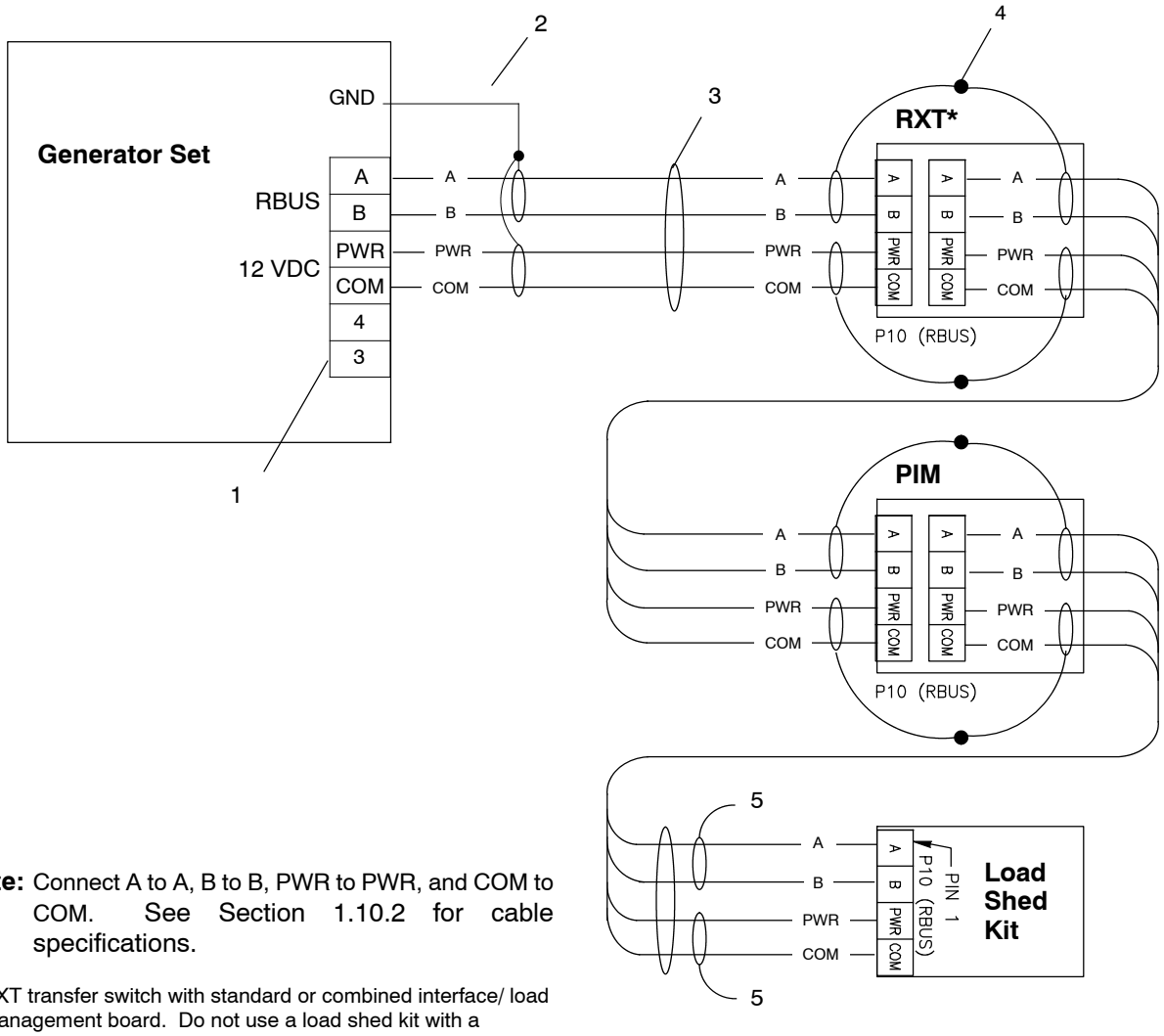
Figure 1-16 Total Cable Lengths for PWR and COM Connections

1.10.3 System Connections with Accessory Modules

See Figure 1-17 through Figure 1-20 for connection options with up to three accessory modules. Accessory modules can include one Model RXT transfer switch, one programmable interface module (PIM), and/or one load shed kit.

Note: Refer to the installation instructions provided with the Automatic Paralleling Module (APM) for RBUS connections to the APM.

Connect A to A, B to B, PWR to PWR, and COM to COM. See Figure 1-16 for the maximum total cable length with 1, 2, or 3 accessory modules per cable run.

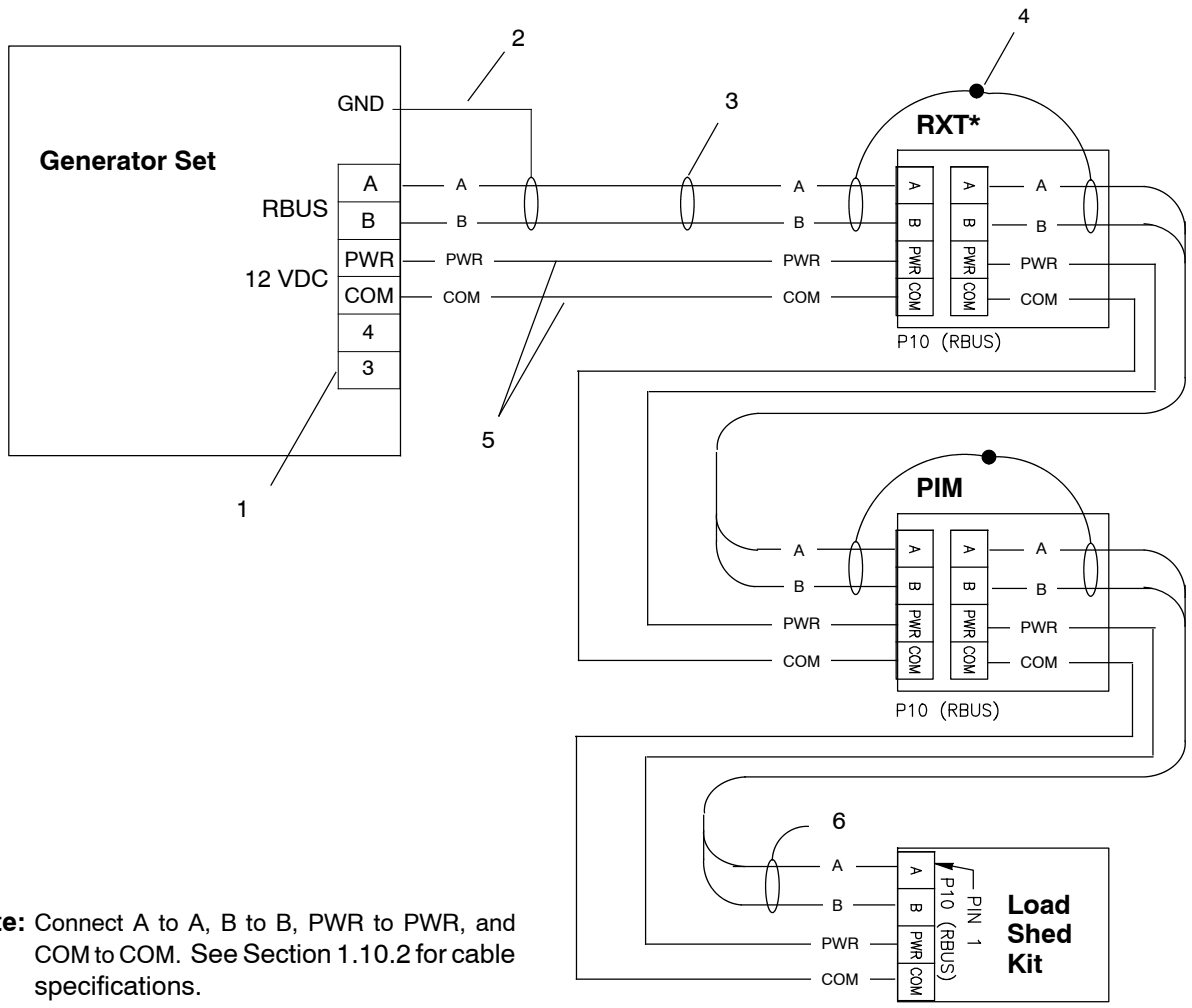


Note: Connect A to A, B to B, PWR to PWR, and COM to COM. See Section 1.10.2 for cable specifications.

* RXT transfer switch with standard or combined interface/ load management board. Do not use a load shed kit with a combined interface board.

1. Customer connection terminal block. See the dimension drawing in Section 3 for location. Check the decal on the generator set for terminal block connections.
2. Connect one end of each cable shield to GROUND at the generator set.
3. Communication cable Belden #9402 or equivalent 20 AWG shielded, twisted-pair cable
4. Connect shields together as shown.
5. Leave one end of each cable shield disconnected at the last device.

Figure 1-17 Accessory Module Communication Connections Using Two-Pair Communication Cable

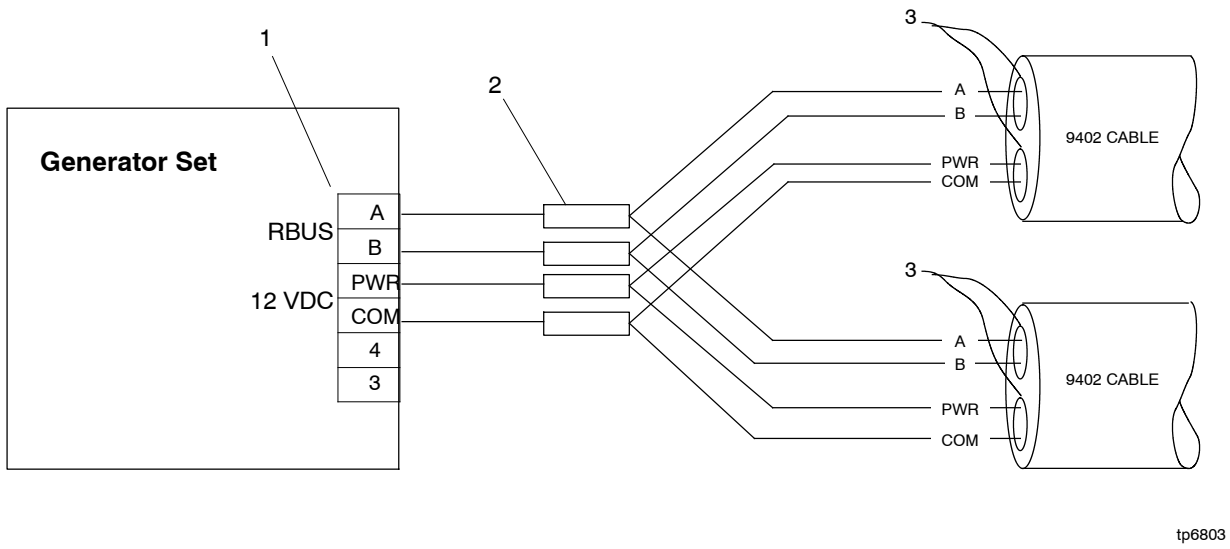


Note: Connect A to A, B to B, PWR to PWR, and COM to COM. See Section 1.10.2 for cable specifications.

* RXT transfer switch with standard or combined interface/ load management board. Do not use a load shed kit if the RXT has a combined interface board.

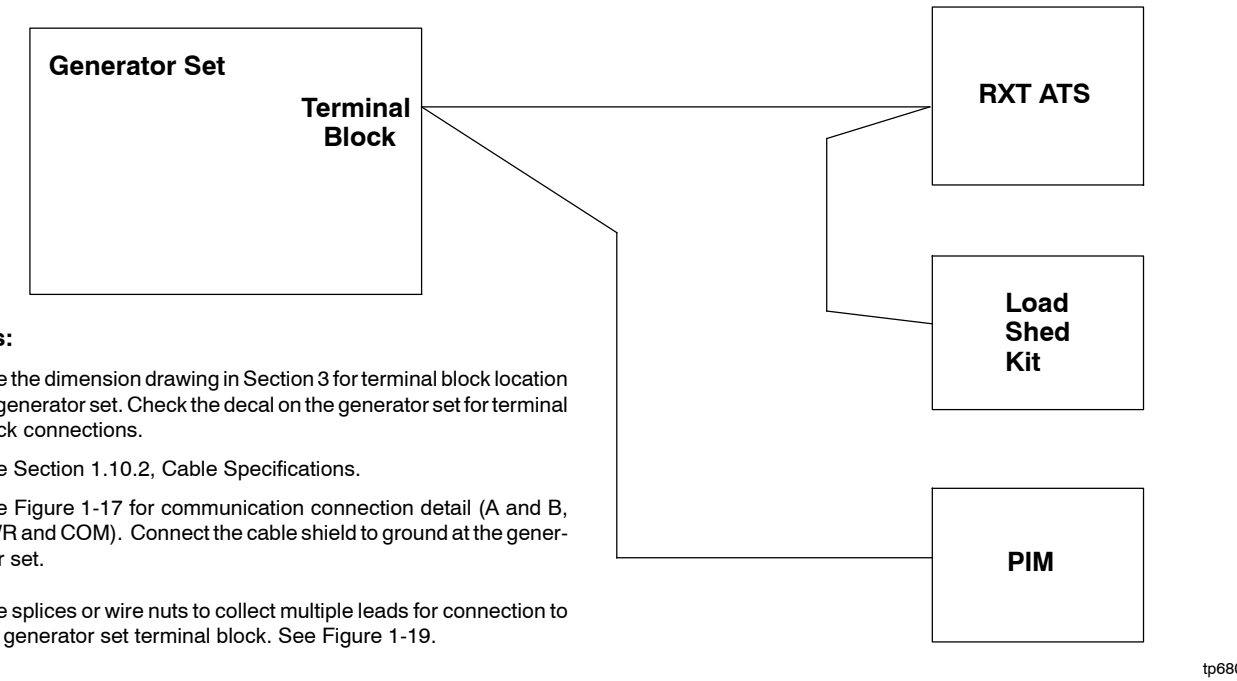
1. Customer connection terminal block. See the dimension drawing in Section 3 for location. Check the decal on the generator set for terminal block connections.
2. Connect one end of each cable shield to GROUND at the generator set.
3. Communication cable Belden #8762 or equivalent 20 AWG shielded, twisted-pair cable (one pair)
4. Connect shields together as shown.
5. 12 AWG or 14 AWG leads for PWR and COM
6. Leave one end of each cable shield disconnected at the last device.

Figure 1-18 Accessory Module Connections Using Single-Pair Communication Cable and 12–14 AWG Power Leads (one cable run with three modules shown)



1. Customer connection terminal block. See the dimension drawing in Section 3 for location. Check the decal on the generator set for terminal block connections.
2. Splice
3. Connect all of the shield leads on this end to GROUND at the generator set.

Figure 1-19 Multiple Connections to the Generator Set



Notes:

- See the dimension drawing in Section 3 for terminal block location on generator set. Check the decal on the generator set for terminal block connections.
- See Section 1.10.2, Cable Specifications.
- See Figure 1-17 for communication connection detail (A and B, PWR and COM). Connect the cable shield to ground at the generator set.
- Use splices or wire nuts to collect multiple leads for connection to the generator set terminal block. See Figure 1-19.

Figure 1-20 Accessory Module Connections with Two Cable Runs

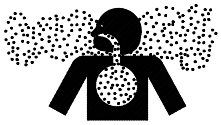
1.11 Prestart Installation Check

⚠ 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



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.

Review the entire installation section. Inspect all wiring and connections to verify that the generator set is ready for operation. Check all items in the following Prestart Checklist.

Prestart Checklist

Air Cleaner. Check that a clean air cleaner element is installed to prevent unfiltered air from entering the engine. See the generator set operation manual for instructions.

Air Inlets. Check for clean and unobstructed air inlets.

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

Enclosure. Check that all enclosure panels and internal baffling are in place.

Exhaust System. Check for exhaust leaks and blockages. Check the muffler condition.

- Inspect the exhaust system components for cracks, leaks, and corrosion. Check for tight exhaust system connections.
- Check for corroded or broken metal parts and replace them as needed.
- Check that the exhaust outlet is unobstructed.

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

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

1.12 Set the Exerciser

Set the exerciser to automatically run the generator set on the desired day and time every week or every two weeks. See the generator set Operation Manual for detailed descriptions of the unloaded and loaded exercise operation.

1.12.1 Set Exercise Procedure

When power is applied to the RDC2 controller (when the battery or the utility power for the battery charger is connected), you will be prompted to set the date and time, and then to set the 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 the date, time, and exercise are set and the controller display shows the main menu. See the generator set Operation Manual for more detailed instructions to set the date and time and set the exerciser.

Press AUTO to place the generator set controller into automatic mode.

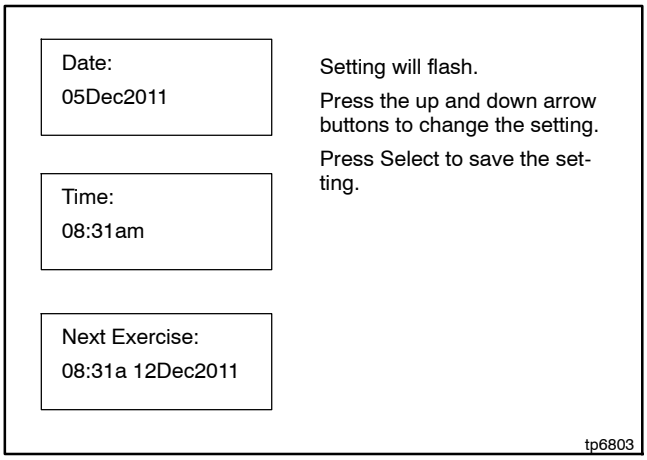


Figure 1-21 Set Time, Date, and Exercise (RDC2)

1.12.2 Loaded Exercise

In order to set a loaded exercise using the RDC2 controller, a Kohler® Model RXT transfer switch must be connected. See the generator set operation manual for instructions to set a loaded exercise.

To set a loaded exercise on a generator set connected to a transfer switch other than a Model RXT, use the transfer switch controller to set the exercise. Refer to the transfer switch operation manual for instructions.

2.1 Introduction

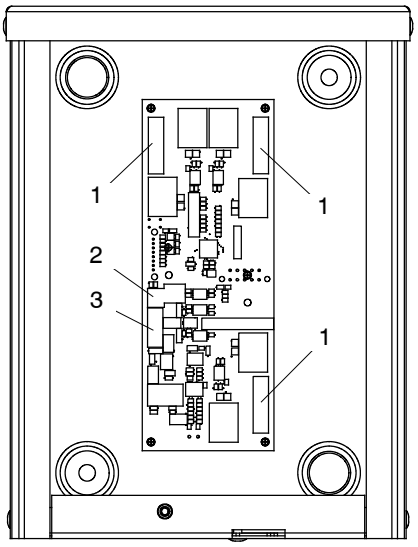
Have accessories installed by an authorized distributor/ dealer or a licensed electrician. Follow the installation instructions provided with each kit. Use separate conduit for AC and DC leads to reduce the possibility of electrical interference. Verify that the leads and conduit do not interfere with the operation of the generator set or obstruct the service areas. Verify that the electrical installation complies with the National Electrical Code (NEC) and all applicable local codes. See the wiring diagrams in Section 3 for more information regarding generator set electrical connections.

2.2 Programmable Interface Module (PIM)

The optional programmable interface module (PIM) provides two programmable inputs and six dry contact outputs, four of which are programmable. See TT-1584 for PIM installation and connection instructions. Also see Section 1.10 of this manual for connection to the generator set.

The default settings for the inputs and outputs are shown in Figure 2-2. To change the input and output settings, use a personal computer running Kohler® SiteTech™ software. See TP-6701, SiteTech Software Operation Manual, for instructions.

Kohler® OnCue® Plus can be used to actively control PIM outputs. See the OnCue® Plus Operation Manual for instructions.



1. Output connections (3 terminal blocks, 6 outputs)
2. Input connections (2 inputs)
3. RBUS communication connection to generator set terminal block TB1

Figure 2-1 Optional PIM

PIM Connection	Factory Default Setting
Input 1	None
Input 2	None
Output 1 (Relay 1)	Run
Output 2 (Relay 2)	Common Fault
Output 3 (Relay 3)	Low Battery Voltage (Programmable)
Output 4 (Relay 4)	Not in Auto (Programmable)
Output 5 (Relay 5)	Cooldown (Programmable)
Output 6 (Relay 6)	Normal Source Failure (Programmable)

Figure 2-2 PIM Inputs and Outputs

2.3 Load Management

Two optional load management devices are available for use with single-phase generator sets and a model RXT or RDT transfer switch:

- The optional Load Shed Kit mounts inside a model RDT or RXT transfer switch. Figure 2-3 shows the load shed assembly.
- The combined interface/load management board is available for the Model RXT transfer switch.

The devices provide an automatic load management system to comply with Section 702.5 of NEC 2008. The installer is responsible for ensuring that the power system installation complies with all applicable state and local codes.

Note: The load management devices are only compatible with single-phase generator sets.

With a load management system, less critical appliances can be powered by the generator set when the more important appliances are not running, allowing the use of a smaller generator set than would be needed to run all of the building's electrical equipment at the same time.

The load management device automatically manages up to six residential loads.

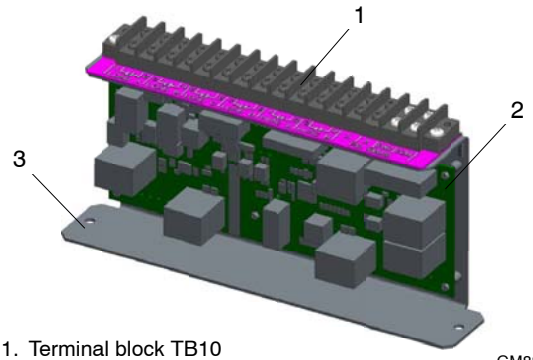
- Up to four normally closed power relays can be connected through normally open relay contacts on the circuit board. See the load shed kit installation instructions for relay specifications. Kohler® Power Relay Modules are recomended.
- Two relays are included to control two independent heating, ventilation, and air conditioning (HVAC) loads.

Note: Connect only non-essential loads to the load shed kit.

The load management device receives commands from the RDC2 or DC2 generator controller and energizes or de-energizes the appropriate load relays to add or shed non-critical loads according to their priority.

An adequate electrical supply is required for operation of the customer-supplied power relays connected to the load shed kit. Check the electrical requirements of the customer-provided equipment prior to installation to determine the wire size and circuit protection required.

For detailed installation and connection instructions, see the installation instructions provided with the load shed kit or the Operation/Installation Manual for the Model RXT transfer switch.



1. Terminal block TB10
2. Load control circuit board
3. Mounting bracket

GM88281

Note: Kit includes current transformer (CT), not shown.

Figure 2-3 Load Shed Assembly GM88281-1 (mounts inside the transfer switch enclosure)

2.3.1 Power Relay Module

The power relay module kit contains one 50 amp normally closed relay with connecting lugs in a NEMA type 3R enclosure. Connect up to four (4) power relay modules to the load management devices listed above.

The power relay modules can be mounted indoors or outdoors. Two (2) 120 VAC loads (shed simultaneously) or a single 240 VAC load can be wired to each relay.

For detailed installation and connection instructions, see the installation instructions provided with the power relay module kit.

Figure 2-4 Power Relay Module

2.4 OnCue Plus Generator Management System

The OnCue® Plus Generator Management System allows monitoring and control of your generator set from a personal computer, smart phone, or tablet. OnCue Plus can also be configured to send email or text message notifications in the event of a generator set fault. Both a network cable connection version (OnCue Plus) and a wireless version (OnCue Plus Wireless) are available. See TP-6928, OnCue Plus Operation Manual, for instructions.

OnCue Plus

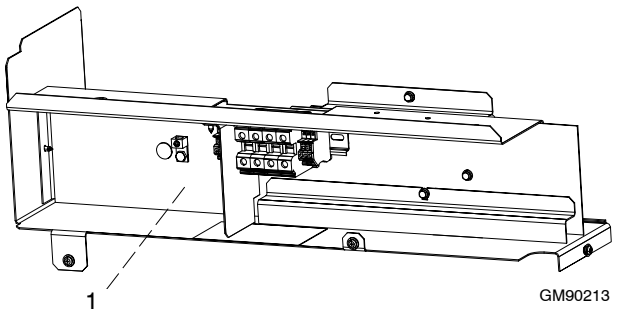
OnCue Plus is available separately as a loose kit. Use category 5E network cable to connect the RDC2 controller to the customer-supplied Ethernet router or modem. Route the cable with other low-voltage signal wiring (for example, the RBUS communication leads or engine start leads to the transfer switch), in separate conduit from the AC load leads. If a network cable is longer than 100 meters (328 ft.), use a repeater or switch.

Recommended: Use a laptop computer to verify the network connection before connecting to the generator set.

Checking the network connection

1. Check for and turn OFF any wireless connections to the laptop.
2. Connect the network cable to the laptop. Connect the other end of the network cable to the customer's router or modem.
3. Verify the Internet connection by opening your web browser and going to www.kohlerpower.com or any known website.
4. After verifying the connection through the network cable, disconnect the network cable from the laptop and turn the laptop wireless connections back on.

Connect to the Ethernet cable in the customer connection area of the generator set. See Figure 2-5. Use an RJ45 inline coupler, provided with the OnCue Plus kit, to connect the customer's Ethernet cable to the cable in the customer connection box.



1. Location of Ethernet cable in customer connection box

Figure 2-5 Network Connection for OnCue® Plus

OnCue Plus Wireless

The OnCue Plus Wireless kit allows connection of the generator set to the Internet through the customer's wireless router without running a network cable from the generator to the customer's Ethernet router. Follow the instructions provided with the kit to install and set up the wireless kit.

2.5 Carburetor Heater

An optional carburetor heater is recommended for improved cold starting in locations where the ambient temperature drops below 0°C (32°F). The carburetor heater prevents condensation and carburetor icing. The heater turns on when the temperature at the thermostat falls below approximately 4°C (40°F) and turns off when the temperature rises above approximately 16°C (60°F). The carburetor heater is shown in Figure 2-6.

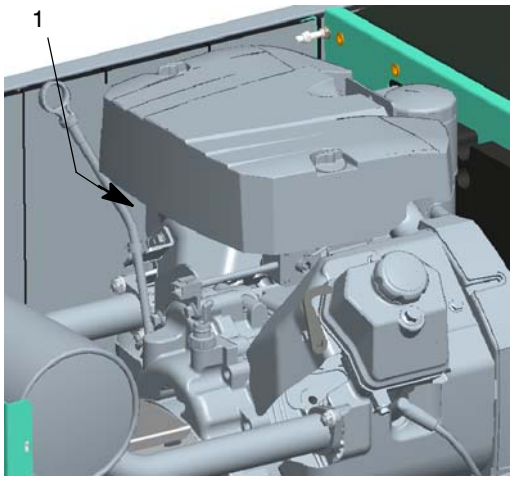
To install the carburetor heater, follow the instructions provided with the kit. Figure 2-7 shows the carburetor heater kit location.

The heater thermostat is installed in the cord. Figure 2-6 shows the location of the thermostat on the power cord. The heater power cord and thermostat are located in the generator set housing air intake area/ battery compartment.

The heater requires a continuous source of power. Plug the carburetor heater into the AC receptacle provided.

1. Power plug
2. Thermostat
3. Heater

Figure 2-6 Carburetor Heater



1. Carburetor heater location under air cleaner. Insert from the back of the generator set.

Figure 2-7 Carburetor Heater Location

Detail view:

1. Carburetor heater

Figure 2-8 Carburetor Heater Location

2.6 Regulator Heater

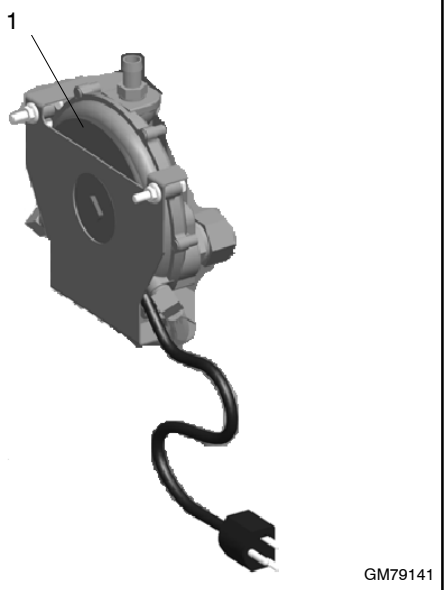
The regulator heater kit is recommended in addition to the carburetor heater for reliable engine starting in temperatures below −18°C (0°F). See Figure 2-9 for heater specifications.

Regulator Heater	
Heater rating	120 VAC, 60 W
Thermostat	4°C/13°C (40°F/55°F) Snap action
Pad diameter	127 mm (5 in.)
Cord length	610 mm (24 in.)

Figure 2-9 Regulator Heater Specifications

The regulator heater requires a source of AC power. The generator set is equipped with one 120 VAC receptacle. The kit includes an outlet splitter for powering the regulator heater and an optional carburetor heater.

To install the regulator heater kit, follow the instructions in TT-1569, provided with the kit. Figure 2-10 shows the installed regulator heater kit.



1. Fuel regulator heater pad

Note: Typical regulator mounting bracket is shown. Brackets may vary for different generator set models.

Figure 2-10 Installed Fuel Regulator Heater Kit

2.7 Emergency Stop Button

An emergency stop button is available as a loose kit. See the instructions provided with the kit for installation and connection procedures.

Figure 2-11 Optional Emergency Stop Pushbutton

2.8 PowerSync Automatic Paralleling Module (APM)

The PowerSync® Automatic Paralleling Module (APM) allows the use of two Model 20RESA/B/C/D generator sets in a single-phase paralleling system to supply power to one building or site. See Figure 2-12.

The APM provides a common connection point for paralleling generators and permits individual control of the generator connections, allowing for synchronization, redundancy, and generator management.

Generator management provides these features and benefits:

- Generator management runs one generator set when power requirements are low, and automatically starts, synchronizes, and connects the second generator set when the load increases.
- Longer generator life: Smart generator management automatically operates the generator with the lowest operating hours first, splitting the run time evenly between the two generator sets and extending the life of both units.
- Redundancy: If one generator set requires service or even fails, the other generator set is still available to provide power to your critical electronics.
- Dual fuels: Allows operation of one generator set on natural gas and the other on LPG, if desired.
- Simultaneous exercise: Setting the exercise time and date on one generator set schedules both generator sets to exercise at the same time.
- Power during generator service: Customer override allows maintenance or service to one generator set while the other continues to run.

The following combinations of single-phase generator sets can be paralleled:

- Two single-phase model 20RESA/B/C/D generator sets with the same 110/220, 115/230, 120/240, 220, 230 or 240 volt configuration can be paralleled.

Automatic paralleling requires:

- Two single-phase generator sets as shown above
- RDC2 paralleling firmware version 105.4 or higher on each generator set. Download the paralleling firmware from TechTools.
- One Model RXT automatic transfer switch (ATS)
- One Automatic Paralleling Module (APM) kit
- A personal computer (laptop) with Kohler® SiteTech™ software version 3.5 or higher is required for system setup.
- A load management device is **required** if one generator set cannot support the maximum total load.

The load management device (load shed kit or RXT combined interface/load management board) is necessary in order to shed non-critical loads in the event that one generator set shuts down and the other generator set cannot support all of the loads.

See TT-1596, provided with the APM, for complete installation instructions. The APM and associated equipment must be installed by a Kohler® trained and authorized distributor or dealer.

If the APM is not installed within sight of the generator sets, local codes may require the installation of circuit breakers near the APM. Circuit breaker kits are available for installation inside the APM enclosure. See TT-1596 for the circuit breaker kit numbers.

Figure 2-12 PowerSync® Automatic Paralleling Module

Figure 3-1 lists the wiring diagram numbers and page numbers.

Dimension Drawings	Drawing Number	Page
20RESB Dimension Drawing	ADV-8564-C	
Dimensions	Sheet 1	36
Location and clearance requirements	Sheet 2	37
20RESD Dimension Drawing	ADV-8758-A	
Dimensions	Sheet 1	38
Location and clearance requirements	Sheet 2	39
Wiring Diagrams		
20RESB Schematic Diagram	ADV-8706-C	
2-pole circuit breaker	Sheet 1	40
1-pole circuit breaker	Sheet 2	41
3-pole circuit breaker	Sheet 3	42
20RESB Wiring Diagram	GM93298-C	
2-pole circuit breaker	Sheet 1	43
1-pole circuit breaker	Sheet 2	44
3-pole circuit breaker	Sheet 3	45
20RESD Schematic Diagram	ADV-8771	
2-pole circuit breaker	Sheet 1	46
1-pole circuit breaker	Sheet 2	47
3-pole circuit breaker	Sheet 3	48
20RESD Wiring Diagram	GM96293	
2-pole circuit breaker	Sheet 1	49
1-pole circuit breaker	Sheet 2	50
3-pole circuit breaker	Sheet 3	51

Figure 3-1 Diagrams and Drawings

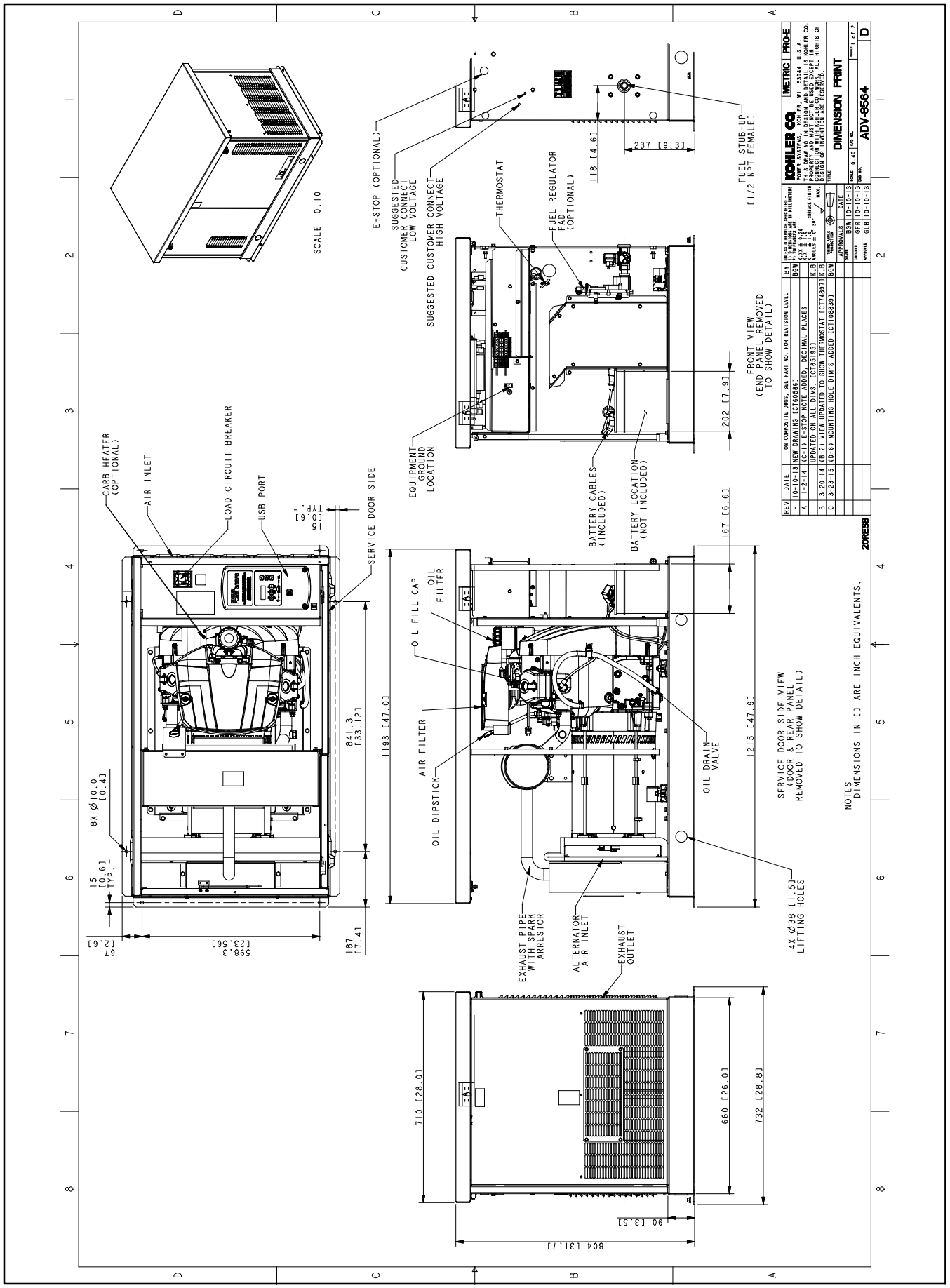


Figure 3-2 Dimension Drawing, 20RESB, ADV-8564 Sheet 1

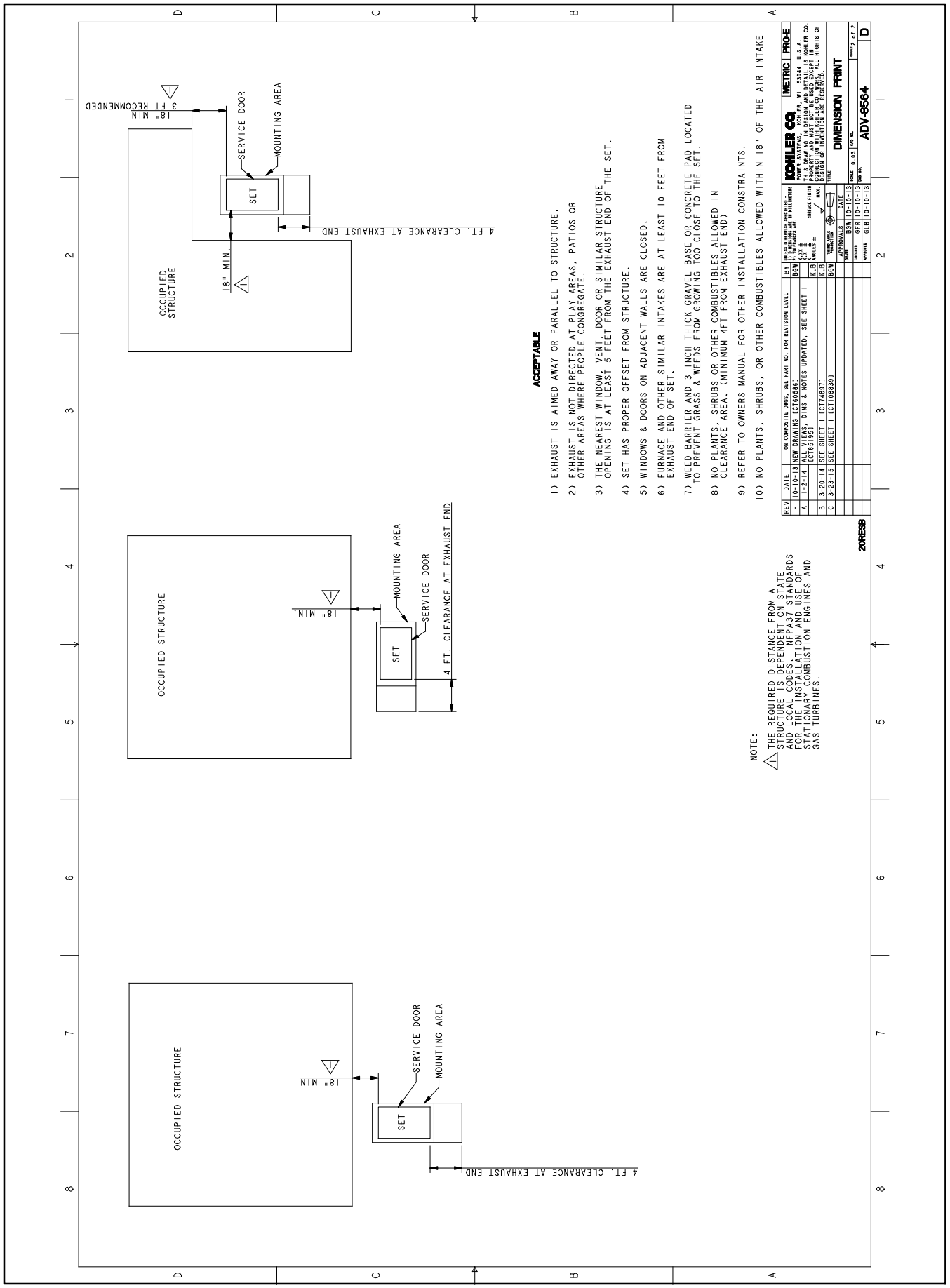


Figure 3-3 Dimension Drawing, 20RESB, ADV-8564, Sheet 2 of 2

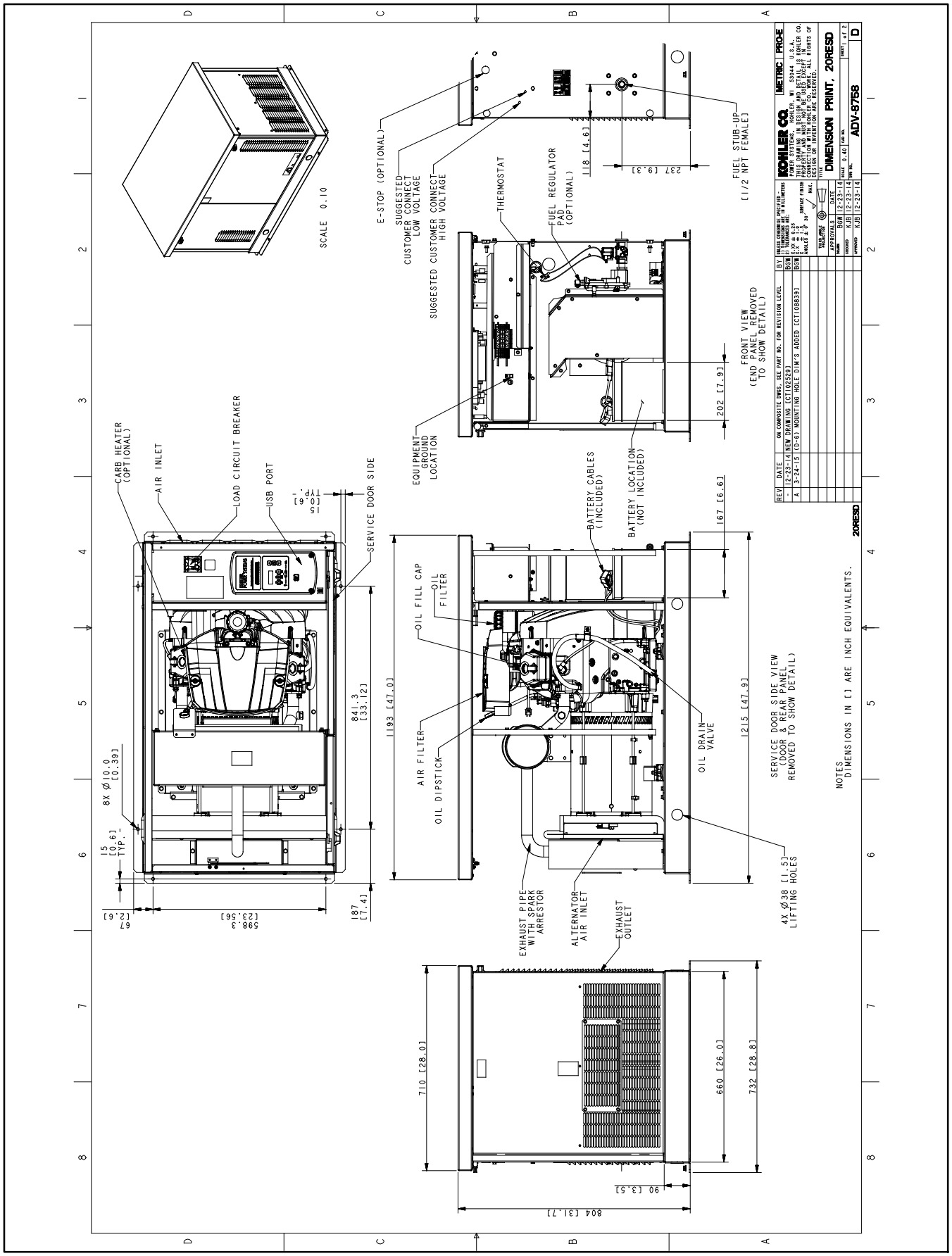


Figure 3-4 Dimension Drawing, Model 20RESD, ADV-8758, Sheet 1 of 2

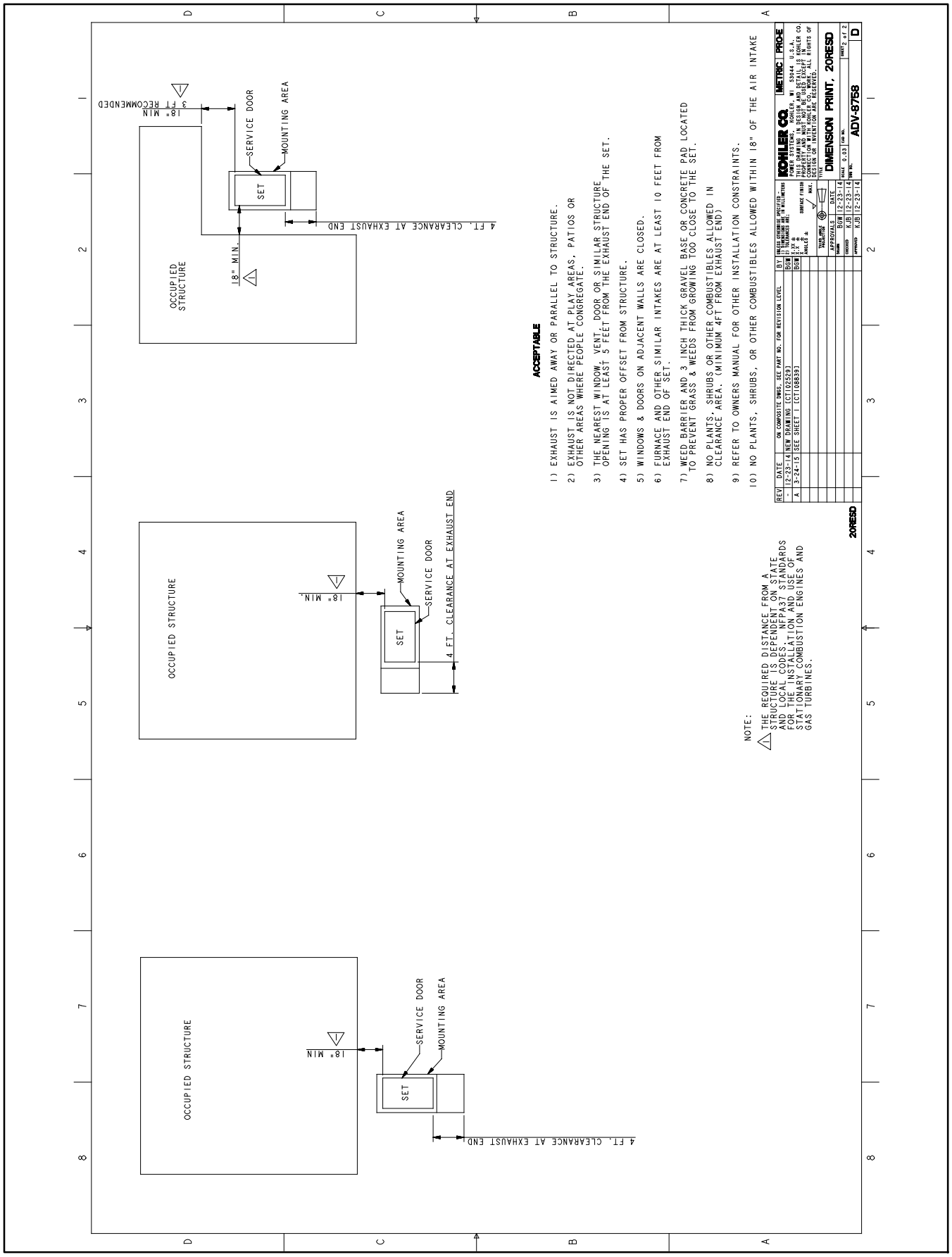


Figure 3-5 Dimension Drawing, Model 20RESD, ADV-8758, Sheet 2 of 2

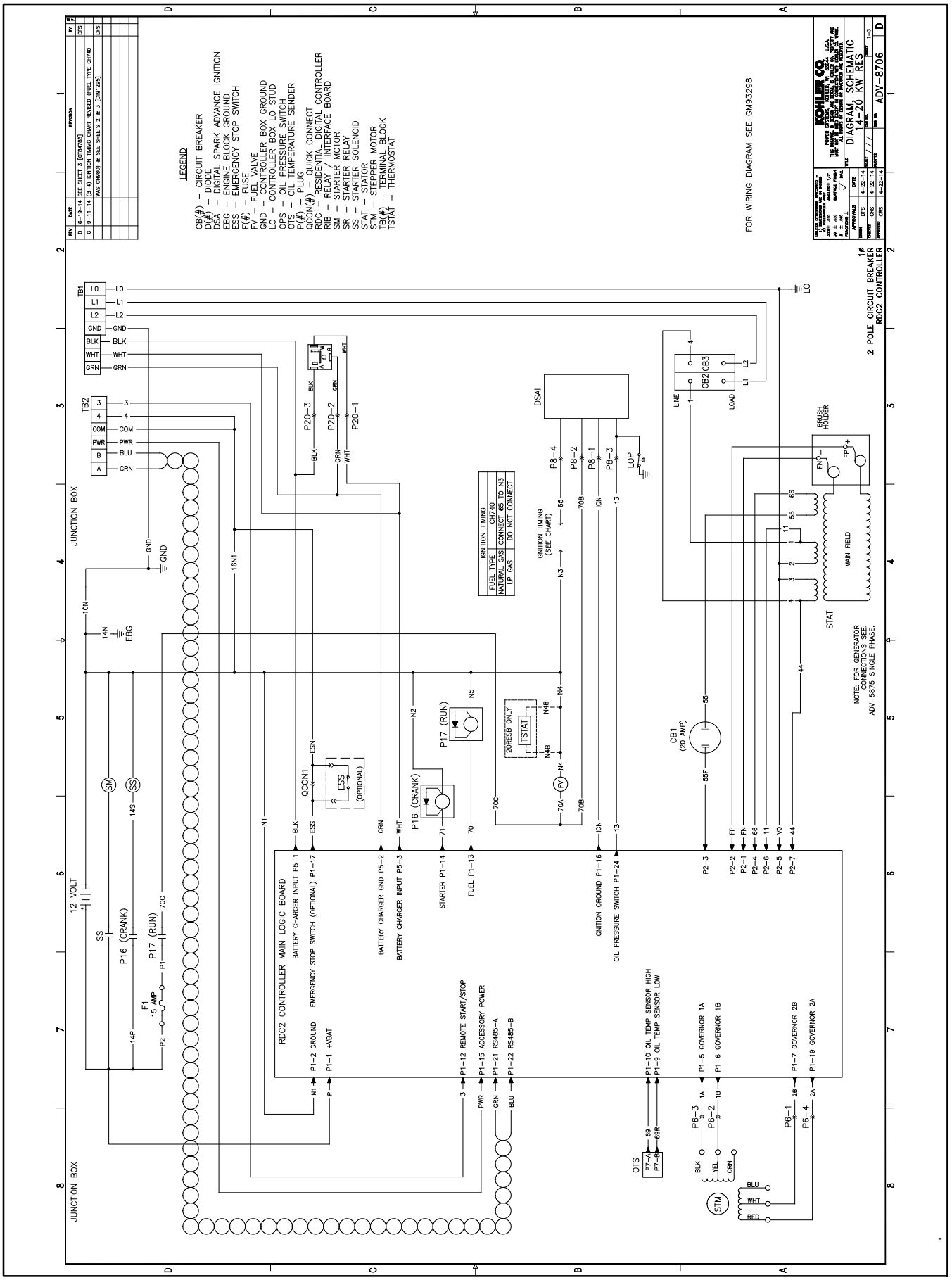


Figure 3-6 Schematic Diagram, 20RESB, ADV-8706, Sheet 1 of 3

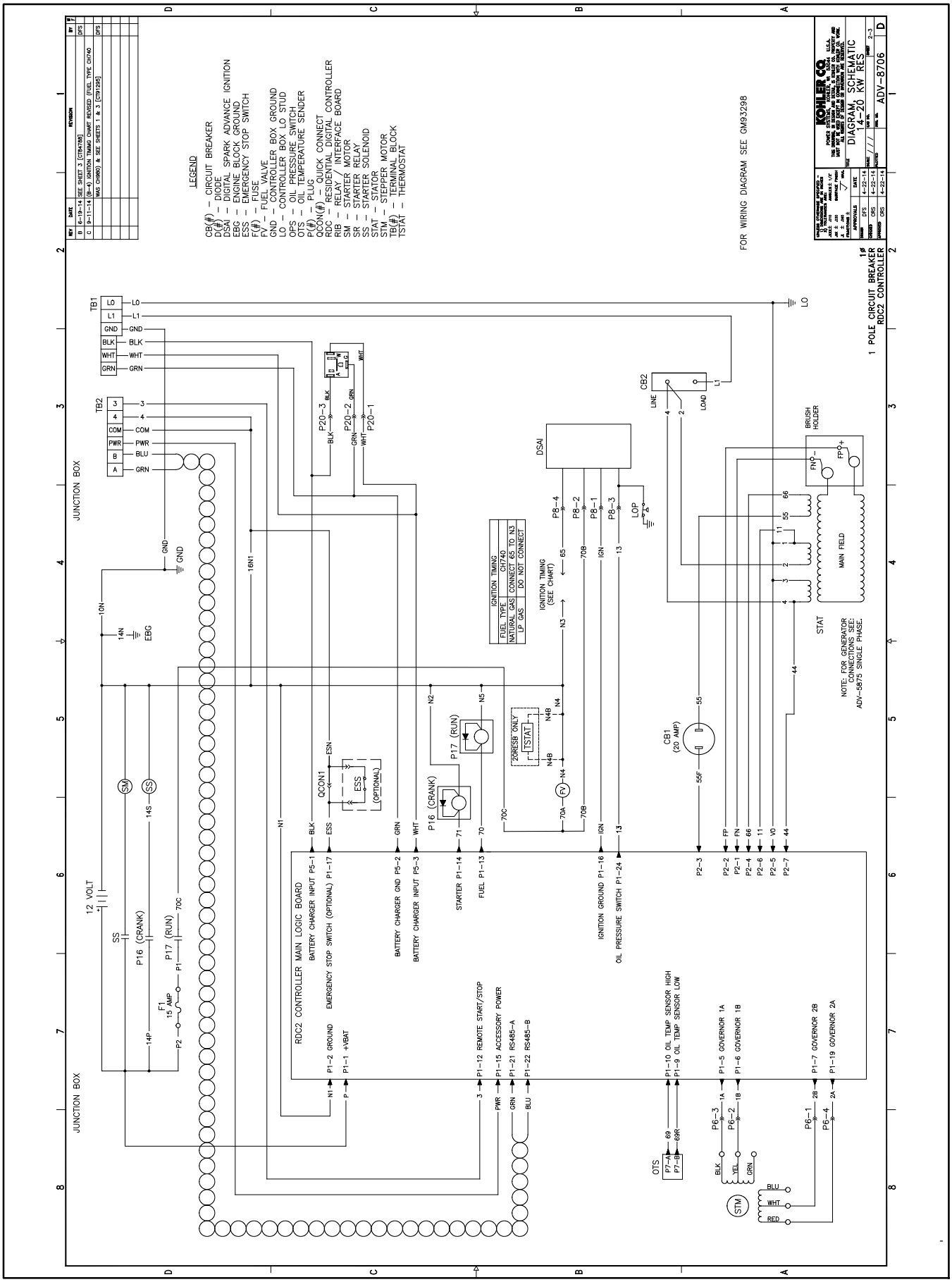


Figure 3-7 Schematic Diagram, 20RESB, ADV-8706, Sheet 2 of 3

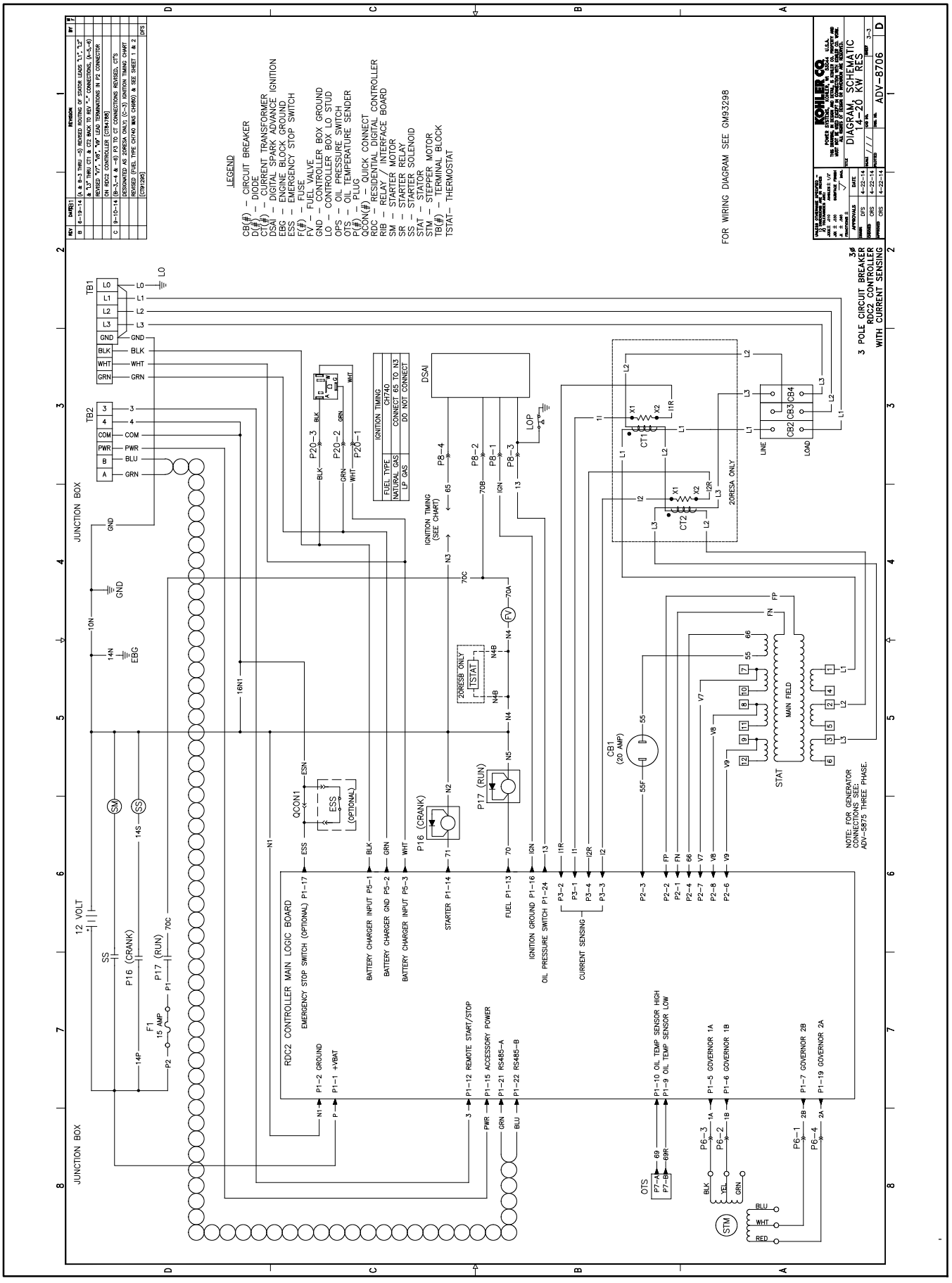


Figure 3-8 Schematic Diagram, 20RESB, ADV-8706, Sheet 3 of 3

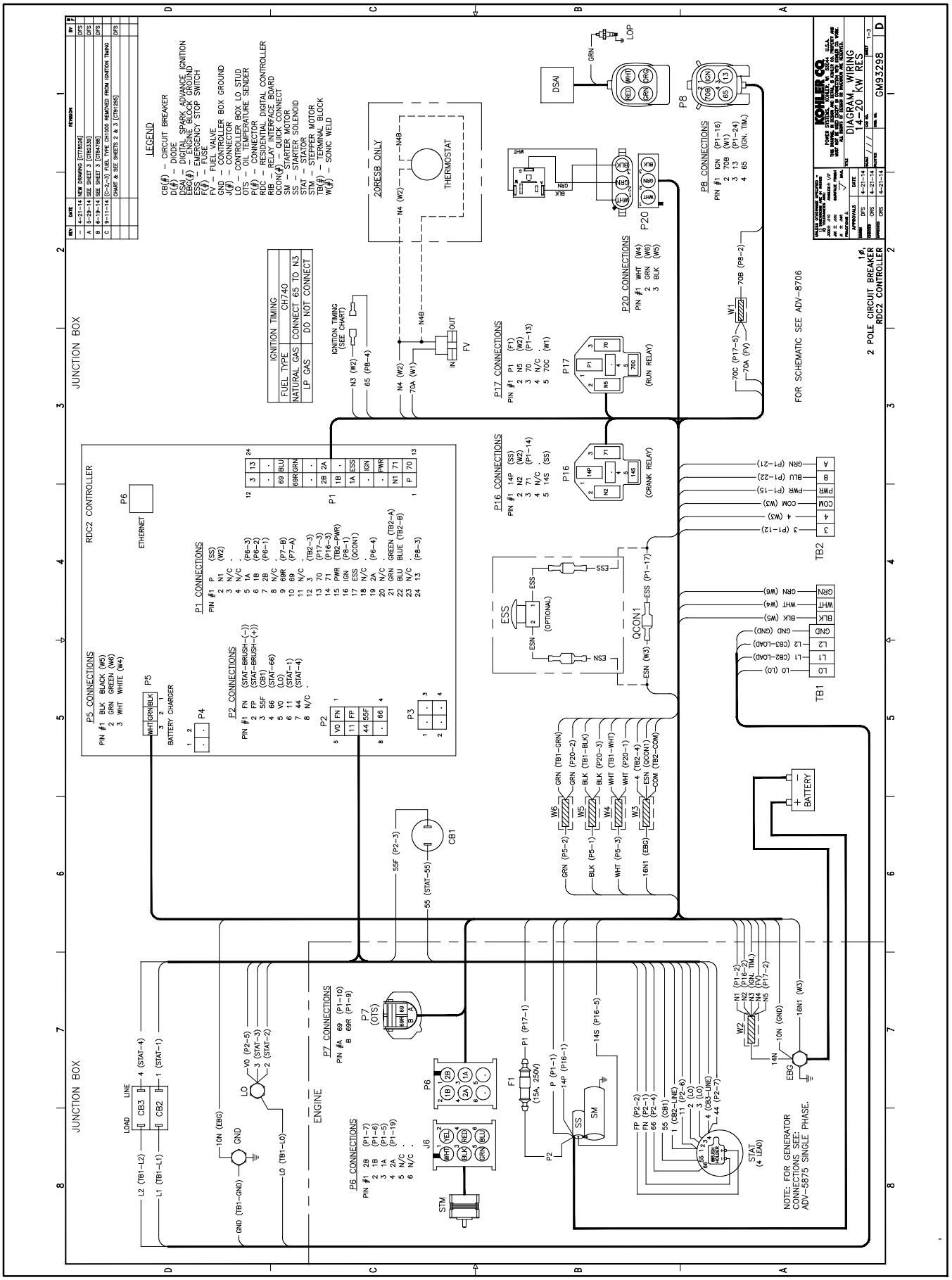


Figure 3-9 Point-to-Point Wiring Diagram, 20RESB, GM93298, Sheet 1 of 3

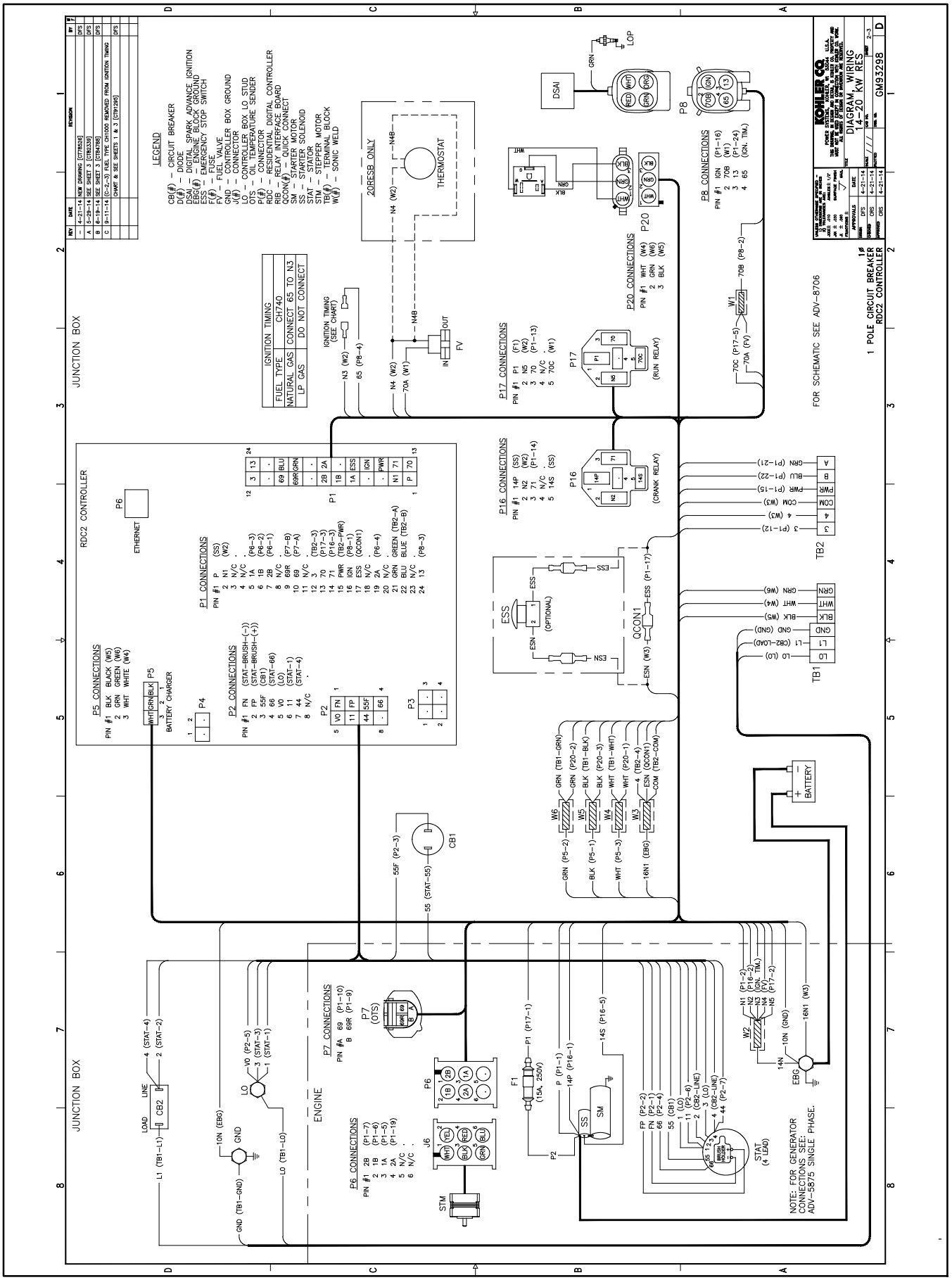


Figure 3-10 Point-to-Point Wiring Diagram, 20RESB, GM93298, Sheet 2 of 3

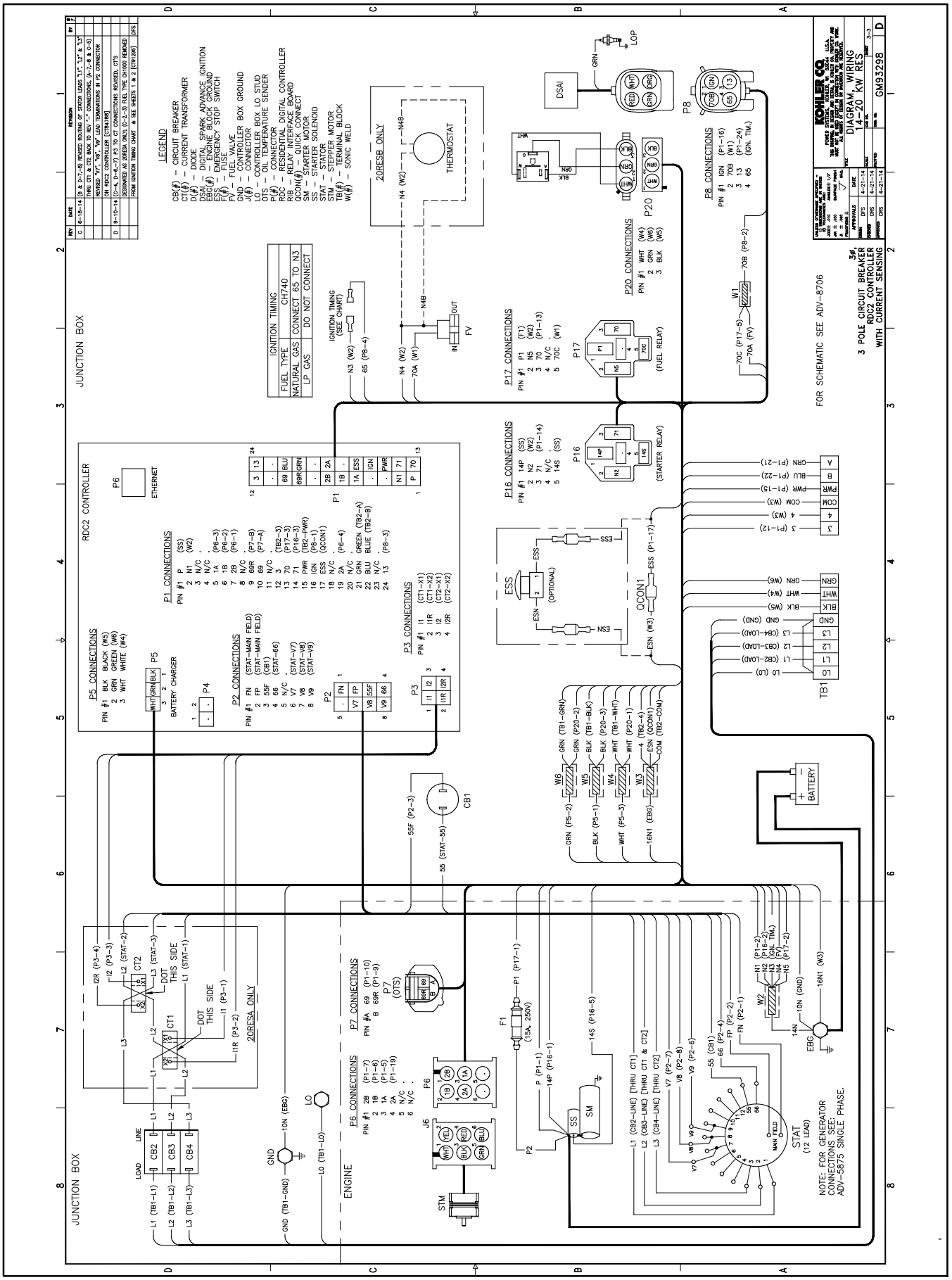


Figure 3-11 Point-to-Point Wiring Diagram, 20RESB, GM93298, Sheet 3 of 3

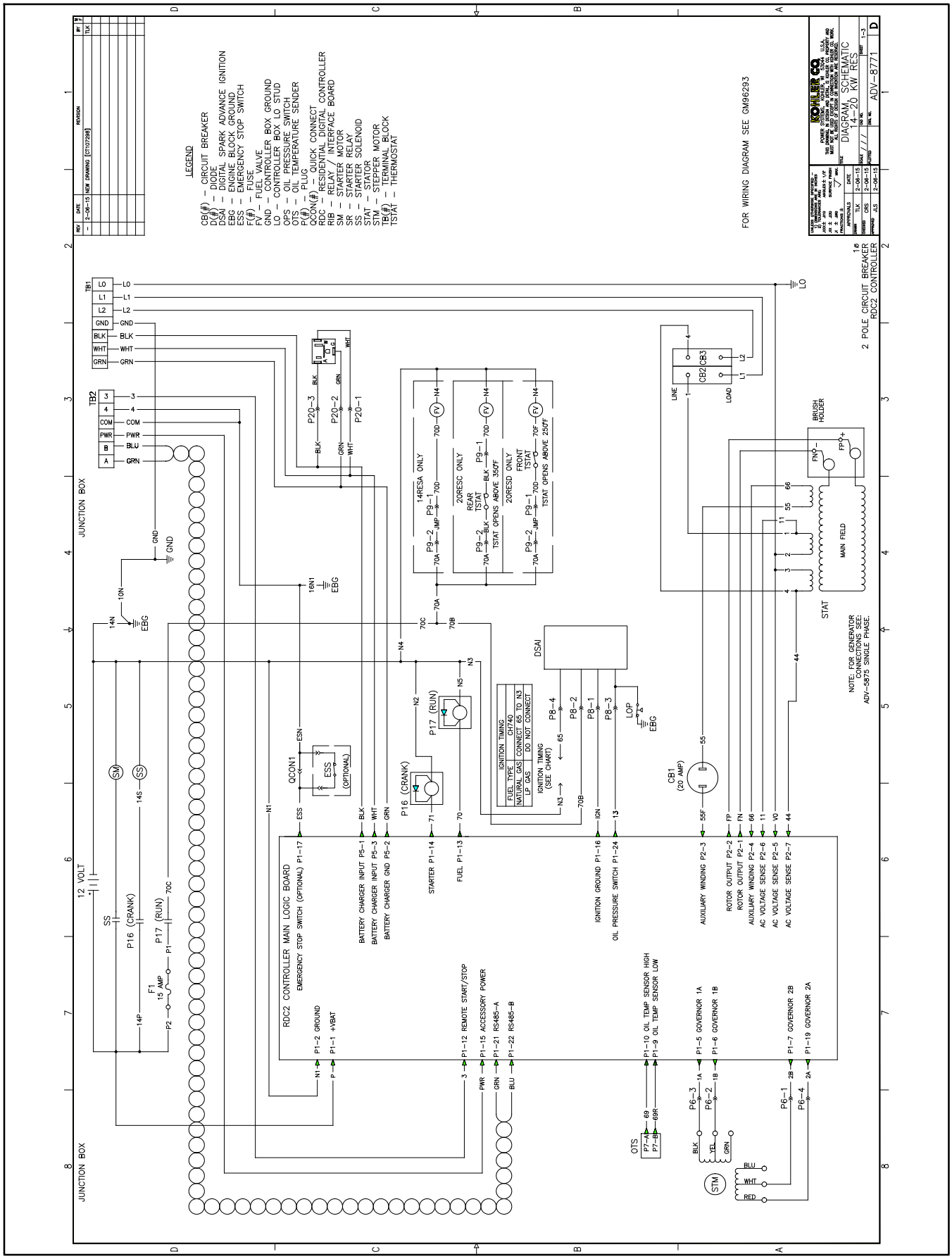


Figure 3-12 Schematic Diagram, Model 20RESD, ADV-8771, Sheet 1 of 3

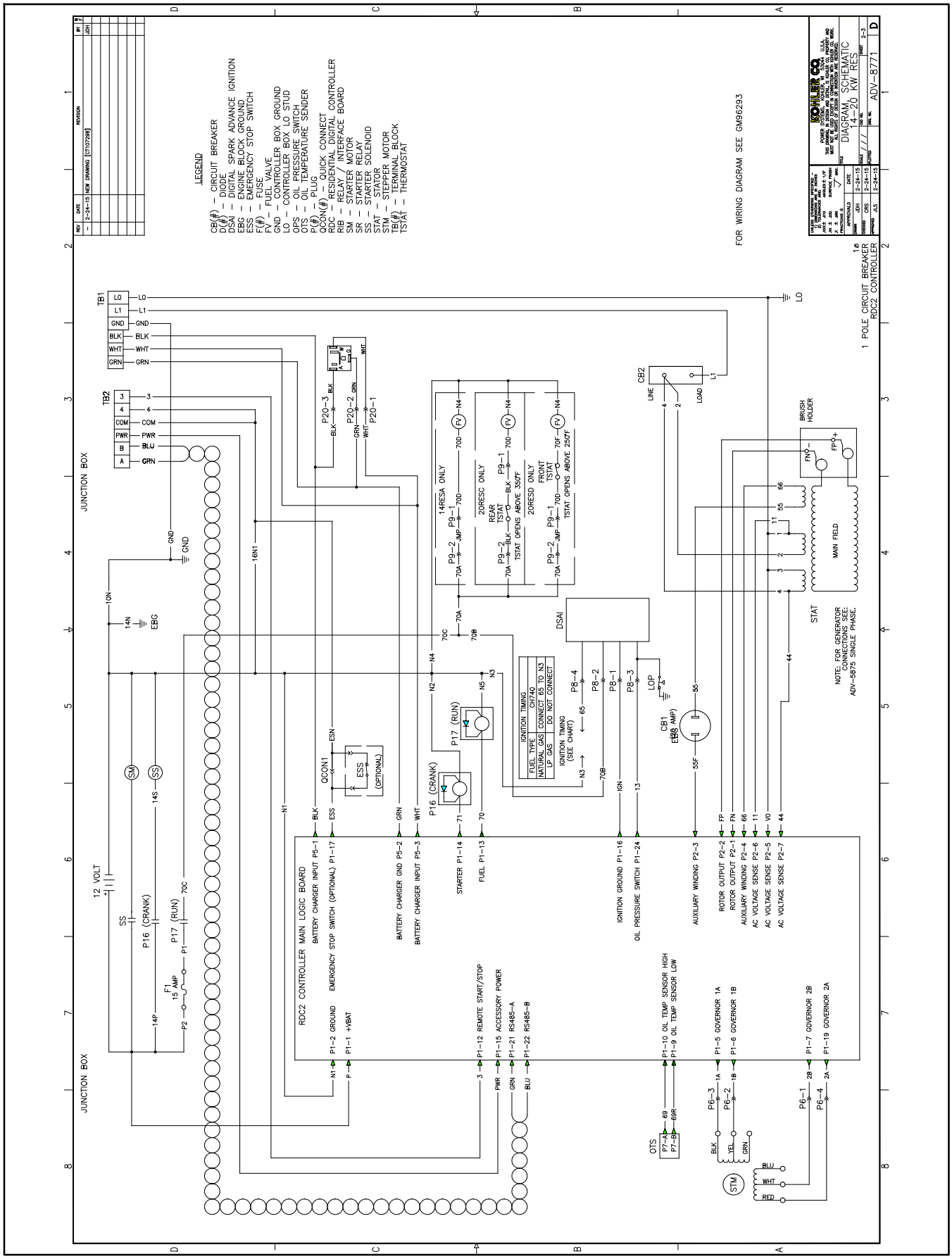


Figure 3-13 Schematic Diagram, Model 20RESD, ADV-8771, sheet 2 of 3

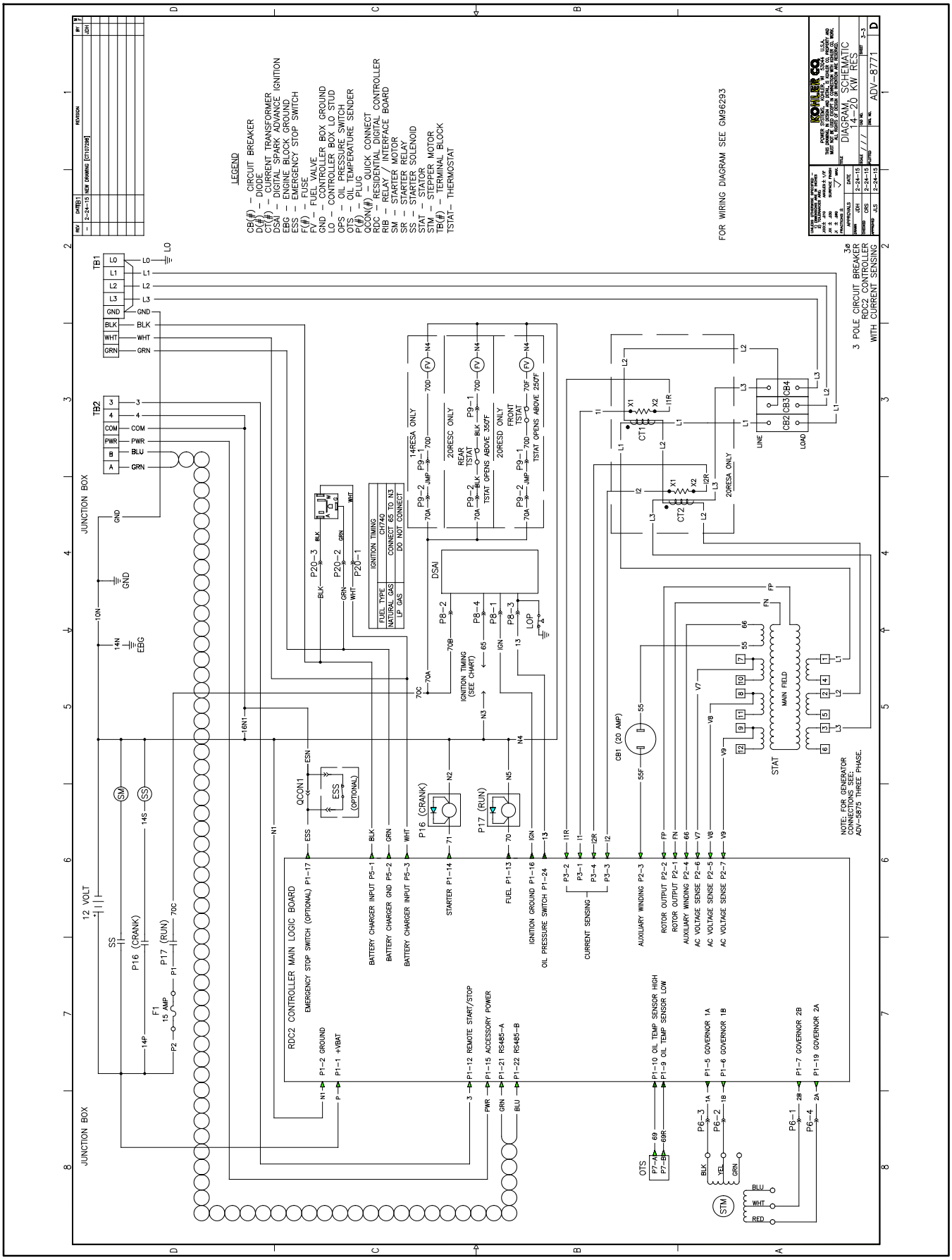


Figure 3-14 Schematic Diagram, Model 20RESD, ADV-8771, Sheet 3 of 3

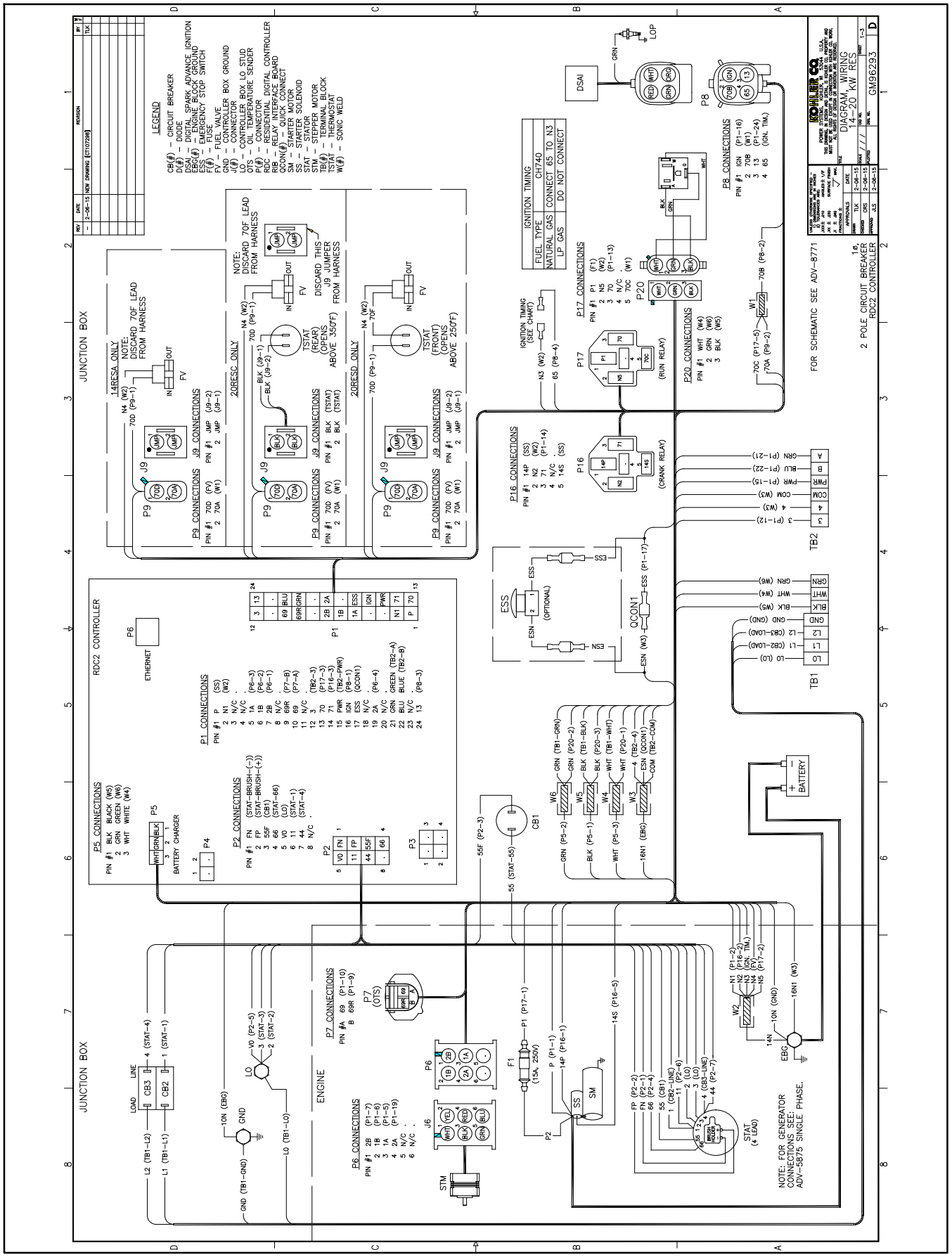


Figure 3-15 Wiring Diagram, Model 20RESD, GM96293, Sheet 1 of 3

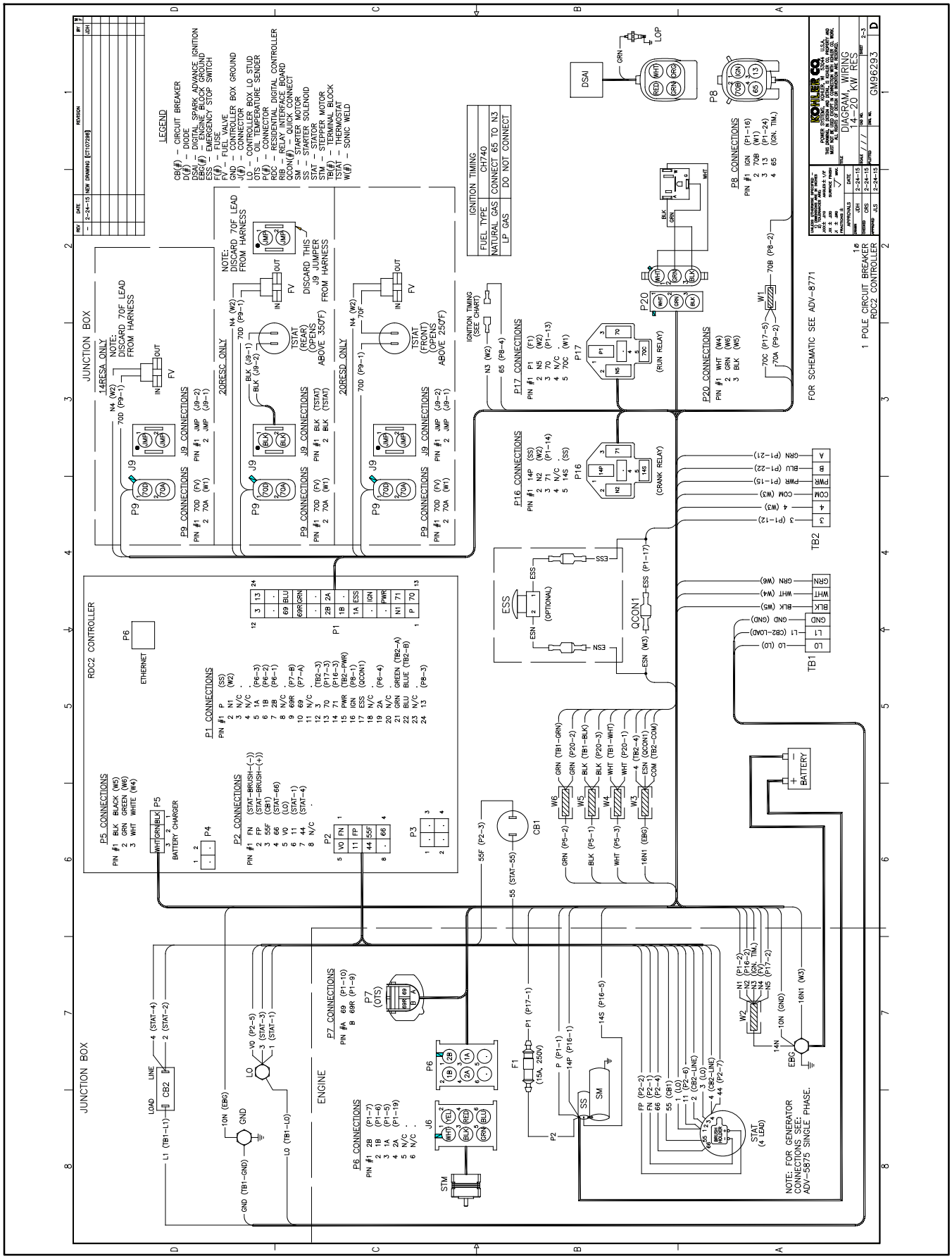


Figure 3-16 Wiring Diagram, Model 20RESD, GM96293, Sheet 2 of 3

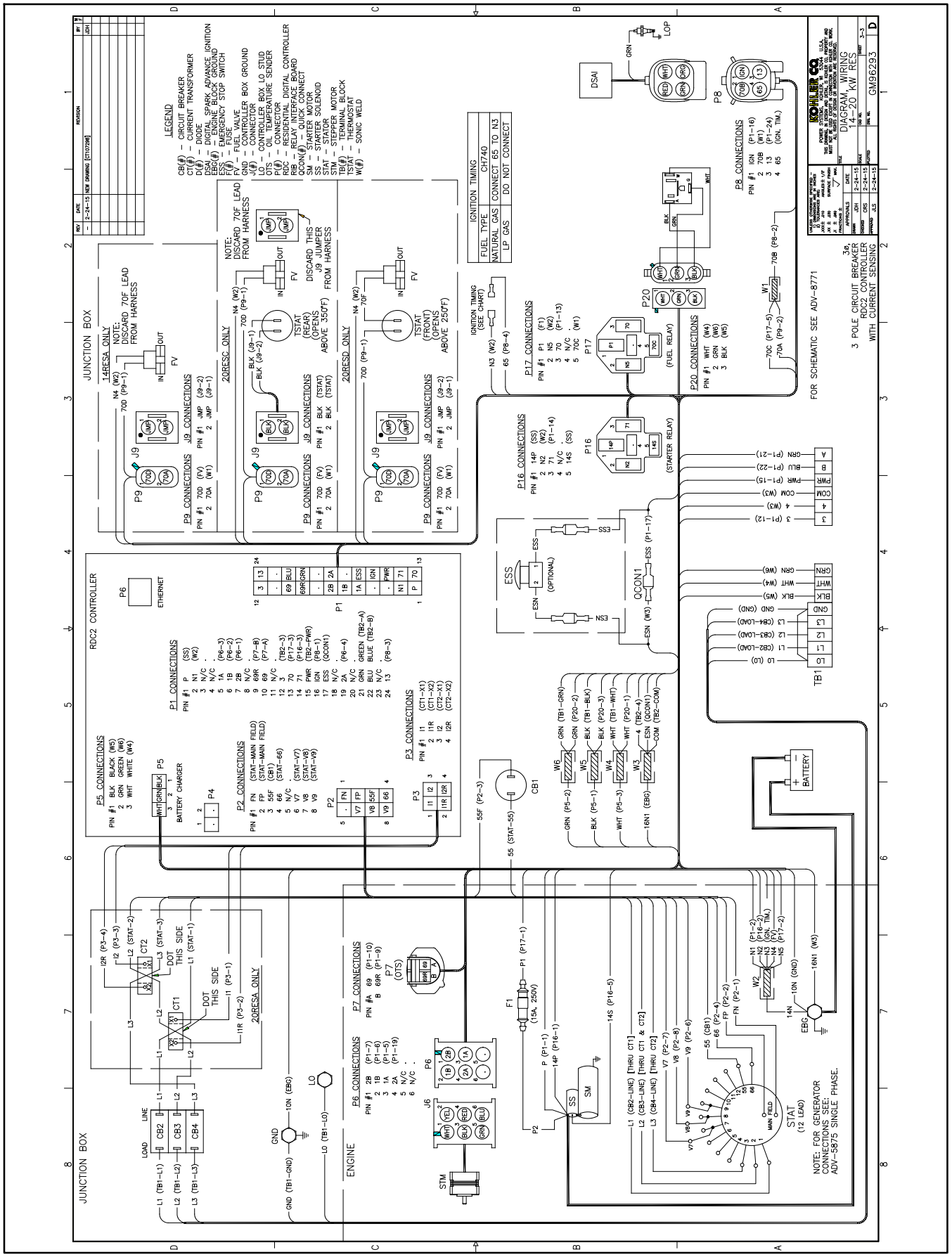


Figure 3-17 Wiring Diagram, Model 20RESD, GM96293, Sheet 3 of 3

Notes

Appendix A Abbreviations

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

A, amp	ampere
ABDC	after bottom dead center
AC	alternating current
A/D	analog to digital
ADC	advanced digital control; analog to digital converter
adj.	adjust, adjustment
ADV	advertising dimensional drawing
Ah	amp-hour
AHWT	anticipatory high water temperature
AISI	American Iron and Steel Institute
ALOP	anticipatory low oil pressure
alt.	alternator
Al	aluminum
ANSI	American National Standards Institute (formerly American Standards Association, ASA)
AO	anticipatory only
APDC	Air Pollution Control District
API	American Petroleum Institute
approx.	approximate, approximately
APU	Auxiliary Power Unit
AQMD	Air Quality Management District
AR	as required, as requested
AS	as supplied, as stated, as suggested
ASE	American Society of Engineers
ASME	American Society of Mechanical Engineers
assy.	assembly
ASTM	American Society for Testing Materials
ATDC	after top dead center
ATS	automatic transfer switch
auto.	automatic
aux.	auxiliary
avg.	average
AVR	automatic voltage regulator
AWG	American Wire Gauge
AWM	appliance wiring material
bat.	battery
BBDC	before bottom dead center
BC	battery charger, battery charging
BCA	battery charging alternator
BCI	Battery Council International
BDC	before dead center
BHP	brake horsepower
blk.	black (paint color), block (engine)
blk. htr.	block heater
BMEP	brake mean effective pressure
bps	bits per second
br.	brass
BTDC	before top dead center
Btu	British thermal unit
Btu/min.	British thermal units per minute
C	Celsius, centigrade
cal.	calorie
CAN	controller area network
CARB	California Air Resources Board
CAT5	Category 5 (network cable)
CB	circuit breaker
CC	crank cycle
cc	cubic centimeter
CCA	cold cranking amps
ccw.	counterclockwise
CEC	Canadian Electrical Code
cert.	certificate, certification, certified
cfh	cubic feet per hour
cfm	cubic feet per minute
CG	center of gravity
CID	cubic inch displacement
CL	centerline
cm	centimeter
CMOS	complementary metal oxide substrate (semiconductor)
com	communications (port)
coml	commercial
Coml/Rec	Commercial/Recreational
conn.	connection
cont.	continued
CPVC	chlorinated polyvinyl chloride
crit.	critical
CSA	Canadian Standards Association
CT	current transformer
Cu	copper
cUL	Canadian Underwriter's Laboratories
CUL	Canadian Underwriter's Laboratories
cu. in.	cubic inch
cw.	clockwise
CWC	city water-cooled
cyl.	cylinder
D/A	digital to analog
DAC	digital to analog converter
dB	decibel
dB(A)	decibel (A weighted)
DC	direct current
DCR	direct current resistance
deg., °	degree
dept.	department
dia.	diameter
DI/EO	dual inlet/end outlet
DIN	Deutsches Institut fur Normung e. V. (also Deutsche Industrie Normenausschuss)
DIP	dual inline package
DPDT	double-pole, double-throw
DPST	double-pole, single-throw
DS	disconnect switch
DVR	digital voltage regulator
E^2PROM, EEPROM	electrically-erasable programmable read-only memory
E, emer.	emergency (power source)
ECM	electronic control module, engine control module
EDI	electronic data interchange
EFR	emergency frequency relay
e.g.	for example (*exempli gratia)*
EG	electronic governor
EGSA	Electrical Generating Systems Association
EIA	Electronic Industries Association
EI/EO	end inlet/end outlet
EMI	electromagnetic interference
emiss.	emission
eng.	engine
EPA	Environmental Protection Agency
EPS	emergency power system
ER	emergency relay
ES	engineering special, engineered special
ESD	electrostatic discharge
est.	estimated
E-Stop	emergency stop
etc.	et cetera (and so forth)
exh.	exhaust
ext.	external
F	Fahrenheit, female
FHM	flat head machine (screw)
fl. oz.	fluid ounce
flex.	flexible
freq.	frequency
FS	full scale
ft.	foot, feet
ft. lb.	foot pounds (torque)
ft./min.	feet per minute
ftp	file transfer protocol
g	gram
ga.	gauge (meters, wire size)
gal.	gallon
gen.	generator
genset	generator set
GFI	ground fault interrupter
GND, ⏚	ground
gov.	governor
gph	gallons per hour
gpm	gallons per minute
gr.	grade, gross
GRD	equipment ground
gr. wt.	gross weight
H x W x D	height by width by depth
HC	hex cap
HCHT	high cylinder head temperature
HD	heavy duty
HET	high exhaust temp., high engine temp.
hex	hexagon
Hg	mercury (element)
HH	hex head
HHC	hex head cap
HP	horsepower
hr.	hour
HS	heat shrink
hsg.	housing
HVAC	heating, ventilation, and air conditioning
HWT	high water temperature
Hz	hertz (cycles per second)
IBC	International Building Code
IC	integrated circuit
ID	inside diameter, identification
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IMS	improved motor starting
in.	inch
in. H_2O	inches of water
in. Hg	inches of mercury
in. lb.	inch pounds
Inc.	incorporated
ind.	industrial
int.	internal
int./ext.	internal/external
I/O	input/output
IP	internet protocol
ISO	International Organization for Standardization
J	joule
JIS	Japanese Industry Standard
k	kilo (1000)
K	kelvin
kA	kiloampere
KB	kilobyte (2^{10} bytes)
KBus	Kohler communication protocol
kg	kilogram

kg/cm^2	kilograms per square centimeter
kgm	kilogram-meter
kg/m^3	kilograms per cubic meter
kHz	kilohertz
kJ	kilojoule
km	kilometer
kOhm, kΩ	kilo-ohm
kPa	kilopascal
kph	kilometers per hour
kV	kilovolt
kVA	kilovolt ampere
kVAR	kilovolt ampere reactive
kW	kilowatt
kWh	kilowatt-hour
kWm	kilowatt mechanical
kWth	kilowatt-thermal
L	liter
LAN	local area network
L x W x H	length by width by height
lb.	pound, pounds
lbm/ft^3	pounds mass per cubic feet
LCB	line circuit breaker
LCD	liquid crystal display
LED	light emitting diode
Lph	liters per hour
Lpm	liters per minute
LOP	low oil pressure
LP	liquefied petroleum
LPG	liquefied petroleum gas
LS	left side
L_{wa}	sound power level, A weighted
LWL	low water level
LWT	low water temperature
m	meter, milli (1/1000)
M	mega (10^6 when used with SI units), male
m^3	cubic meter
$m^3/hr.$	cubic meters per hour
$m^3/min.$	cubic meters per minute
mA	milliampere
man.	manual
max.	maximum
MB	megabyte (2^{20} bytes)
MCCB	molded-case circuit breaker
MCM	one thousand circular mils
meggar	megohmmeter
MHz	megahertz
mi.	mile
mil	one one-thousandth of an inch
min.	minimum, minute
misc.	miscellaneous
MJ	megajoule
mJ	millijoule
mm	millimeter
mOhm, mΩ	milliohm
MOhm, MΩ	megohm
MOV	metal oxide varistor
MPa	megapascal
mpg	miles per gallon
mph	miles per hour
MS	military standard
ms	millisecond
m/sec.	meters per second
mtg.	mounting
MTU	Motoren-und Turbinen-Union
MW	megawatt
mW	milliwatt
μF	microfarad
N, norm.	normal (power source)
NA	not available, not applicable
nat. gas	natural gas
NBS	National Bureau of Standards
NC	normally closed
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
Nm	newton meter
NO	normally open
no., nos.	number, numbers
NPS	National Pipe, Straight
NPSC	National Pipe, Straight-coupling
NPT	National Standard taper pipe thread per general use
NPTF	National Pipe, Taper-Fine
NR	not required, normal relay
ns	nanosecond
OC	overcrank
OD	outside diameter
OEM	original equipment manufacturer
OF	overfrequency
opt.	option, optional
OS	oversize, overspeed
OSHA	Occupational Safety and Health Administration
OV	overvoltage
oz.	ounce
p., pp.	page, pages
PC	personal computer
PCB	printed circuit board
pF	picofarad
PF	power factor
ph., ∅	phase
PHC	Phillips® head Crimptite® (screw)
PHH	Phillips® hex head (screw)
PHM	pan head machine (screw)
PLC	programmable logic control
PMG	permanent magnet generator
pot	potentiometer, potential
ppm	parts per million
PROM	programmable read-only memory
psi	pounds per square inch
psig	pounds per square inch gauge
pt.	pint
PTC	positive temperature coefficient
PTO	power takeoff
PVC	polyvinyl chloride
qt.	quart, quarts
qty.	quantity
R	replacement (emergency) power source
rad.	radiator, radius
RAM	random access memory
RBUS	RS-485 proprietary communications
RDO	relay driver output
ref.	reference
rem.	remote
Res/Coml	Residential/Commercial
RFI	radio frequency interference
RH	round head
RHM	round head machine (screw)
rly.	relay
rms	root mean square
rnd.	round
RO	read only
ROM	read only memory
rot.	rotate, rotating
rpm	revolutions per minute
RS	right side
RTDs	Resistance Temperature Detectors
RTU	remote terminal unit
RTV	room temperature vulcanization
RW	read/write
SAE	Society of Automotive Engineers
scfm	standard cubic feet per minute
SCR	silicon controlled rectifier
s, sec.	second
SI	*Systeme international d'unites,* International System of Units
SI/EO	side in/end out
sil.	silencer
SMTP	simple mail transfer protocol
SN	serial number
SNMP	simple network management protocol
SPDT	single-pole, double-throw
SPST	single-pole, single-throw
spec	specification
specs	specification(s)
sq.	square
sq. cm	square centimeter
sq. in.	square inch
SMS	short message service
SS	stainless steel
std.	standard
stl.	steel
tach.	tachometer
TB	terminal block
TCP	transmission control protocol
TD	time delay
TDC	top dead center
TDEC	time delay engine cooldown
TDEN	time delay emergency to normal
TDES	time delay engine start
TDNE	time delay normal to emergency
TDOE	time delay off to emergency
TDON	time delay off to normal
temp.	temperature
term.	terminal
THD	total harmonic distortion
TIF	telephone influence factor
tol.	tolerance
turbo.	turbocharger
typ.	typical (same in multiple locations)
UF	underfrequency
UHF	ultrahigh frequency
UIF	user interface
UL	Underwriter's Laboratories, Inc.
UNC	unified coarse thread (was NC)
UNF	unified fine thread (was NF)
univ.	universal
URL	uniform resource locator (web address)
US	undersize, underspeed
UV	ultraviolet, undervoltage
V	volt
VAC	volts alternating current
VAR	voltampere reactive
VDC	volts direct current
VFD	vacuum fluorescent display
VGA	video graphics adapter
VHF	very high frequency
W	watt
WCR	withstand and closing rating
w/	with
WO	write only
w/o	without
wt.	weight
xfmr	transformer

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TP-6925 6/15b