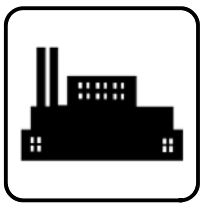
Service

Industrial, Mobile, and Residential/Light Commercial Generator Sets



Models:

15–40 kW

Alternators:

4D
4E

KOHLER®

TP-6878 7/18b

⚠ WARNING: This product can expose you to chemicals, including carbon monoxide and benzene, which are known to the State of California to cause cancer and birth defects or other reproductive harm.
For more information go to www.P65warnings.ca.gov

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

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

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

Product Identification Information

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

Generator Set Identification Numbers

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

Model Designation _____

Specification Number _____

Serial Number _____

Accessory Number	Accessory Description

Controller Identification

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

Controller Description _____

Engine Identification

Record the product identification information from the engine nameplate.

Manufacturer _____

Model Designation _____

Serial Number _____

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***.

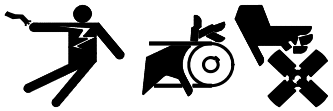
NOTICE

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

(Decision-Maker® 550 Controller)

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.

(APM402, RDC2, Decision-Maker® 3000, and 3500 Controllers)

Battery

WARNING

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

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

WARNING

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

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

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

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

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

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

Engine Backfire/Flash Fire

⚠ WARNING

Risk of fire.
Can cause severe injury or death.

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

Servicing the fuel system. A flash fire can cause severe injury or death. Do not smoke or permit flames or sparks near the fuel mixer, fuel line, fuel filter, or other potential sources of fuel vapors. When removing the fuel line or fuel system be aware that liquid propane can cause frostbite on contact.

(Gas-fueled model)

Servicing the fuel system. A flash fire can cause severe injury or death. Do not smoke or permit flames or sparks near the fuel injection system, 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 fuel system.

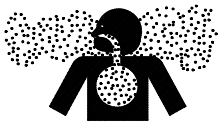
(Diesel-fueled model)

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

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

Exhaust System

⚠ WARNING



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

The exhaust system must be leakproof and routinely inspected.

Generator set operation. Carbon monoxide can cause severe nausea, fainting, or death. Carbon monoxide is an odorless, colorless, tasteless, nonirritating gas that can cause death if inhaled for even a short time. Avoid breathing exhaust fumes when working on or near the generator set. Never operate the generator set inside a building unless the exhaust gas is piped safely outside. Never operate the generator set where exhaust gas could accumulate and seep back inside a potentially occupied building.

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

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

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

Fuel System

⚠ WARNING

Explosive fuel vapors.
Can cause severe injury or death.

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

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

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

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

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

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

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

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

LPG liquid withdrawal fuel leaks. Explosive fuel vapors can cause severe injury or death. Fuel leakage can cause an explosion. Check the LPG liquid withdrawal fuel system for leakage by using a soap and water solution with the fuel system test pressurized to at least 90 psi (621 kPa). Do not use a soap solution containing either ammonia or chlorine because both prevent bubble formation. A successful test depends on the ability of the solution to bubble.

Hazardous Noise

⚠ CAUTION

Hazardous noise.
Can cause hearing loss.

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

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

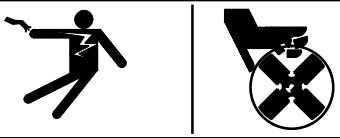
Hazardous Voltage/ Moving Parts

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

⚠ DANGER



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

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

⚠ WARNING

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

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

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

Disconnecting the electrical load. Hazardous voltage will cause severe injury or death. Disconnect the generator set from the load by turning off the line circuit breaker or by disconnecting the generator set output leads from the transfer switch and heavily taping the ends of the leads. High voltage transferred to the load during testing may cause personal injury and equipment damage.

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

Testing the photo transistor circuit board. Hazardous voltage will cause severe injury or death. When the end cover is removed, do not expose the photo transistor circuit board mounted on the generator set end bracket to any external light source, as exposure to light causes high voltage. Keep foreign sources of light away from the photo transistor circuit board during testing. Place black electrical tape over the LED on the circuit board before starting the generator set.

Installing the photo transistor circuit board. Hazardous voltage will cause severe injury or death. Ensure that the foil side of the photo transistor circuit board, the end of the shaft, and the threaded holes are clean and free of metal particles and chips. Metal debris may short-circuit the photo transistor circuit board and cause hazardous voltage in the generator set. Do not reconnect the generator set to the load until the AC voltmeter shows the correct output.

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.

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

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

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

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

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

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

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

⚠ WARNING

Airborne particles.
Can cause severe injury or blindness.

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

Heavy Equipment

⚠ WARNING

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

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

Hot Parts

⚠ WARNING

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

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

⚠ WARNING

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

Do not work on the generator set until it cools.

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

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

Notice

NOTICE

This generator set has been rewired from its nameplate voltage to

246242

NOTICE

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

NOTICE

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

Notes

This manual provides troubleshooting and repair instructions for the generator set models listed on the front cover using permanent magnet alternators.

Wiring diagram manuals are available separately.

Refer to the generator set controller operation manual for operating instructions. Refer to the engine operation manual for generator set engine scheduled maintenance information. Refer to the engine service manual for generator set engine repair and overhaul information.

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

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

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

List of Related Materials

Separate literature contains voltage regulator setup information not provided in this manual. Figure 1 lists the available literature part numbers.

Manual Description	Literature Part No.
Decision-Maker® 550 Controller Operation Manual	TP-6200
Decision-Maker® 550 Controller Setup and Application Manual	TP-6140
APM402 and Decision-Maker® 3000 Controller Operation Manual	TP-6694
Decision-Maker® 3500 Controller Operation Manual	TP-6914
35/45REOZT4 Trailer and Decision-Maker® 3500 Controller Operation Manual	TP-6895
Controller Service Manual	TP-6356
24/30RCL and 38RCLB Generator Set Service Manual	TP-6907
REOZK and REOZK4 Wiring Diagram Manual	TP-6924
REOZT4 Wiring Diagram Manual	TP-6913

Figure 1 Related Literature

Service Assistance

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

- Visit the Kohler Co. website at KOHLERPower.com.
- Look at the labels and decals on your Kohler product or review the appropriate literature or documents included with the product.
- Call toll free in the US and Canada 1-800-544-2444.
- Outside the US and Canada, call the nearest regional office.

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

1.1 Introduction

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

The alternator is identified with one of the following designations: 4D_ or 4E_. Example: Gen. Model 4D3.1. The first alpha character (D) identifies the alternator family.

Voltage regulation is provided by the generator set controller. Refer to the respective Controller Operation Manual and Controller Service Manual for additional voltage regulator information.

1.2 Wound-Field Alternator Concept

These generator sets utilize a wound-field alternator to produce AC voltage. Upon activation of the generator master switch, DC current from the battery magnetizes the rotor (field). When the magnetized rotor rotates within the stator windings, an electrical voltage develops within the stator. As engine speed and generator output increase, the voltage regulator feeds rectified stator output current to the rotor through the exciter to increase the strength of the rotor field. As the rotor field increases in strength, generator output also increases.

The voltage regulator (integrated in the controller) monitors the generator output voltage through leads A and B (for 1-phase models) and leads A, B, and C (for 3-phase models). The duty cycle of the pulse width modulator (PWM) signal to the activator board adjusts the exciter field current changing the main field current to meet load requirements. See Figure 1-1 through Figure 1-6.

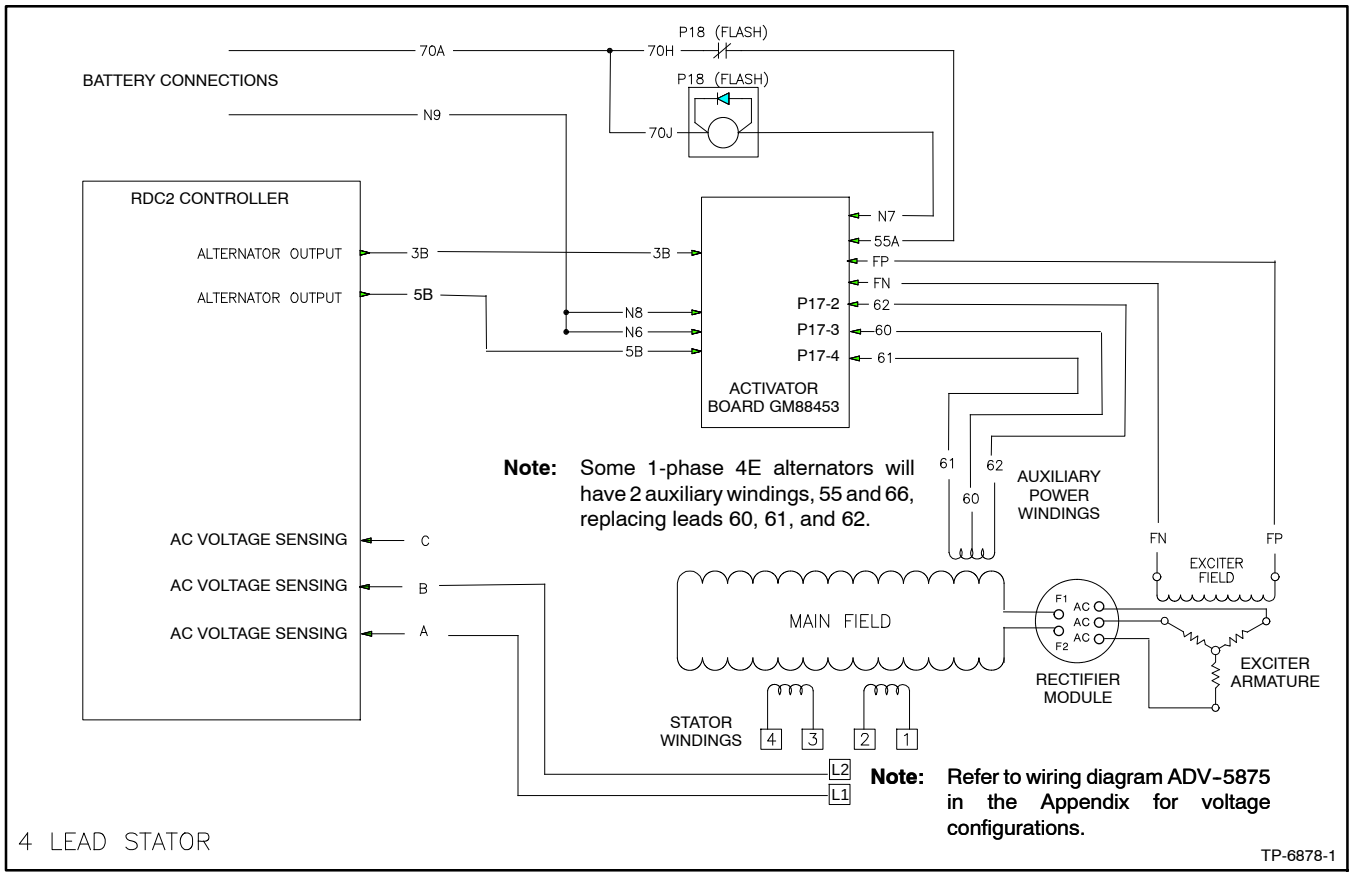


Figure 1-1 4-Lead Brushed Alternator Schematic with RDC2 Controller

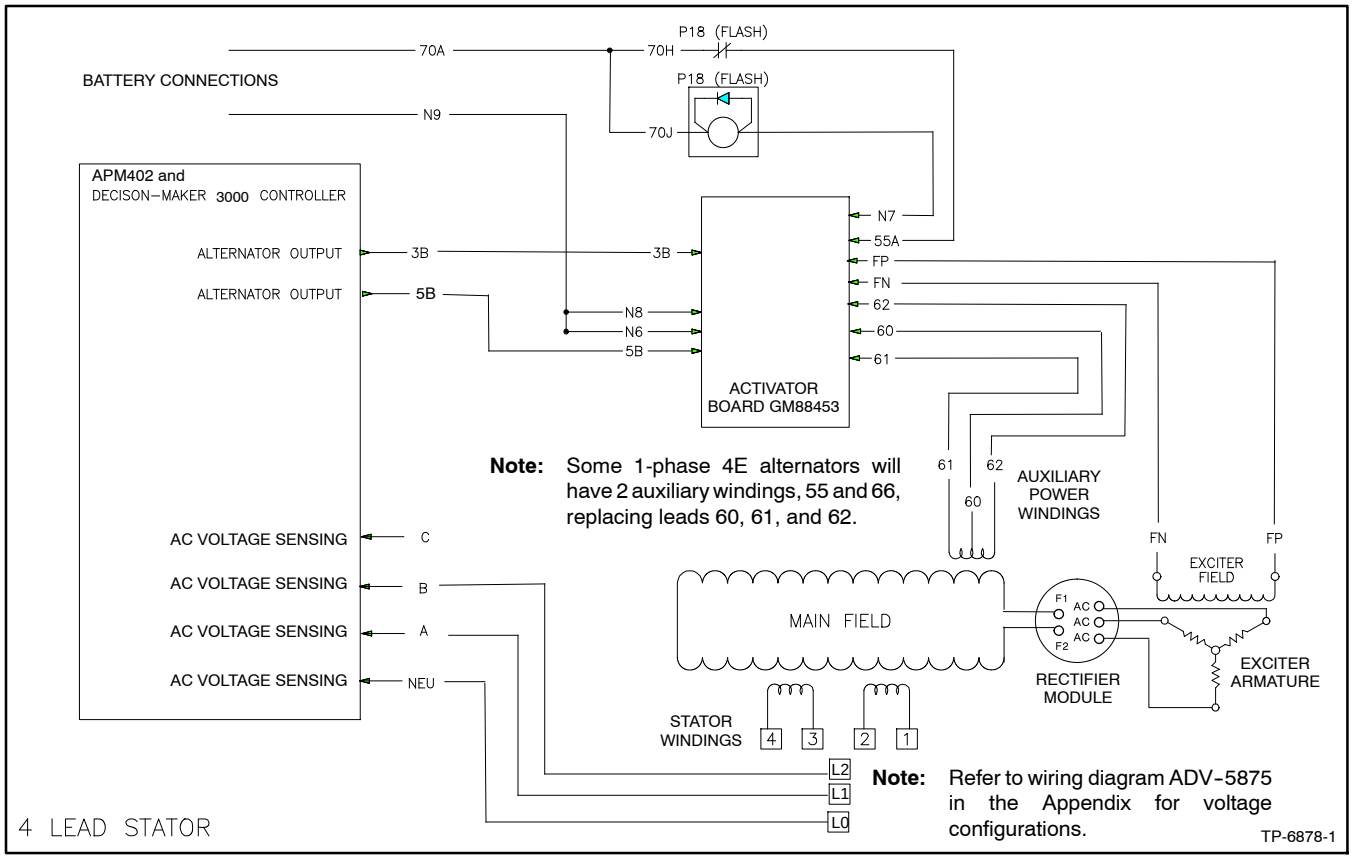


Figure 1-2 4-Lead Brushed Alternator Schematic with APM402 and Decision-Maker® 3000 Controller

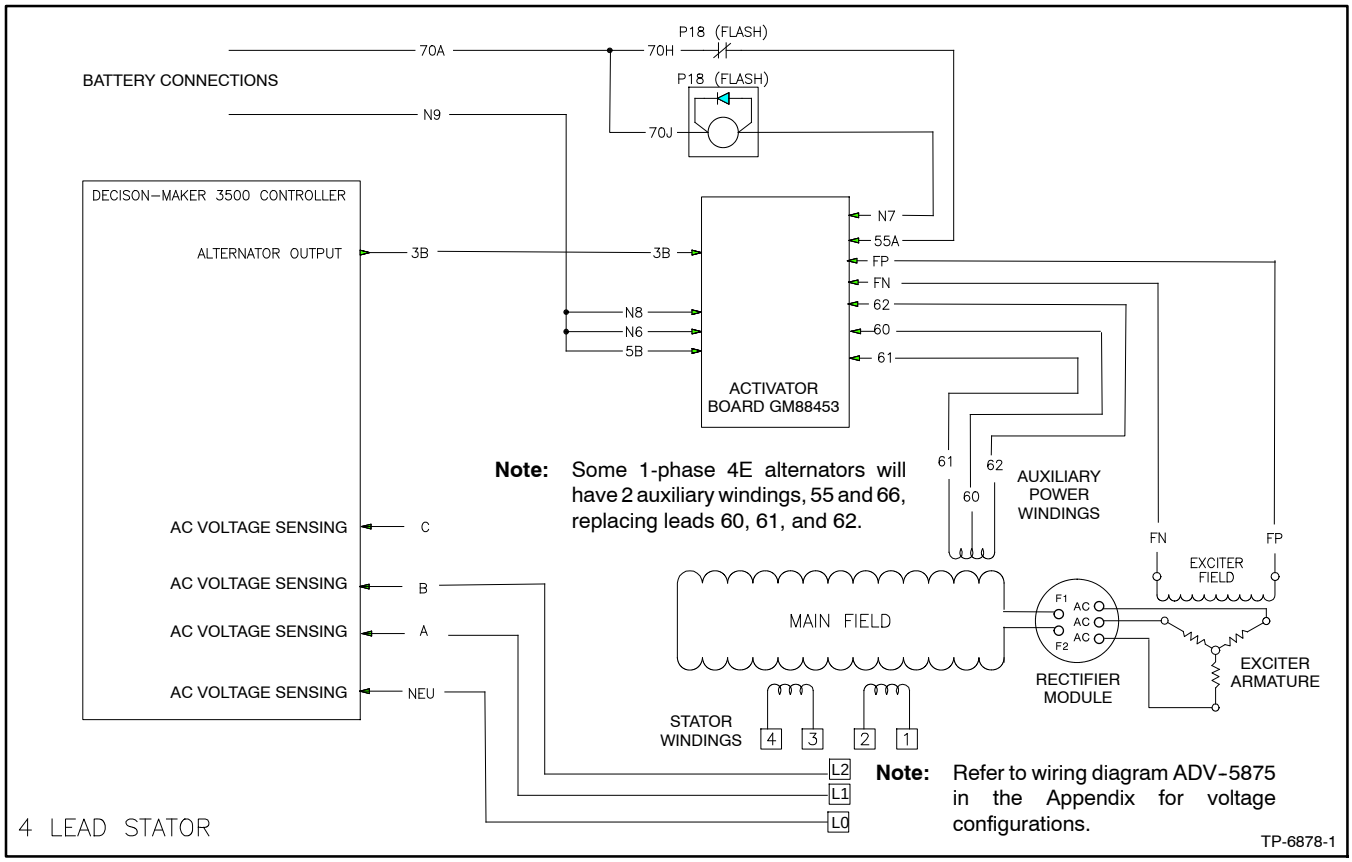


Figure 1-3 4-Lead Brushed Alternator Schematic with Decision-Maker® 3500 Controller

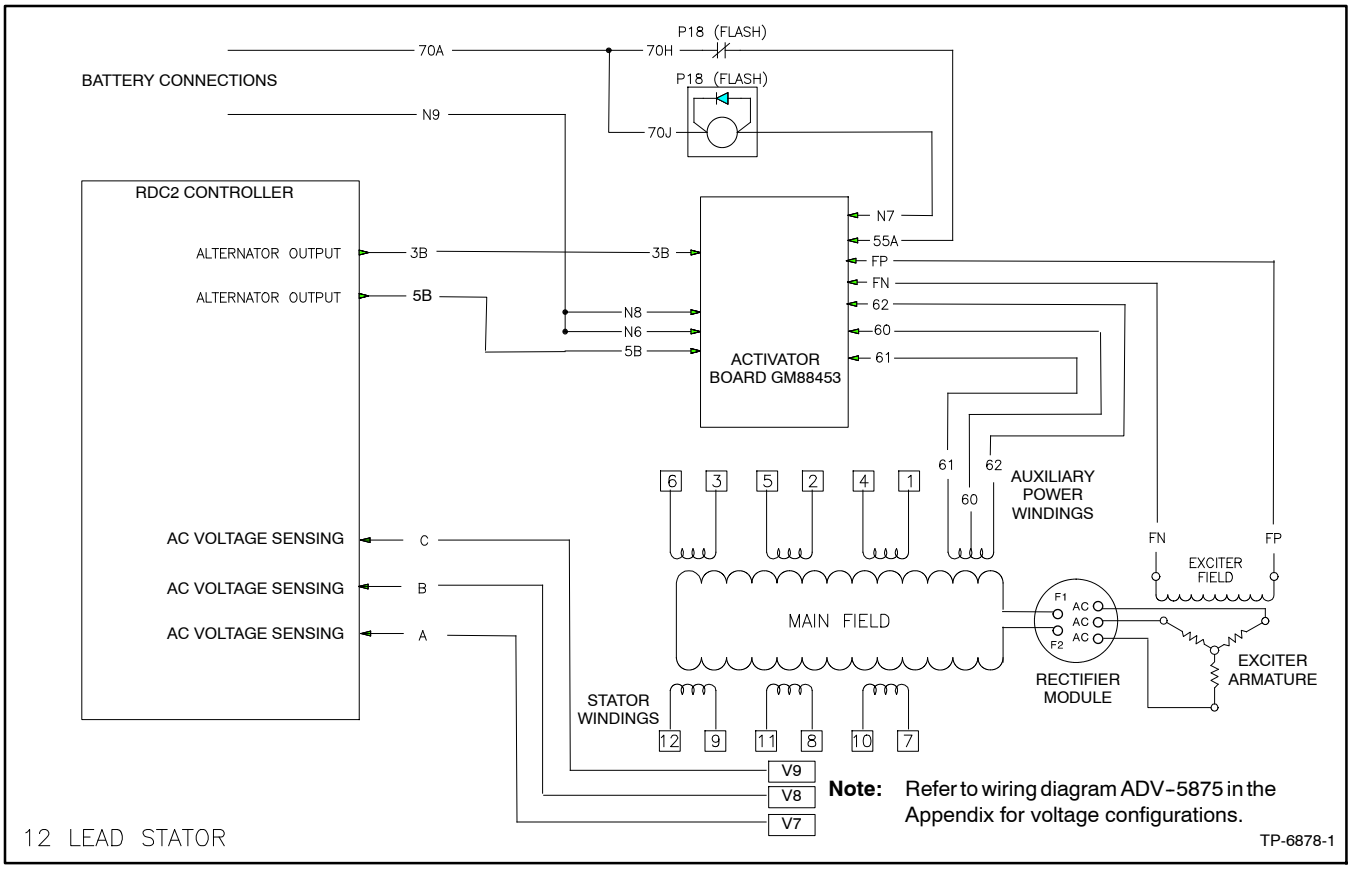


Figure 1-4 12-Lead Brushless Alternator Schematic with RDC2 Controller

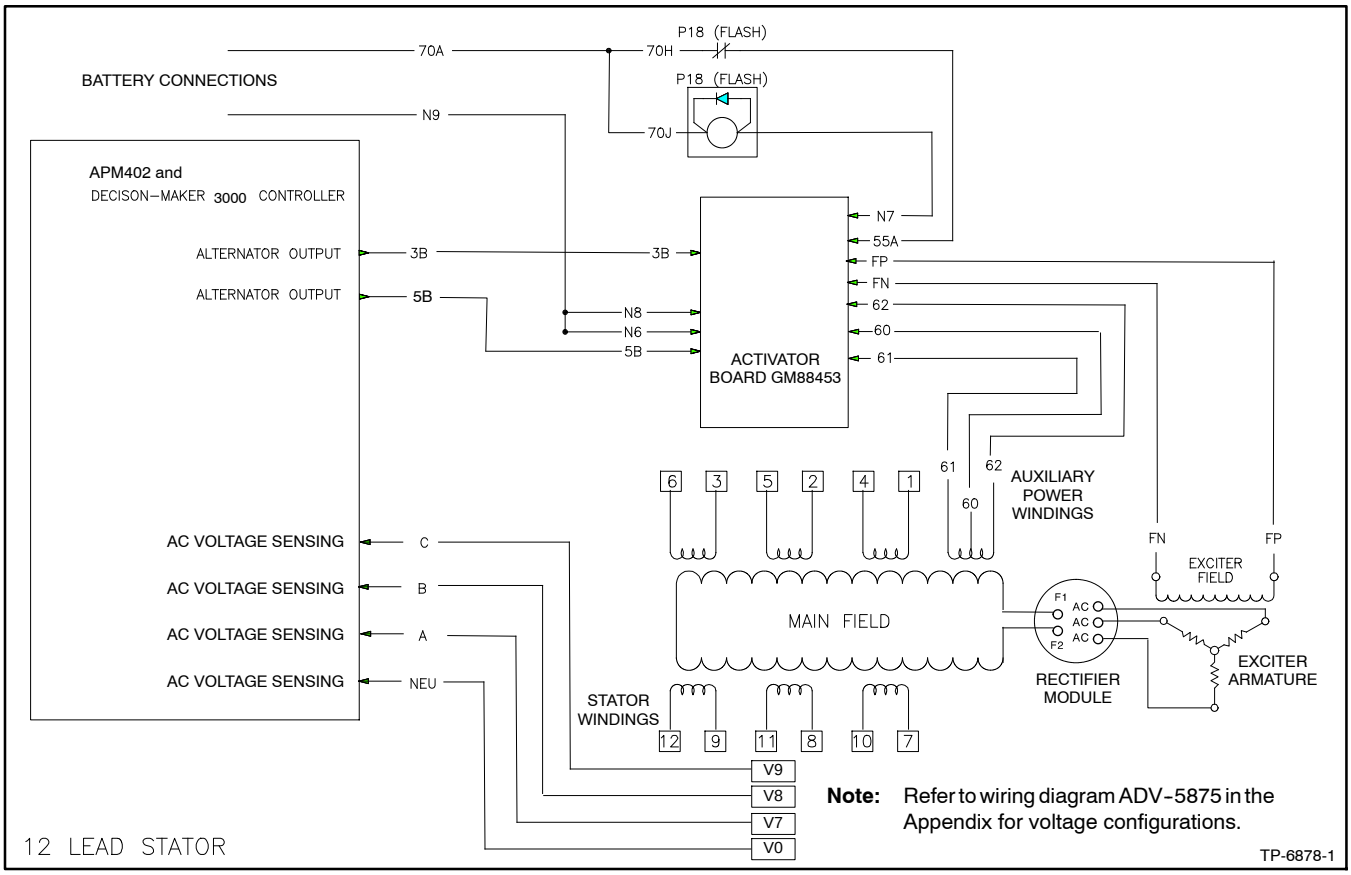


Figure 1-5 12-Lead Brushless Alternator Schematic with APM402 and Decision-Maker® 3000 Controller

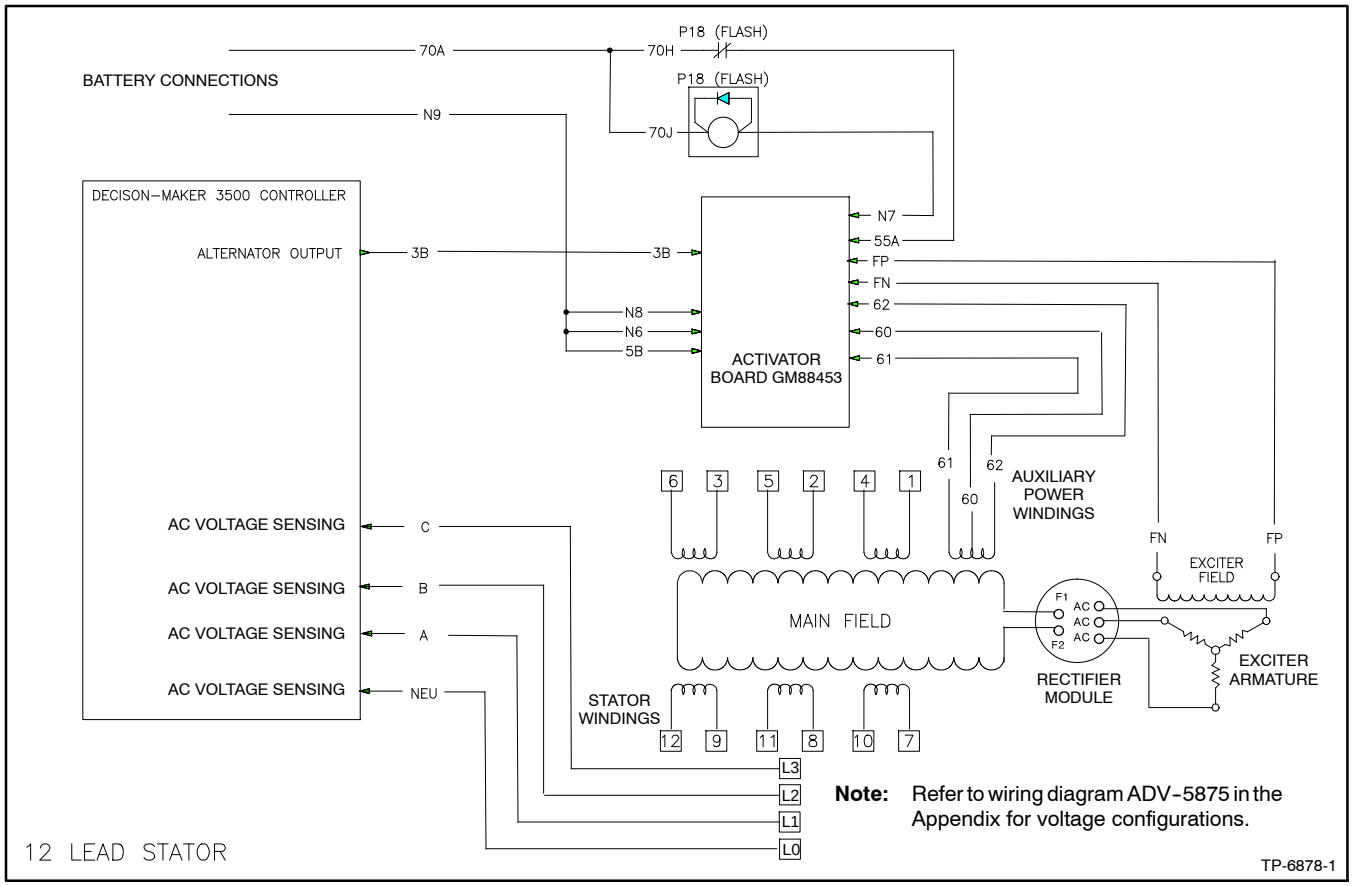


Figure 1-6 12-Lead Brushless Alternator Schematic with Decision-Maker® 3500 Controller

When a large motor is connected to the alternator, the output voltage will decrease suddenly (due to the increased requirements of the motor load). The voltage regulator increases the current target (transmitted through a PWM signal on 3B and 5B) to respond to the change in the output voltage, which causes the activator board to apply full auxiliary winding voltage to the exciter field until it reaches the new target current. As the exciter field current increases, the rotor field current starts to increase, causing the output voltage of the alternator to start to recover. As the motor speed increases, the current draw to the motor decreases, resulting in a decrease of the alternator load.

When a short circuit condition occurs on the output of the alternator, the output voltage will go to to 0 volts and the voltage regulator will set a 100% PWM output duty cycle in an effort to recover the voltage to rated. This causes the activator to apply full auxiliary winding voltage (about 160 VDC) to the exciter field until the exciter field current reaches 7.8 amps DC (when it decreases the voltage applied to maintain 7.8 amps DC on the exciter field). The high current in the exciter field applies a maximum voltage across the rotor field, driving it toward a maximum current. The current supplied to the fault will increase as the rotor field current increases, but the initial short circuit current is supplied by stored energy in the alternator.

When a large load is removed from the alternator, the output voltage of that alternator increases and the voltage regulator decreases the duty cycle of the PWM signal to the activator board. This causes the activator board to turn off the voltage to the exciter field until the current reaches the new target. The exciter armature generates voltage until the exciter field current reaches 0 amps, causing the rotor field current to increase for a short time after the load is removed. After the exciter field current reaches 0 amps, the output voltage of the alternator decreases until it decays to the target voltage, when the voltage regulator increases the PWM duty cycle again and the activator applies full voltage to the exciter field until the current matches the target set by the PWM signal (when it decreases the voltage to maintain the target current).

1.3 Electrical Values

Component Specification (12-Lead)	4D3.1	4D3.8	4D4.2	4D5.0	4D5.6	4D8.3
Hot exciter field winding voltage/amperage readings at rated voltage						
No load (63 Hz)—volts/amps	6/0.7	8/1.2	7/1.0	7/0.9		
Full load (60 Hz)—volts/amps	26/3.4	38/4.8	30/4.0	25/3.5	27/3.8	30/2.7
No load (50 Hz)—volts/amps	7/0.8	10/1.4	8/1.0			
Exciter field winding resistance (cold)—ohms @ 20°C (68°F)	6.0					7.2
Exciter armature resistance (cold)—ohms (line-to-line)	0.5					0.6
Main field (rotor) resistance (cold)—ohms @ 20°C (68°F)	3.2	3.5	3.8	4.0	4.3	5.3
Stator output voltages with separately excited generator, using 12-volt battery (60 Hz only)						
1-4, 2-5, 3-6, 7-10, 8-11, 9-12—volts	>150					
60-61—volts	>150					
60-62—volts	>150					
Cold stator resistance						
1-4, 2-5, 3-6, 7-10, 8-11, 9-12—ohms	0.20	0.12	0.11	0.09	0.08	0.04
60-61—ohms	1.1	0.5	0.6	0.7	0.5	
60-62—ohms	2.2	1.0	1.2	1.4	0.9	1.0

Component Specification (4-Lead)	4E3.1	4E3.8	4E4.2	4E5.0	4E5.0B	4E5.6	4E8.3
Hot exciter field winding voltage/amperage readings at rated voltage							
No load (63 Hz)—volts/amps	6/0.8		6/1.0	9/1.2	9/1.2	8/1.1	9/1.1
Full load (60 Hz)—volts/amps	19/2.6	26/3.4	30/4.0	25/3.5	17/1.8	20/2.9	20/2.5
No load (50 Hz)—volts/amps	13/1.7		13/2.1	19/2.5		17/2.3	19/2.3
Exciter field winding resistance (cold)—ohms @ 20°C (68°F)	6.0						7.2
Exciter armature resistance (cold)—ohms (line-to-line)	0.5						0.6
Main field (rotor) resistance (cold)—ohms @ 20°C (68°F)	3.2	3.5	3.7	4.0		4.3	5.3
Stator output voltages with separately excited generator, using 12-volt battery (60 Hz only)							
1-2, 3-4—volts	>150						
60-61—volts	>150						
60-62—volts	>150						
Cold stator resistance							
1-2, 3-4—ohms	0.15	0.14	0.13	0.12		0.09	0.06
60-61—ohms	1.1	0.5	0.6	0.7		0.5	
60-62—ohms	2.2	1.0	1.2	1.4		0.9	1.0

Component Specification (6-Lead, 600 Volt)	4D3.1	4D3.8	4D4.2	4D5.0	4D5.6	4D8.3
Hot exciter field winding voltage/amperage readings at rated voltage						
No load (63 Hz)—volts/amps	6/0.7	8/1.2		7/0.9		
Full load (60 Hz)—volts/amps	19/2.5	43/5.0	40/4.5	28/4.0	34/4.3	30/4.0
Exciter field winding resistance (cold)—ohms @ 20°C (68°F)	6.0					7.2
Exciter armature resistance (cold)—ohms (line-to-line)	0.5					0.6
Main field (rotor) resistance (cold)—ohms @ 20°C (68°F)	3.2	3.5	3.7	4.0	4.3	5.3
Stator output voltages with separately excited generator, using 12-volt battery (60 Hz only)						
1-4, 2-5, 3-6—volts	>750					
60-61—volts	>750					
60-62—volts	>750					
Cold stator resistance						
1-4, 2-5, 3-6—ohms	1.0	0.60	0.52	0.45	0.40	0.20
60-61—ohms	1.1	0.5	0.6	0.7	0.5	
60-62—ohms	2.2	1.0	1.2	1.4	0.9	1.0

1.4 Torque Values and Assembly Specifications

Use the torque values shown below during alternator assembly. For assembly torque values not shown, use the guidelines in Appendix C, General Torque Specifications.

Alternator Models->	4D and 4E
Component Specification	**Bolt Size/Thread/Class: Torque Value, Nm (ft. lbs.)**
Drive discs to rotor shaft bolts	M8-1.25 Class 10.9: 33 (24) *
Drive discs to flywheel bolts	M8-1.25 Class 12.9: 43 (32) *
Alternator fan to rotor assembly bolts	M6-1.0 Class 8.8: 10 (7) *
Stator housing studs	Use Appendix C, General Torque Specifications
End bracket to stator housing bolts	Use Appendix C, General Torque Specifications
Exciter armature retaining bolt	M10-1.50 Class 10.9: 65 (48)
Rotor lead to rectifier board screws	#8-32: 1.8 Nm (16 in. lbs.)
Exciter armature lead to rectifier board screws	#8-32: 1.8 Nm (16 in. lbs.)
Rectifier board to exciter field screws	#10-24: 4.0 Nm (35 in. lbs.)
Exciter field bolts	M5-0.8 Class 8.8: 5.8 Nm (51 in. lbs.)
End bracket to generator adapter studs/nuts	M10-1.5: 30 (22)
* Apply Loctite® 242 Blue or equivalent to bolt threads.	

Loctite® is a registered trademark of the Henkel Corporation.

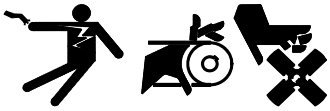
2.1 Introduction

This section contains alternator troubleshooting, diagnostic, and repair information.

Refer to the respective generator set controller Operation Manual for general service information. Refer to the Controller Service Manual for controller service information. Refer to the engine service manual for engine service information.

Before beginning the troubleshooting procedures, follow all safety precautions at the beginning of this manual and the additional precautions within the text.

⚠ 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.

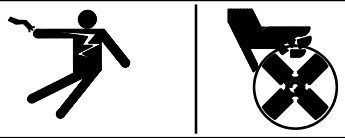
Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or equipment connected to the set, disable the generator set as follows: (1) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

(Decision-Maker® 550 Controller)

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.

(APM402, RDC2, Decision-Maker® 3000, and 3500 Controllers)

⚠ DANGER



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

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

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

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

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

2.2 Initial Checks

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

- **Discharged or dead battery.** Check for a non-functioning battery charging alternator or battery charger.
- **Loose connections or damaged wiring.**
- **Fault shutdown.** Check for a fault message on the controller display. See the controller Operation Manual for fault messages.
- **Open circuit breaker.** Reset the circuit breaker. If the circuit breaker blows again, check the circuit wiring and components for the cause.
- **Blown fuses.** Always check and replace the fuses before replacing other components.
- **Incorrect controller settings.** Always check the controller settings before replacing the controller. See the controller service manual.

Controller Firmware

Some problems may be solved by updating the controller's application program. Check the Tech Tools area of the Kohler Power Resource Center site for information on controller firmware updates. A personal computer (laptop) and Kohler® SiteTech™ software are required to update the firmware. See the SiteTech™ Software Operation manual for instructions.

2.3 Troubleshooting Chart

Use the chart on the following page to diagnose and correct alternator problems. The chart includes a list of common problems, possible causes of the problem, recommended corrective actions, and references to detailed information or repair procedures.

Trouble Symptoms					Probable Causes	Recommended Actions	Section or Publication Reference*
Does not crank	Cranks but does not start	No or low output voltage	Stops suddenly	Excessive or abnormal noise			
Alternator (4D/4E)							
		x			AC output circuit breaker open	Reset the breaker and check for AC voltage at the generator set side of the circuit breaker.	—
x					Transfer switch test switch in the OFF position	Move the transfer switch test switch to the AUTO position.	ATS O/M
		x			Transfer switch fails to transfer load	Move the ATS test switch to the AUTO position. Troubleshoot the transfer circuit and time delays.	ATS O/M, S/M
		x			Wiring, terminals, or pin in the exciter field open	Check for continuity.	Section 3, W/D
		x			Main field (rotor) inoperative (open or grounded)	Test and/or replace the rotor.†	Section 3
		x			Stator inoperative (open or grounded)	Test and/or replace the stator.†	Section 3
				x	Vibration excessive	Tighten loose components.†	—
		x	x		Voltage regulator settings incorrect	Adjust the voltage regulator.	Gen. O/M, SiteTech O/M
Controller and Emergency Stop Switch							
x	x				Controller circuit board(s) inoperative	Replace the controller.	Contr. S/M
x	x				Controller circuit board(s) wiring fault	Check the wiring.	W/D
			x		Controller fault	Troubleshoot the controller. †	Contr. S/M
x	x		x		Controller internal fuse blown	Check for power battery power to the circuit board. If fuse does not auto-reset troubleshoot the controller wiring.†	W/D, Contr. S/M
x					Controller master control buttons inoperative	Replace the controller master control button circuit board.	—
x					Controller master control button in the OFF/RESET mode	Press the controller master control RUN or AUTO button.	Gen. O/M
x					Engine start circuit open	Press the controller master control RUN button to test the generator set. Troubleshoot the auto start circuit and time delays.	Gen. O/M, Contr. S/M, W/D, ATS O/M, S/M
x			x		Emergency stop switch activated, if equipped	Reset the emergency stop switch.	Gen. O/M
		x	x		Voltage regulation inoperative	Replace the junction box sensing fuses. If the fuse blows again, troubleshoot the controller.	W/D, Contr. S/M
			x		Controller communication error	Verify that RS-485 cable “shield” wire is connected on only one end.	W/D

* Sec./Section—numbered section of this manual; ATS—Automatic Transfer Switch; Eng.—Engine; Contr.—Controller; Gen.—Generator Set; I/M—Installation Manual; O/M—Operation Manual; S/M—Service Manual; S/S—Spec Sheet; W/D—Wiring Diagram Manual

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

Trouble Symptoms					Probable Causes	Recommended Actions	Section or Publication Reference*
Does not crank	Cranks but does not start	No or low output voltage	Stops suddenly	Excessive or abnormal noise			
Electrical System (DC Circuits)							
x	x				Battery connections loose, corroded, or incorrect	Verify that the battery connections are correct, clean, and tight.	Gen. O/M, W/D
x	x				Battery weak or dead	Recharge or replace the battery. The spec sheet provides recommended battery CCA rating.	Gen. O/M, S/S
x	x				Starter/starter solenoid inoperative	Replace the starter or starter solenoid.	Eng. S/M
x			x		Engine harness connector(s) not locked tight	Disconnect the engine harness connector(s) then reconnect it to the controller.	W/D
			x		Fault shutdown	Reset the fault switches and troubleshoot the controller.	Gen. O/M

* Sec./Section—numbered section of this manual; ATS—Automatic Transfer Switch; Eng.—Engine; Contr.—Controller; Gen.—Generator Set; I/M—Installation Manual; O/M—Operation Manual; S/M—Service Manual; S/S—Spec Sheet; W/D—Wiring Diagram Manual

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

3.1 Introduction

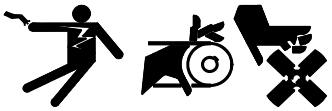
This section provides information on troubleshooting the alternator and testing components of the generator set. Contact an authorized service distributor/dealer for the appropriate technical manuals for the controller and integrated voltage regulator.

To troubleshoot the alternator assembly components, the following equipment is needed for many of the tests:

- Multimeter, qty. 2
- DC Ammeter (0–10 Amps) (required if multimeter doesn't have 10 amp current measuring capability)
- Megohmmeter
- 12-Volt battery
- 10-Amp fuse and wiring

Follow all safety precautions listed in the front of this manual and the additional precautions within the text.

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

(Decision-Maker® 550 Controller)

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.

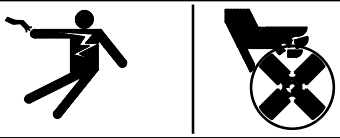
(APM402, RDC2, Decision-Maker® 3000, and 3500 Controllers)

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

⚠ DANGER



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

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

Disconnecting the electrical load. Hazardous voltage will cause severe injury or death. Disconnect the generator set from the load by turning off the line circuit breaker or by disconnecting the generator set output leads from the transfer switch and heavily taping the ends of the leads. High voltage transferred to the load during testing may cause personal injury and equipment damage.

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

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

3.2 Separate Excitation

To determine the cause of no- or low-AC output, refer to the troubleshooting flowchart in Figure 3-1. Before beginning the test procedures, read all of the safety precautions at the beginning of this manual. Many of the test procedures include additional safety precautions.

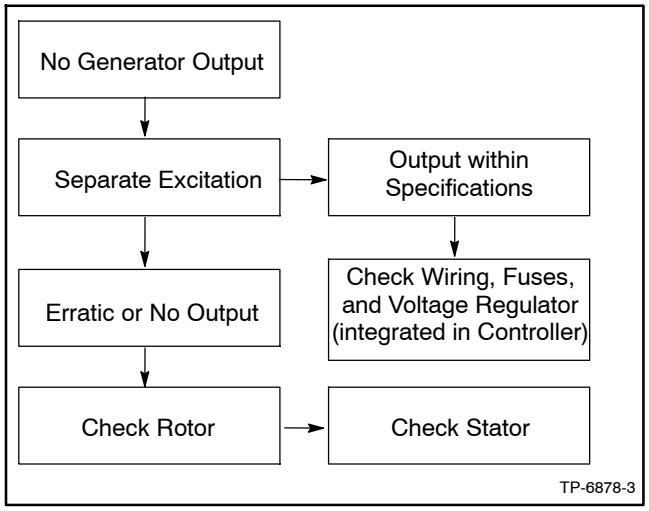


Figure 3-1 General Troubleshooting

Check the condition of the alternator fuse before performing the separate excitation procedure. If the fuse is not blown, use the following procedure to separately excite the generator using an external voltage source (a 12-volt battery).

Separately exciting the alternator can determine the presence of a faulty voltage regulator or determine if a running fault exists in the rotor and/or stator. An alternator component that appears good while static (stationary) may exhibit a running open or short circuit while dynamic (moving). Short circuits can be caused by centrifugal forces acting on the windings during rotation or insulation breakdown as temperatures increase.

1. Stop the generator set. Refer to the respective controller operation manual as needed.

2. Disconnect the FP/FN connector.

3. Connect an ohmmeter to the exciter field winding and measure the resistance. Note and record the ohmmeter reading.

4. Disconnect the ohmmeter after measuring the resistance.

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

The approximate ammeter reading should be battery voltage divided by the specified exciter field winding resistances (cold). See Section 1, Specifications, for the values.

Example:

$$\frac{\text{12 Volts (Battery Voltage)}}{\text{5.8 Ohms Exciter Field Winding Resistance}} = \text{2.1 amps Exciter Field Winding Current}$$

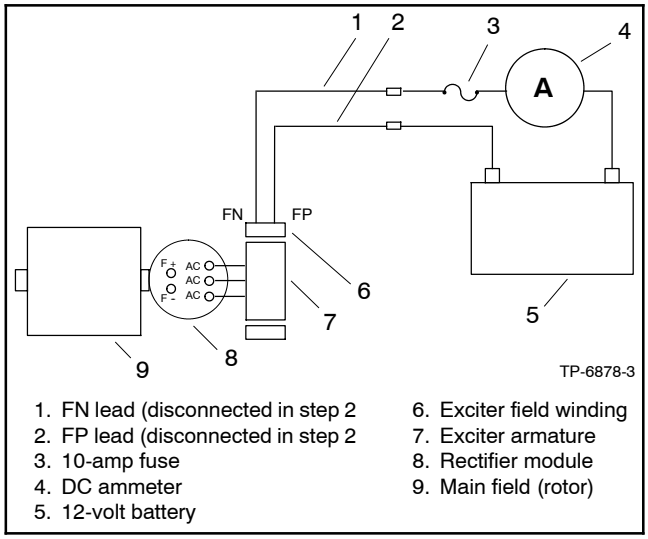


Figure 3-2 Separate Excitation Connections

6. Start the generator set. Refer to the respective controller operation manual as needed.

7. Check the ammeter values.

   Unstable ammeter reading. An increasing meter reading indicates a shorted exciter field. A decreasing meter reading to zero, or unstable reading, suggests a running open in the exciter.

   Stable ammeter reading. If the ammeter is stable, continue with the next step.

8. Use a voltmeter and check for AC output across the stator main windings and compare it to the values in Section 1, Specifications. If the stator main windings output varies considerably from those listed, a faulty stator, rotor, rectifier module, or exciter armature is likely.

9. Stop the generator set. Refer to the respective controller operation manual as needed.

If there is no alternator AC output during normal operation, but AC output is available when the generator set is separately excited, the voltage regulator is probably defective.

Note: See Section 1, Specifications, for the stator output voltages (with separately excited alternator). These specifications are based on a battery voltage of 12. Should the battery voltage vary (11–14 volts), the resulting stator output values will also vary.

3.3 Exciter Field

Direct current from the battery magnetizes the exciter field. When the exciter armature rotates within the magnetized exciter field windings, an electrical current develops within the exciter armature. Test the exciter field according to the following procedure.

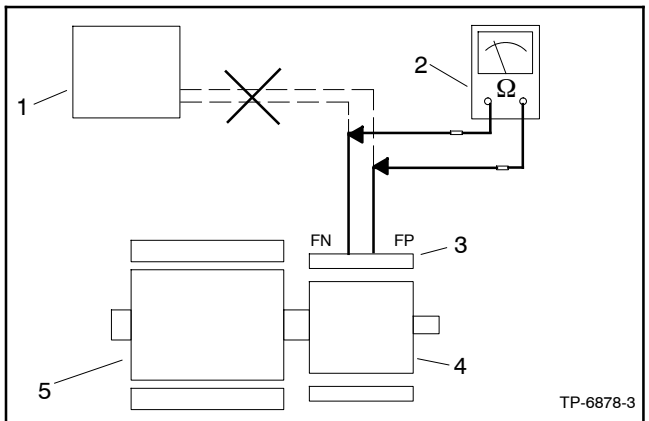
Exciter Field Test Procedure

1. Stop the generator set. Refer to the respective controller operation manual as needed.

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

3. Disconnect the FP/FN connector between the controller/activator board and the exciter field.

4. Check the exciter field resistance by connecting an ohmmeter across exciter field FN and FP leads. See Figure 3-3. See Section 1, Specifications, for the resistance value of a cold exciter field.



1. Generator set controller/activator board
2. Ohmmeter
3. Exciter field
4. Exciter armature
5. Main field (rotor)

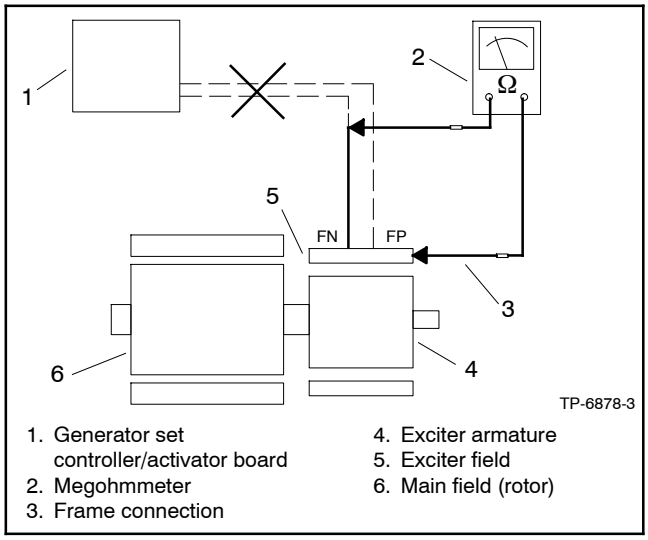
Figure 3-3 Exciter Field Resistance Test

A low reading indicates an internal short and a high reading indicates an open winding. Repair or replace the exciter field if the ohmmeter readings indicate an inoperative exciter field (refer to Section 4, Generator Disassembly/Reassembly, for removal).

If the resistance test is inconclusive, perform a megohmmeter test on the exciter field as described in the next step.

5. Check the exciter field for a short-to-ground condition. Use a megohmmeter to apply 500 volts DC to the FN or FP lead and the exciter field frame. See Figure 3-4. Follow the megohmmeter manufacturer's instructions for megohmmeter use.

   A reading of approximately 1.5 MOhms and higher indicates the field winding is functional. A reading of less than approximately 1.5 MOhms indicates deterioration of the winding insulation and possible current flow to ground; if so, replace the exciter field.



1. Generator set controller/activator board
2. Megohmmeter
3. Frame connection
4. Exciter armature
5. Exciter field
6. Main field (rotor)

Figure 3-4 Megohmmeter Connections on the Exciter Field

3.3.1 Exciter Armature

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

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

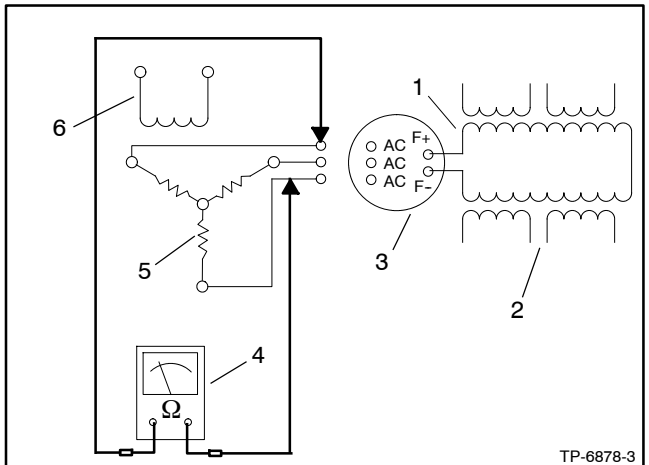
The exciter armature supplies excitation current to the generator main field through the rectifier module. Test the exciter armature as described in the following steps.

Exciter Armature Test Procedure

1. Disassemble the alternator. Refer to Section 4, Generator Disassembly/Reassembly.

2. With the alternator disassembled, disconnect the exciter armature leads from the rectifier module AC terminals

3. With an ohmmeter on the R x 1 scale, check the resistance across the exciter armature leads. See Figure 3-5. See Section 1, Specifications, for the exciter armature resistance.



1. Main field (rotor)
2. Stator windings
3. Rectifier module
4. Ohmmeter
5. Exciter armature
6. Exciter field winding

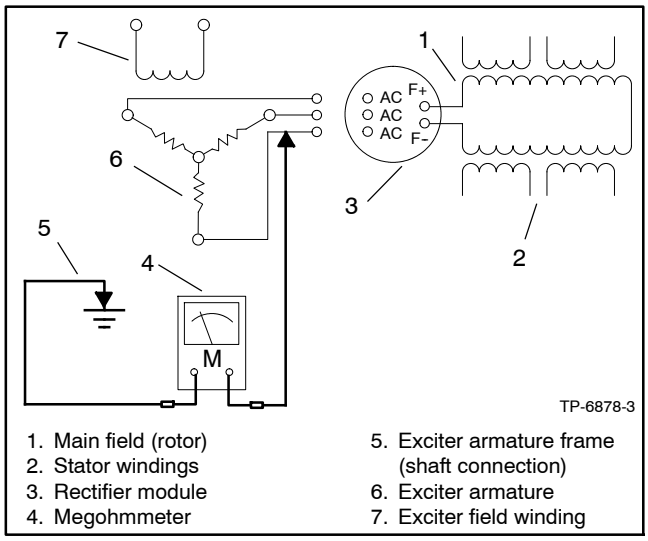
Figure 3-5 Exciter Armature Ohmmeter Test

No continuity indicates an open exciter armature winding. If the resistance test is inconclusive, perform a megohmmeter test on the exciter armature as described in the next step.

Note: Most ohmmeters will not accurately measure less than one ohm. Consider the exciter armature functional if the resistance reading (continuity) is low and there is no evidence of a shorted winding (heat discoloration).

4. Check the exciter armature winding for a short-to-ground condition. Use a megohmmeter to apply 500 volts DC to either armature lead and the exciter armature frame. Follow the megohmmeter manufacturer's instructions for using the megohmmeter. See Figure 3-6.

   A reading of approximately 1.5 MOhms and higher indicates the exciter armature is functional. A reading of less than approximately 1.5 MOhms indicates deterioration of the winding insulation and possible current flow to ground; if so, replace the exciter armature.



1. Main field (rotor)
2. Stator windings
3. Rectifier module
4. Megohmmeter
5. Exciter armature frame (shaft connection)
6. Exciter armature
7. Exciter field winding

Figure 3-6 Megohmmeter Connections on Exciter Armature

3.3.2 Rectifier Module

The rectifier module located between the exciter armature and the main field (rotor) converts AC from the exciter armature to DC, which magnetizes the generator main field (rotor). Test the rectifier module as described in the following steps.

Rectifier Module Test Procedure

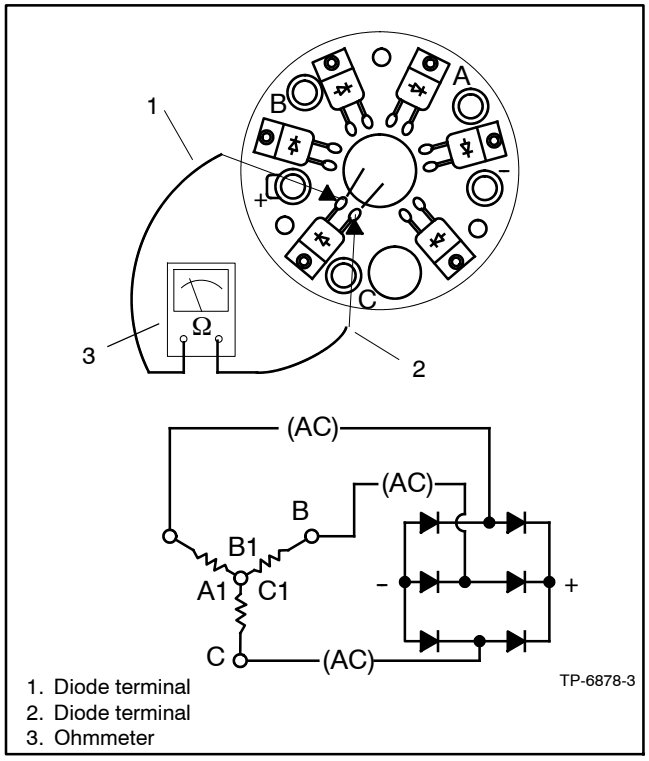
1. Disconnect the exciter armature and the main field leads from the rectifier module.

2. Perform a diode check of all six of the rectifier board diodes. Replace the rectifier module if any of the diodes tests differently than described.

   a. Test each individual diode using the multimeter diode check feature if so equipped. Refer to the multimeter instructions for procedure.

   or

   b. Use an ohmmeter on the R x 100 scale to check the resistance of the rectifier diodes as shown in Figure 3-7. The ohmmeter should show a low resistance in one direction and, upon reversing the ohmmeter leads, a high resistance in the other direction.



1. Diode terminal
2. Diode terminal
3. Ohmmeter

Figure 3-7 Rectifier Module Test

3.4 Rotor (Main Field)

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

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

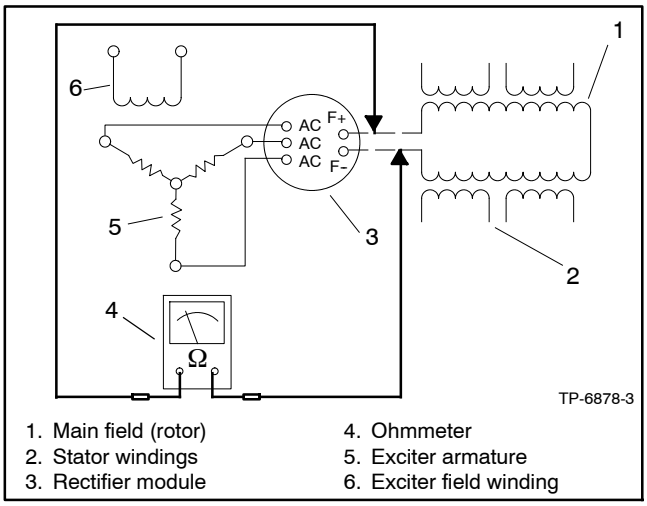
The generator rotor (magnetized by DC from the rectifier module) rotating within the stator windings induces AC in the stator windings. Test the generator rotor (main field) as described in the following steps. Disassemble the generator prior to performing this test. See Section 4, Generator Disassembly/Reassembly.

Generator Main Field (Rotor) Test Procedure

1. With the generator disassembled, disconnect the generator main field (rotor) windings at the rectifier module terminals F+ and F–.

2. Check the main field (rotor) resistance by connecting an ohmmeter across the main field (rotor) F+ and F– leads. See Figure 3-8. See Section 1, Specifications, for the resistance value.

   A low reading indicates an internal short and a high reading indicates an open winding. Repair or replace the main field (rotor) if the ohmmeter readings indicate the main field (rotor) is inoperative. If the resistance test is inconclusive, perform a megohmmeter test on the main field (rotor) as described in the next step.

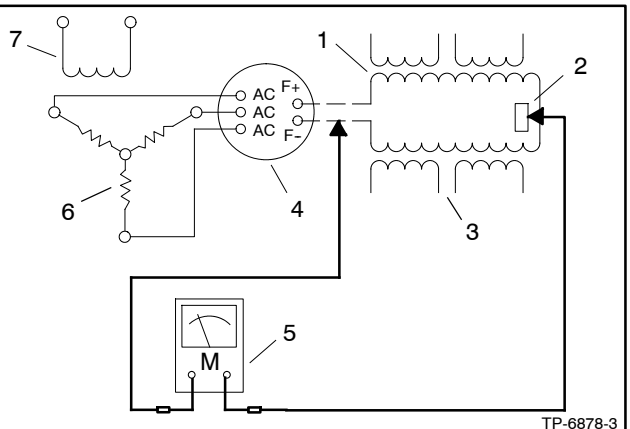


1. Main field (rotor)
2. Stator windings
3. Rectifier module
4. Ohmmeter
5. Exciter armature
6. Exciter field winding

Figure 3-8 Ohmmeter Connections on Main Field

3. Check the main field (rotor) for a short-to-ground condition by using a megohmmeter. Apply 500 volts DC to either field lead (rotor) and the main field (rotor) frame. Follow the megohmmeter manufacturer's instructions for using the megohmmeter. See Figure 3-9.

   A reading of 1.5 MOhms and higher indicates the main field (rotor) is functional. A reading of less than 1.5 MOhms indicates deterioration of the winding insulation and possible current flow to ground; if so, replace the main field (rotor).



1. Main field (rotor)
2. Main field (rotor) frame (shaft connection)
3. Stator windings
4. Rectifier module
5. Megohmmeter
6. Exciter armature
7. Exciter field winding

Figure 3-9 Megohmmeter Connections on Main Field

3.5 Stator

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

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

The stator consists of a series of coils of wire laid in a laminated steel frame. The stator leads supply voltage to the AC load and exciter regulator.

Before testing the stator, inspect it for heat discoloration and visible damage to the housing lead wires and exposed and varnished areas of the frame laminations. Be sure the stator is securely fastened in the stator housing.

The stator produces electrical output (AC) as the magnetized main field rotates within the stator windings. Test the condition of the stator according to the following procedure.

Leads 1, 2, 3, and 4 are the generator output leads on single-phase models. The 4E5.0, 4E5.6, and 4E8.3, 4-lead single-phase stators have dual output leads labeled 1, 2, 3, 4, and 1A, 2A, 3A, and 4A. Leads 1 through 12 are the output leads on three-phase models. Leads 60, 61, and 62 are the auxiliary power winding leads. Refer to the schematic in Figure 3-10 or Figure 3-11 when performing the following tests.

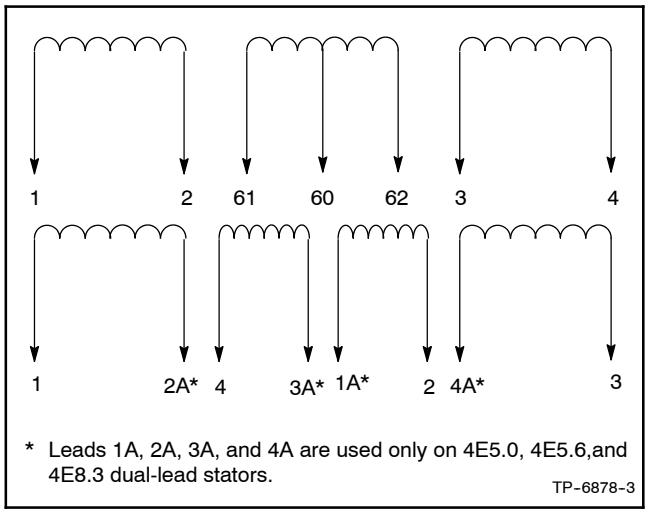


Figure 3-10 Alternator Stator Leads (Single Phase)

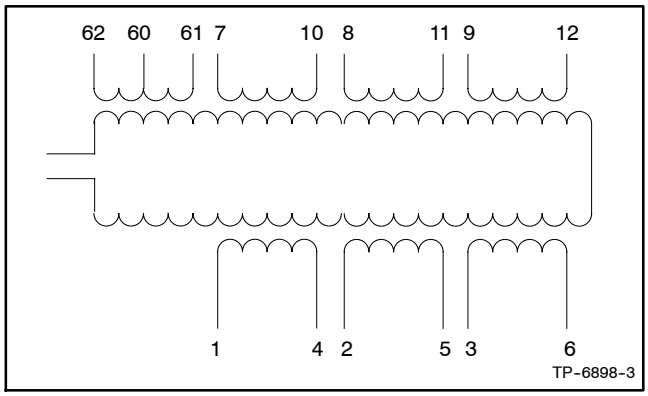


Figure 3-11 Alternator Stator Leads (Three Phase)

Stator Test Procedure

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

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

3. Check the generator output lead connections. See wiring diagram ADV-5875 in the Appendix to determine the voltage connection of the unit. Make note of the voltage connection for reassembly later.

4. Disconnect all the stator leads to isolate the windings. To check the stator continuity, set the ohmmeter on the R x 1 scale. Check the stator continuity by connecting the meter leads to the

stator leads as shown in Figure 3-10 for single phase or Figure 3-11 for three phase. See Figure 3-12 for single-phase or Figure 3-13 for three-phase continuity test results. Perform the stator tests on all the stator windings.

Leads			Continuity
1 and 2	1 and 2A, 1A and 2 (4E5.0, 4E5.6 and 4E8.3)		Yes
3 and 4	3 and 4A, 3A and 4 (4E5.0, 4E5.6 and 4E8.3)		
60 and 61	61 and 62	60 and 62	
Any other combination of stator leads not shown above			No
Any stator lead and ground on stator housing or frame laminations			No

Figure 3-12 Stator Continuity Test Results on a Good Stator (Single Phase)

Leads			Continuity
1 and 4	2 and 5	3 and 6	Yes
7 and 10	8 and 11	9 and 12	
60 and 61	61 and 62	60 and 62	
Any other combination of stator leads not shown above			No
Any stator lead and ground on stator housing or frame laminations			No

Figure 3-13 Stator Continuity Test Results on a Good Stator (Three Phase)

5. Check the cold resistance of the stator windings by connecting the meter leads to the stator leads as shown in Figure 3-12 or Figure 3-13. See Section 1, Specifications, for the stator resistance values. If the stator resistance test is inconclusive, perform a megohmmeter test on the stator as described in the next step.

   Note: Consider the stator functional if the resistance reading (continuity) is low and there is no evidence of shorted windings (heat discoloration).

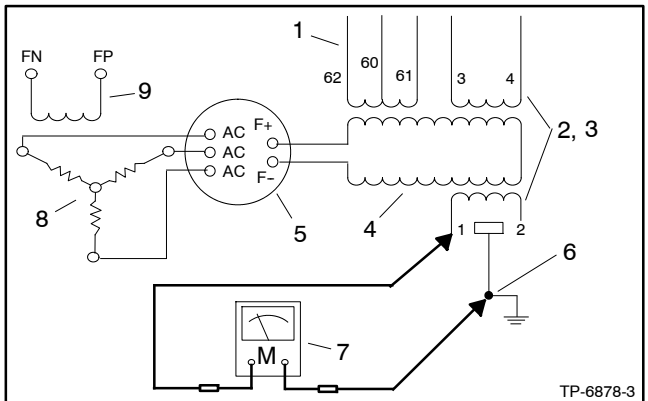
   Note: When taking an ohmmeter reading using leads 60, 61, or 62, make the connection before the fuse if used.

   Note: The stator resistance can vary directly with increased temperature.

   If any of the stator readings vary during the previous checks, replace the stator.

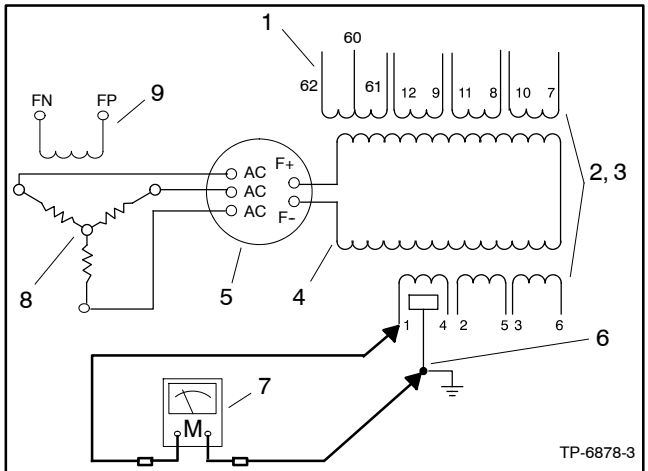
6. Check the stator for a short-to-ground condition using a megohmmeter. See Figure 3-14 for a single-phase megohmmeter connections and Figure 3-15 for three-phase megohmmeter connections.

   Apply 500 volts DC to any stator lead from each winding and the stator frame. Follow the megohmmeter manufacturer's instructions for using the megohmmeter. Repeat the test on the other leads until all of the stator windings have been tested. A reading of 1.5 MOhms and higher indicates the stator is functional. A reading of less than 1.5 MOhms indicates deterioration of the winding insulation and possible current flow to ground; if so, repair or replace the stator.



1. Auxiliary power for exciter field and voltage regulator
2. Voltage sensing (A, B, and NEU) leads (208–240 volts nominal)
3. Stator windings
4. Main field (rotor)
5. Rectifier module
6. Frame connection
7. Megohmmeter
8. Exciter armature
9. Exciter field winding

Figure 3-14 Megohmmeter Connections on Stator (Single Phase)



1. Auxiliary power for exciter field and voltage regulator
2. Voltage sensing (A, B, C, and NEU) leads (208–240 volts nominal)
3. Stator windings
4. Main field (rotor)
5. Rectifier module
6. Frame connection
7. Megohmmeter
8. Exciter armature
9. Exciter field winding

Figure 3-15 Megohmmeter Connections on Stator (Three Phase)

3.6 Voltage Regulator

Several generator set controllers have integrated voltage regulators. The following controllers have integrated voltage regulators:

- APM402
- Decision-Maker® 550
- Decision-Maker® 3000
- Decision-Maker® 3500
- RDC2

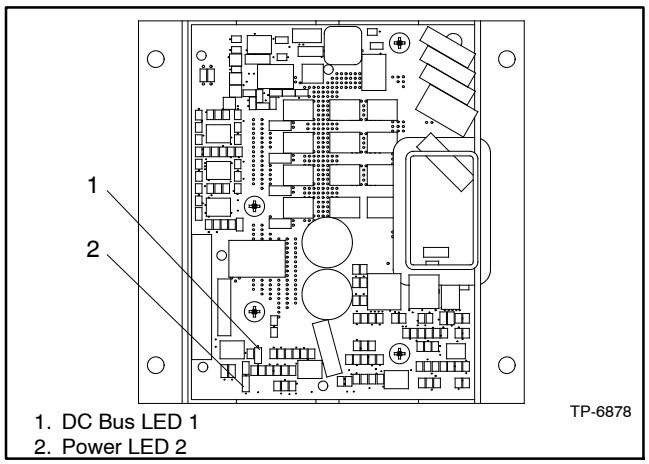
If the generator set has one of the controllers listed previously, refer to the respective controller operation manual and/or controller service manual for information on troubleshooting the voltage regulator. See the list of related materials in the Introduction on page 11 of this manual for literature part numbers.

Voltage regulation is performed by the generator set controller. The activator board only interprets the pulse width modulator (PWM) signal as a target current for the alternator field and controls the current to match the target.

3.7 Activator Board GM88453

3.7.1 General

The activator board (Figure 3-16) is a current-controlling device. The output current of the activator is controlled to a given target based on the duty cycle of the pulse width modulated (PWM) signal from the LED output of the controller. The activator board switches DC voltage to the field to increase the field current when the target current increases and turns the field voltage off until the field current decays to the new level when the target current decreases.



1. DC Bus LED 1
2. Power LED 2

Figure 3-16 Activator Board GM88453

The activator board receives power from one of two sources when used with wound field alternators:

- An auxiliary winding on the alternator. This winding is located on the stator where it requires field current to produce voltage. The activator requires an additional power source to supply initial current to the field causing the auxiliary winding to produce voltage.

  Note: If the generator set has been running recently, the alternator field will typically have enough residual magnetism to power the activator board and provide power to the field.

- The cranking battery provides input voltage without a second power source to the activator board only when it is not receiving power from the auxiliary windings. The activator board energizes a relay that disconnects the DC input to the activator board when the AC input reaches about 25 VAC.

The activator board contains two LEDs for troubleshooting purposes. Power to the activator board is supplied by the alternator; therefore, the LEDs will only illuminate while the generator set is running.

- **DC Bus.** Indicates that the DC bus that provides power to the field has voltage present. The LED starts to illuminate at 8 VDC on the bus and is fully illuminated by about 14 VDC.
- **Power.** Indicates that activator board is receiving power and is able to control the output to the field. This LED must be fully illuminated (max. brightness) before any power is supplied to the field.

3.7.2 Theory of Operation

The activator board receives power as soon as the run relay is energized (the flash relay is not energized). After receiving power, the board begins controlling the field current to the target sent by the controller.

After the controller requests field current, the activator applies voltage to the field to increase the field current to the target. The flash relay is energized when the auxiliary winding voltage reaches about 25 VAC, which is usually occurs between 800 and 1200 rpm as the engine accelerates. The field current is limited by the battery voltage until enough current is flowing on the rotor field to energize the auxiliary windings.

The activator board controls current to the exciter field which controls the voltage on the exciter armature that is rectified by the rotating diode board and provides a DC voltage to the rotor field. In constant load and speed operation, the rotor field current is related to the exciter current.

In transient conditions (changing load or speed) operation, the two currents may not be related, as the rotor field has a long time constant (it takes time to change the rotor field current). The field current in the main field increases when voltage is applied to it and decreases when voltage is not applied to it. The voltage applied to the main field is proportional to the exciter field current.

3.7.3 Activator Board Function and Connections

Activator board GM88453 provides the connection between the controller with integrated voltage regulator and the alternator assembly with wiring for the rotor exciter field leads (FN and FP) and auxiliary power windings (60, 61, and 62). See Figure 3-17 and Figure 3-18.

3.7.4 Activator Board Troubleshooting

Use the flowcharts on the following pages to troubleshoot the alternator assembly and activator board. The following equipment is required:

- Multimeter, qty. 2
- DC Ammeter (0–10 Amps) (required if multimeter doesn't have 10 amp current measuring capability)

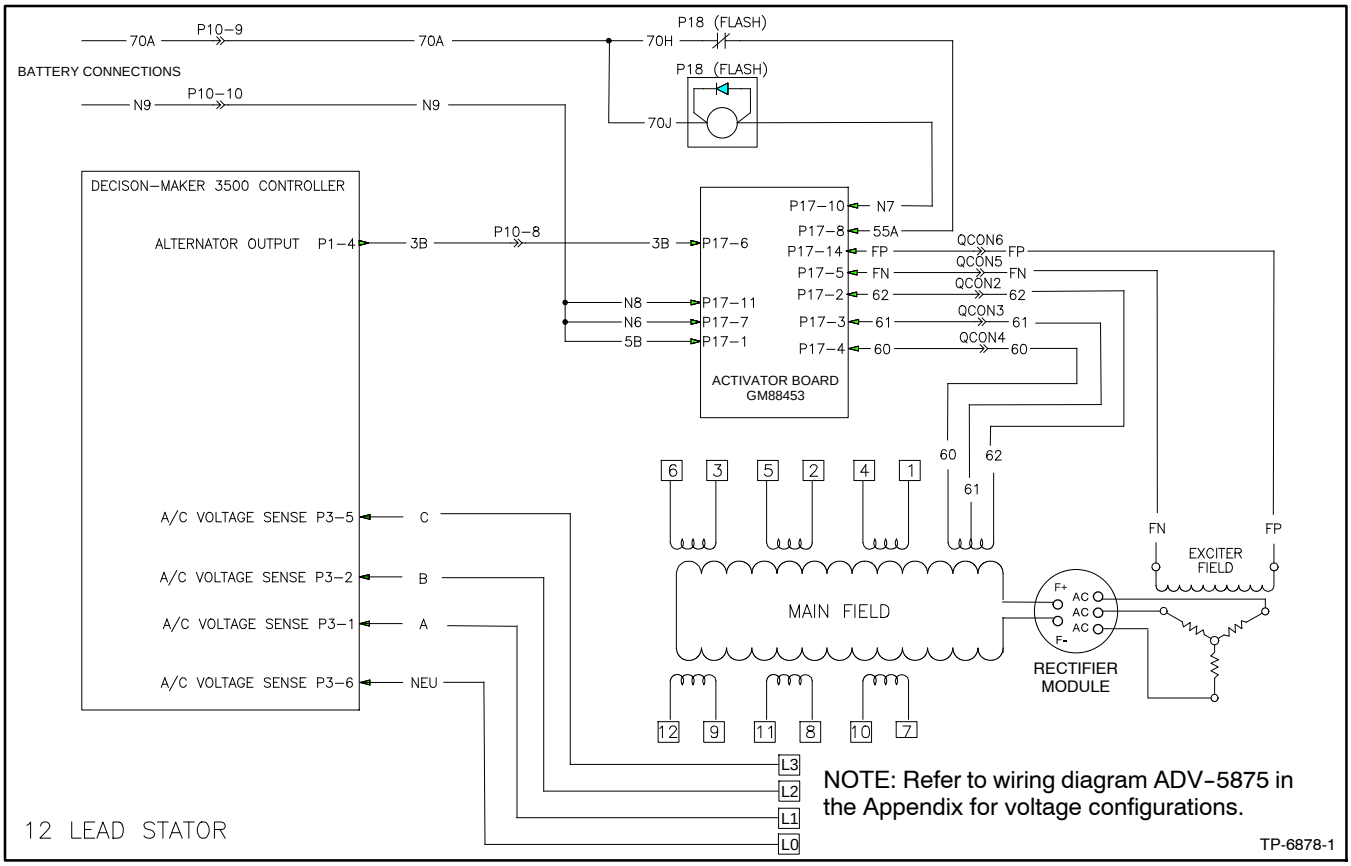
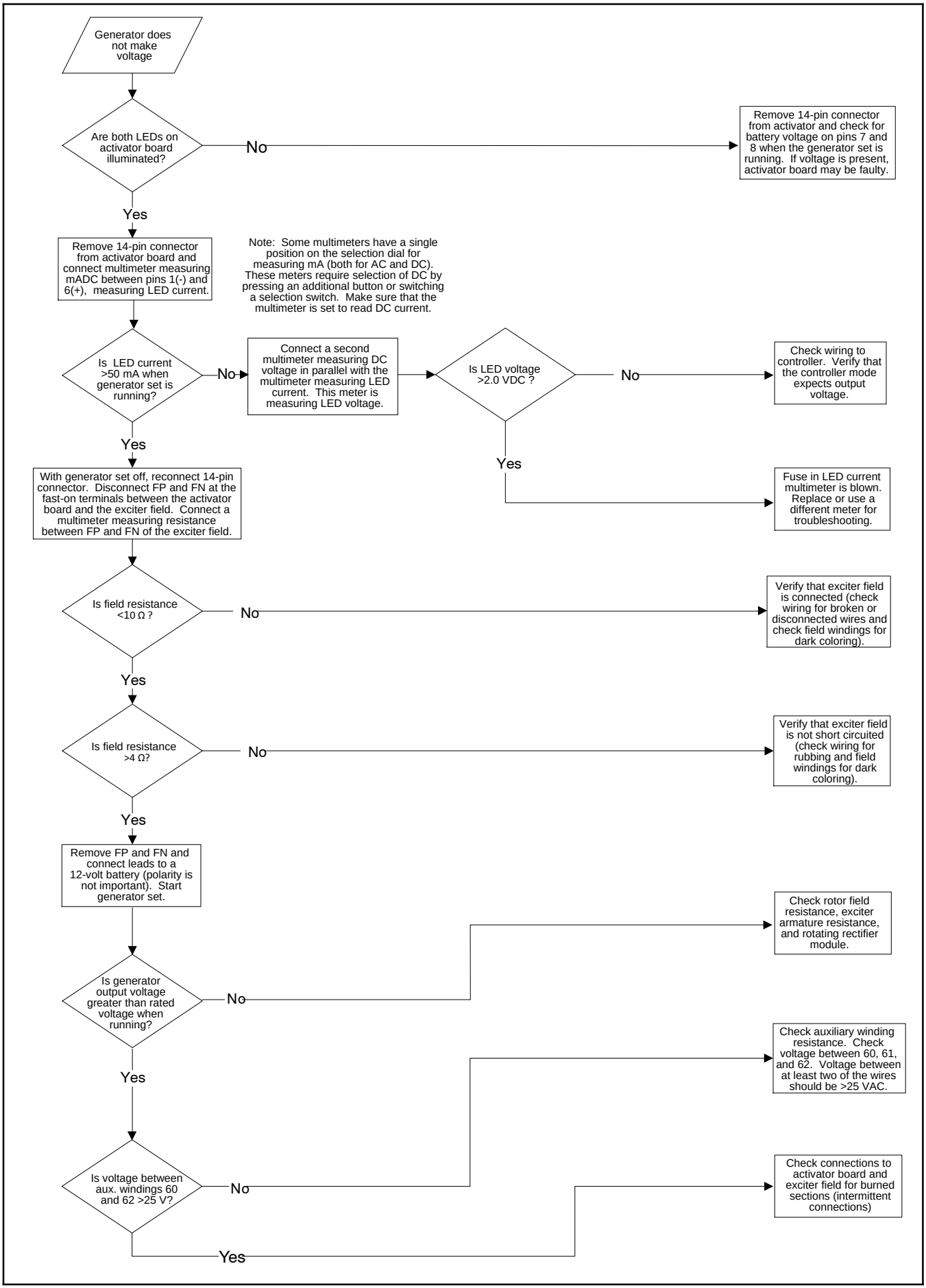
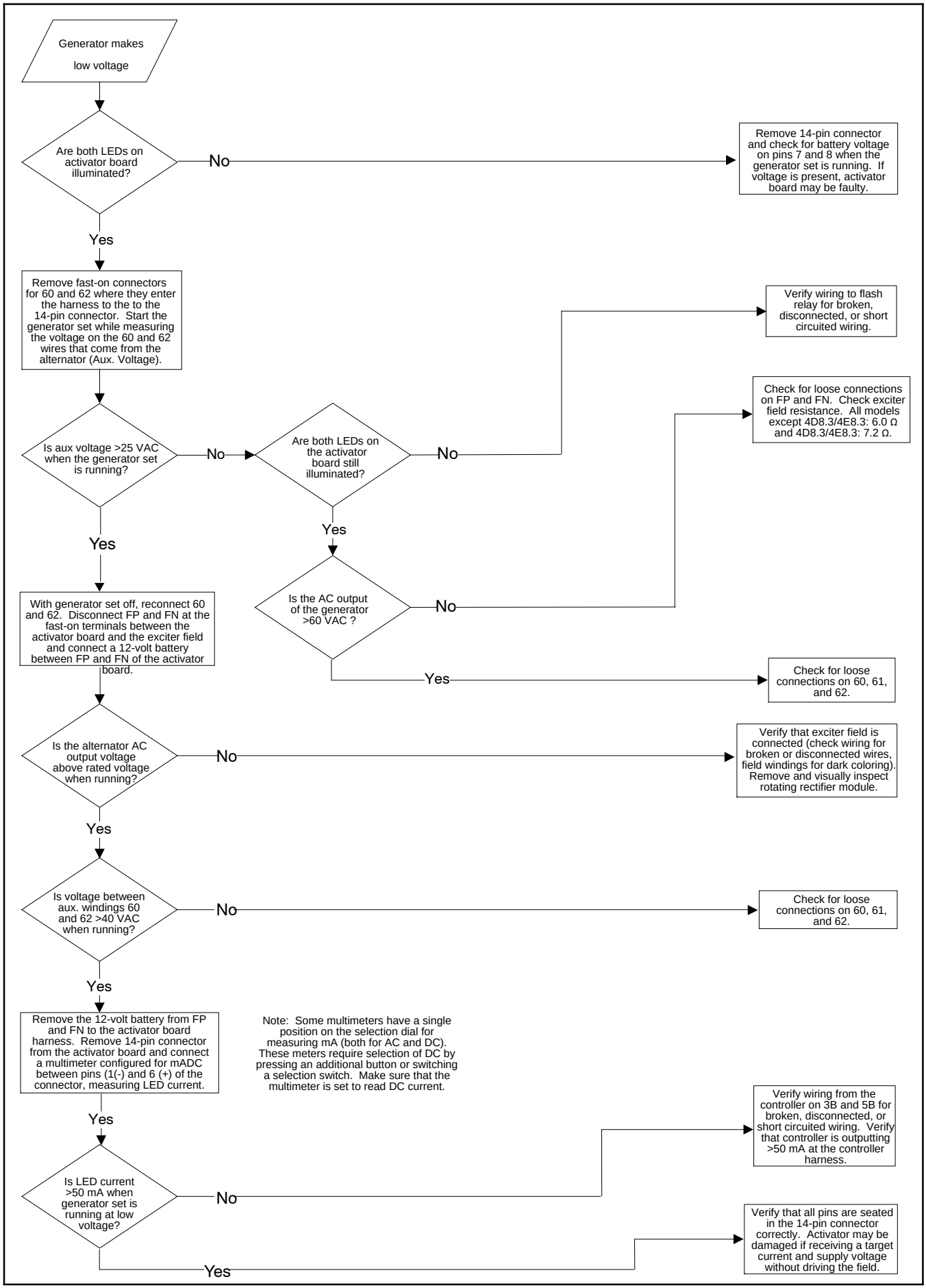


Figure 3-17 Activator Board GM88453 Connections (shown with Decision-Maker® 3500 controller)

Activator Board	Description	Comments
P17-1	PWM target current signal, 5B, LED(-)	LED is 1.2 VDC max. Can be connected to a 12-volt battery negative terminal as an activator troubleshooting test. Add a 120 ohm resistor when using a 12 VDC (battery).
P17-2	Normal power input	25-250 VAC @ 30-400 Hz (3 amps.).
P17-3	Normal power input	
P17-4	Normal power input	
P17-5	Field current output (-)	Rated at 5.0 amps continuous, 7.8 amps peak for 1 minute.
P17-6	PWM target current signal, 3B, LED(+)	LED is 1.2 VDC max. Can be connected to a 12-volt battery positive terminal as an activator troubleshooting test. Add a 120 ohm resistor when using a 12 VDC (battery).
P17-7	Alternator power input (+)	12-200 VDC or 120 VAC (for powering the board during testing).
P17-8	Alternator power input (-)	
P17-9	Not used	
P17-10	DC bus voltage (+)	Rated at up to 30 VDC, 250 mA, relay driver output. Turns on when the DC bus that provides current to the field reaches 35 VDC. This occurs when the alternator is producing at least 25 VAC on the auxiliary windings. This output is typically used to disconnect the field flash relay.
P17-11	DC bus voltage (-)	
P17-12	Field overvoltage (+)	Rated at up to 30 VDC, 250 mA, relay driver output. Turns on when the DC voltage of the field (between FP and FN) exceeds 80 VDC indicating an over excitation condition.
P17-13	Field overvoltage (-)	
P17-14	Field current output (+)	Rated at 5.0 amps continuous, 7.8 amps peak for 1 minute.

Figure 3-18 Activator Board P1 Connections


Generator does not make voltage
Are both LEDs on activator board illuminated?
No
Remove 14-pin connector from activator and check for battery voltage on pins 7 and 8 when the generator set is running. If voltage is present, activator board may be faulty.
Yes
Remove 14-pin connector from activator board and connect multimeter measuring mADC between pins 1(-) and 6(+), measuring LED current.
Note: Some multimeters have a single position on the selection dial for measuring mA (both for AC and DC). These meters require selection of DC by pressing an additional button or switching a selection switch. Make sure that the multimeter is set to read DC current.
Is LED current >50 mA when generator set is running?
No
Connect a second multimeter measuring DC voltage in parallel with the multimeter measuring LED current. This meter is measuring LED voltage.
Is LED voltage >2.0 VDC ?
No
Check wiring to controller. Verify that the controller mode expects output voltage.
Yes
Fuse in LED current multimeter is blown. Replace or use a different meter for troubleshooting.
Yes
With generator set off, reconnect 14-pin connector. Disconnect FP and FN at the fast-on terminals between the activator board and the exciter field. Connect a multimeter measuring resistance between FP and FN of the exciter field.
Is field resistance <10 Ω ?
No
Verify that exciter field is connected (check wiring for broken or disconnected wires and check field windings for dark coloring).
Yes
Is field resistance >4 Ω?
No
Verify that exciter field is not short circuited (check wiring for rubbing and field windings for dark coloring).
Yes
Remove FP and FN and connect leads to a 12-volt battery (polarity is not important). Start generator set.
Is generator output voltage greater than rated voltage when running?
No
Check rotor field resistance, exciter armature resistance, and rotating rectifier module.
Yes
Is voltage between aux. windings 60 and 62 >25 V?
No
Check auxiliary winding resistance. Check voltage between 60, 61, and 62. Voltage between at least two of the wires should be >25 VAC.
Yes
Check connections to activator board and exciter field for burned sections (intermittent connections)


Generator makes low voltage
Are both LEDs on activator board illuminated?
No
Remove 14-pin connector and check for battery voltage on pins 7 and 8 when the generator set is running. If voltage is present, activator board may be faulty.
Yes
Remove fast-on connectors for 60 and 62 where they enter the harness to the to the 14-pin connector. Start the generator set while measuring the voltage on the 60 and 62 wires that come from the alternator (Aux. Voltage).
Verify wiring to flash relay for broken, disconnected, or short circuited wiring.
Check for loose connections on FP and FN. Check exciter field resistance. All models except 4D8.3/4E8.3: 6.0 Ω and 4D8.3/4E8.3: 7.2 Ω.
Is aux voltage >25 VAC when the generator set is running?
No
Are both LEDs on the activator board still illuminated?
No
Yes
Yes
Is the AC output of the generator >60 VAC ?
No
Yes
With generator set off, reconnect 60 and 62. Disconnect FP and FN at the fast-on terminals between the activator board and the exciter field and connect a 12-volt battery between FP and FN of the activator board.
Check for loose connections on 60, 61, and 62.
Is the alternator AC output voltage above rated voltage when running?
No
Verify that exciter field is connected (check wiring for broken or disconnected wires, field windings for dark coloring). Remove and visually inspect rotating rectifier module.
Yes
Is voltage between aux. windings 60 and 62 >40 VAC when running?
No
Check for loose connections on 60, 61, and 62.
Yes
Remove the 12-volt battery from FP and FN to the activator board harness. Remove 14-pin connector from the activator board and connect a multimeter configured for mADC between pins (1(-) and 6 (+) of the connector, measuring LED current.
Note: Some multimeters have a single position on the selection dial for measuring mA (both for AC and DC). These meters require selection of DC by pressing an additional button or switching a selection switch. Make sure that the multimeter is set to read DC current.
Yes
Verify wiring from the controller on 3B and 5B for broken, disconnected, or short circuited wiring. Verify that controller is outputting >50 mA at the controller harness.
Is LED current >50 mA when generator set is running at low voltage?
No
Verify that all pins are seated in the 14-pin connector correctly. Activator may be damaged if receiving a target current and supply voltage without driving the field.
Yes

3.8 Voltage Reconnection

For voltage reconnection instructions and diagrams, refer to the wiring diagrams in Appendix F, Voltage Reconnection Wiring Diagrams and the Generator Set Operation and Wiring Diagram Manuals. See the List of Related Materials in the Introduction for document part numbers.

4.1 Introduction

Before beginning the alternator disassembly procedure, carefully read all safety precautions at the beginning of this manual. Please observe these precautions and those included in the text during the disassembly/reassembly procedure.

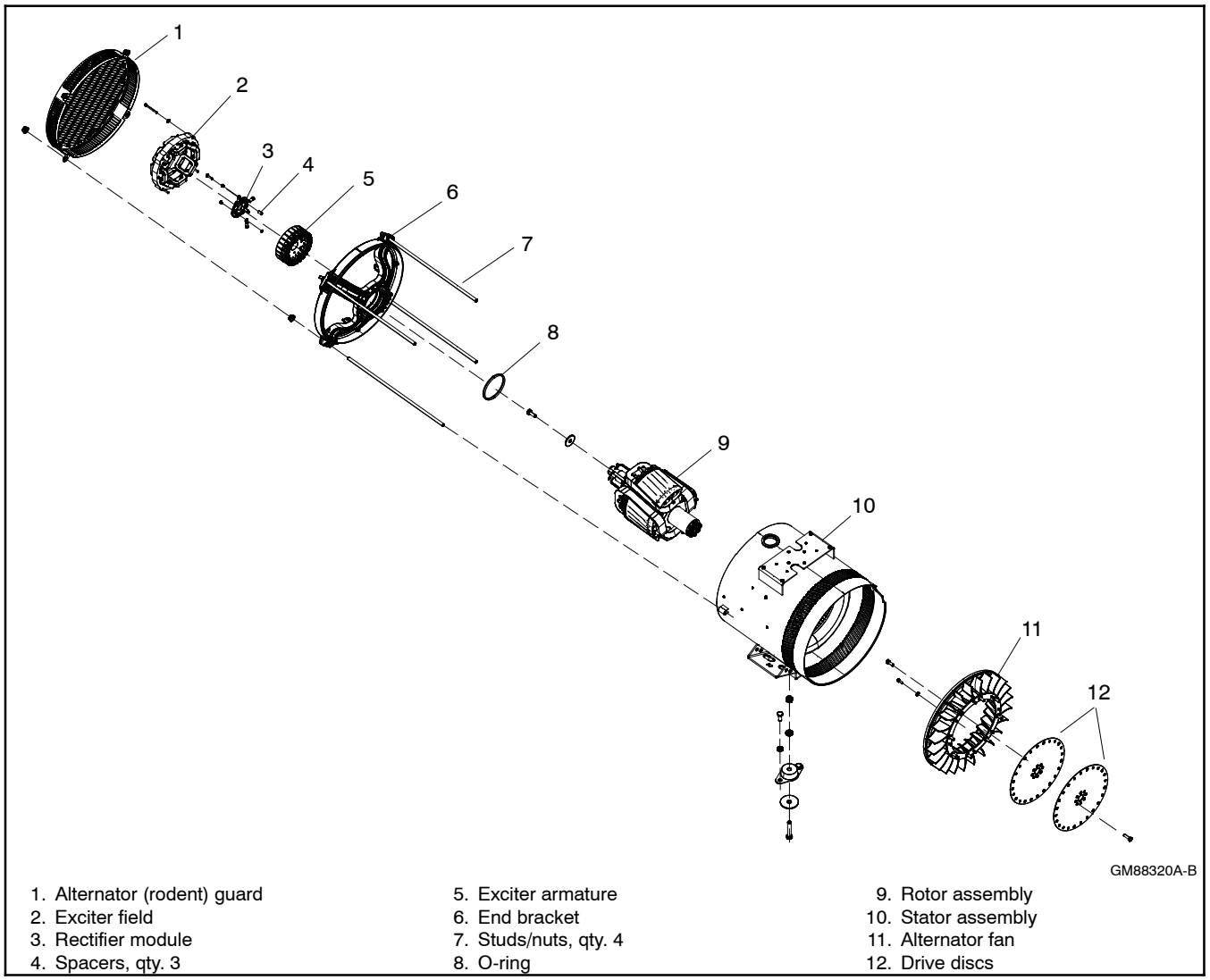
For enclosed units, remove the enclosure door, roof, and side and end panels as required to access the generator set.

Mark leads as they are disconnected. Refer to the respective wiring diagrams manual during reassembly. See the list of related materials in the Introduction on page 11 of this manual for literature part numbers.

Any cranes, hoists, or other lifting devices used in the disassembly or reassembly procedure must be rated for one-half ton or greater.

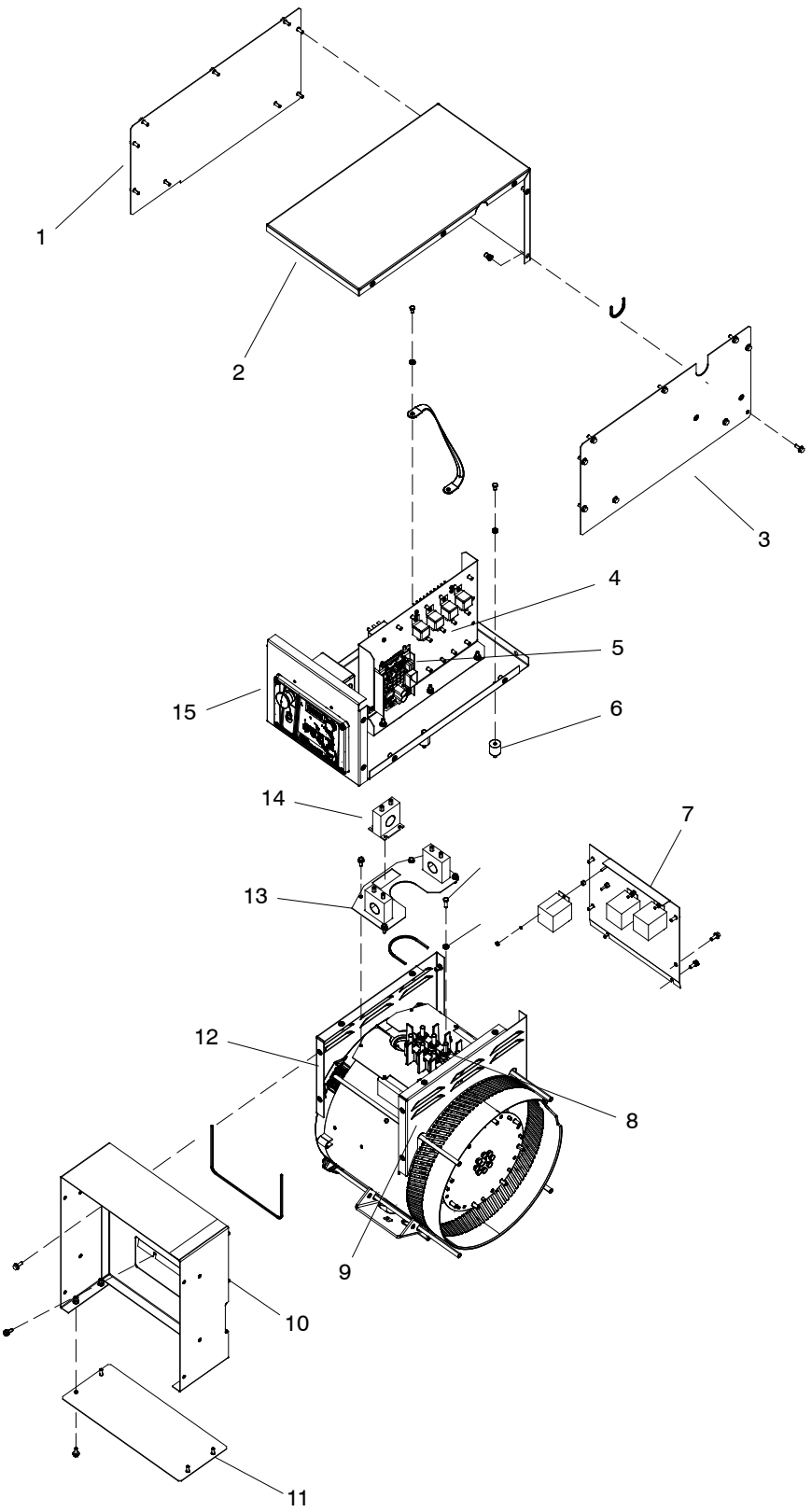
The following procedures cover many models and some steps may not apply to a particular generator set. Use Figure 4-1 to Figure 4-6 to help understand component descriptions and general configuration of the alternator and associated components of the junction box, control box, and power panel.

Use the disassembly procedure as a step-by-step means to help disassemble the alternator. The disassembly procedure provides important information to minimize disassembly time and indicates where special configurations exist that may require taking notes. The reassembly procedure includes important alignment steps and provides critical torque specs.



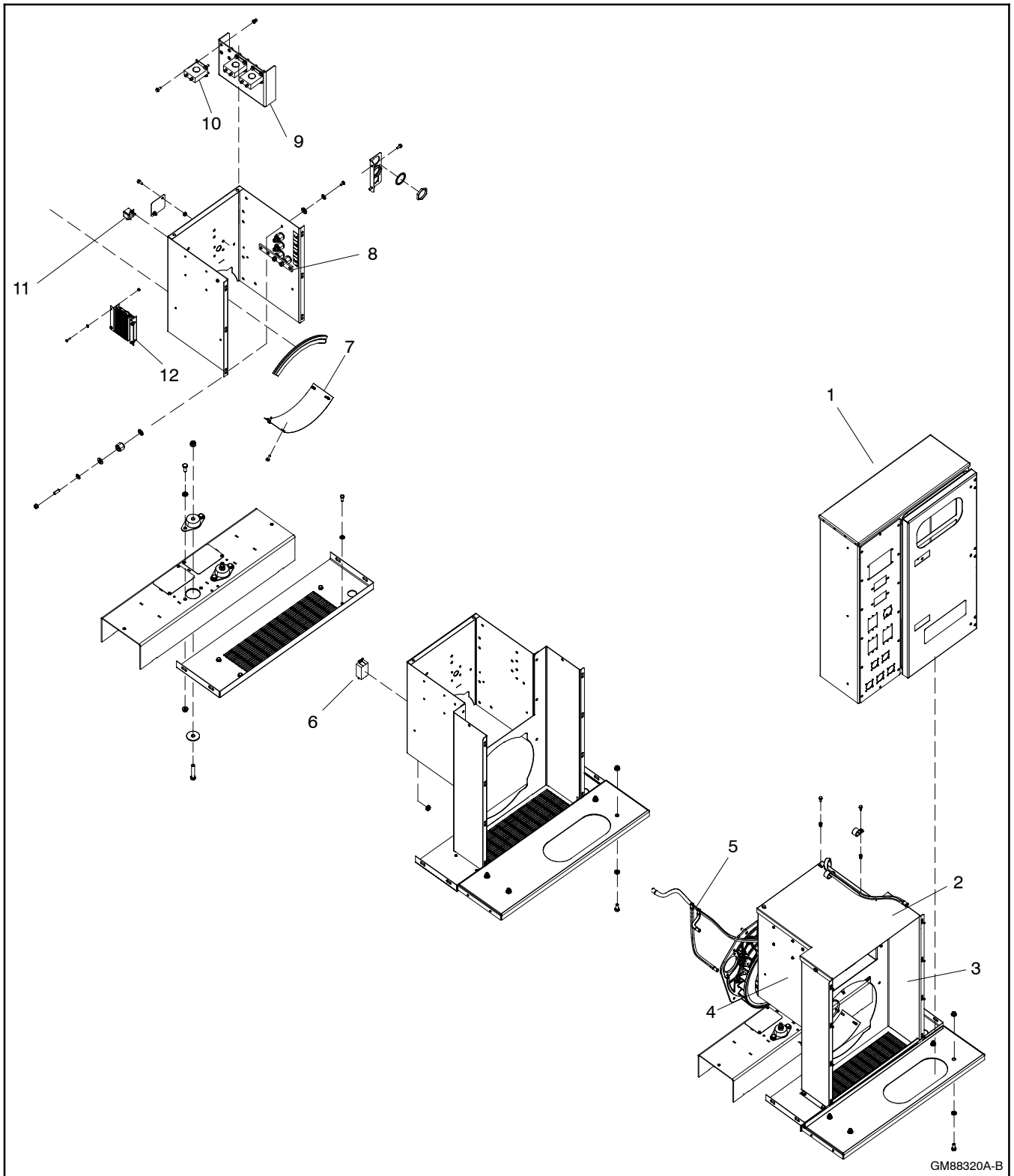
1. Alternator (rodent) guard
2. Exciter field
3. Rectifier module
4. Spacers, qty. 3
5. Exciter armature
6. End bracket
7. Studs/nuts, qty. 4
8. O-ring
9. Rotor assembly
10. Stator assembly
11. Alternator fan
12. Drive discs

Figure 4-1 Alternator Components, Typical



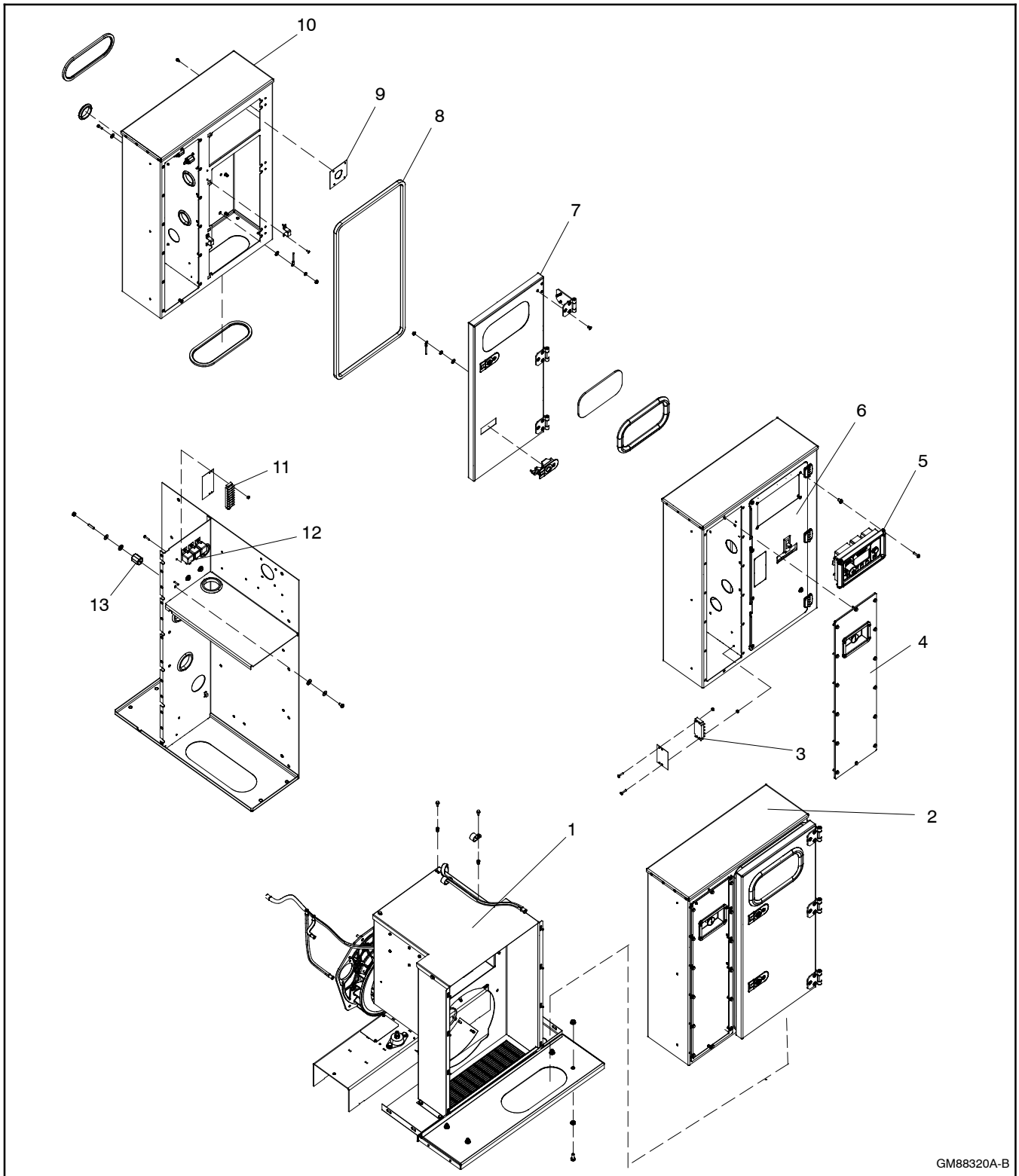
1. Control box rear panel
2. Control box top panel
3. Control box front panel
4. Relays including flash relay
5. Activator board
6. Vibromount
7. Junction box left panel
8. Current transformer mounting bracket
9. Junction box front panel
10. Circuit breaker box
11. Circuit breaker box bottom plate
12. Junction box rear panel
13. CT mounting bracket
14. Current transformer
15. Controller assembly

Figure 4-2 Alternator Components, 15/20 kW with Junction Box and Control Box, Typical



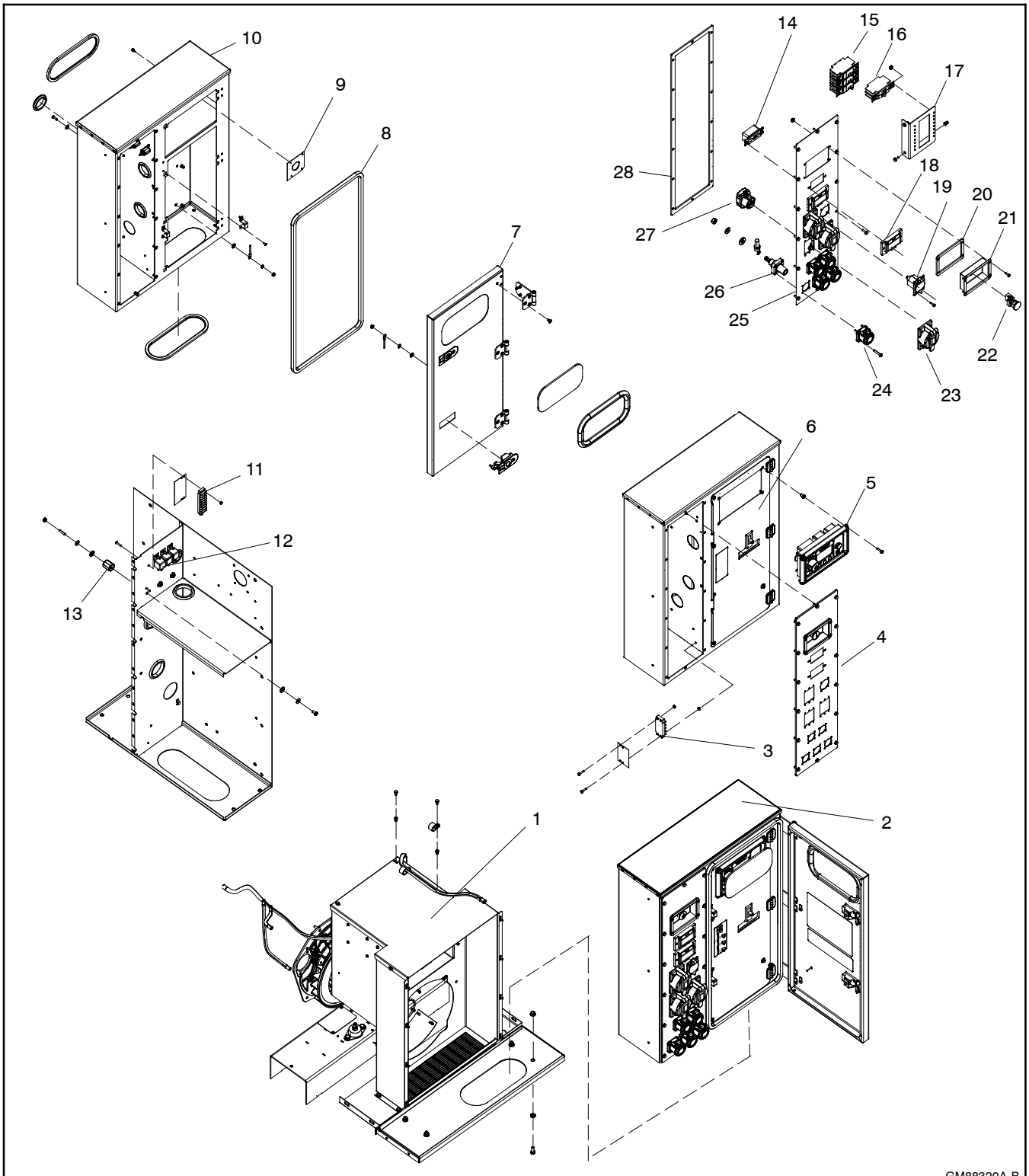
1. Power panel
2. Junction box cover panel
3. Junction box rear panel
4. Junction box front panel
5. Engine wire harness
6. Duplex receptacle, 15 amp
7. Alternator air shield
8. Buss load
9. CT mounting bracket
10. Current transformer
11. Flash relay
12. Activator board

Figure 4-3 30/40 kW, 35/45 kVA with Junction Box and Power Panel Typical



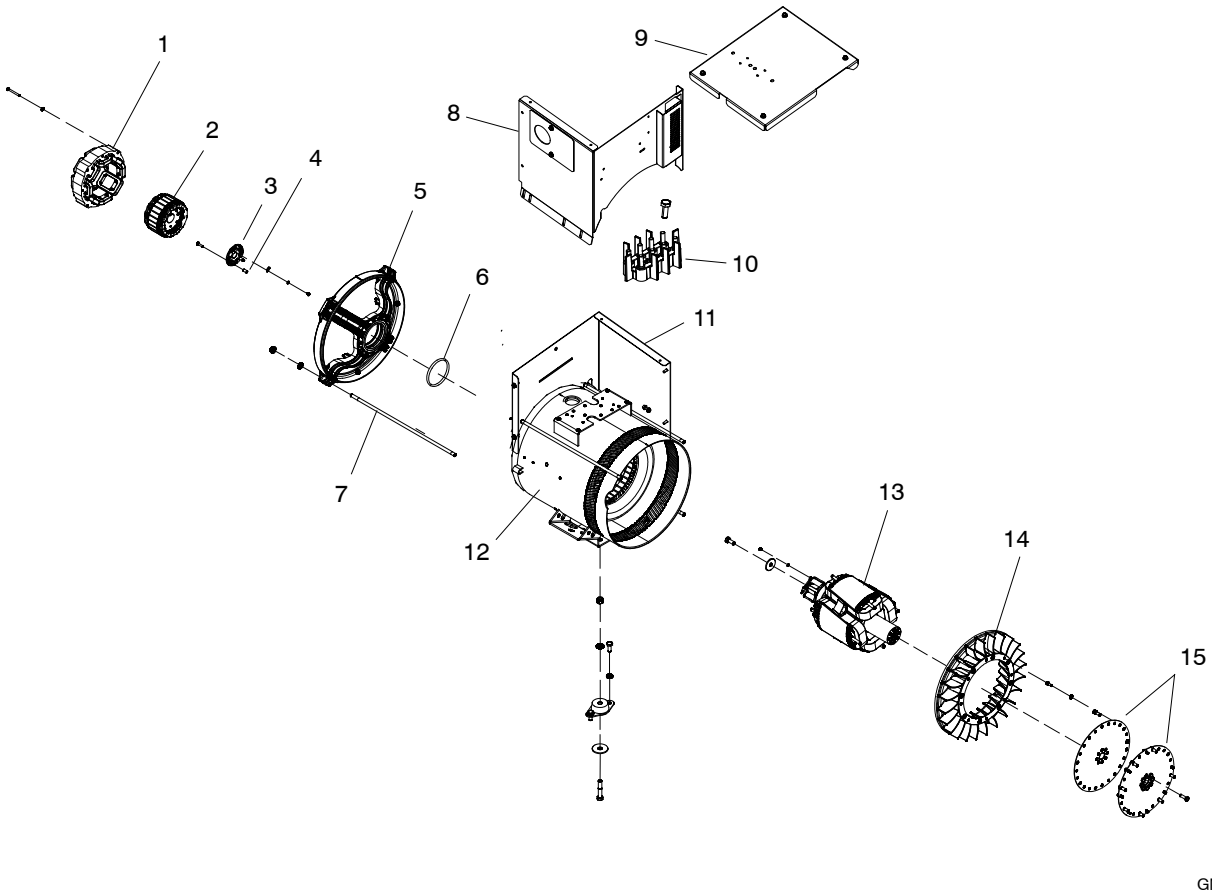
1. Junction box
2. Power panel assembly
3. Terminal strip
4. Accessory panel with E-stop button
5. Controller
6. Circuit breaker box
7. Outer door
8. Outer door seal
9. Harness connector plate
10. Power panel enclosure
11. Terminal block
12. Relays, 12 VDC
13. Standoff insulator

Figure 4-4 30/40 kW, 35/45 kVA with Industrial Power Panel, Typical



1. Junction box
2. Power panel assembly
3. Terminal strip
4. Accessory panel
5. Controller
6. Circuit breaker box
7. Outer door
8. Outer door seal
9. Harness connector plate
10. Power panel enclosure
11. Terminal block
12. Relays, 12 VDC
13. Standoff insulator
14. GFCI duplex receptacle
15. Main circuit breaker
16. Circuit breaker, 15 amp
17. Circuit breaker bracket
18. GFCI receptacle cover
19. Flanged inlet
20. E-stop box gasket
21. E-stop mounting panel
22. E-stop pushbutton switch
23. Waterproof receptacle cover, 50 A
24. Camlock cover
25. Accessory panel
26. Camlock connector
27. Receptacle, 50 A
28. Accessory panel gasket

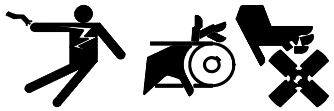
Figure 4-5 30/40 kW, 35/45 kVA with Mobile Power Panel, Typical



1. Exciter field
2. Exciter armature
3. Rectifier module
4. Spacers, qty. 3
5. End bracket
6. O-ring
7. Studs/nuts, qty. 4
8. Box, saddle
9. Cover, saddle box
10. Terminal block
11. Side panel
12. Stator assembly
13. Rotor assembly
14. Alternator fan
15. Drive discs

Figure 4-6 24/30RCL and 38RCLB with Saddle Box, Typical

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

(Decision-Maker® 550 Controller)

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.

(APM402, RDC2, Decision-Maker® 3000, and 3500 Controllers)

⚠ WARNING

Risk of fire.
Can cause severe injury or death.

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

Servicing the fuel system. A flash fire can cause severe injury or death. Do not smoke or permit flames or sparks near the fuel mixer, fuel line, fuel filter, or other potential sources of fuel vapors. When removing the fuel line or fuel system be aware that liquid propane can cause frostbite on contact.

(Gas-fueled model)

Servicing the fuel system. A flash fire can cause severe injury or death. Do not smoke or permit flames or sparks near the fuel injection system, 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 fuel system.

(Diesel-fueled model)

⚠ WARNING

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

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

⚠ 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.

⚠ WARNING

Explosive fuel vapors.
Can cause severe injury or death.

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

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

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

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

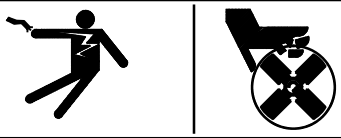
Natural Gas—Adequate ventilation is mandatory. Because natural gas rises, install natural gas detectors high in a room. Inspect the detectors per the manufacturer's instructions.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

⚠ DANGER



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

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

Perform the following steps prior to disassembling the generator set.

1. Disconnect (negative lead first) and remove starting batteries from work area to prevent fire hazard. Disconnect AC-powered accessories, such as battery charger, block heater, battery heater, and fuel transfer pump (if equipped).

2. Shut off fuel supply. Drain fuel system as necessary by emptying fuel into proper containers. Remove fuel containers from work area to prevent fire hazard. Ventilate the work area to clear fumes.

3. Disconnect fuel, cooling, and exhaust systems as necessary to tilt generator set. Disconnect output leads or load circuit cables at generator set.

4. Any cranes, hoists, or other lifting devices used in the disassembly or reassembly procedure must be rated for the weight of the generator set. Check generator set nameplate or spec sheet for weight.

4.2 Disassembly Procedure

1. Remove the junction box and/or control box panels to access the internal components.

2. Disconnect all controller-to-engine and engine-to-alternator harnesses and wiring in the junction box. Be sure to mark the wiring as needed for reconnection during reassembly.

3. If the unit has a power panel, check that all wiring is disconnected and remove the power panel as a unit. Be sure to mark the wiring as needed for reconnection during reassembly.

4. Remove the remaining junction box and/or control box components.

5. Remove the nuts and alternator (rodent) guard from the studs.

6. Remove the exciter field.

   a. Remove the four bolts to remove the exciter field. See Figure 4-7.

   b. Remove the three bolts and spacers from the rectifier module.

      Note: Use a new washer when reassembling the exciter armature. See the generator set parts catalog for the washer part number .

      Note: Newer versions of the 4D alternators use a different spacer to position the rotating rectifier board. The rotor leads connect to studs on the spacer instead of the rectifier board. See Section 4.4 for this alternate procedure.

   c. Disconnect the main field rotor leads from the rectifier module positive/negative terminals. Remove the exciter armature retaining bolt and washer. See Figure 4-8.

   d. Remove the exciter armature from the shaft, guiding the rotor leads through the open spaces in the exciter armature windings. See Figure 4-8.

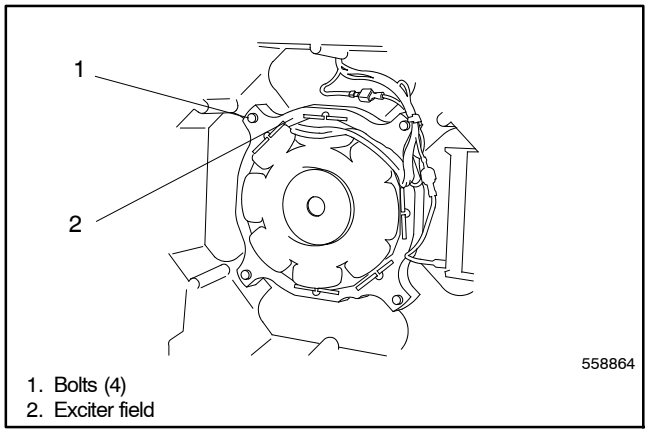
7. Attach a hoist hook to the engine lifting eye. See Figure 4-9.

   Note: The hoist capacity rating should be 500 kg (one-half ton) or greater.

8. Remove the vibromount locknut, small washer, bolt, and large washer from each vibromount. See Figure 4-9.

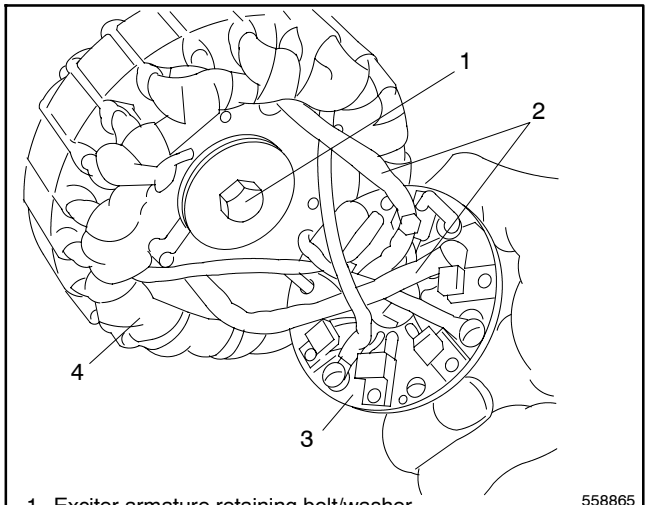
9. Raise the alternator end and place a wood block under the backplate. Lower the alternator until the wood block supports the backplate. See Figure 4-9.

10. Locate and remove the four long studs and nuts from the end bracket.



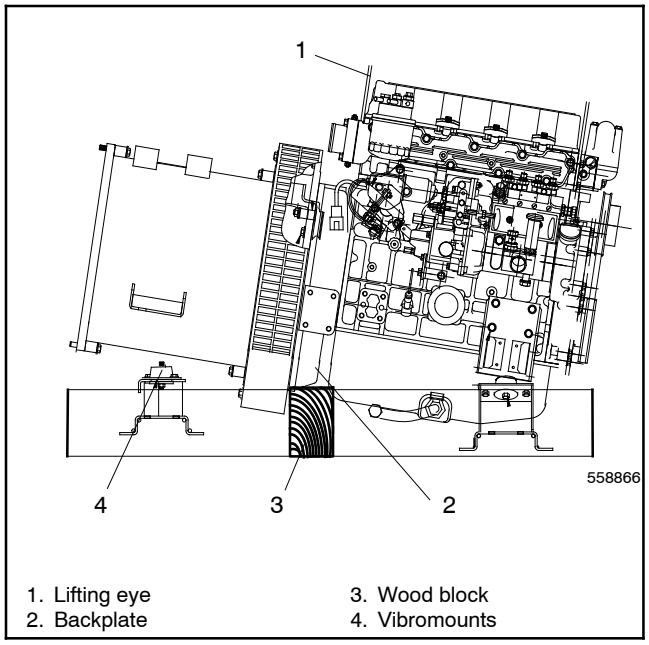
1. Bolts (4)
2. Exciter field

Figure 4-7 Exciter Field Removal



1. Exciter armature retaining bolt/washer
2. Rotor leads
3. Rectifier module
4. Exciter armature

Figure 4-8 Armature Removal



1. Lifting eye
2. Backplate
3. Wood block
4. Vibromounts

Figure 4-9 Supporting the Generator, Typical

11. Use a permanent marker (or scribe) to make an alignment mark on the stator and engine adapter for reference during reassembly. See Figure 4-10.

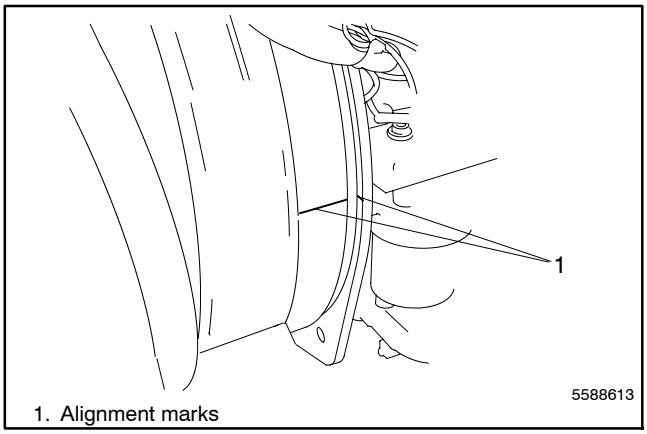
12. Install a sling capable of handling the weight of the alternator assembly on the stator housing. See Figure 4-11.

13. Use a two-jaw puller to pull the end bracket/stator assembly from the bearing on the rotor shaft. See Figure 4-11.

14. Remove the stator assembly from the rotor. Remove or rotate the fan guard, if necessary, to clear the vibromounts.

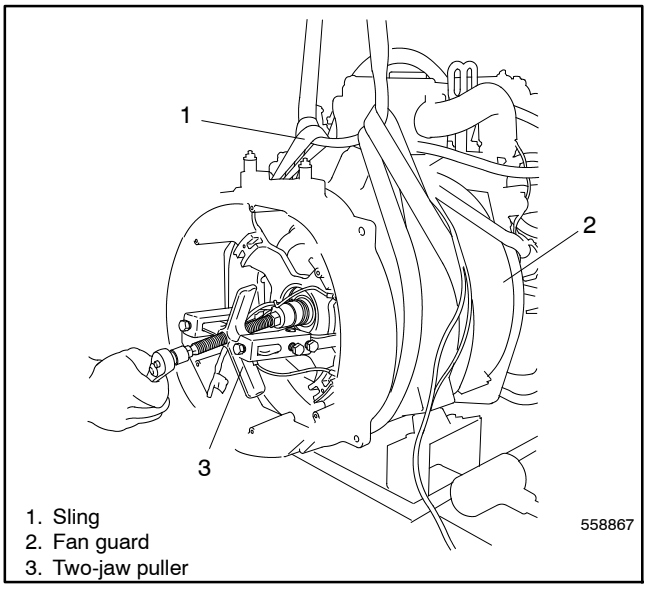
15. Use a permanent marker (or scribe) to make an alignment mark to show the fan's position on the rotor/drive disc assembly for reference during reassembly.

16. Remove the eight screws and washers attaching the alternator fan to the rotor. See Figure 4-12.



1. Alignment marks

Figure 4-10 Alignment Marks on Stator and Engine Adapter



1. Sling
2. Fan guard
3. Two-jaw puller

Figure 4-11 Stator Assembly Removal

17. Remove the alternator fan. See Figure 4-12.

18. Remove the eight bolts and remove the drive disc/rotor assembly from the engine flywheel. See Figure 4-13.

19. Clamp the rotor in a soft-jaw vise. Remove the eight bolts and remove the drive disc assembly from the rotor. See Figure 4-14.

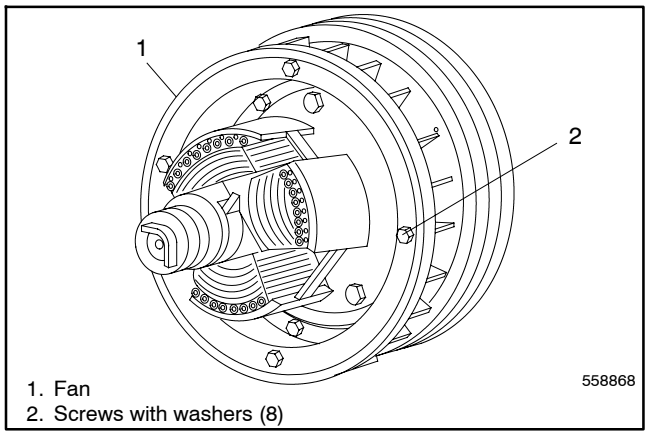


Figure 4-12 Fan Removal

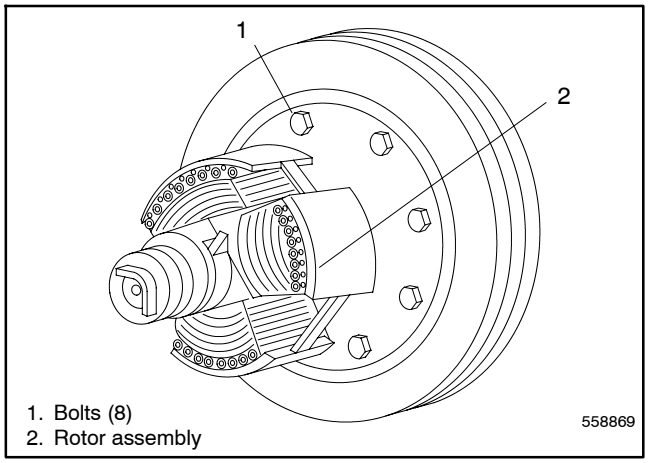


Figure 4-13 Disc/Rotor Assembly

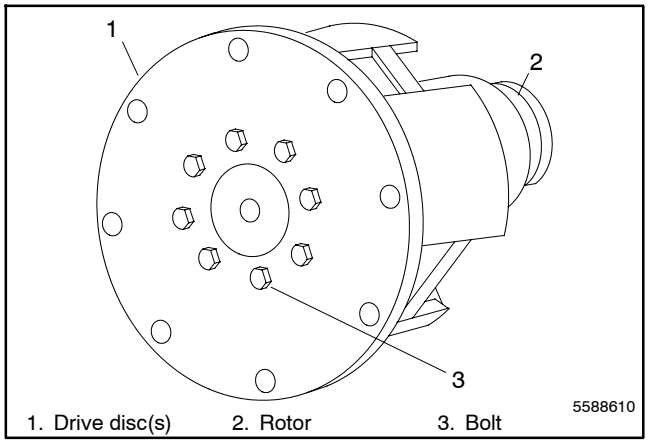


Figure 4-14 Drive Disc(s)

4.3 Reassembly

Refer to Section 1, Specifications for Torque Values and Assembly Specifications and Appendix C, General Torque Specifications during reassembly.

Note: Some hardware assembly requires the use of Loctite® 242 Blue or equivalent to the bolt threads.

1. Use solvent to clean any threaded component holes and hardware that contain used thread sealant if they will be reused. Allow the components and hardware to dry.

2. Clamp the rotor in a soft-jaw vise. Apply thread sealant to the bolt threads. Install the drive disc(s) on the rotor and torque the eight bolts to specifications. See Figure 4-15.

3. Apply thread sealant to the bolt threads. Place the rotor/drive disc assembly on the engine flywheel and torque the eight washers and bolts to specifications.

4. Apply thread sealant to the bolt threads. Align the fan to the rotor/drive disc assembly using the marks created in the disassembly procedure. Install the fan to the drive disc using eight screws and washers and torque to specifications.

   Note: Install the fan with the flange side facing away from the flywheel.

5. Apply multi-purpose grease to the O-ring and install in the end bracket bearing bore. See Figure 4-16. Use a sling to support the stator assembly while installing the stator over the rotor. Be careful not to damage the rotor.

6. Check that the alignment marks on the stator housing and engine adapter match. See Figure 4-17.

7. Install the four long studs thru the stator assembly holes and thread into the engine adapter.

8. Align the end bracket holes over the studs and position the end bracket over the rotor bearing

9. Install the nuts on the studs and torque the studs/nuts to specifications.

10. Use the hoist to raise the alternator end. Remove the wood block from under the backplate. Lower the generator set and install a bolt, a large washer, a small washer, and a locknut on each vibromount. Remove the hoist equipment.

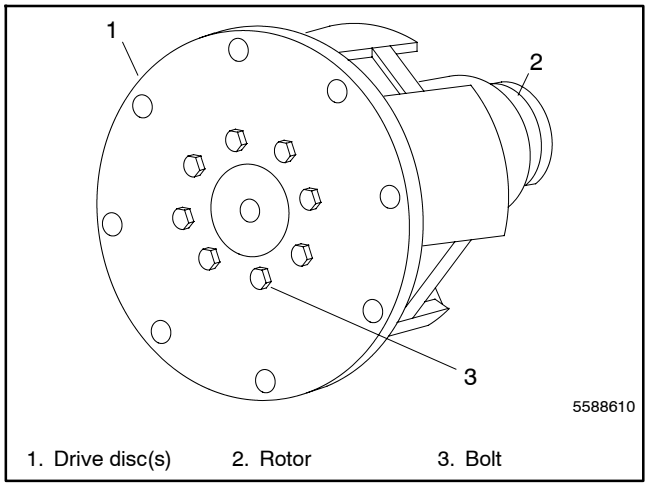


Figure 4-15 Drive Disc(s) Installation

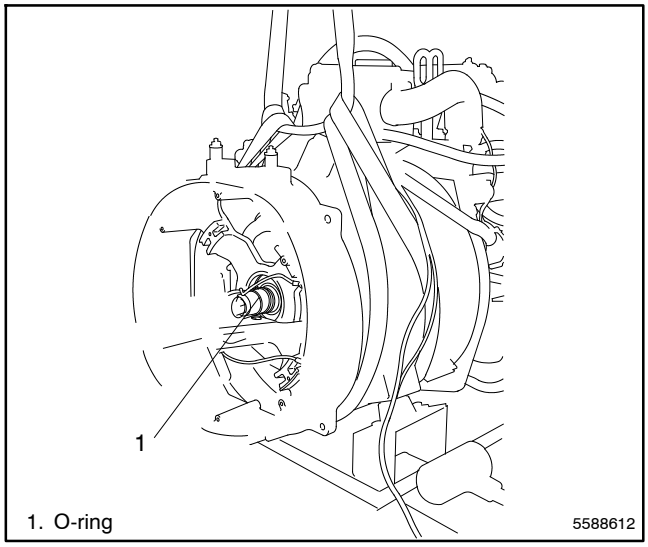


Figure 4-16 Stator Installation

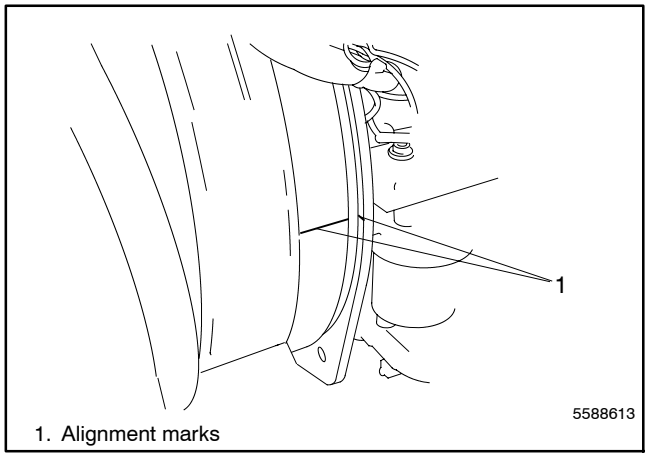


Figure 4-17 Alignment Marks

Loctite® is a registered trademark of the Henkel Corporation.

11. Apply antiseize compound to the keyed end of the rotor shaft.

    Note: Use a new washer when reassembling the exciter armature. See the generator set parts catalog for the washer part number .

12. Bring the rotor leads F1 and F2 through the open spaces in the exciter armature windings while installing the exciter armature on the shaft. Check the keyway of the shaft and key of the exciter armature for damage. Install the exciter armature retaining bolt and washer and torque to specifications. See Figure 4-18.

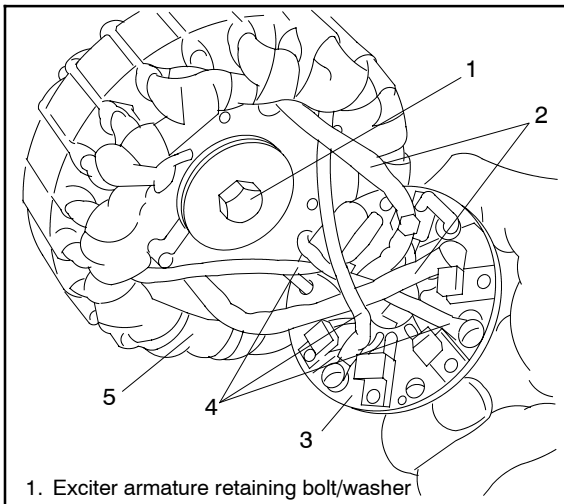
13. Use screws and lock washers to install the rotor leads F1 and F2 to the rectifier module at the positive (+) and negative (–) terminals and torque to specifications. See Figure 4-19.

    Note: Position the lock washers against the rectifier module.

14. If the exciter armature is new, locate the exciter armature lead mounting locations on the rectifier module (see Figure 4-19) and cut the exciter armature leads to eliminate slack. Attach crimp-on terminals.

15. Use screws and lock washers to install the exciter armature leads AC (qty. 3) to the rectifier module at the A, B, and C terminals and torque to specifications.

    Note: Position the lock washers against the rectifier module.



1. Exciter armature retaining bolt/washer
2. Rotor leads F1 and F2
3. Rectifier module
4. Exciter armature leads
5. Exciter armature

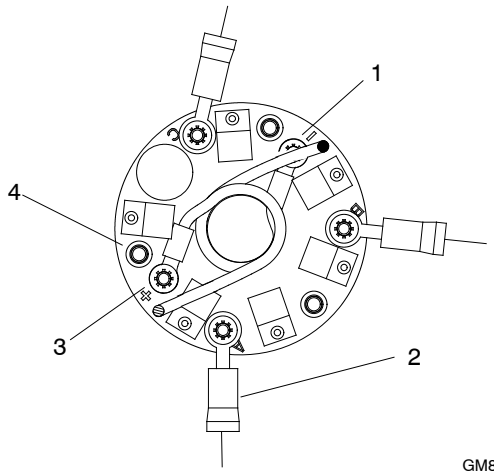
Figure 4-18 Exciter Armature and Rectifier Module

16. Align the holes of the rectifier module to the threaded holes in the exciter armature. Install the three screws in the rectifier module, place the three spacers on the screws, and attach the rectifier module to the exciter armature. Torque to specifications.

    Note: Position the spacers between the rectifier module and exciter armature.

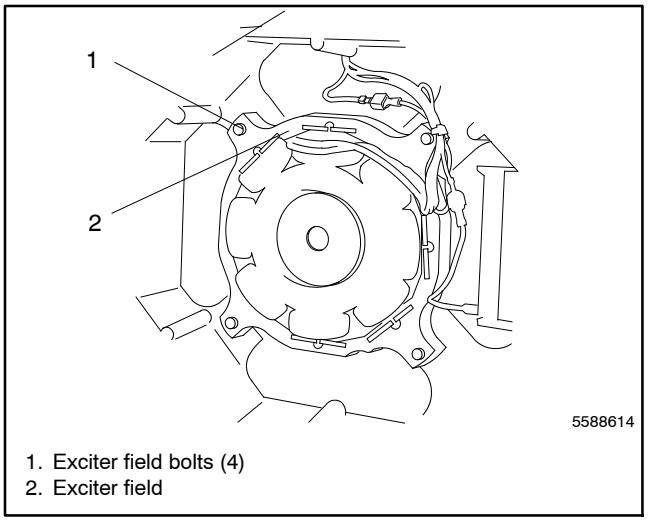
    Note: Newer versions of the 4D alternators use a different spacer to position the rotating retifier board. The rotor leads connect to studs on the spacer instead of the rectifier board. See Section 4.4 for this alternate procedure.

17. Position the exciter field leads at the top. Install the exciter field using four bolts and washers, and torque to specifications. See Figure 4-20.



1. Rotor F2 lead to negative (–) terminal
2. Exciter armature leads (3) AC to A, B, And C terminals
3. Rotor F1 lead to positive (+) terminal
4. Rectifier module screws, qty. 3

Figure 4-19 Rectifier Module Connections



1. Exciter field bolts (4)
2. Exciter field

Figure 4-20 Installing Exciter Field

18. Use tie wraps to secure the wires as necessary.

19. Install the alternator (rodent) guard and hardware.

20. Reinstall the junction box and/or control box components and related wiring. Do not install the panels at this time.

21. If the unit has a power panel, reinstall the power panel assembly and related wiring.

22. Reconnect the leads to the circuit breaker and neutral stud (LO) as marked during disassembly.

    Note: For voltage reconnection instructions and diagrams, refer to the wiring diagrams in Appendix F, Voltage Reconnection Wiring Diagrams and the Generator Set Operation and Wiring Diagram Manuals. See the List of Related Materials in the Introduction for document part numbers.

    Note: Check the generator set nameplate to verify the original voltage configuration on units without a voltage selector switch.

23. Reconnect all controller-to-engine and engine-to-alternator harnesses and wiring in the junction box.

24. Reinstall the junction box panels.

25. Reconnect all of the external connections—the exhaust line, the fuel line to the fuel pump filter inlet, the remote interface connector, the AC output leads, and the battery cables to the battery (negative (–) lead last).

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

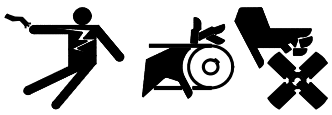
27. Reconnect power to the battery charger and other AC accessories, if equipped.

4.4 Rotating Rectifier, 4–60 kW with 4D Alternators

With newer versions of the alternators that use a spacer to position the rotating rectifier board, use the following procedures, adapted from TT–1745, to disconnect and reconnect the rotating rectifier board.

Observe the following safety precautions while performing this procedure.

⚠ WARNING



Accidental starting.
Can cause severe injury or death.

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

Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or equipment connected to the set, disable the generator set as follows: (1) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (–) lead first. Reconnect the negative (–) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

(Decision-Maker® 3+ and 550 Controllers)

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.

(APM402, RDC, DC, RDC2, DC2, Decision-Maker® 3000, 3500, and 6000 Controllers)

4.4.1 Disconnect the Rotating Rectifier Board

1. Remove the generator set from service.

   a. Press the generator set master control OFF/RESET button or move the generator set master switch to the OFF position.

   b. Disconnect power to the battery charger, if equipped.

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

2. Access the alternator end of the generator set.

   a. Open the enclosure panels as needed.

   b. Remove the junction box rear cover.

   c. Remove the alternator (rodent) guard, if used.

3. Remove five stainless steel nylock nuts that secure the rotating rectifier board to the spacer studs.

4. Remove the rotating rectifier board to access the alternator leads.

5. Remove the **five stainless steel hex nuts** that secure leads A, B, C, F1 and F2 to the spacer studs. Note the lead terminals and their positioning. See Figure 4-21.

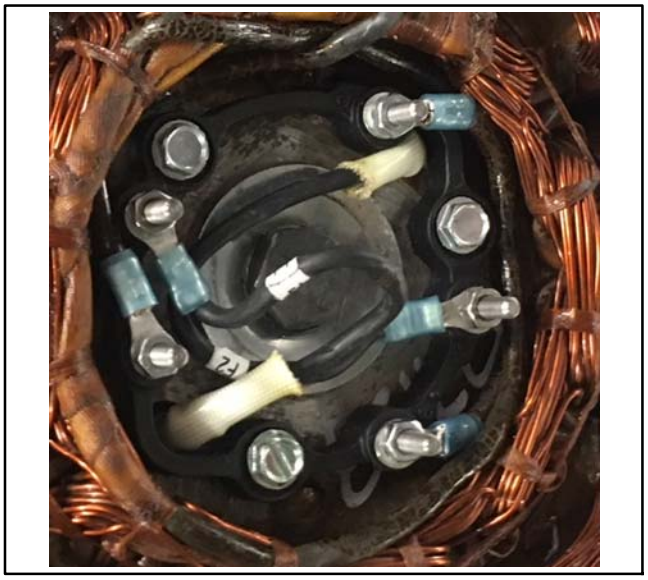
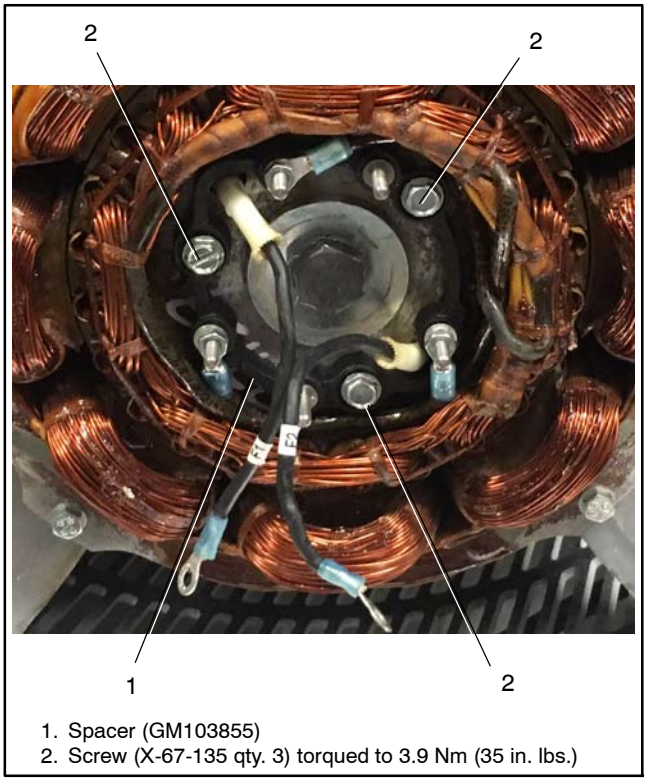


Figure 4-21 Disconnect Leads to Studs on Spacer

6. Remove the three screws that secure the spacer to the exciter armature. Remove the spacer. See Figure 4-22.



1. Spacer (GM103855)
2. Screw (X-67-135 qty. 3) torqued to 3.9 Nm (35 in. lbs.)

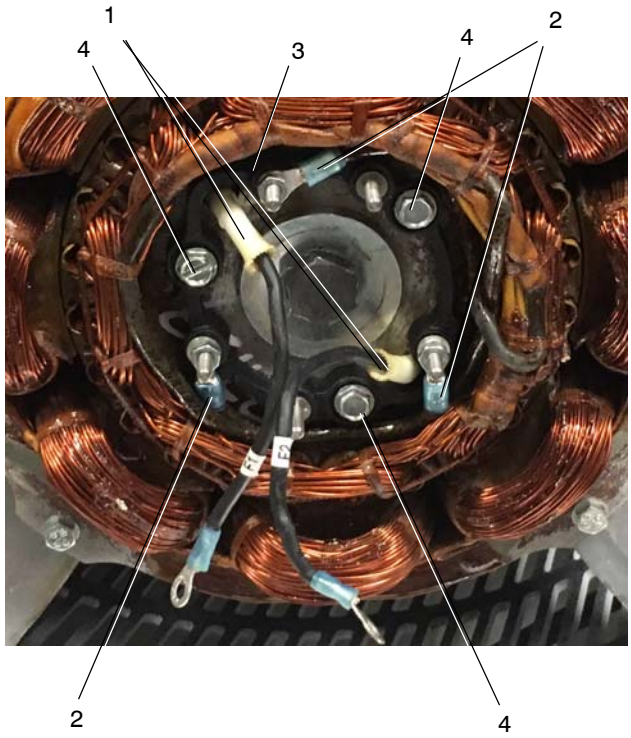
Figure 4-22 Remove the Spacer

4.4.2 Reconnect the Rotating Rectifier Board

1. Position the rotor and exciter leads on the spacer studs.

   a. Route the rotor leads (F1 and F2) around the inner diameter of the spacer as shown in Figure 4-23.

   b. Route the exciter armature leads (A, B, and C) around the outer diameter of the spacer as shown in Figure 4-23.



1. Rotor leads (F1 and F2)
2. Exciter armature leads (A, B, and C)
3. Spacer
4. Screw, torqued to 3.9 Nm (35 in. lbs.)

Figure 4-23 Route Leads to Spacer

2. Mount the spacer to the exciter armature using 3 screws and torque to 3.9 Nm (35 in. lbs.). See Figure 4-23.

Note: Lead connection locations are identified on the spacer. See Figure 4-24.

Note: Route leads such that they are contained and no excess lies outside the armature.

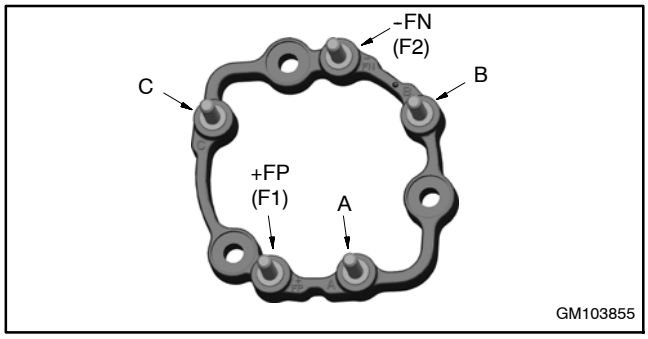


Figure 4-24 Spacer

3. Use the **five stainless steel hex nuts** to connect leads A, B, C, F1 and F2 to the spacer studs. Torque to 1.3 Nm (12 in. lbs.). See Figure 4-25.

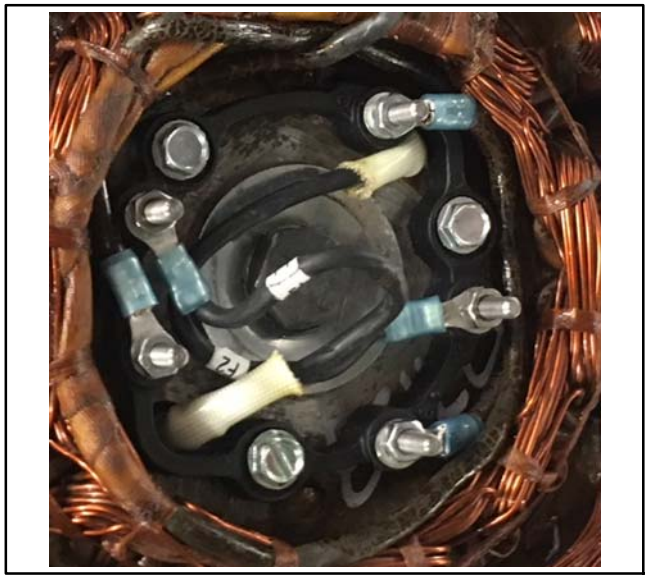


Figure 4-25 Connect Leads to Studs on Spacer

4. Secure the new rotating rectifier board to the studs on the spacer by using five stainless steel nylock nuts. Torque to 1.3 Nm (12 in. lbs.).

5. Install the alternator (rodent) guard to the end bracket (if equipped).

6. Replace the junction box panels.

7. Replace the enclosure panels (if equipped).

8. Restore the generator set to service.

   a. Check that the generator set is OFF.

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

   c. Reconnect power to the battery charger, if equipped.

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
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

Appendix B Common Hardware Application Guidelines

Use the information below and on the following pages to identify proper fastening techniques when no specific reference for reassembly is made.

Bolt/Screw Length: When bolt/screw length is not given, use Figure 1 as a guide. As a general rule, a minimum length of one thread beyond the nut and a maximum length of 1/2 the bolt/screw diameter beyond the nut is the preferred method.

Washers and Nuts: Use split lock washers as a bolt locking device where specified. Use SAE flat washers with whiz nuts, spiralock nuts, or standard nuts and preloading (torque) of the bolt in all other applications.

See Appendix C, General Torque Specifications, and other torque specifications in the service literature.

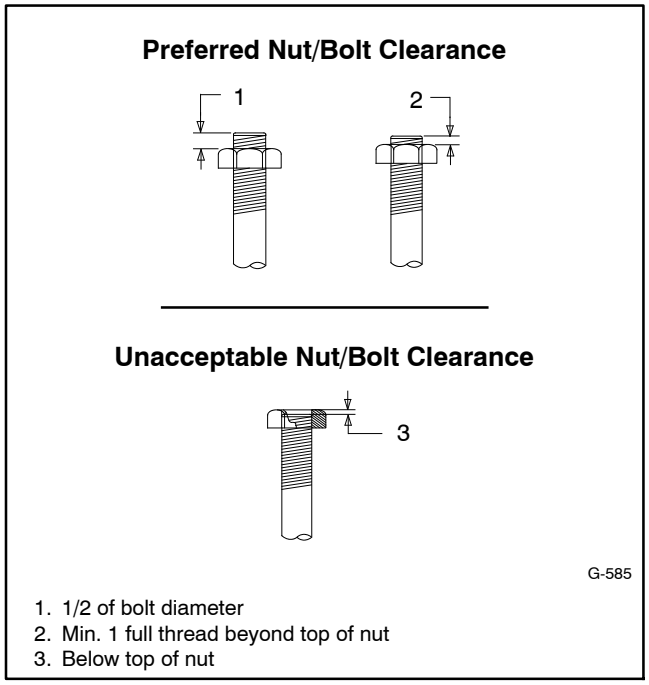


Figure 1 Acceptable Bolt Lengths

Steps for common hardware application:

1. Determine entry hole type: round or slotted.
2. Determine exit hole type: fixed female thread (weld nut), round, or slotted.

   For round and slotted exit holes, determine if hardware is greater than 1/2 inch in diameter, or 1/2 inch in diameter or less. Hardware that is *greater than 1/2 inch* in diameter takes a standard nut and SAE washer. Hardware *1/2 inch or less* in diameter can take a properly torqued whiz nut or spiralock nut. See Figure 2.
3. Follow these SAE washer rules after determining exit hole type:
   a. Always use a washer between hardware and a slot.
   b. Always use a washer under a nut (see 2 above for exception).
   c. Use a washer under a bolt when the female thread is fixed (weld nut).
4. Refer to Figure 2, which depicts the preceding hardware configuration possibilities.

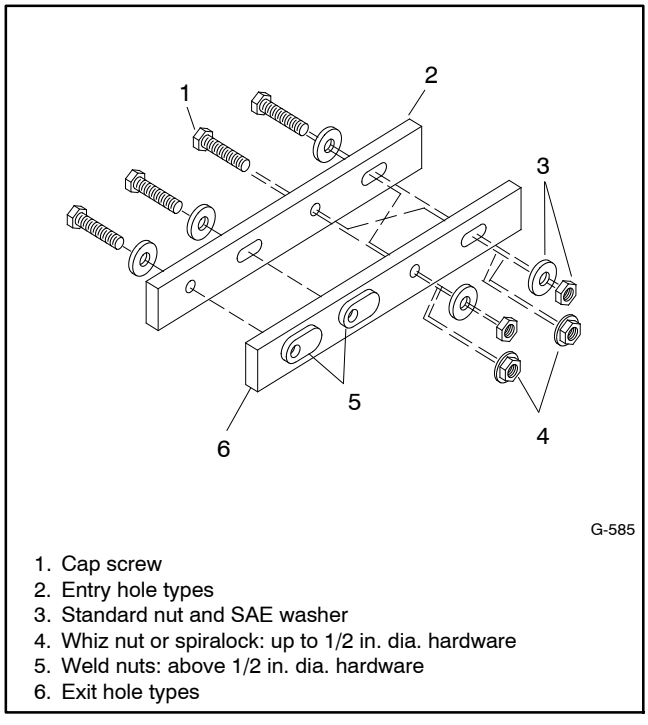


Figure 2 Acceptable Hardware Combinations

Appendix C General Torque Specifications

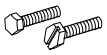
American Standard Fasteners Torque Specifications								
Size	Torque Measurement	Assembled into Cast Iron or Steel						Assembled into Aluminum Grade 2 or 5
		Grade 2		Grade 5		Grade 8		
8-32	Nm (in. lb.)	1.8	(16)	2.3	(20)	—		See Note 3
10-24	Nm (in. lb.)	2.9	(26)	3.6	(32)	—		
10-32	Nm (in. lb.)	2.9	(26)	3.6	(32)	—		
1/4-20	Nm (in. lb.)	6.8	(60)	10.8	(96)	14.9	(132)	
1/4-28	Nm (in. lb.)	8.1	(72)	12.2	(108)	16.3	(144)	
5/16-18	Nm (in. lb.)	13.6	(120)	21.7	(192)	29.8	(264)	
5/16-24	Nm (in. lb.)	14.9	(132)	23.1	(204)	32.5	(288)	
3/8-16	Nm (ft. lb.)	24	(18)	38	(28)	53	(39)	
3/8-24	Nm (ft. lb.)	27	(20)	42	(31)	60	(44)	
7/16-14	Nm (ft. lb.)	39	(29)	60	(44)	85	(63)	
7/16-20	Nm (ft. lb.)	43	(32)	68	(50)	95	(70)	
1/2-13	Nm (ft. lb.)	60	(44)	92	(68)	130	(96)	
1/2-20	Nm (ft. lb.)	66	(49)	103	(76)	146	(108)	
9/16-12	Nm (ft. lb.)	81	(60)	133	(98)	187	(138)	
9/16-18	Nm (ft. lb.)	91	(67)	148	(109)	209	(154)	
5/8-11	Nm (ft. lb.)	113	(83)	183	(135)	259	(191)	
5/8-18	Nm (ft. lb.)	128	(94)	208	(153)	293	(216)	
3/4-10	Nm (ft. lb.)	199	(147)	325	(240)	458	(338)	
3/4-16	Nm (ft. lb.)	222	(164)	363	(268)	513	(378)	
1-8	Nm (ft. lb.)	259	(191)	721	(532)	1109	(818)	
1-12	Nm (ft. lb.)	283	(209)	789	(582)	1214	(895)	

Metric Fasteners Torque Specifications, Measured in Nm (ft. lb.)								
Size (mm)	Assembled into Cast Iron or Steel						Assembled into Aluminum Grade 5.8 or 8.8	
	Grade 5.8		Grade 8.8		Grade 10.9			
M6 x 1.00	6.2	(4.6)	9.5	(7)	13.6	(10)	See Note 3	
M8 x 1.25	15	(11)	23	(17)	33	(24)		
M8 x 1.00	16	(11)	24	(18)	34	(25)		
M10 x 1.50	30	(22)	45	(34)	65	(48)		
M10 x 1.25	31	(23)	47	(35)	68	(50)		
M12 x 1.75	53	(39)	80	(59)	115	(85)		
M12 x 1.50	56	(41)	85	(63)	122	(90)		
M14 x 2.00	83	(61)	126	(93)	180	(133)		
M14 x 1.50	87	(64)	133	(98)	190	(140)		
M16 x 2.00	127	(94)	194	(143)	278	(205)		
M16 x 1.50	132	(97)	201	(148)	287	(212)		
M18 x 2.50	179	(132)	273	(201)	390	(288)		
M18 x 1.50	189	(140)	289	(213)	413	(305)		
M20 x 2.50	245	(181)	374	(276)	535	(395)		
M20 x 1.50	264	(195)	402	(297)	576	(425)		
M22 x 2.50	332	(245)	507	(374)	725	(535)		
M22 x 1.50	351	(259)	535	(395)	766	(565)		
M24 x 3.00	425	(314)	649	(479)	928	(685)		
M24 x 2.00	447	(330)	682	(503)	976	(720)		
M27 x 3.00	—		937	(692)	1341	(990)		
M27 x 2.00	—		985	(727)	1409	(1040)		
M30 x 3.50	—		1278	(943)	1829	(1350)		
M30 x 2.00	—		1349	(996)	1931	(1425)		

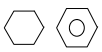
Notes:

1. The torque values above are general guidelines. Always use the torque values specified in the service manuals and/or assembly drawings when they differ from the above torque values.
2. The torque values above are based on new plated threads. Increase torque values by 15% if non-plated threads are used.
3. Hardware threaded into aluminum must have either two diameters of thread engagement or a 30% or more reduction in the torque to prevent stripped threads.
4. Torque values are calculated as equivalent stress loading on American hardware with an approximate preload of 90% of the yield strength and a friction coefficient of 0.125.

Appendix D Common Hardware Identification

Screw/Bolts/Studs	
Head Styles	
Hex Head or Machine Head	
Hex Head or Machine Head with Washer	
Flat Head (FHM)	
Round Head (RHM)	
Pan Head	
Hex Socket Head Cap or Allen™ Head Cap	
Hex Socket Head or Allen™ Head Shoulder Bolt	
Sheet Metal Screw	
Stud	
Drive Styles	
Hex	
Hex and Slotted	
Phillips®	
Slotted	
Hex Socket	

Nuts	
Nut Styles	
Hex Head	
Lock or Elastic	
Square	
Cap or Acorn	
Wing	
Washers	
Washer Styles	
Plain	
Split Lock or Spring	
Spring or Wave	
External Tooth Lock	
Internal Tooth Lock	
Internal-External Tooth Lock	

Hardness Grades	
American Standard	
Grade 2	
Grade 5	
Grade 8	
Grade 8/9 (Hex Socket Head)	
Metric	
Number stamped on hardware; 5.8 shown	

Allen™ head screw is a trademark of Holo-Krome Co.

Phillips® screw is a registered trademark of Phillips Screw Company.

Sample Dimensions

American Standard (Screws, Bolts, Studs, and Nuts)

1/4-20 x 1

- 1 — Length In Inches (Screws and Bolts)
- 20 — Threads Per Inch
- 1/4 — Major Thread Diameter In Fractional Inches Or Screw Number Size

Metric (Screws, Bolts, Studs, and Nuts)

M8-1.25 x 20

- 20 — Length In Millimeters (Screws and Bolts)
- 1.25 — Distance Between Threads In Millimeters
- M8 — Major Thread Diameter In Millimeters

Plain Washers

9/32 x 5/8 x 1/16

- 1/16 — Thickness
- 5/8 — External Dimension
- 9/32 — Internal Dimension

Lock Washers

5/8

- 5/8 — Internal Dimension

Appendix E Common Hardware List

The Common Hardware List lists part numbers and dimensions for common hardware items.

American Standard

Part No.	Dimensions
Hex Head Bolts (Grade 5)	
X-465-17	1/4-20 x .38
X-465-6	1/4-20 x .50
X-465-2	1/4-20 x .62
X-465-16	1/4-20 x .75
X-465-18	1/4-20 x .88
X-465-7	1/4-20 x 1.00
X-465-8	1/4-20 x 1.25
X-465-9	1/4-20 x 1.50
X-465-10	1/4-20 x 1.75
X-465-11	1/4-20 x 2.00
X-465-12	1/4-20 x 2.25
X-465-14	1/4-20 x 2.75
X-465-21	1/4-20 x 5.00
X-465-25	1/4-28 x .38
X-465-20	1/4-28 x 1.00
X-125-33	5/16-18 x .50
X-125-23	5/16-18 x .62
X-125-3	5/16-18 x .75
X-125-31	5/16-18 x .88
X-125-5	5/16-18 x 1.00
X-125-24	5/16-18 x 1.25
X-125-34	5/16-18 x 1.50
X-125-25	5/16-18 x 1.75
X-125-26	5/16-18 x 2.00
230578	5/16-18 x 2.25
X-125-29	5/16-18 x 2.50
X-125-27	5/16-18 x 2.75
X-125-28	5/16-18 x 3.00
X-125-22	5/16-18 x 4.50
X-125-32	5/16-18 x 5.00
X-125-35	5/16-18 x 5.50
X-125-36	5/16-18 x 6.00
X-125-40	5/16-18 x 6.50
X-125-43	5/16-24 x 1.75
X-125-44	5/16-24 x 2.50
X-125-30	5/16-24 x .75
X-125-39	5/16-24 x 2.00
X-125-38	5/16-24 x 2.75
X-6238-2	3/8-16 x .62
X-6238-10	3/8-16 x .75
X-6238-3	3/8-16 x .88
X-6238-11	3/8-16 x 1.00
X-6238-4	3/8-16 x 1.25
X-6238-5	3/8-16 x 1.50
X-6238-1	3/8-16 x 1.75
X-6238-6	3/8-16 x 2.00
X-6238-17	3/8-16 x 2.25
X-6238-7	3/8-16 x 2.50
X-6238-8	3/8-16 x 2.75
X-6238-9	3/8-16 x 3.00
X-6238-19	3/8-16 x 3.25
X-6238-12	3/8-16 x 3.50
X-6238-20	3/8-16 x 3.75
X-6238-13	3/8-16 x 4.50
X-6238-18	3/8-16 x 5.50
X-6238-25	3/8-16 x 6.50

Part No.	Dimensions
Hex Head Bolts, cont.	
X-6238-14	3/8-24 x .75
X-6238-16	3/8-24 x 1.25
X-6238-21	3/8-24 x 4.00
X-6238-22	3/8-24 x 4.50
X-6024-5	7/16-14 x .75
X-6024-2	7/16-14 x 1.00
X-6024-8	7/16-14 x 1.25
X-6024-3	7/16-14 x 1.50
X-6024-4	7/16-14 x 2.00
X-6024-11	7/16-14 x 2.75
X-6024-12	7/16-14 x 6.50
X-129-15	1/2-13 x .75
X-129-17	1/2-13 x 1.00
X-129-18	1/2-13 x 1.25
X-129-19	1/2-13 x 1.50
X-129-20	1/2-13 x 1.75
X-129-21	1/2-13 x 2.00
X-129-22	1/2-13 x 2.25
X-129-23	1/2-13 x 2.50
X-129-24	1/2-13 x 2.75
X-129-25	1/2-13 x 3.00
X-129-27	1/2-13 x 3.50
X-129-29	1/2-13 x 4.00
X-129-30	1/2-13 x 4.50
X-463-9	1/2-13 x 5.50
X-129-44	1/2-13 x 6.00
X-129-51	1/2-20 x .75
X-129-45	1/2-20 x 1.25
X-129-52	1/2-20 x 1.50
X-6021-3	5/8-11 x 1.00
X-6021-4	5/8-11 x 1.25
X-6021-2	5/8-11 x 1.50
X-6021-1	5/8-11 x 1.75
273049	5/8-11 x 2.00
X-6021-5	5/8-11 x 2.25
X-6021-6	5/8-11 x 2.50
X-6021-7	5/8-11 x 2.75
X-6021-12	5/8-11 x 3.75
X-6021-11	5/8-11 x 4.50
X-6021-10	5/8-11 x 6.00
X-6021-9	5/8-18 x 2.50
X-6239-1	3/4-10 x 1.00
X-6239-8	3/4-10 x 1.25
X-6239-2	3/4-10 x 1.50
X-6239-3	3/4-10 x 2.00
X-6239-4	3/4-10 x 2.50
X-6239-5	3/4-10 x 3.00
X-6239-6	3/4-10 x 3.50
X-792-1	1-8 x 2.25
X-792-5	1-8 x 3.00
X-792-8	1-8 x 5.00

Part No.	Dimensions	Type
Hex Nuts		
X-6009-1	1-8	Standard
X-6210-3	6-32	Whiz
X-6210-4	8-32	Whiz
X-6210-5	10-24	Whiz
X-6210-1	10-32	Whiz
X-6210-2	1/4-20	Spiralock
X-6210-6	1/4-28	Spiralock
X-6210-7	5/16-18	Spiralock
X-6210-8	5/16-24	Spiralock
X-6210-9	3/8-16	Spiralock
X-6210-10	3/8-24	Spiralock
X-6210-11	7/16-14	Spiralock
X-6210-12	1/2-13	Spiralock
X-6210-15	7/16-20	Spiralock
X-6210-14	1/2-20	Spiralock
X-85-3	5/8-11	Standard
X-88-12	3/4-10	Standard
X-89-2	1/2-20	Standard

Washers

Part No.	ID	OD	Thick.	Bolt/ Screw
X-25-46	.125	.250	.022	#4
X-25-9	.156	.375	.049	#6
X-25-48	.188	.438	.049	#8
X-25-36	.219	.500	.049	#10
X-25-40	.281	.625	.065	1/4
X-25-85	.344	.687	.065	5/16
X-25-37	.406	.812	.065	3/8
X-25-34	.469	.922	.065	7/16
X-25-26	.531	1.062	.095	1/2
X-25-15	.656	1.312	.095	5/8
X-25-29	.812	1.469	.134	3/4
X-25-127	1.062	2.000	.134	1

Metric

Hex head bolts are hardness grade 8.8 unless noted.

Hex Head Bolts (Partial Thread)

Part No.	Dimensions
M931-05055-60	M5-0.80 x 55
M931-06040-60	M6-1.00 x 40
M931-06055-60	M6-1.00 x 55
M931-06060-60	M6-1.00 x 60
M931-06060-SS	M6-1.00 x 60
M931-06070-60	M6-1.00 x 70
M931-06070-SS	M6-1.00 x 70
M931-06075-60	M6-1.00 x 75
M931-06090-60	M6-1.00 x 90
M931-06145-60	M6-1.00 x 145
M931-06150-60	M6-1.00 x 150
M931-08035-60	M8-1.25 x 35
M931-08040-60	M8-1.25 x 40
M931-08045-60	M8-1.25 x 45
M931-08050-60	M8-1.25 x 50
M931-08055-60	M8-1.25 x 55
M931-08055-82	M8-1.25 x 55*
M931-08060-60	M8-1.25 x 60
M931-08070-60	M8-1.25 x 70
M931-08070-82	M8-1.25 x 70*
M931-08075-60	M8-1.25 x 75
M931-08080-60	M8-1.25 x 80
M931-08090-60	M8-1.25 x 90
M931-08095-60	M8-1.25 x 95
M931-08100-60	M8-1.25 x 100
M931-08110-60	M8-1.25 x 110
M931-08120-60	M8-1.25 x 120
M931-08130-60	M8-1.25 x 130
M931-08140-60	M8-1.25 x 140
M931-08150-60	M8-1.25 x 150
M931-08200-60	M8-1.25 x 200
M931-10040-82	M10-1.25 x 40*
M931-10040-60	M10-1.50 x 40
M931-10045-60	M10-1.50 x 45
M931-10050-60	M10-1.50 x 50
M931-10050-82	M10-1.25 x 50*
M931-10055-60	M10-1.50 x 55
M931-10060-60	M10-1.50 x 60
M931-10065-60	M10-1.50 x 65
M931-10070-60	M10-1.50 x 70
M931-10080-60	M10-1.50 x 80
M931-10080-82	M10-1.25 x 80*
M931-10090-60	M10-1.50 x 90
M931-10090-82	M10-1.50 x 90*
M931-10100-60	M10-1.50 x 100
M931-10110-60	M10-1.50 x 110
M931-10120-60	M10-1.50 x 120
M931-10130-60	M10-1.50 x 130
M931-10140-60	M10-1.50 x 140
M931-10180-60	M10-1.50 x 180
M931-10235-60	M10-1.50 x 235
M931-10260-60	M10-1.50 x 260
M960-10330-60	M10-1.25 x 330
M931-12045-60	M12-1.75 x 45
M960-12050-60	M12-1.25 x 50
M960-12050-82	M12-1.25 x 50*
M931-12050-60	M12-1.75 x 50
M931-12050-82	M12-1.75 x 50*
M931-12055-60	M12-1.75 x 55
M931-12060-60	M12-1.75 x 60
M931-12060-82	M12-1.75 x 60*
M931-12065-60	M12-1.75 x 65
M931-12075-60	M12-1.75 x 75
M931-12080-60	M12-1.75 x 80
M931-12090-60	M12-1.75 x 90
M931-12100-60	M12-1.75 x 100
M931-12110-60	M12-1.75 x 110

Hex Head Bolts (Partial Thread), continued

Part No.	Dimensions
M960-16090-60	M16-1.50 x 90
M931-16090-60	M16-2.00 x 90
M931-16100-60	M16-2.00 x 100
M931-16100-82	M16-2.00 x 100*
M931-16120-60	M16-2.00 x 120
M931-16150-60	M16-2.00 x 150
M931-20065-60	M20-2.50 x 65
M931-20090-60	M20-2.50 x 90
M931-20100-60	M20-2.50 x 100
M931-20120-60	M20-2.50 x 120
M931-20140-60	M20-2.50 x 140
M931-20160-60	M20-2.50 x 160
M931-22090-60	M22-2.50 x 90
M931-22120-60	M22-2.50 x 120
M931-22160-60	M22-2.50 x 160
M931-24090-60	M24-3.00 x 90
M931-24120-60	M24-3.00 x 120
M931-24160-60	M24-3.00 x 160
M931-24200-60	M24-3.00 x 200

Hex Head Bolts (Full Thread)

Part No.	Dimensions
M933-04006-60	M4-0.70 x 6
M933-05030-60	M5-0.80 x 30
M933-05035-60	M5-0.80 x 35
M933-05050-60	M5-0.80 x 50
M933-06010-60	M6-1.00 x 10
M933-06012-60	M6-1.00 x 12
M933-06014-60	M6-1.00 x 14
M933-06016-60	M6-1.00 x 16
M933-06020-60	M6-1.00 x 20
M933-06025-60	M6-1.00 x 25
M933-06030-60	M6-1.00 x 30
M933-06040-60	M6-1.00 x 40
M933-06050-60	M6-1.00 x 50
M933-07025-60	M7-1.00 x 25
M933-08010-60	M8-1.25 x 10
M933-08012-60	M8-1.25 x 12
M933-08016-60	M8-1.25 x 16
M933-08020-60	M8-1.25 x 20
M933-08025-60	M8-1.25 x 25
M933-08030-60	M8-1.25 x 30
M933-08030-82	M8-1.25 x 30*
M933-10012-60	M10-1.50 x 12
M961-10020-60	M10-1.25 x 20
M933-10020-60	M10-1.50 x 20
M933-10025-60	M10-1.50 x 25
M961-10025-60	M10-1.25 x 25
M933-10025-82	M10-1.50 x 25*
M961-10030-60	M10-1.25 x 30
M933-10030-60	M10-1.50 x 30
M933-10030-82	M10-1.50 x 30*
M961-10035-60	M10-1.25 x 35
M933-10035-60	M10-1.50 x 35
M933-10035-82	M10-1.50 x 35*
M961-10040-60	M10-1.25 x 40

Hex Head Bolts (Full Thread), continued

Part No.	Dimensions
M933-12016-60	M12-1.75 x 16
M933-12020-60	M12-1.75 x 20
M961-12020-60F	M12-1.50 x 20
M933-12025-60	M12-1.75 x 25
M933-12025-82	M12-1.75 x 25*
M961-12030-60	M12-1.25 x 30
M933-12030-82	M12-1.75 x 30*
M961-12030-82F	M12-1.50 x 30*
M933-12030-60	M12-1.75 x 30
M933-12035-60	M12-1.75 x 35
M961-12040-82	M12-1.25 x 40*
M933-12040-60	M12-1.75 x 40
M933-12040-82	M12-1.75 x 40*
M961-14025-60	M14-1.50 x 25
M933-14025-60	M14-2.00 x 25
M961-14050-82	M14-1.50 x 50*
M961-16025-60	M16-1.50 x 25
M933-16025-60	M16-2.00 x 25
M961-16030-82	M16-1.50 x 30*
M933-16030-82	M16-2.00 x 30*
M933-16035-60	M16-2.00 x 35
M961-16040-60	M16-1.50 x 40
M933-16040-60	M16-2.00 x 40
M961-16045-82	M16-1.50 x 45*
M933-16045-82	M16-2.00 x 45*
M933-16050-60	M16-2.00 x 50
M933-16050-82	M16-2.00 x 50*
M933-16060-60	M16-2.00 x 60
M933-16070-60	M16-2.00 x 70
M933-18035-60	M18-2.50 x 35
M933-18050-60	M18-2.50 x 50
M933-18060-60	M18-2.50 x 60
M933-20050-60	M20-2.50 x 50
M933-20055-60	M20-2.50 x 55
M933-24060-60	M24-3.00 x 60
M933-24065-60	M24-3.00 x 65
M933-24070-60	M24-3.00 x 70

Pan Head Machine Screws

M7985A-03010-20	M3-0.50 x 10
M7985A-03012-20	M3-0.50 x 12
M7985A-04010-20	M4-0.70 x 10
M7985A-04016-20	M4-0.70 x 16
M7985A-04020-20	M4-0.70 x 20
M7985A-04050-20	M4-0.70 x 50
M7985A-04100-20	M4-0.70 x 100
M7985A-05010-20	M5-0.80 x 10
M7985A-05012-20	M5-0.80 x 12
M7985A-05016-20	M5-0.80 x 16
M7985A-05020-20	M5-0.80 x 20
M7985A-05025-20	M5-0.80 x 25
M7985A-05030-20	M5-0.80 x 30
M7985A-05080-20	M5-0.80 x 80
M7985A-05100-20	M5-0.80 x 100
M7985A-06100-20	M6-1.00 x 100

Flat Head Machine Screws

M965A-04012-SS	M4-0.70 x 12
M965A-05012-SS	M5-0.80 x 12
M965A-05016-20	M5-0.80 x 16
M965A-06012-20	M6-1.00 x 12

* This metric hex bolt's hardness is grade 10.9.

Metric, continued

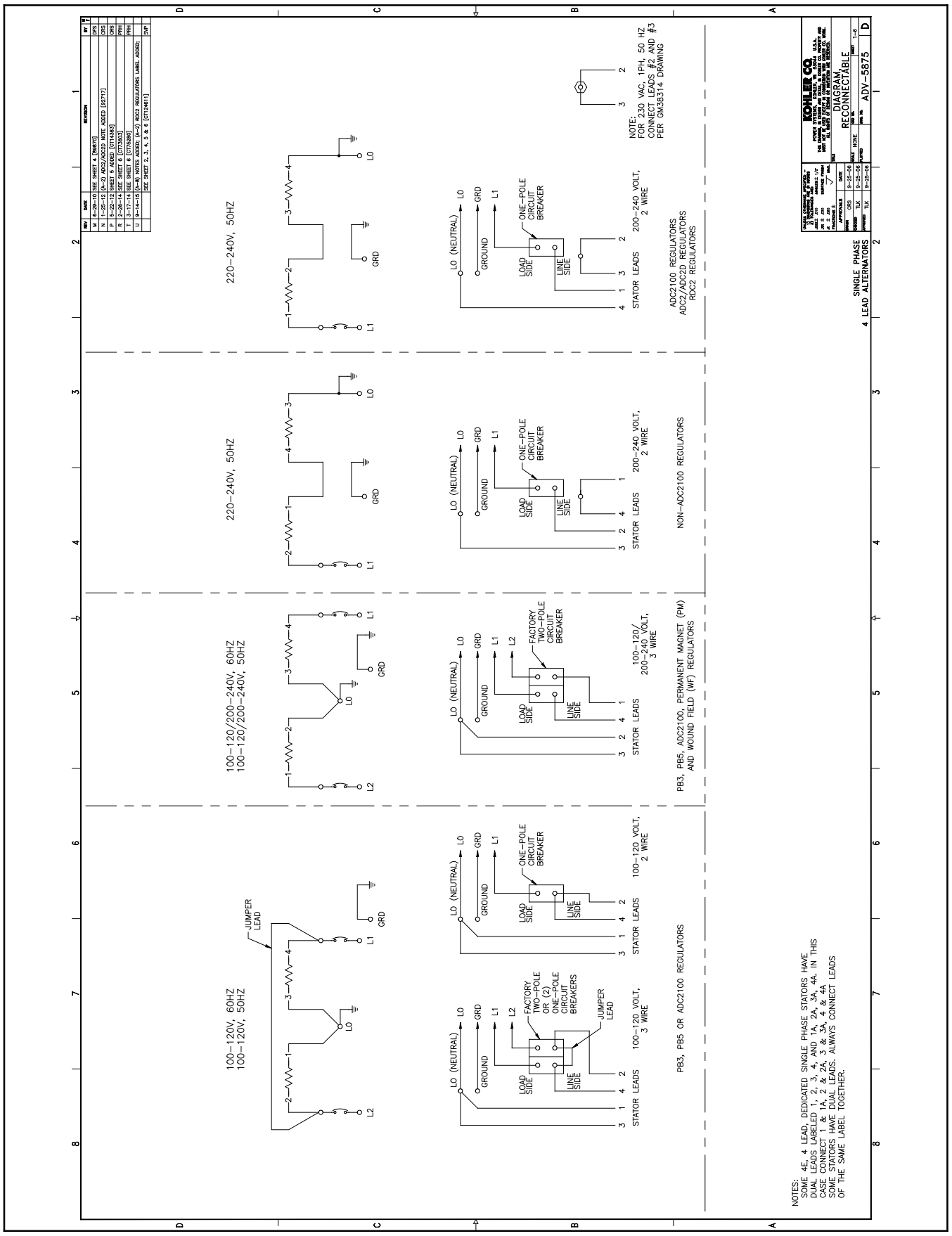
Hex Nuts

Part No.	Dimensions	Type
M934-03-50	M3-0.50	Standard
M934-04-50	M4-0.70	Standard
M934-04-B	M4-0.70	Brass
M934-05-50	M5-0.80	Standard
M934-06-60	M6-1.00	Standard
M934-06-64	M6-1.00	Std. (green)
M6923-06-80	M6-1.00	Spiralock
M982-06-80	M6-1.00	Elastic Stop
M934-08-60	M8-1.25	Standard
M6923-08-80	M8-1.25	Spiralock
M982-08-80	M8-1.25	Elastic Stop
M934-10-60	M10-1.50	Standard
M934-10-60F	M10-1.25	Standard
M6923-10-80	M10-1.50	Spiralock
M6923-10-62	M10-1.50	Spiralock†
M982-10-80	M10-1.50	Elastic Stop
M934-12-60	M12-1.75	Standard
M934-12-60F	M12-1.25	Standard
M6923-12-80	M12-1.75	Spiralock
M982-12-80	M12-1.75	Elastic Stop
M982-14-60	M14-2.00	Elastic Stop
M6923-16-80	M16-2.00	Spiralock
M982-16-80	M16-2.00	Elastic Stop
M934-18-80	M18-2.5	Standard
M982-18-60	M18-2.50	Elastic Stop
M934-20-80	M20-2.50	Standard
M982-20-80	M20-2.50	Elastic Stop
M934-22-60	M22-2.50	Standard
M934-24-80	M24-3.00	Standard
M982-24-60	M24-3.00	Elastic Stop
M934-30-80	M30-3.50	Standard

Washers

Part No.	ID	OD	Thick.	Bolt/ Screw
M125A-03-80	3.2	7.0	0.5	M3
M125A-04-80	4.3	9.0	0.8	M4
M125A-05-80	5.3	10.0	1.0	M5
M125A-06-80	6.4	12.0	1.6	M6
M125A-08-80	8.4	16.0	1.6	M8
M125A-10-80	10.5	20.0	2.0	M10
M125A-12-80	13.0	24.0	2.5	M12
M125A-14-80	15.0	28.0	2.5	M14
M125A-16-80	17.0	30.0	3.0	M16
M125A-18-80	19.0	34.0	3.0	M18
M125A-20-80	21.0	37.0	3.0	M20
M125A-24-80	25.0	44.0	4.0	M24

† This metric hex nut's hardness is grade 8.

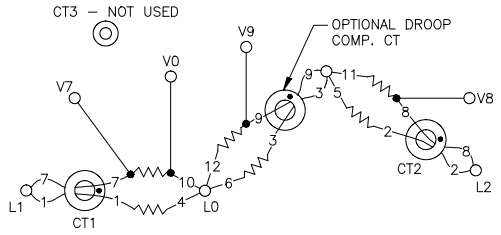

REVISION
SEE SHEET 4 [84870]
ADC2/ADC2D NOTE ADDED [92717]
SHEET 5 ADDED [GT14383]
SEE SHEET 6 [GT73840]
SEE SHEET 6 [GT73840]
NOTES ADDED; (A-2) RDC2 REGULATORS, LABEL ADDED;
SEE SHEET 2, 3, 4, 5 & 6 [GT124611]
220-240V, 50HZ
100-120/200-240V, 60HZ
100-120/200-240V, 50HZ
100-120V, 60HZ
100-120V, 50HZ
JUMPER LEAD
LO (NEUTRAL)
GROUND
LOAD SIDE
LINE SIDE
ONE-POLE CIRCUIT BREAKER
FACTORY TWO-POLE CIRCUIT BREAKER
FACTORY TWO-POLE OR (2) ONE-POLE CIRCUIT BREAKERS
STATOR LEADS
100-120 VOLT, 3 WIRE
100-120 VOLT, 2 WIRE
100-120/ 200-240 VOLT, 3 WIRE
200-240 VOLT, 2 WIRE
PB3, PB5, ADC2100, PERMANENT MAGNET (PM) AND WOUND FIELD (WF) REGULATORS
PB3, PB5 OR ADC2100 REGULATORS
NON-ADC2100 REGULATORS
ADC2100 REGULATORS
ADC2/ADC2D REGULATORS
RDC2 REGULATORS
NOTE:
FOR 230 VAC, 1PH, 50 HZ
CONNECT LEADS #2 AND #3
PER GM38314 DRAWING
SINGLE PHASE
4 LEAD ALTERNATORS
NOTES:
SOME 4E, 4 LEAD, DEDICATED SINGLE PHASE STATORS HAVE DUAL LEADS LABELED 1, 2, 3, 4, AND 1A, 2A, 3A, 4A. IN THIS CASE CONNECT 1 & 1A, 2 & 2A, 3 & 3A, 4 & 4A
SOME STATORS HAVE DUAL LEADS. ALWAYS CONNECT LEADS OF THE SAME LABEL TOGETHER.
KOHLER CO.
DIAGRAM, RECONNECTABLE
ADV-5875
D

REV	DATE	REVISION	BY	MF
M	6-29-10	SEE SHEET 4 [89870]	DFS	
N	1-25-12	SEE SHEET 1 [92717]	CRS	
P	5-22-12	SHEET 5 ADDED [CT14383]	CRS	
R	2-26-14	SEE SHEET 6 [CT73603]	PRH	
T	3-17-14	SEE SHEET 6 [CT75280]	PRH	
U	9-14-15	(A-4) DUAL LEADS STATOR NOTE ADDED; SEE SHEET 1, 3, 4, 5 & 6 [CT124611]	SVP	

12 LEAD ALTERNATOR, 3 WIRE, SINGLE PHASE

60 HZ: 100/200V
60 HZ: 120/240V
50 HZ: 100/200V
50 HZ: 110/220V

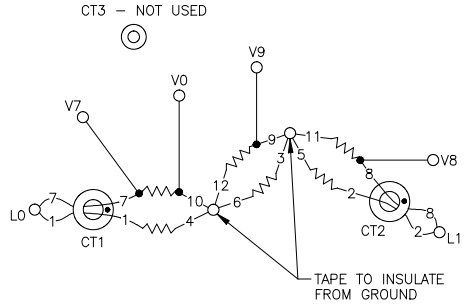
SOME SETS NOT RATED FOR SINGLE PHASE – SEE MANUALS



TB3 UP V7 LO METER SCALE LAMP JUMPER

12 LEAD ALTERNATOR, 3 WIRE, SINGLE PHASE

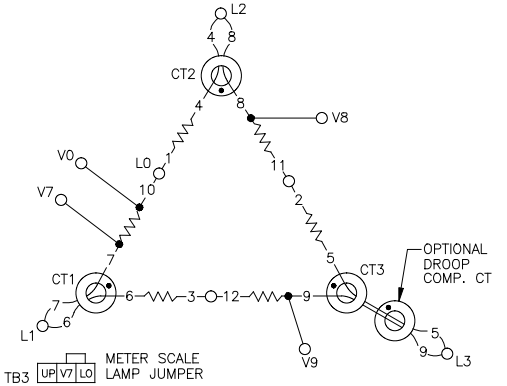
60 HZ: 240V
50 HZ: 220V
(MARINE ONLY)



TB3 UP V7 LO METER SCALE LAMP JUMPER

12 LEAD ALTERNATOR, 4 WIRE, DELTA

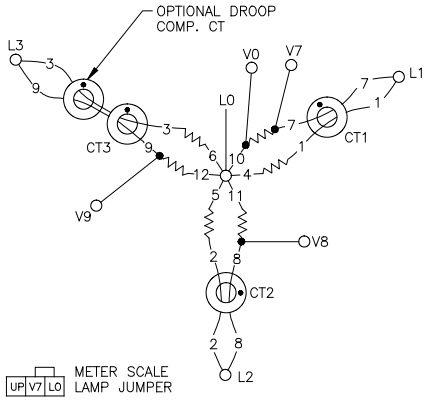
60 HZ: 120/240V
50 HZ: 110/220V



TB3 UP V7 LO METER SCALE LAMP JUMPER

12 LEAD ALTERNATOR, 4 WIRE, LOW WYE

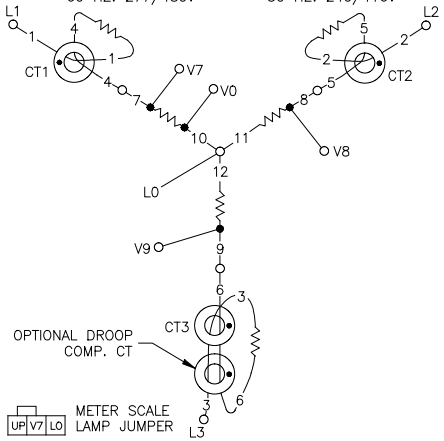
60 HZ: 120/208V
60 HZ: 127/220V
60 HZ: 139/240V
50 HZ: 110/190V
50 HZ: 115/200V
50 HZ: 120/208V



TB3 UP V7 LO METER SCALE LAMP JUMPER

12 LEAD ALTERNATOR, 4 WIRE, HI WYE

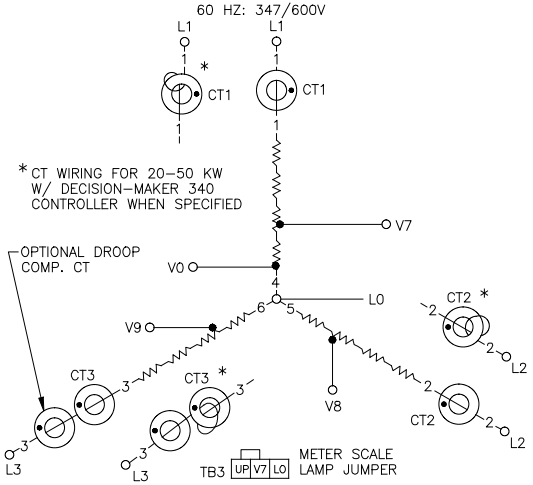
60 HZ: 220/380V
60 HZ: 240/416V
60 HZ: 277/480V
50 HZ: 220/380V
50 HZ: 230/400V
50 HZ: 240/416V



TB3 UP V7 LO METER SCALE LAMP JUMPER

6 LEAD ALTERNATOR, 4 WIRE, WYE

60 HZ: 347/600V



TB3 UP V7 LO METER SCALE LAMP JUMPER

NOTES:

CURRENT TRANSFORMER DOT OR "H1" TOWARD GENERATOR.
CURRENT TRANSFORMERS NOT USED ON ALL SETS.
SOME STATORS HAVE DUAL LEADS. ALWAYS CONNECT LEADS OF THE SAME LABEL TOGETHER.

PHASE ROTATION

A	B	C
L1	L2	L3

3 PHASE
FRII ALTERNATORS,
20–60KW WOUND EXCITER FIELD ALTERNATORS,
AND 10–20KW SMALL STANDBY

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX± .010 ANGLES ± 1/2°
.XX ± .030 SURFACE FINISH
.X ± .060 MAX.
FRACTIONS ±

APPROVALS		DATE
DRAWN	DFS	7-28-92
CHECKED	TLK	6-23-99
APPROVED	JMH	6-23-99

TITLE: DIAGRAM, RECONNECTABLE

SCALE: NONE | CAD NO. | SHEET 2-6

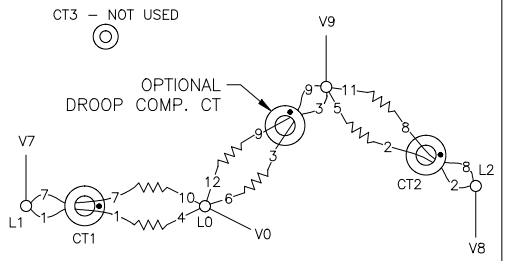
PLOTTED | DWG. NO. ADV-5875 | C

REV	DATE	REVISION	BY	MF
M	6-29-10	SEE SHEET 4 [89870]	DFS	
N	1-25-12	SEE SHEET 1 [92717]	CRS	
P	5-22-12	SHEET 5 ADDED [CT14383]	CRS	
R	2-26-14	SEE SHEET 6 [CT73603]	PRH	
T	3-17-14	SEE SHEET 6 [CT75280]	PRH	
U	9-14-15	(A-4) DUAL LEADS STATOR NOTE ADDED; SEE SHEET 1, 2, 4,		
		5 & 6 [CT124611]	SVP	

12 LEAD ALTERNATOR, 3 WIRE, SINGLE PHASE

60 HZ: 100/200V
60 HZ: 120/240V
50 HZ: 100/200V
50 HZ: 110/220V

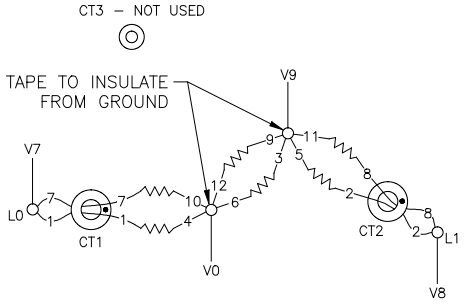
SOME SETS NOT RATED FOR SINGLE PHASE – SEE MANUALS



TB3 UP V7 LO METER SCALE LAMP JUMPER

12 LEAD ALTERNATOR, 3 WIRE, SINGLE PHASE

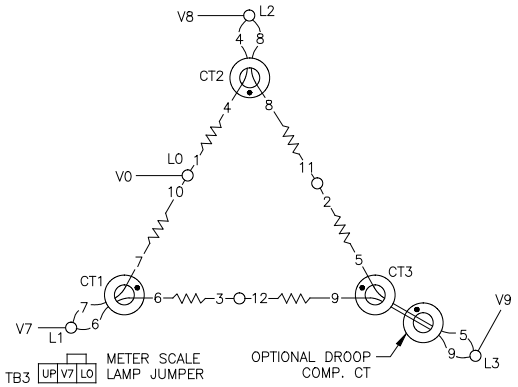
60 HZ: 240V
50 HZ: 220V
(MARINE ONLY)



TB3 UP V7 LO METER SCALE LAMP JUMPER

12 LEAD ALTERNATOR, 4 WIRE, DELTA

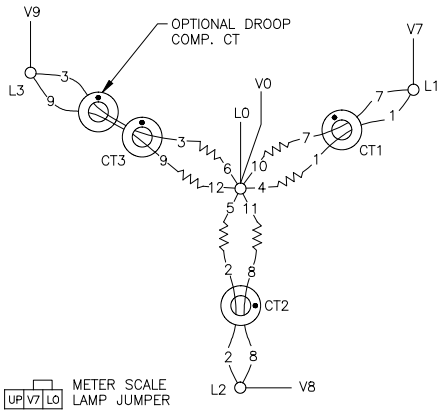
60 HZ: 120/240V
50 HZ: 110/220V



TB3 UP V7 LO METER SCALE LAMP JUMPER

12 LEAD ALTERNATOR, 4 WIRE, LOW WYE

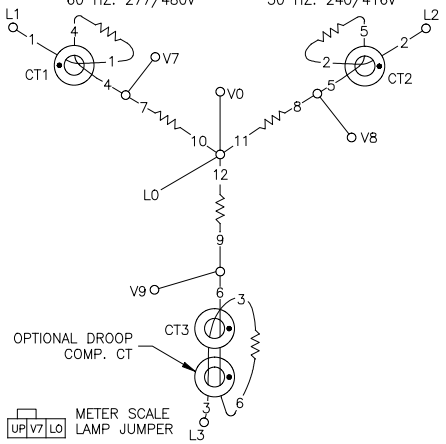
60 HZ: 120/208V
60 HZ: 127/220V
60 HZ: 139/240V
50 HZ: 110/190V
50 HZ: 115/200V
50 HZ: 120/208V



TB3 UP V7 LO METER SCALE LAMP JUMPER

12 LEAD ALTERNATOR, 4 WIRE, HI WYE

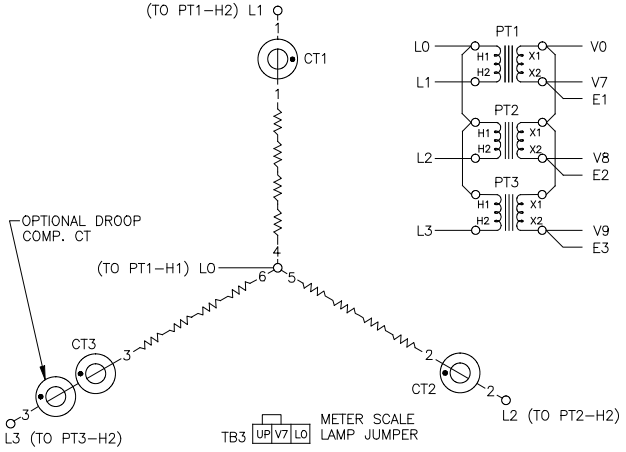
60 HZ: 220/380V
60 HZ: 240/416V
60 HZ: 277/480V
50 HZ: 220/380V
50 HZ: 230/400V
50 HZ: 240/416V



TB3 UP V7 LO METER SCALE LAMP JUMPER

6 LEAD ALTERNATOR, 4 WIRE, WYE

60 HZ: 347/600V



TB3 UP V7 LO METER SCALE LAMP JUMPER

NOTES:

CURRENT TRANSFORMER DOT OR "H1" TOWARD GENERATOR.
CURRENT TRANSFORMERS NOT USED ON ALL SETS.
SOME STATORS HAVE DUAL LEADS. ALWAYS CONNECT LEADS OF THE SAME LABEL TOGETHER.

PHASE ROTATION

A	B	C
L1	L2	L3

3 PHASE
60 (I.M.S.)–300 KW WOUND EXCITER FIELD
600V FRII
ALTERNATORS

UNLESS OTHERWISE SPECIFIED – 1) DIMENSIONS ARE IN INCHES 2) TOLERANCES ARE: .XXX± .010 ANGLES± 1/2° .XX ± .030 SURFACE FINISH .X ± .060 MAX. FRACTIONS ±

APPROVALS	DATE
DRAWN LDS	8-25-98
CHECKED TLK	6-23-99
APPROVED JMH	6-23-99

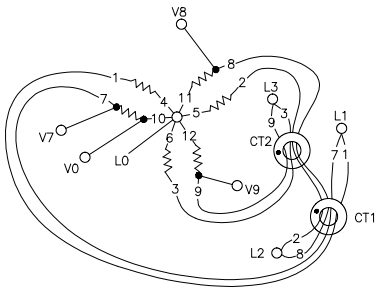
KOHLER CO.
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

TITLE: DIAGRAM, RECONNECTABLE

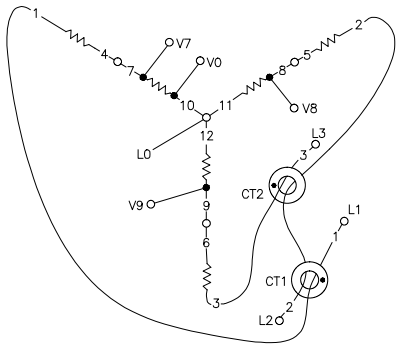
SCALE NONE | CAD NO. | SHEET 3-6
PLOTTED | DWG. NO. ADV-5875 | C

REV	DATE	REVISION	BY	MFG
P	5-21-12	THIS SHEET ADDED [CT14383]	CRS	
R	2-26-14	SEE SHEET 6 [CT73383]	PRH	
T	3-17-14	SEE SHEET 6 [CT75280]	PRH	
U	9-14-15	(A-4) DUAL LEADS STATOR NOTE ADDED; SEE SHEET 1, 2, 3,		
		4 & 6 [CT124611]	SVP	

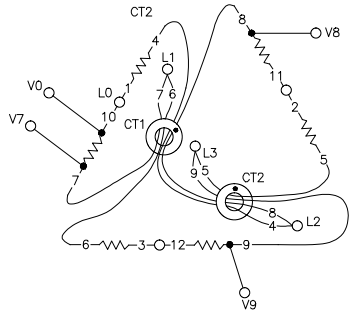
12 LEAD ALTERNATOR, 4 WIRE, LOW WYE
60 HZ: 120/208V
60 HZ: 127/220V



12 LEAD ALTERNATOR, 4 WIRE, HI WYE
60 HZ: 277/480V
50 HZ: 220/380V
50 HZ: 230/400V
50 HZ: 240/416V



12 LEAD ALTERNATOR, 4 WIRE, DELTA
60 HZ: 120/240V



PHASE ROTATION

A	B	C
L1	L2	L3

NOTES:

CURRENT TRANSFORMER DOT OR "H1" TOWARD GENERATOR. SOME STATORS HAVE DUAL LEADS. ALWAYS CONNECT LEADS OF THE SAME LABEL TOGETHER.

3 PHASE
RDC2 CONTROLLER
w/2 CURRENT TRANSFORMERS

UNLESS OTHERWISE SPECIFIED –
1) DIMENSIONS ARE IN INCHES
2) TOLERANCES ARE:
.XXX± .010 ANGLES ± 1/2°
.XX ± .030 SURFACE FINISH
.X ± .060 MAX.
FRACTIONS ±

APPROVALS		DATE
DRAWN	CRS	5-21-12
CHECKED	PH	5-21-12
APPROVED	PH	5-21-12

TITLE: DIAGRAM, RECONNECTABLE

SCALE: NONE | CAD NO. | SHEET 5-6

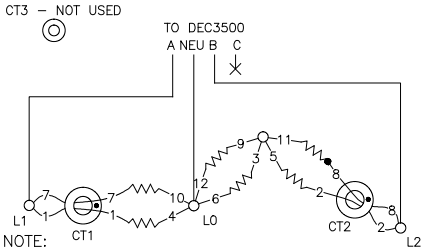
PLOTTED | DWG. NO. ADV-5875 | C

REV	DATE	REVISION	BY
R	2-12-14	THIS SHEET ADDED [CT73603]	PRH
T	3-17-14	(B,C-7, B,C-5 & B,C-3) A NEU B C WAS L1 L0 L2 L3;	
		(C-6) CT3- NOT USED ADDED; (C-6-7-8 & C-4-5-6)	
		NOTE ADDED [CT75280]	PRH
U	9-14-15	(A-8) DUAL LEADS STATOR NOTE ADDED; SEE SHEET 1, 2, 3,	
		4 & 5 [CT124611]	SVP

12 LEAD ALTERNATOR, 3 WIRE, SINGLE PHASE

60 HZ: 100/200V
60 HZ: 120/240V
50 HZ: 100/200V
50 HZ: 110/220V

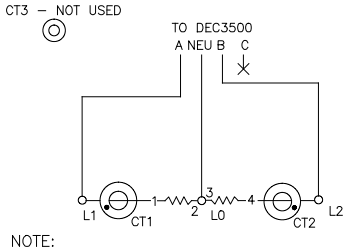
SOME SETS NOT RATED FOR SINGLE PHASE – SEE MANUALS



NOTE:
NEU MUST BE CONNECTED TO L0, EVEN IF L0 IS NOT CONNECTED TO THE LOAD.

4 LEAD ALTERNATOR, 3 WIRE, SINGLE PHASE

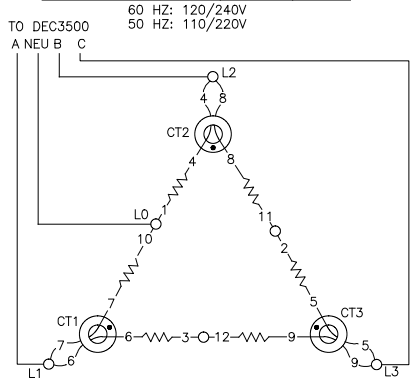
60 HZ: 100–120/200–240V
50 HZ: 100–120/200–240V



NOTE:
NEU MUST BE CONNECTED TO L0, EVEN IF L0 IS NOT CONNECTED TO THE LOAD.

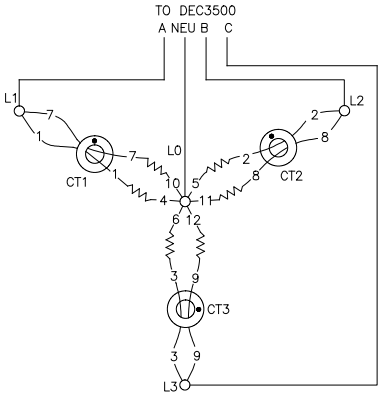
12 LEAD ALTERNATOR, 4 WIRE, DELTA

60 HZ: 120/240V
50 HZ: 110/220V



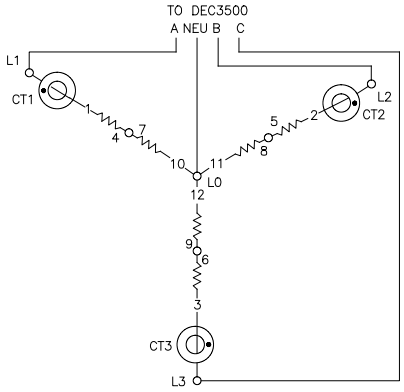
12 LEAD ALTERNATOR, 4 WIRE, LOW WYE

60 HZ: 120/208V
60 HZ: 127/220V
60 HZ: 139/240V
50 HZ: 110/190V
50 HZ: 115/200V
50 HZ: 120/208V



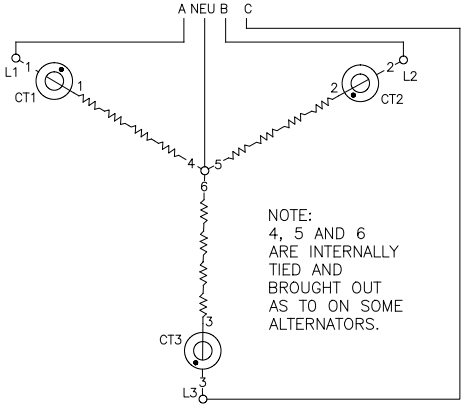
12 LEAD ALTERNATOR, 4 WIRE, HI WYE

60 HZ: 220/380V
60 HZ: 240/416V
60 HZ: 277/480V
50 HZ: 220/380V
50 HZ: 230/400V
50 HZ: 240/416V



6 LEAD ALTERNATOR, 4 WIRE, WYE

60 HZ: 347/600V
TO DEC3500
A NEU B C



NOTE:
4, 5 AND 6 ARE INTERNALLY TIED AND BROUGHT OUT AS TO ON SOME ALTERNATORS.

PHASE ROTATION

A	B	C
L1	L2	L3

NOTES:
CURRENT TRANSFORMER DOT OR "H1" TOWARD GENERATOR.
CURRENT TRANSFORMERS NOT USED ON ALL SETS.
SOME STATORS HAVE DUAL LEADS. ALWAYS CONNECT LEADS OF THE SAME LABEL TOGETHER.

DEC3500

UNLESS OTHERWISE SPECIFIED: 1) DIMENSIONS ARE IN INCHES 2) TOLERANCES ARE: DECIMALS .XX ±.010, .XXX ±.005, .X ±.030, FRACTIONS ±1/64, ANGLES ±1/2°, SURFACE FINISH 125 MAX.

APPROVALS	DATE
DRAWN PRH	5-27-04
CHECKED JF	5-27-04
APPROVED JF	5-27-04

KOHLER CO.
POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

TITLE: DIAGRAM, RECONNECTABLE
SCALE: NONE | CAD NO. | SHEET: 6-6
PLOTTED | DWG NO. ADV-5875 | D

RECONNECTION DIAGRAM

CURRENT TRANSFORMER DOT TOWARDS GENERATOR

GM91223

High Wye — 277/480V 3PH, 220/380V 3PH

GND LEAD	ALT. LEADS	ENGINE	ALT. LEADS	LOAD LEADS
	6 9		3	L3
	5 8		2	L2
	4 7		1	L1
GND	10 11 12	JUMP		L0

Single Loop Through CT's

1, 7 CT1 — 2, 8 CT2 — 3, 9 CT3

BACK OF GENSET

Low Wye — 120/208V 3PH, 139/240V 3PH, 127/220V 3PH

GND LEAD	ALT. LEADS	ENGINE	ALT. LEADS	LOAD LEADS
	3 9	JUMP		L3
	2 8	JUMP		L2
	1 7	JUMP		L1
GND	10 11 12	JUMP	4 5 6	L0

Single Loop Through CT's

1, 7 CT1 — 2, 8 CT2 — 3, 9 CT3

BACK OF GENSET

Delta — 120/240V 3PH

GND LEAD	ALT. LEADS	ENGINE	ALT. LEADS	LOAD LEADS
			5 9	L2
	3 12		4 8	
	2 11		6 7	L1
GND	1 10	JUMP		L0

Single Loop Through CT's

6, 7 CT1 — 4, 8 CT2 — 5, 9 CT3

BACK OF GENSET

1PH Dogleg — 120/240V 1PH

GND LEAD	ALT. LEADS	ENGINE	ALT. LEADS	LOAD LEADS
	3 5 9 11			L3
	2 8	JUMP		L2
	1 7	JUMP		L1
GND	4 6	JUMP	10 12	L0

Single Loop Through CT's

1, 7 CT1 — 2, 8 CT2 — N/A CT3

BACK OF GENSET

6 Lead 600V — 347/600V 3PH

GND LEAD	ALT. LEADS	ENGINE	ALT. LEADS	LOAD LEADS
	3	JUMP		L3
	2	JUMP		L2
	1	JUMP		L1
GND	4 5 6	JUMP		L0

Single Loop Through CT's

1 CT1 — 2 CT2 — 3 CT3

BACK OF GENSET

4 Lead 1 Phase — 120/240V 1PH

GND LEAD	ALT. LEADS	ENGINE	ALT. LEADS	LOAD LEADS
	4	JUMP		L2
	1	JUMP		L1
GND	2 3	JUMP		L0

Single Loop Through CT's

1 CT1 — 4 CT2 — N/A CT3

BACK OF GENSET

PHASE ROTATION

A B C

L1 L2 L3

NOTES:

CURRENT TRANSFORMER DOT OR "HI" TOWARD GENERATOR.
CURRENT TRANSFORMERS NOT USED ON ALL SETS.

1 AND 3 PHASE
4P INDUSTRIAL ALTERNATORS
4D INDUSTRIAL ALTERNATORS

REV	DATE	ON COMPOSITE DWGS, SEE PART NO. FOR REVISION LEVEL	BY
-	3-12-14	NEW DRAWING [CT73347]	CEK
A	4-14-14	(C-7) UPDATE HIGH WYE CONNECTIONS [CT77727]	CEK
B	08-21-14	VIEWS UPDATED [CT88800]	PAS
C	11-06-14	(B-2) ALT.LEADS 4 WAS 1 & 1 WAS 4, (B-2,B-3)	
		1 CT1 WAS 4 CT1, 4 CT2 WAS 1 CT2, (B-2) LOAD	
		LEADS L2 WAS L3 [CT97249]	KNN

UNLESS OTHERWISE SPECIFIED - 1) DIMENSIONS ARE IN MILLIMETERS 2) TOLERANCES ARE: X.XX ± 0.25, X.X ± 1.0, ANGLES ± 1.0°, SURFACE FINISH 3.2 MAX., THIRD ANGLE PROJECTION

APPROVALS		DATE
DRAWN	CEK	3-12-14
CHECKED	CEK	3-12-14
APPROVED	BMK	3-12-14

KOHLER CO. METRIC | PRO-E

POWER SYSTEMS, KOHLER, WI 53044 U.S.A.

TITLE: DIAGRAM, RECONNECTABLE

SCALE 2.00 | CAD NO. | SHEET 1 of 1

DWG NO. ADV-8677 | D

TP-6878 7/18b

KOHLER CO., Kohler, Wisconsin 53044
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KOHLERPower.com