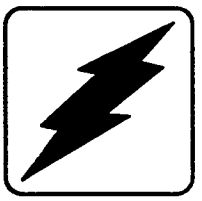
Service Manual

Standby Generator Sets



Models:

6ROZ
6RFOZ
10ROZ
10RFOZ
15ROZ
15RFOZ

KOHLER®
POWER SYSTEMS

TP–5557 10/92

Introduction

This manual covers the general operation, maintenance, troubleshooting, and repair of the Kohler 6ROZ/6RFOZ, 10ROZ/10RFOZ, and 15ROZ/15RFOZ standby generator sets.

Read through this manual and carefully follow all procedures and safety precautions to ensure proper generator operation and to avoid serious bodily injury. Keep this manual with the generator set for future reference. See Figure 1–1, 1–2, or 1–3 for identification and location of components.

Service requirements are minimal but are very important to the safe and reliable operation of your generator set; therefore, inspect associated parts often. It is recommended that an Authorized Service Dealer perform required servicing to keep your set in top condition.

All information found in this publication is based on data available at time of printing. Kohler Co. reserves the right to make changes to this literature and the products represented at any time without notice and without incurring obligation.

Service Assistance

For service or information, check the yellow pages of your telephone directory under the heading GENERATORS – ELECTRIC for the Authorized Kohler Service Dealer in your area.

KOHLER CO., Kohler, Wisconsin 53044
Phone 414–565–3381, Telex 26888,
Fax 414–565–3648
For Sales and Service in U.S.A. and Canada
Phone 1–800–544–2444

In any communications regarding your generator set, please include the MODEL, SPEC. and SERIAL numbers as found on the nameplate attached to the generator and the ENGINE number as found on the engine nameplate. Enter numbers in spaces provided below. This information will enable your Authorized Kohler Service Dealer to supply the correct part or data for your particular version. Part numbers do not appear in this manual due to variations in this series of generator set models.

Model No. .....

Specification No. .....

Serial No. .....

Engine No. .....

At the time of print, this manual applied to the model numbers and specification (spec.) numbers following. On occasion this manual may be used for specs. not listed below. These circumstances occur when similar new specs. are created after the printing of this manual and prior to the updated reprint; or in cases where the manual is deemed an acceptable substitute for a manual under development.

Model No.	Spec. No.	Wiring Diagrams	Controller	Cooling
6ROZ (6RFOZ)	126503	225088, ADV–5769	Relay	Radiator
6ROZ (6RFOZ)	126504	225088, ADV–5769 (relay) 225089, ADV–5771 (5–light) 225089, ADV–5772 (5–light) (600 Volt) 225142, ADV–5771 (remote)	Optional	Optional
10ROZ (10RFOZ)	126603	225088, ADV–5769	Relay	Radiator
10ROZ (10RFOZ)	126604	225088, ADV–5769 (relay) 225089, ADV–5771 (5–light) 225089, ADV–5772 (5–light) (600 Volt) 225142, ADV–5771 (remote)	Optional	Optional
15ROZ (15RFOZ)	126703	225088, ADV–5769	Relay	Radiator
15ROZ (15RFOZ)	126704	225088, ADV–5769 (relay) 225089, ADV–5771 (5–light) 225089, ADV–5772 (5–light) (600 Volt) 225142, ADV–5771 (remote)	Optional	Optional

Optional Controller is one of the following: Relay Controller, 5–Light Microprocessor Controller, or Remote 5–Light Microprocessor Controller.
Optional Cooling is one of the following: Radiator Cooling or City Water Cooling.

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Safety Precautions and Instructions

A Generator Set, like any other electro–mechanical device can pose potential dangers to life and limb if improperly maintained or imprudently operated. The best way to prevent accidents is to be aware of the potential dangers and to always use good common sense. In the interest of safety, some general precautions relating to operating of a Generator Set follow. Keep these in mind. This manual contains several types of safety precautions which are explained below.

⚠ DANGER

Danger is used to indicate the presence of a hazard which *will* cause *severe* personal injury, death, or substantial property damage if the warning is ignored.

⚠ WARNING

Warning is used to indicate the presence of a hazard which *can* cause *severe* personal injury, death, or substantial property damage if the warning is ignored.

⚠ CAUTION

Caution is used to indicate the presence of a hazard which *will* or *can* cause *minor* personal injury or property damage if the warning is ignored.

NOTE

Note is used to notify people of installation, operation, or maintenance information which is important but not hazard–related.

Safety decals are affixed to the generator set in prominent places to advise the operator or service technician of potentially hazardous situations. The decals are reproduced here to improve operator recognition and thereby increase decal effectiveness. For a further explanation of decal information, reference the accompanying safety precautions. Before operating or servicing the generator set, be sure you understand the message of these decals. Replace decals if missing or damaged.

MOVING PARTS

⚠ WARNING

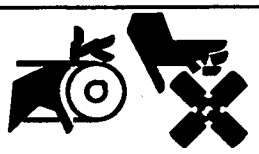
Hazardous voltage.

Moving rotor.

Can cause severe injury or death.

Do not operate generator set without all guards and electrical enclosures in place.

⚠ WARNING



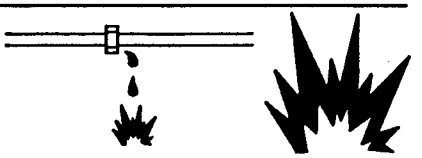
Rotating parts.
Can cause severe injury or death.

Do not operate generator set without all guards, screens, or covers in place.

Exposed moving parts can cause severe injury or death. Keep hands, feet, hair, and clothing away from belts and pulleys when unit is running. Replace guards, covers, and screens before operating generator set.

Flying projectiles can cause severe injury or death. Retorque all crankshaft and rotor hardware after servicing. When making adjustments or servicing generator set, do not loosen crankshaft hardware or rotor thru–bolt. If rotating crankshaft manually, direction should be clockwise only. Turning crankshaft bolt or rotor thru–bolt counterclockwise can loosen hardware and result in serious personal injury from hardware or pulley flying off engine while unit is running.

FUEL SYSTEM



⚠ WARNING

Explosive fuel vapors.
Can cause severe injury or death.

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

Explosive fuel vapors can cause severe injury or death. All fuels are highly explosive in a vapor state. Use extreme care when handling, storing, and using fuels. Store fuel 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 since spilled fuel may ignite on contact with hot parts or from ignition spark. Do not smoke or permit flame or spark to occur near potential sources of spilled fuel or fuel vapors. Keep fuel lines and connections tight and in good condition—don't replace flexible fuel lines with rigid lines. Flexible sections are used to avoid breakage due to vibration.

Explosive fuel vapors can cause severe injury or death. Storing gasoline and other volatile fuels in day or sub–base fuel tanks can cause an explosion. Store only diesel fuel in day or sub–base fuel tanks.

HEAVY EQUIPMENT

⚠ WARNING

Unbalanced weight.
Improper lift can cause severe injury, death, or equipment damage.

Do not use lifting eyes.
Use lifting bars thru holes in skid to lift set.

HAZARDOUS VOLTAGE/ ELECTRICAL SHOCK

⚠ WARNING

Hazardous voltage.

Moving rotor.

Can cause severe injury or death.

Do not operate generator set without all guards and electrical enclosures in place.

⚠ WARNING

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

When generator is used for standby power, use of automatic transfer switch is recommended to prevent inadvertent interconnection of standby and normal sources of supply.

Hazardous voltage can cause severe injury or death. Perform electrical service only as prescribed in equipment manual. Be sure that generator is properly grounded. Never touch electrical leads or appliances with wet hands, when standing in water, or on wet ground as the chance of electrocution is especially prevalent under such conditions. Wiring should be inspected at the interval recommended in the service schedule — replace leads that are frayed or in poor condition. The function of a generator set is to produce electricity and wherever electricity is present, there is the hazard of electrocution.

Hazardous voltage can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Do not contact electrical connections with tools or jewelry while adjustments are made. Remove wristwatch, rings, and jewelry that can cause short circuits.

Hazardous voltage can cause severe injury or death. Follow instructions of test equipment manufacturer when performing high voltage test on rotor or stator. Improper test procedure can damage equipment or lead to future generator failures.

Hazardous voltage can cause severe injury or death. The heat sink of the voltage regulator contains high voltage. Do not touch voltage regulator heat sink when testing or electrical shock will occur.

Hazardous voltage can cause severe injury or death. Electrical shock may occur if battery charger is not properly grounded. Connect battery charger enclosure to ground of a permanent wiring system. As an alternative, run an equipment-- grounding conductor with circuit conductors and connect to equipment–grounding terminal or lead on battery charger. Battery charger installation should be performed as prescribed in equipment manual and must comply with all local codes and ordinances.

Hazardous voltage can cause severe injury or death. Improper reconnection may damage battery charger and battery(ies), and create an electrical shock hazard. Installation must be done by a qualified electrician.

Hazardous voltage can cause severe injury or death. Service day tank ECM (Electrical Control Module) as prescribed in equipment manual. Before servicing, disconnect power to day tank. When day tank ECM "OFF" push button is engaged the unit is disabled. However, 120 VAC power is still present within the ECM as indicated by the "POWER ON" light. Be sure that generator and day tank are properly grounded. Do not operate when standing in water, on wet ground, or when your hands are wet.

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

Hazardous voltage can cause severe injury or death. Disconnect set from load by opening line circuit breaker or by disconnecting generator output leads from transfer switch and heavily taping ends of leads. If high voltage is transferred to load during test, personal injury and equipment damage may result. The GENERATOR SAFEGUARD BREAKER MUST NOT BE USED IN PLACE OF LINE CIRCUIT BREAKER!

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

BATTERY

⚠ WARNING

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

Use protective goggles and clothes. Can cause permanent damage to eyes, burn skin, and eat holes in clothing.

⚠ WARNING

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

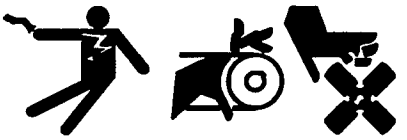
Locate in a well ventilated area. Keep explosive fumes away.

(Applies to optional Battery Charger)

Explosion can cause severe injury or death. Battery gases can cause an explosion. Do not smoke or permit flame or spark to occur near a battery at any time, particularly when it is being charged. Avoid contacting terminals with tools, etc. to prevent burns and to prevent sparks that could cause an explosion. Remove wristwatch, rings, and any other jewelry before handling battery. Never connect negative (–) battery cable to positive (+) connection terminal of starter solenoid. Do not test battery condition by shorting terminals together or sparks could ignite battery gases or fuel vapors. Any compartment containing batteries must be well ventilated to prevent accumulation of explosive gases. To avoid sparks, do not disturb battery charger connections while battery is being charged and always turn charger off before disconnecting battery connections. When disconnecting battery, remove negative lead first and reconnect it last.

Sulfuric acid in batteries can cause severe injury or death. Sulfuric acid in batteries can cause permanent damage to eyes, burn skin, and eat holes in clothing. Always wear splash–proof safety goggles when working around the battery. If battery electrolyte is splashed in the eyes or on skin, immediately flush the affected area for 15 minutes with large quantities of clean water. In the case of eye contact, seek immediate medical aid. Never add acid to a battery once the battery has been placed in service. Doing so may result in hazardous spattering of electrolyte.

ACCIDENTAL STARTING



⚠ WARNING

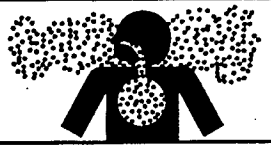
Accidental starting.
Can cause severe injury or death.

Disconnect battery cables before working on generator set (negative lead first and reconnect it last).

Accidental starting can cause severe injury or death. Turn Generator Master Switch to OFF position, disconnect power to battery charger, and remove battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator. The generator set can be started by automatic transfer switch or remote start/stop switch unless these precautions are followed.

EXHAUST SYSTEM

⚠ WARNING



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

The exhaust system must be leakproof and routinely inspected.

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

Carbon monoxide can cause severe nausea, fainting, or death. Diesel fumes can rapidly destroy copper tubing in diesel exhaust systems. Do not use copper tubing in diesel exhaust systems. Exhaust sulphur will cause rapid deterioration and this could result in exhaust/water leakage.

HAZARDOUS NOISE

⚠ CAUTION

Hazardous noise.
Can cause loss of hearing.

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

HOT PARTS

⚠ WARNING

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

Before removing pressure cap stop generator, allow to cool and loosen pressure cap to relieve pressure.

⚠ WARNING

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

Do not work on generator set until unit is allowed to cool.

Hot coolant can cause severe injury or death. Allow engine to cool and release pressure from cooling system before opening pressure cap. To release pressure, cover the pressure cap with a thick cloth then turn it slowly counterclockwise to the first stop. After pressure has been completely released and the engine has cooled, remove cap. If generator set is equipped with a coolant recovery tank, check coolant level at tank.

Hot parts can cause severe injury or death. Avoid touching generator field or exciter armature. Generator field and exciter armature will get hot if shorted.

Hot parts can cause severe injury or death. Do not touch hot engine parts. An engine gets hot while running and exhaust system components get extremely hot.

ENGINE BACKFIRE/FLASH FIRE

⚠ WARNING

Fire.
Can cause severe injury or death.

Do not smoke or permit flame or spark to occur near fuel or fuel system.

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

NOTES

NOTICE

This generator set has been rewired from its name-plate voltage to:

246242

NOTICE

This is a positive terminal only.
Do not attach negative lead!

NOTE

Wipe up all spilled diesel fuel after bleeding system. Wash hands after any contact with fuel oil.

NOTE

HARDWARE DAMAGE! Engine and generator may make use of both American Standard and metric hardware. Be sure to use the correct size tools to prevent rounding of bolt heads and nuts.

NOTE

When replacing hardware, do not substitute with inferior grade hardware. Screws and nuts are available in different hardness ratings. American Standard hardware uses a series of markings and metric hardware uses a numeric system to indicate hardness. Check markings on bolt head and nuts for proper identification.

NOTE

Special attention should be given when checking for proper coolant level. After the coolant has been drained, it normally requires some time before complete refill of the engine water jacket takes place.

NOTE

ENGINE DAMAGE! Failure to bleed air from cooling system may cause overheating and subsequent damage to engine.

NOTE

Charge only LEAD–ACID or NICKEL–CADMIUM batteries with Kohler battery charger.

Section 1. Specifications

6ROZ/6RFOZ

General

	6ROZ	6RFOZ
Dimensions – L x W x H in. (mm)	53.5 x 29 x 35.8 (1359 x 737 x 909)	
Weight – lbs. (kg)	714 (324)	714 (324)
Air Requirements (Radiator model)		
– Combustion – cfm (cmm)	30 (0.85)	24 (0.68)
– Cooling – cfm (cmm)	1815 (51)	1512 (43)

Fuel Consumption	Diesel – gph (Lph)			
Load	25%	50%	75%	100%
6ROZ	0.15 (0.6)	0.31 (1.2)	0.46 (1.7)	0.61 (2.3)
6RFOZ	0.13 (0.5)	0.26 (1.0)	0.38 (1.4)	0.51 (1.9)

Engine

Some general engine specifications are listed below. Refer to the appropriate service section and the engine service manual for specific service details.

Manufacturer	Yanmar
Model	3TN75E–RK
Cycle	4
Number Cylinders	3
Combustion System	Direct Injection
Compression Ratio	17.6:1
Displacement – cu.in. (cc)	61 (994)
Rated Horsepower	12.7 (1800 rpm), 10.6 (1500 rpm)
RPM	1800 (60 Hz), 1500 (50 Hz)
Bore – in. (mm)	2.953 (75)
Stroke – in. (mm)	2.953 (75)
Valve Material	Heat Resistant Steel
Valve Clearance – in. (mm)	
Intake	0.008 (0.2)
Exhaust	0.008 (0.2)
Cylinder Block Material	Cast Iron
Cylinder Head Tightening Torque – ft. lbs (Nm)	Step 1: 24–26 (3.4 – 3.6) Step 2: 49–52 (6.8 – 7.2)
Cylinder Head Material	Cast Iron
Piston Rings	2 Compression/1 Oil
Crankshaft Material	Carbon Steel
Main Bearings, Number & Type	4, Replaceable Sleeves
Governor	Mechanical
Lubrication System	Full Pressure
Oil Capacity (with filter) – qts. (L)	3.6 (3.4)
Oil Type (API)	CC or CD
Oil Pressure – psi (kPa)	43–57 (294 – 392)
Direction of Rotation (from Generator End)	Counterclockwise

Fuel Type	Diesel – ASTM D975 No. 2–D (Cetane No. > 45)
Aspiration	Natural Aspiration
Fuel Injection Pressure – psi (kPa)	2844 (19609)
Battery Voltage	12
Battery Ground	Negative
Battery Recommendation (min.)	500 Cold Cranking Amps.
Battery Charging	Belt–Driven Alternator
Starter Motor	12–Volt, Positive Engagement
Cooling System .	Water–Cooled
Cooling System Capacity – gal. (L)	2 (7.6)
Recommended Coolant	50% ethylene glycol 50% clean, softened water
Engine Firing Order	1–3–2
Timing (B.T.D.C.)	16° ± 1°
Fan Belt Tension (Deflection) – in. (mm)	0.4 – 0.6 (10 – 15)
Air Cleaner	Dry Paper Element

Generator

	6ROZ		6RFOZ
Rated kW		see chart following	
Frequency – Hz	60		50
RPM	1800		1500
Rated Voltage	Broadrange/ Reconnectable		Broadrange/ Reconnectable
Excitation Method	Brushless Exciter		Brushless Exciter
Coupling Type	Flexible Disc		Flexible Disc
Magnetic Pick–up Air Gap	0.030 in. (0.76 mm) +/–0.010 in. (0.25 mm)		
Rotor Resistance (ohms)*(cold)	5.1 (Main Field) 1.05 (Exciter Armature)		5.1 (Main Field) 1.05 (Exciter Armature)
Stator Resistance (ohms)*(cold)			
Leads:			
1–4, 2–5, 3–6, 7–10, 8–11, 9–12	0.10		0.10
55–66	2.3		2.3
Exciter Field	0.56		0.56
Stator Output Voltages with Separately Excited Rotor Using 12 Volt Battery			
1–4, 2–5, 3–6, 7–10, 8–11, 9–12	175		175
55–66	190		190
Voltage Regulator Type	PowerBoost V		PowerBoost V
Number of Output Leads	12		12
Insulation (Rotor and Stator)		Class F, Epoxy Varnish Vacuum Impregnated	
Winding Material		Copper	
Bearing, Quantity and Type		1, Replaceable Ball	
Circuit Protection			
Controller		See Section 2, "Circuit Protection"	
Generator		Optional Line Circuit Breaker (Size Dependent on Voltage)	

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

DERATION: The output capability of the generator set will decrease 4% for each 1000 feet (305 meters) above sea level and 1% for each 10°F (5.5°C) increase in ambient temperature above 85°F (29°C). Ambient temperature is measured at air cleaner inlet.

Model Series	Voltage Code	Voltage	Standby Amps.	Generator Model	Phase	Hz.	Power Factor	Continuous Standby Ratings kW/kVA	Prime Rating kW/kVA
6ROZ	01	100/200	20	4J3	3	60	0.8	5.5/6.9	5/6.2
6ROZ	01	120/240	18	4J3	3	60	0.8	6/7.5	5.5/6.9
6ROZ	51	139/240	18	4J3	3	60	0.8	6/7.5	5.5/6.9
6ROZ	51	127/220	20	4J3	3	60	0.8	6/7.5	5.5/6.9
6ROZ	61	120/240	25	4H3	1	60	1.0	6/6	4.5/4.5
6ROZ	71	277/480	9	4J3	3	60	0.8	6/7.5	5.5/6.9
6ROZ	71	220/380	11	4J3	3	60	0.8	6/7.5	5.5/6.9
6ROZ	81	120/208	21	4J3	3	60	0.8	6/7.5	5.5/6.9
6ROZ	91	347/600	7	4J3	3	60	0.8	6/7.5	5.5/6.9
6RFOZ	01	100/200	18	4J3	3	50	0.8	5/6.2	4.5/5.6
6RFOZ	01	110/220	16	4J3	3	50	0.8	5/6.2	4.5/5.6
6RFOZ	01	115/230	16	4J3	3	50	0.8	5/6.2	4.5/5.6
6RFOZ	51	110/190	19	4J3	3	50	0.8	5/6.2	4.5/5.6
6RFOZ	51	127/220	16	4J3	3	50	0.8	5/6.2	4.5/5.6
6RFOZ	61	110/220	23	4H3	1	50	1.0	5/5	4.5/4.5
6RFOZ	61	115/230	22	4H3	1	50	1.0	5/5	4.5/4.5
6RFOZ	71	220/380	10	4J3	3	50	0.8	5/6.2	4.5/5.5
6RFOZ	71	230/400	9	4J3	3	50	0.8	5/6.2	4.5/5.5
6RFOZ	71	240/415	9	4J3	3	50	0.8	5/6.2	4.5/5.5
6RFOZ	81	120/208	17	4J3	3	50	0.8	5/6.2	4.5/5.5

1. Controller
2. Fuel Solenoid
3. Fuel Filter
4. Mechanical Governor
5. Air Cleaner
6. High Engine Temperature Shutdown
7. Coolant Fill
8. Low Coolant Level Shutdown
9. Injectors
10. Fuel Injection Pump
11. Oil Fill
12. Coolant Drain
13. Fuel Injection Pump Priming Lever
14. Oil Filter
15. Oil Check
16. Oil Drain
17. Low Oil Pressure Switch
18. Nameplate
19. Air Intake Connection
20. Voltage Regulator
21. Circuit Breakers
22. Starter Solenoid
23. Starter
24. Belt Guard
25. Battery Charging Alternator
26. Radiator

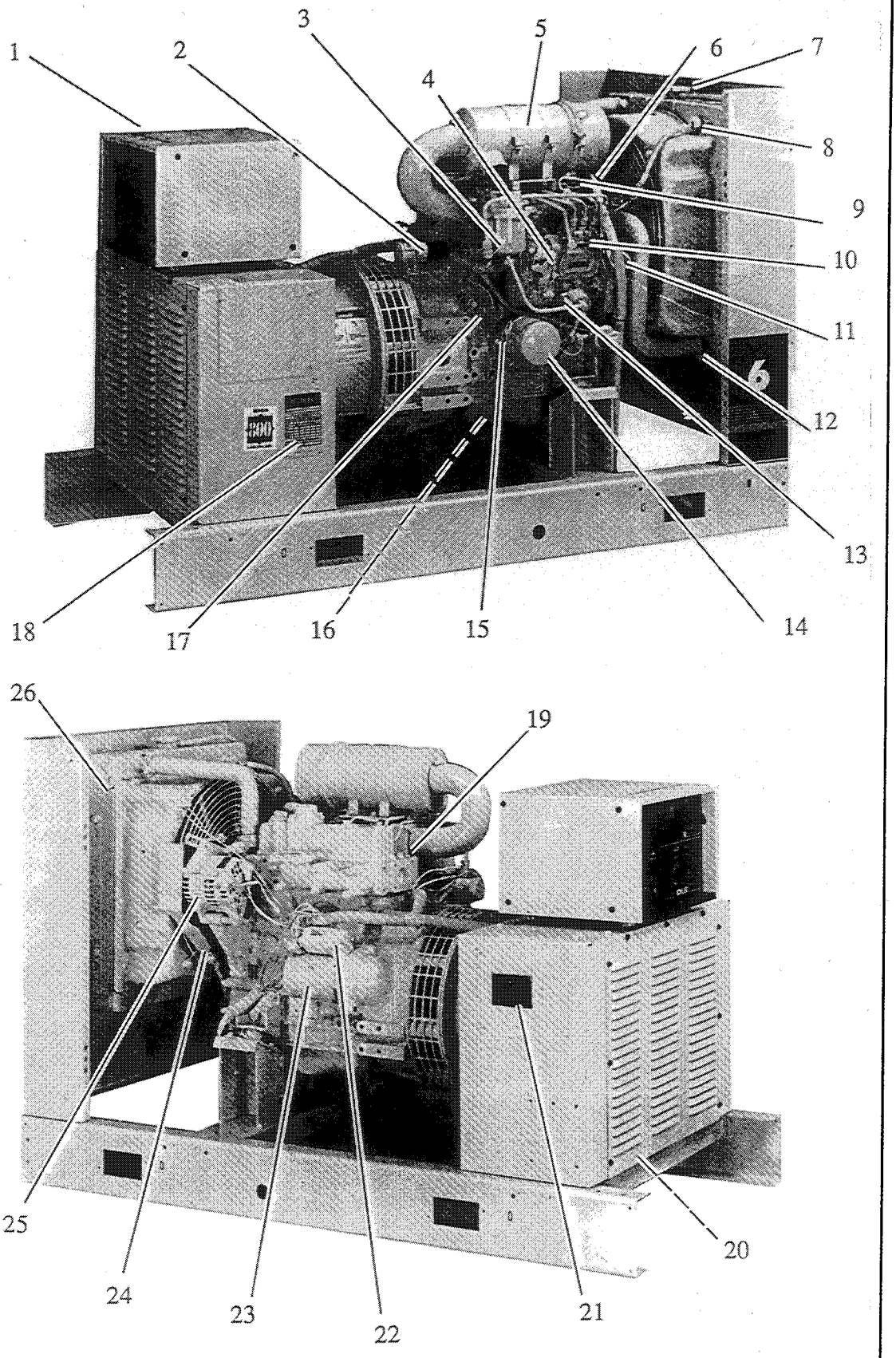


Figure 1–1. Service Views – 6ROZ/6RFOZ Generator Sets

10ROZ/10RFOZ

General

	10ROZ	10RFOZ
Dimensions – L x W x H —in. (mm)	53.5 x 29 x 35.8 (1359 x 737 x 909)	
Weight – lbs. (kg)	798 (362)	798 (362)
Air Requirements (Radiator model)		
– Combustion – cfm (cmm)	39 (1.1)	32 (0.9)
– Cooling – cfm (cmm)	1815 (51)	1512 (43)

Fuel Consumption	Diesel – gph (Lph)			
Load	25%	50%	75%	100%
10ROZ	0.3 (1.1)	0.6 (2.3)	0.8 (3)	1.1 (4.2)
10RFOZ	0.2 (0.8)	0.5 (1.9)	0.7 (2.6)	0.9 (3.4)

Engine

Some general engine specifications are listed below. Refer to the appropriate service section and the engine service manual for specific service details.

Manufacturer	Yanmar
Model	3TN84E–RK
Cycle	4
Number Cylinders	3
Combustion System	Direct Injection
Compression Ratio	17.79:1
Displacement – cu.in. (cc)	87 (1430)
Rated Horsepower	19 (1800 rpm), 14 (1500 rpm)
RPM	1800 (60 Hz), 1500 (50 Hz)
Bore – in. (mm)	3.307 (84)
Stroke – in. (mm)	3.386 (86)
Valve Material	Heat Resistant Steel
Valve Clearance – in. (mm)	
Intake	0.008 (0.2)
Exhaust	0.008 (0.2)
Cylinder Block Material	Cast Iron
Cylinder Head Tightening Torque – ft. lbs (Nm)	Step 1: 25–31 (3.5 – 4.3) Step 2: 54–61.5 (7.5 – 8.5)
Cylinder Head Material	Cast Iron
Piston Rings	2 Compression/1 Oil
Crankshaft Material	Carbon Steel
Main Bearings, Number & Type	4, Replaceable Sleeves
Governor	Mechanical
Lubrication System	Full Pressure
Oil Capacity (with filter) – qts. (L)	5 (4.7)
Oil Type (API)	CC or CD
Oil Pressure – psi (kPa)	43–57 (294 – 392)
Direction of Rotation (from Generator End)	Counterclockwise

Fuel Type	Diesel – ASTM D975 NO. 2–D (Cetane No. > 45)
Aspiration	Natural Aspiration
Fuel Injection Pressure – psi (kPa)	2844 (19609)
Battery Voltage	12
Battery Ground	Negative
Battery Recommendation (min.)	500 Cold Cranking Amps.
Battery Charging	Belt–Driven Alternator
Starter Motor	12–Volt, Positive Engagement
Cooling System .	Water–Cooled
Cooling System Capacity – gal. (L)	2 (7.6)
Recommended Coolant	50% ethylene glycol 50% clean, softened water
Engine Firing Order	1–3–2
Timing (B.T.D.C.)	16° ± 1°
Air Cleaner	Dry Paper Element

Generator

	10ROZ	10RFOZ
Rated kW	see chart following	
Frequency – Hz	60	50
RPM	1800	1500
Rated Voltage	Broadrange/ Reconnectable	Broadrange/ Reconnectable
Excitation Method	Brushless Exciter	Brushless Exciter
Coupling Type	Flexible Disc	Flexible Disc
Magnetic Pick–up Air Gap	0.030 in. (0.76 mm) +/–0.010 in. (0.25 mm)	
Rotor Resistance (ohms)*(cold)	6.7 (Main Field) 1.05 (Exciter Armature)	6.7 (Main Field) 1.05 (Exciter Armature)
Stator Resistance (ohms)*(cold)		
Leads:		
1–4, 2–5, 3–6, 7–10, 8–11, 9–12	0.05	0.05
55–66	1.4	1.4
Exciter Field	0.56	0.56
Stator Output Voltages with Separately Excited Rotor Using 12 Volt Battery		
1–4, 2–5, 3–6, 7–10, 8–11, 9–12	175	175
55–66	190	190
Voltage Regulator Type	PowerBoost V	PowerBoost V
Number of Output Leads	12	12
Insulation (Rotor and Stator)	Class F, Epoxy Varnish Vacuum Impregnated	
Winding Material	Copper	
Bearing, Quantity and Type	1, Replaceable Ball	
Circuit Protection		
Controller	See Section 2, "Circuit Protection"	
Generator	Optional Line Circuit Breaker (Size Dependent on Voltage)	

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

DERATION: The output capability of the generator set will decrease 4% for each 1000 feet (305 meters) above sea level and 1% for each 10°F (5.5°C) increase in ambient temperature above 85°F (29°C). Ambient temperature is measured at air cleaner inlet.

Model Series	Voltage Code	Voltage	Standby Amps.	Generator Model	Phase	Hz.	Power Factor	Continuous Standby Ratings kW/kVA	Prime Rating kW/kVA
10ROZ	01	100/200	34	4J6	3	60	0.8	9.5/11.9	8.5/11.3
10ROZ	01	120/240	30	4J6	3	60	0.8	10/12.5	9/11.3
10ROZ	51	139/240	30	4J6	3	60	0.8	10/12.5	9/11.3
10ROZ	51	127/220	33	4J6	3	60	0.8	10/12.5	9/11.3
10ROZ	61	120/240	42	4H5	1	60	1.0	10/10	9/9
10ROZ	71	277/480	15	4J6	3	60	0.8	10/12.5	9/11.3
10ROZ	71	220/380	19	4J6	3	60	0.8	10/12.5	9/11.3
10ROZ	81	120/208	35	4J6	3	60	0.8	10/12.5	9/11.3
10ROZ	91	347/600	12	4J6	3	60	0.8	10/12.5	9/11.3
10RFOZ	01	100/200	26	4J6	3	50	0.8	8/10	7.5/9.4
10RFOZ	01	110/220	29	4J6	3	50	0.8	8/10	7.5/9.4
10RFOZ	01	115/230	25	4J6	3	50	0.8	8/10	7.5/9.4
10RFOZ	51	110/190	30	4J6	3	50	0.8	8/10	7.5/9.4
10RFOZ	51	127/220	26	4J6	3	50	0.8	8/10	7.5/9.4
10RFOZ	61	110/220	36	4H5	1	50	1.0	8/8	7.5/7.5
10RFOZ	61	115/230	35	4H5	1	50	1.0	8/8	7.5/7.5
10RFOZ	71	220/380	15	4J6	3	50	0.8	8/10	7.5/9.4
10RFOZ	71	230/400	14	4J6	3	50	0.8	8/10	7.5/9.4
10RFOZ	71	240/415	14	4J6	3	50	0.8	8/10	7.5/9.4
10RFOZ	81	120/208	28	4J6	3	50	0.8	8/10	7.5/9.4

1. Controller
2. Fuel Solenoid
3. Air Cleaner
4. Mechanical Governor
5. High Engine Temperature Shutdown
6. Coolant Fill
7. Low Coolant Level Shutdown
8. Injectors
9. Fuel Injection Pump
10. Oil Fill
11. Coolant Drain
12. Oil Filter
13. Oil Check
14. Fuel Filter
15. Oil Drain
16. Fuel Pump
17. Low Oil Pressure Switch
18. Nameplate
19. Air Intake Connection
20. Voltage Regulator
21. Circuit Breakers
22. Starter Solenoid
23. Starter
24. Belt Guard
25. Battery Charging Alternator
26. Radiator

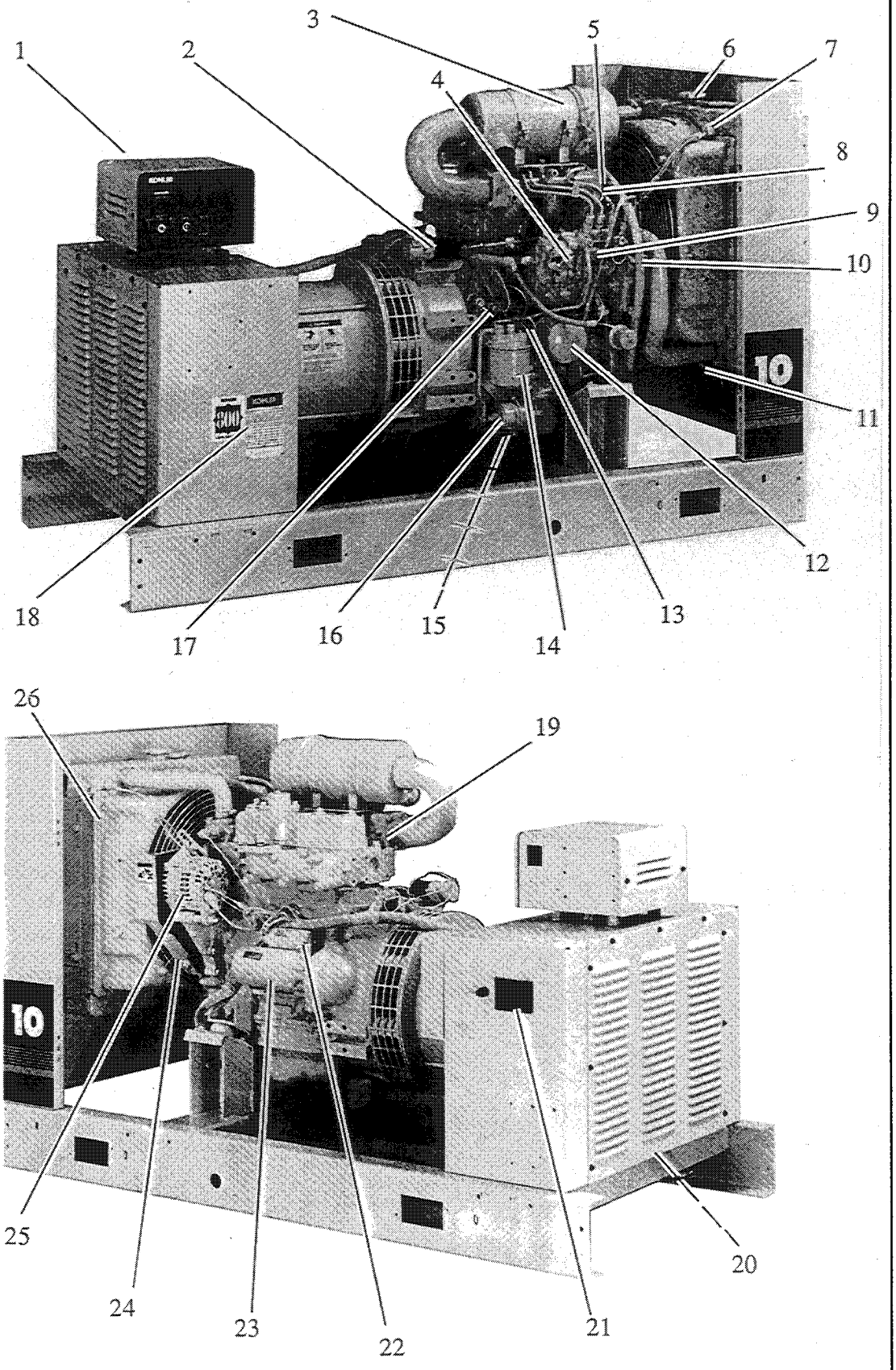


Figure 1–2. Service Views – 10ROZ/10RFOZ Generator Sets

15ROZ/15RFOZ

General

	15ROZ		15RFOZ
Dimensions – L x W x H —in. (mm)		63 x 29 x 35.8 (1600 x 737 x 909)	
Weight – lbs. (kg)	901 (409)		901 (409)
Air Requirements (Radiator model)			
– Combustion – cfm (cmm)	52 (1.5)		43 (1.2)
– Cooling – cfm (cmm)	1815 (51)		1512 (43)

Fuel Consumption	Diesel – gph (Lph)			
Load	25%	50%	75%	100%
15ROZ	0.6 (2.3)	0.8 (3)	1.1 (4.2)	1.4 (5.3)
15RFOZ	0.5 (1.9)	0.7 (2.6)	0.9 (3.4)	1.2 (4.5)

Engine

Some general engine specifications are listed below. Refer to the appropriate service section and the engine service manual for specific service details.

Manufacturer	Yanmar
Model	4TN84E–RK
Cycle	4
Number Cylinders	4
Combustion System	Direct Injection
Compression Ratio	17.79:1
Displacement – cu.in. (cc)	116 (1910)
Rated Horsepower	27 (1800 rpm) 23 (1500 rpm)
RPM	1800 (60 Hz), 1500 (50 Hz)
Bore – in. (mm)	3.307 (84)
Stroke – in. (mm)	3.386 (86)
Valve Material	Heat Resistant Steel
Valve Clearance – in. (mm)	
Intake	0.008 (0.2)
Exhaust	0.008 (0.2)
Cylinder Block Material	Cast Iron
Cylinder Head Tightening Torque – ft. lbs (Nm)	Step 1: 25–31 (3.5 – 4.3) Step 2: 54–61.5 (7.5 – 8.5)
Cylinder Head Material	Cast Iron
Piston Rings	2 Compression/1 Oil
Crankshaft Material	Carbon Steel
Main Bearings, Number & Type	4, Replaceable Sleeves
Governor	Mechanical
Lubrication System	Full Pressure
Oil Capacity (with filter) – qts. (L)	6.1 (5.8)
Oil Type (API)	CC or CD
Oil Pressure – psi (kPa)	43–57 (294 – 392)
Direction of Rotation (from Generator End)	Counterclockwise

Fuel Type	Diesel – ASTM D975 NO. 2–D (Cetane No. > 45)
Aspiration	Natural Aspiration
Fuel Injection Pressure – psi (kPa)	2844 (19609)
Battery Voltage	12
Battery Ground	Negative
Battery Recommendation (min.)	500 Cold Cranking Amps.
Battery Charging	Belt–Driven Alternator
Starter Motor	12–Volt, Positive Engagement
Cooling System .	Water–Cooled
Cooling System Capacity – gal. (L)	4.7 (17.8)
Recommended Coolant	50% ethylene glycol 50% clean, softened water
Engine Firing Order	1–3–4–2
Timing (B.T.D.C.)	16° ± 1°
Air Cleaner	Dry Paper Element

Generator

	15ROZ		15RFOZ
Rated kW		see chart following	
Frequency – Hz	60		50
RPM	1800		1500
Rated Voltage	Broadrange/ Reconnectable		Broadrange/ Reconnectable
Excitation Method	Brushless Exciter		Brushless Exciter
Coupling Type	Flexible Disc		Flexible Disc
Magnetic Pick–up Air Gap	0.030 in. (0.76 mm) +/–0.010 in. (0.25 mm)		
Rotor Resistance (ohms)* (cold)	7.8 (Main Field) 0.71 (Exciter Armature)		7.8 (Main Field) 0.71 (Exciter Armature)
Stator Resistance (ohms)* (cold)			
Leads			
1–4, 2–5, 3–6, 7–10, 8–11, 9–12	0.04		0.04
55–66	1.3		1.3
Exciter Field	0.64		0.64
Stator Output Voltages with Separately Excited Rotor Using 12 Volt Battery			
1–4, 2–5, 3–6, 7–10, 8–11, 9–12	175		175
55–66	190		190
Voltage Regulator Type	PowerBoost V		PowerBoost V
Number of Output Leads	12		12
Insulation (Rotor and Stator)		Class F, Epoxy Varnish Vacuum Impregnated	
Winding Material		Copper	
Bearing, Quantity and Type		1, Replaceable Ball	
Circuit Protection			
– Controller		See Section 2, "Circuit Protection"	
– Generator		Optional Line Circuit Breaker (Size Dependent on Voltage)	

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

DERATION: The output capability of the generator set will decrease 4% for each 1000 feet (305 meters) above sea level and 1% for each 10°F (5.5°C) increase in ambient temperature above 85°F (29°C). Ambient temperature is measured at air cleaner inlet.

Model Series	Voltage Code	Voltage	Standby Amps.	Generator Model	Phase	Hz.	Power Factor	Continuous Standby Ratings kW/kVA	Prime Rating kW/kVA
15ROZ	01	100/200	52	4J7	3	60	0.8	14.5/18.1	13/16.3
15ROZ	01	120/240	45	4J7	3	60	0.8	15/18.8	13.5/16.9
15ROZ	51	139/240	45	4J7	3	60	0.8	15/18.8	13.5/16.9
15ROZ	51	127/220	49	4J7	3	60	0.8	15/18.8	13.5/16.9
15ROZ	61	120/240	63	4H7	1	60	1.0	15/15	13.5/13.5
15ROZ	71	277/480	23	4J7	3	60	0.8	15/18.8	13.5/16.9
15ROZ	71	220/380	29	4J7	3	60	0.8	15/18.8	13.5/16.9
15ROZ	81	120/208	52	4J7	3	60	0.8	15/18.8	13.5/16.9
15ROZ	91	347/600	18	4J7	3	60	0.8	15/18.8	13.5/16.9
15RFOZ	01	100/200	45	4J7	3	50	0.8	12.5/15.6	11/13.8
15RFOZ	01	110/220	41	4J7	3	50	0.8	12.5/15.6	11/13.8
15RFOZ	01	115/230	39	4J7	3	50	0.8	12.5/15.6	11/13.8
15RFOZ	51	110/190	48	4J7	3	50	0.8	12.5/15.6	11/13.8
15RFOZ	51	127/220	41	4J7	3	50	0.8	12.5/15.6	11/13.8
15RFOZ	61	110/220	57	4H7	1	50	1.0	12.5/12.5	11/11
15RFOZ	61	115/230	54	4H7	1	50	1.0	12.5/12.5	11/11
15RFOZ	71	220/380	24	4J7	3	50	0.8	12.5/15.6	11/13.8
15RFOZ	71	230/400	23	4J7	3	50	0.8	12.5/15.6	11/13.8
15RFOZ	71	240/415	22	4J7	3	50	0.8	12.5/15.6	11/13.8
15RFOZ	81	120/208	44	4J7	3	50	0.8	12.5/15.6	11/13.8

1. Controller
2. Fuel Solenoid
3. Air Cleaner
4. Mechanical Governor
5. High Engine Temperature Shutdown
6. Coolant Fill
7. Low Coolant Level Shutdown
8. Injectors
9. Fuel Injection Pump
10. Oil Fill
11. Coolant Drain
12. Oil Drain
13. Oil Filter
14. Oil Check
15. Fuel Pump
16. Fuel Filter
17. Low Oil Pressure Switch
18. Nameplate
19. Air Intake Connection
20. Voltage Regulator
21. Circuit Breakers
22. Starter Solenoid
23. Starter
24. Belt Guard
25. Battery Charging Alternator
26. Radiator

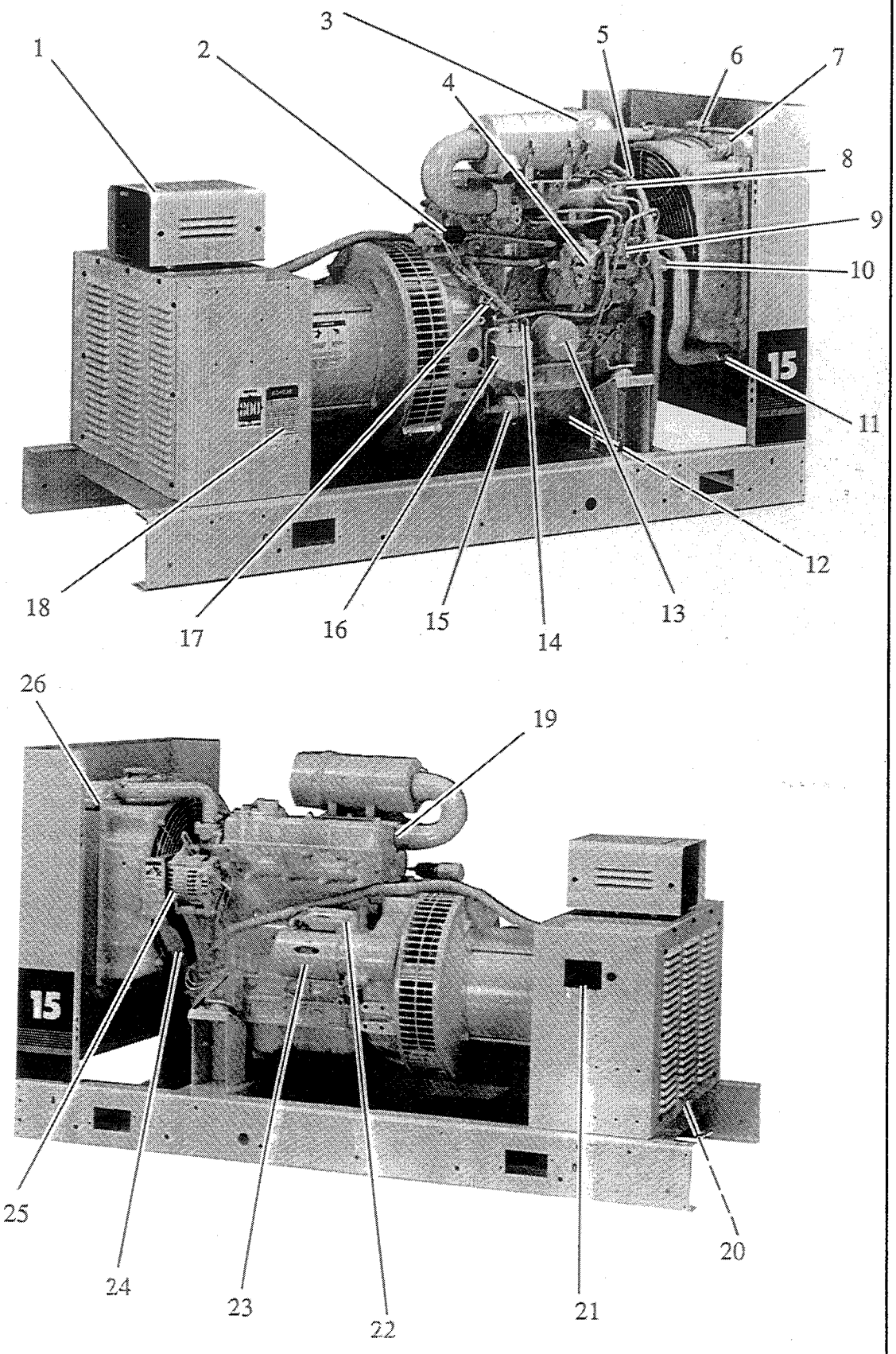


Figure 1–3. Service Views – 15ROZ/15RFOZ Generator Sets

Installation

Distance Between Generator Set and Battery	Cable Size (AWG) At 0°F (–18°C)	At 32°F (0°C)	At 75°F (24°C)
40 Feet (12.2 m)	00	0	1
30 Feet (9.1 m)	0	1	2
25 Feet (7.6 m)	1	2	4
20 Feet (6.1 m)	2	2	6
15 Feet (4.6 m)	2	4	6
10 Feet (3 m)	4	6	8
5 Feet (1.5 m)	6	6	8
2.5 Feet (.8 m)	8	8	8

Battery Cable Size

Torque Specifications

Generator

	6ROZ/6RFOZ	10ROZ/10RFOZ	15ROZ/15RFOZ
Overbolt torque – ft. lbs. (Nm)	18 (24)	18 (24)	18 (24)
Fan to rotor bolt torque ft. lbs. (Nm)	22 (29)	22 (29)	22 (29)
Drive disc to rotor bolt torque ft. lbs. (Nm)	45 (61)	45 (61)	45 (61)
Drive disc to flywheel bolt torque ft. lbs. (Nm)	14 (19)	14 (19)	–
Drive disc to flywheel nut torque ft. lbs. (Nm)	–	–	14 (19)
Generator adapter to flywheel housing bolt torque ft. lbs. (Nm)	27 (37)	27 (37)	25 (34)
Magnetic pickup actuator to rotor bolt torque ft. lbs. (Nm)	8 (11)	8 (11)	8 (11)

General Fastener Assembly Guidelines

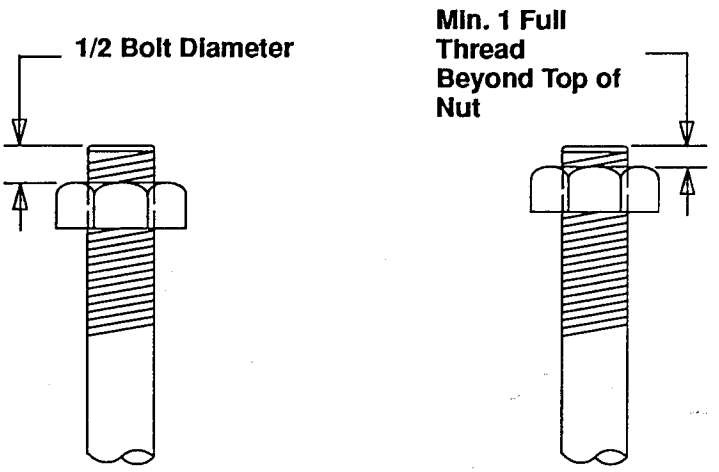
To help identify proper fastening techniques, use this information in cases where the unit is unassembled and no documentation or reference for reassembly has been made.

When bolt/screw length is not given, use Example A for recommendations. 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. See Example A.

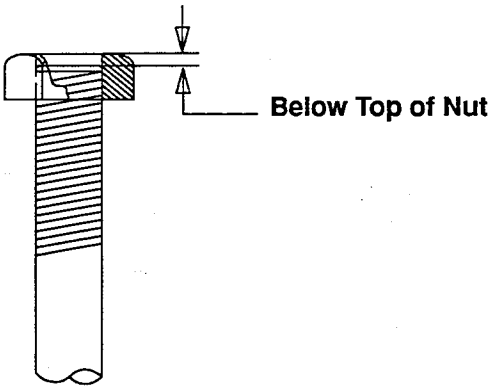
Split lock washers will no longer be used as a locking device. For hardware up to 1/2 in. dia., a whiz nut (serrated flange) will be incorporated. The locking method utilized above 1/2 in. dia. will be SAE flat washers and preloading (torque) of the bolt/screw. Reference *General Torque Specifications* following for situations when no torque spec. is given with the instructions.

For cases where hardware size (diameter and threads per inch) is given but no indication of type of additional hardware (washers, nuts) is shown, use illustration in Example B.

Preferred Nut/Bolt Clearance



Unacceptable Nut/Bolt Clearance



Example A. Acceptable Bolt Lengths

Steps for common hardware application:

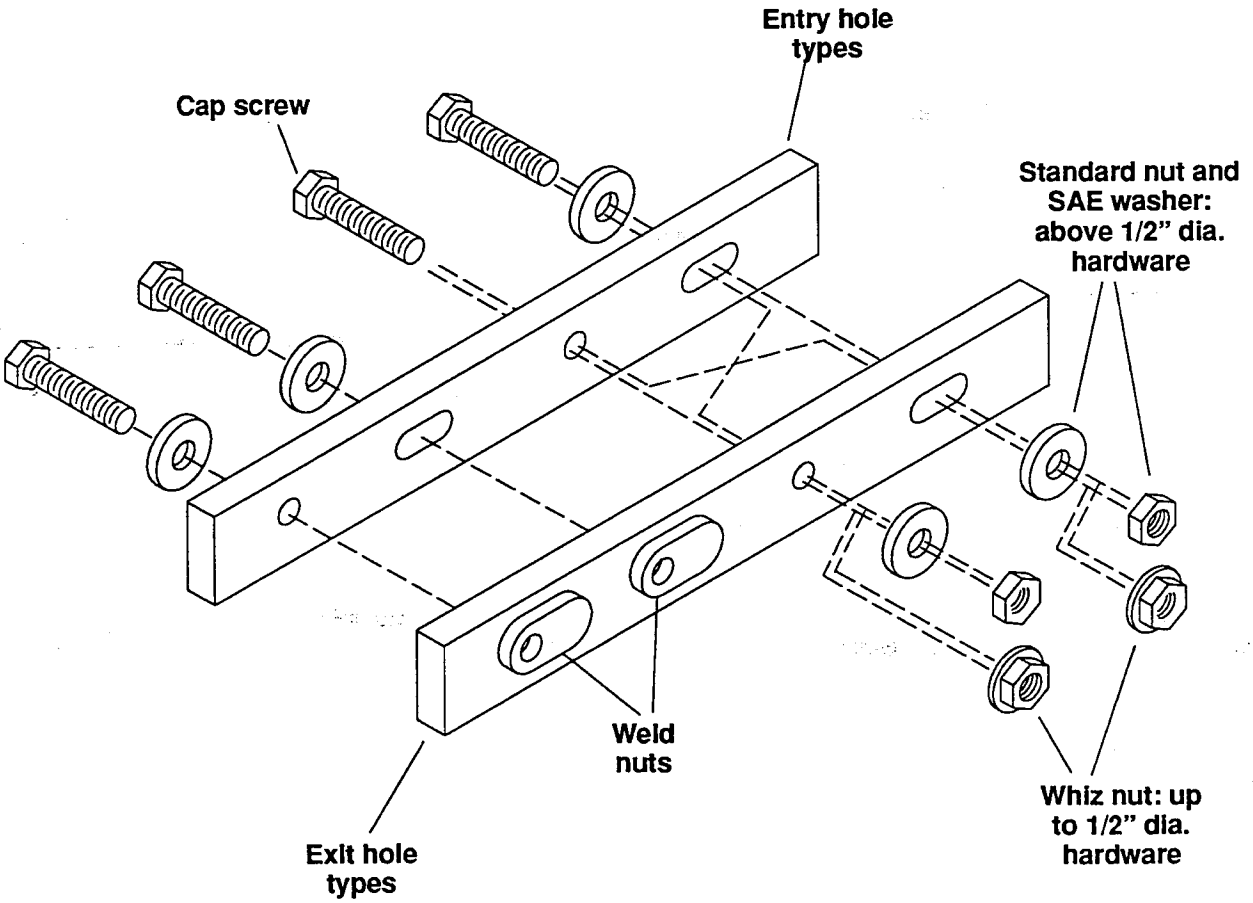
1. Determine entry hole type: round, or slotted.
2. Determine exit hole type: fixed female thread (weld nut), round, or slotted.

a. For non–weld nut exit holes (round and slotted), determine if hardware is greater than 1/2 inch in diameter, or up to 1/2 inch in diameter. Hardware that is greater than 1/2 inch in diameter takes a standard nut and SAE washer. Hardware up to 1/2 inch in diameter can take a properly torqued whiz nut. See diagram below.

3. Follow these SAE washer rules:

   a. Always use a washer between hardware and a slot.
   b. Always use a washer under a nut.
   c. Use a washer under a bolt when the female thread us fixed (weld nut).

4. Refer to the diagram below, which depicts the preceding hardware configuration possibilities.



Example B. Acceptable Hardware Combinations

General Torque Specifications

Use the following specifications for SAE fasteners when no torque values are given elsewhere in this manual for a specified bolt. The values given are for clean, dry threads.

Size	Measurement	Assembled In Cast Iron or Steel Grade 2	Grade 5	Grade 8	Assembled In Aluminum Grade 2 or 5
8–32	in. lbs. (Nm)	20 (2.3)	25 (2.8)	–	20 (2.3)
10–24	in. lbs. (Nm)	32 (3.6)	40 (4.5)	–	32 (3.6)
10–32	in. lbs. (Nm)	32 (3.6)	40 (4.5)	–	–
1/4–20	in. lbs. (Nm)	70 (7.9)	115 (13)	165 (18.6)	70 (7.9)
1/4–28	in. lbs. (Nm)	85 (9.6)	140 (15.8)	200 (22.6)	–
5/16–18	in. lbs. (Nm)	150 (17)	250 (28.2)	350 (40)	150 (17)
5/16–24	in. lbs. (Nm)	165 (18.6)	270 (30.5)	360 (41)	–
3/8–16	ft. lbs. (Nm)	22 (30)	35 (45)	50 (65)	
3/8–24	ft. lbs. (Nm)	25 (35)	40 (54)	60 (80)	
7/16–14	ft. lbs. (Nm)	35 (45)	55 (75)	80 (108)	
7/16–20	ft. lbs. (Nm)	45 (54)	75 (105)	105 (142)	
1/2–13	ft. lbs. (Nm)	50 (65)	80 (110)	115 (155)	
1/2–20	ft. lbs. (Nm)	70 (95)	105 (140)	165 (224)	
9/16–12	ft. lbs. (Nm)	75 (105)	125 (165)	175 (237)	
9/16–18	ft. lbs. (Nm)	100 (136)	165 (224)	230 (312)	
5/8–11	ft. lbs. (Nm)	110(149)	180 (244)	260 (353)	
5/8–18	ft. lbs. (Nm)	140 (190)	230 (312)	330 (447)	
3/4–10	ft. lbs. (Nm)	150 (203)	245 (322)	350 (475)	
3/4–16	ft. lbs. (Nm)	200 (271)	325 (440)	470 (637)	

Use the following specifications for metric fasteners when no torque values are given elsewhere in this manual for a specified bolt. These values on based on clean, dry threads. Reduce the value by 20% if new plated screws are used. Screws threaded into aluminum must have two diameters of threads engaged and may require 30% or more reduction in the torque.

Size	Measurement	5.8	6.9	8.8	10.9	12.9
6	ft. lbs. (Nm)	3 (5)	5 (10)	5 (10)	10 (15)	10 (15)
7	ft. lbs. (Nm)	5 (10)	5 (10)	10 (15)	15 (20)	20 (25)
8	ft. lbs. (Nm)	10 (15)	15 (20)	20 (25)	25 (35)	30 (40)
10	ft. lbs. (Nm)	20 (25)	30 (40)	35 (45)	50 (65)	55 (75)
12	ft. lbs. (Nm)	35 (45)	50 (65)	60 (80)	85 (115)	105 (140)
14	ft. lbs. (Nm)	55 (75)	75 (105)	95 (130)	135 (180)	160 (215)
16	ft. lbs. (Nm)	80 (110)	125 (165)	145 (195)	195 (265)	235 (320)
18	ft. lbs. (Nm)	115 (155)	170 (230)	190 (260)	265 (360)	325 (440)

Section 2. Operation

PRESTART CHECKLIST

The following items should be checked before each start–up of manually controlled generator sets and at regular intervals on sets equipped with automatic transfer switches. See the generator set operation/maintenance manual for specific service procedures.

OIL LEVEL: Should be at or near FULL mark (upper mark) on dipstick — not over.

AIR CLEANER: Must be clean and properly installed to prevent unfiltered air from entering the engine.

DRIVE BELTS: Check radiator fan, water pump and battery charging belts to make sure they are properly tensioned and in good condition.

OPERATING AREA: Make sure there are no obstructions that could block the flow of cooling air. Make sure the area is clean. Rags, tools, or debris must not be left on or near the generator set.

EXHAUST SYSTEM: Exhaust outlet must be clear; silencer and piping must be tight and in good condition; exhaust must be directed safely outside.

LAMP TEST (5 Light Controller Only): Press lamp test button to verify all lamps are functional.

FUEL LEVEL: Make sure there is adequate supply; keep tanks full to allow operation for extended periods.

BATTERY: Check connections and level of battery electrolyte.

COOLANT LEVEL: Maintain coolant level at approximately 3/4 to 1–1/2 in. (19 – 38 mm) below the radiator filler neck seat when the engine is cold. See "Safety Precautions" before filling radiator. A coolant solution of 50% ethylene glycol and 50% clean, softened water is recommended to inhibit corrosion and prevent freezing to –34°F (–37°C). Do not use alcohol or methanol antifreeze or mix them with the specified coolant. Do not add coolant to an engine that has overheated until engine has cooled. Adding coolant to an extremely hot engine can cause a cracked block or cylinder head.

NOTE

Do not turn on block heater (if equipped) before filling cooling system. Run engine until warm and refill radiator to purge air from the system. Block heater may be damaged if not immersed in water.

EXERCISING THE GENERATOR

If the generator set is not equipped with an automatic transfer switch, or the transfer switch does not have the automatic exercise option, run the generator set once a week for one hour (under load). The operator should be in attendance during this period. Be sure to do all the items in the Prestart Checklist before starting the exercise procedure. Start the generator set according to the procedure given for the generator controller. See Relay Controller Operation and 5 Light Microprocessor Controller Operation procedures following for specific starting instructions.

RELAY CONTROLLER OPERATION

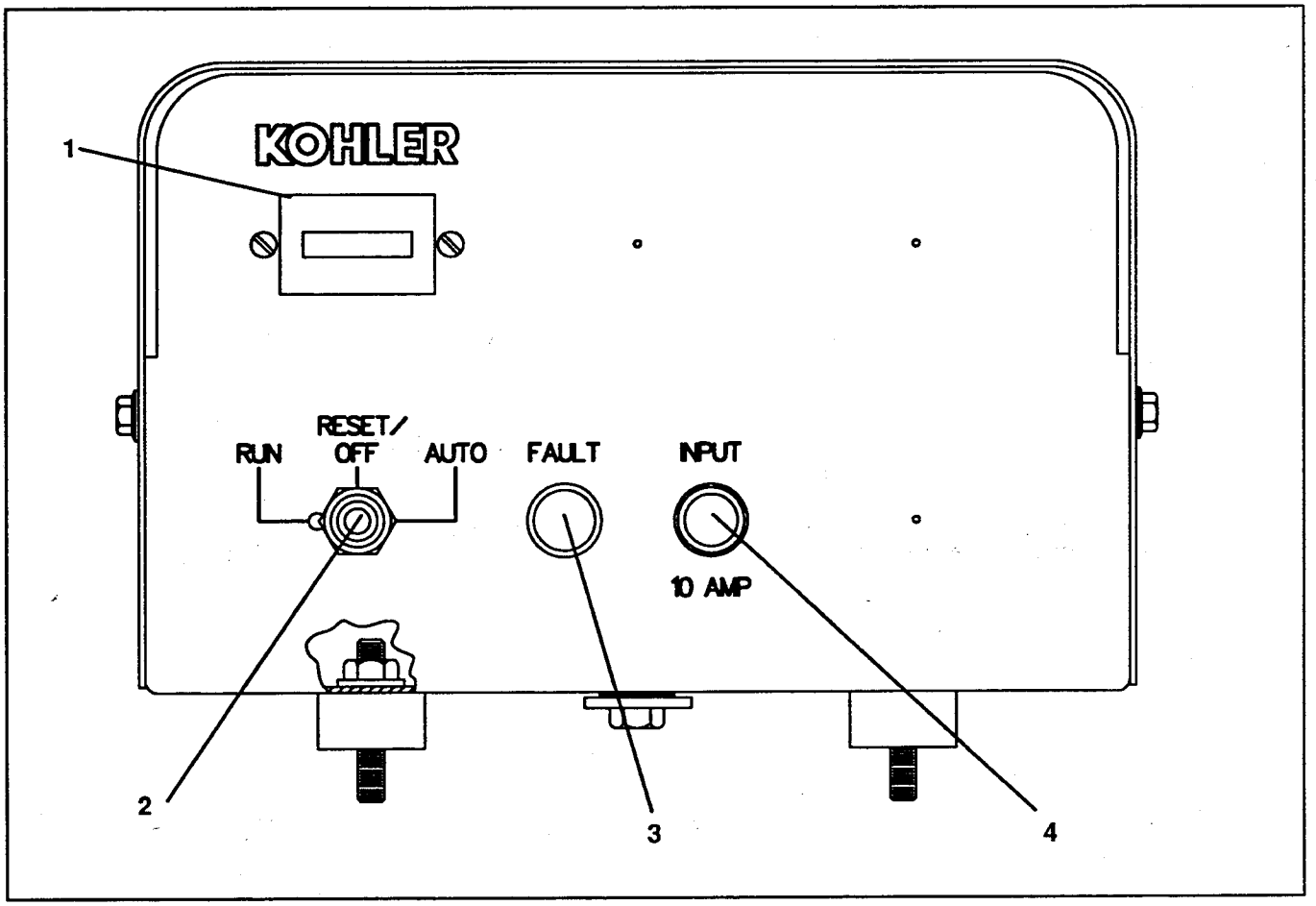
If the generator set is equipped with a relay controller, refer to Figure 2–1 and the following descriptions to identify controller components.

Fault Lamp – lights to indicate a fault condition. Generator will shut down on Overcrank, Overspeed, High Engine Temperature, Low Oil Pressure, and Low Water Level faults. See "Fault Shutdowns" following. (Fault lamp will not stay lit after unit shuts down. Fault lamp will only light as fault occurs.)

Hourmeter – records total generator set operating hours for reference in maintenance scheduling.

Generator Master Switch – dual function of generator operation and generator reset. Refer to "Start/Stop Procedure" and "Resetting Procedure" procedures following.

Controller Fuse – 10 Amp. fuse protects controller circuitry.



1. Hourmeter
2. Generator Master Switch
3. Fault Lamp
4. Controller Fuse

Figure 2–1. Relay Controller Features.

START/STOP PROCEDURE (RELAY CONTROLLER)

STARTING

Move controller or remote Start/Stop switch to "Run" position until the engine starts. If the engine fails to start after cranking for 30 seconds, the unit will stop due to overcrank fault shutdown. Wait for the engine to come to a complete stop before attempting restart. Place switch in RESET/OFF position and then to RUN position.

NOTE

Do not crank engine continuously for more than 30 seconds at a time. A 60 second cool–down period must be allowed between cranking attempts if the engine does not start. If the unit does not start after three attempts, see Section 4. General Troubleshooting for possible causes.

STOPPING

1. Run generator set at no load for 5 minutes to allow engine cool–down.

2. Move controller or remote Start/Stop switch to "Off/Reset" position.

FAULT SHUTDOWNS (RELAY CONTROLLER)

The generator will shut down automatically under the following fault conditions. The shutdown switches will automatically reset when the problem is corrected or the generator set cools (if overheating was the fault).

Overcrank – Cranking stops if engine does not start after 30–60 seconds of continuous cranking.

Overspeed – Generator will shut down immediately if governed frequency exceeds 70 Hz (2100 rpm) on 50 and 60 Hz models.

High Engine Temperature – Shutdown occurs approximately 8 seconds after fault. Fault occurs when engine coolant temperature reaches 230°F (110°C).

Low Oil Pressure – Shutdown occurs approximately 8 seconds after fault. Fault occurs when engine oil pressure drops to 7.1 psi (49 kPa).

Low Coolant Level – Shutdown occurs approximately 8 seconds after coolant level sensor detects no coolant at sensor tip. Coolant level sensor is located in radiator upper tank.

NOTE

If the cause of a high engine temperature, low oil pressure, or low coolant level shutdown is not corrected, the generator can be restarted (after controller reset) and will run approximately 8 seconds before shutting down again. See "Resetting Procedure – Fault Shutdown" for full resetting procedure.

CIRCUIT PROTECTION

An optional line circuit breaker (sized for generator output) is available to protect the generator from damage due to overload or short circuits. If the circuit breaker trips, reduce the load and switch the breakers back to the "ON" position. With the breaker in the "OFF" position, the generator will run but there will be no output voltage.

NOTE

If the generator circuit breaker trips repeatedly, see Section 4. General Troubleshooting for possible causes.

The controller circuitry is protected by a replaceable 10 Amp. fuse. If the generator will not crank and the battery and/or connections appear okay, the controller fuse may be "blown." Replace fuse. If fuse blows again, see Section 4. General Troubleshooting for possible causes.

RESETTING PROCEDURE – FAULT SHUTDOWN (RELAY CONTROLLER)

If the generator set stops running due to a fault shutdown, the controller must be reset and the fault corrected before the generator can be restarted.

NOTE

If the fault is not corrected, the unit will start and then shutdown in 8 seconds.

1. Move generator master switch to the OFF/RESET position until the fault lamp goes out.
2. Disconnect generator set from load with line circuit breaker or automatic transfer switch.
3. Move generator master switch to the RUN position to restart the generator set. Refer to Section 4. General Troubleshooting for possible causes of fault shutdown.
4. Return generator master switch to the OFF/RESET position.
5. Correct cause of fault shutdown. See "Safety Precautions" before proceeding.
6. Move generator master switch to normal position (RUN or AUTO) for start–up.

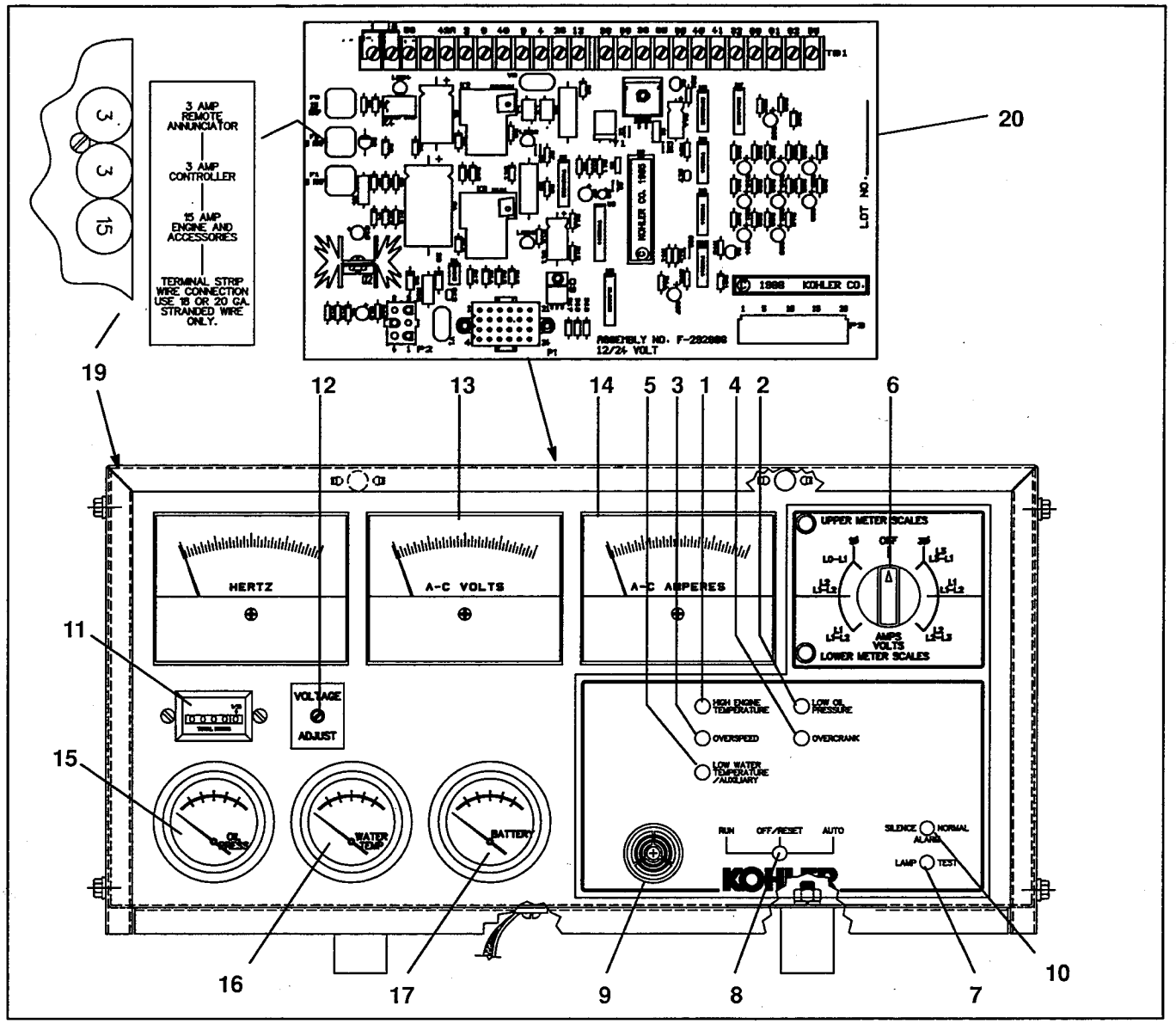


Figure 2–2. 5–Light Microprocessor Controller Features

5 LIGHT MICROPROCESSOR CONTROLLER OPERATION

Features

If the generator set is equipped with a 5–light microprocessor controller, refer to Figure 2–2 and the following descriptions to identify controller components.

LAMPS:

1. **High Engine Temperature** — lamp lights if engine has shut down due to high engine coolant temperature. Shutdown occurs 10–20 seconds after engine reaches temperature of approximately 230°F (110°C).

2. **Low Oil Pressure** — lamp lights if set shuts down due to insufficient oil pressure. Shutdown occurs 10–20 seconds after engine oil pressure drops to 7.1 psi (49 kPa).

3. **Overspeed** — lamp lights if set shuts down due to overspeed condition. Immediate shutdown if governed frequency exceeds 70 Hz (2100 rpm) on 50 and 60 Hz models.

4. **Overcrank** — cranking stops and overcrank lamp will light if engine does not start after 45 seconds of continuous cranking or 75 seconds of cyclic cranking. See Auto Starting.

- cranking stops and overcrank lamp will light after 15 seconds if starter or engine will not turn (locked rotor).

- overcrank lamp will flash if speed sensor signal is absent longer than one second.

NOTE

The microprocessor controller is equipped with an automatic restart function. The genset will attempt to restart if the engine speed drops below 13 Hz (390 rpm). Failure to correct the cause of decreased engine speed will result in an overcrank condition.

5. **Low Water Temperature/Auxiliary** — lamp flashes or lights under the following conditions:

- lamp lights if engine water temperature is too low (if sensor equipped).

- lamp will flash immediately if controller senses no AC output (except during first 10 seconds after start–up).

- lamp lights and engine stops 5 seconds after high water temperature or low coolant level fault (if equipped); inhibited during first 30 seconds after starting.

- lamp will flash if the battery is connected with generator master switch in RUN or AUTO position.

- lamp will flash due to low battery voltage to controller (low voltage reset or hardware reset of controller board internal timer).

- lamp lights and engine shuts down immediately if overvoltage condition arises (if overvoltage equipped).

- lamp lights and engine shuts down if activated by sensing devices connected to auxiliary immediate shutdown port (P1–17).

- lamp lights if optional Emergency Stop Switch is activated.

- lamp lights if optional Emergency Stop Switch is reset with generator master switch in the AUTO or RUN position.

SWITCHES AND ALARMS:

6. **Selector Switch** — selects generator output circuits to be measured. When switched to a position with three circuit lead labels, amperage is measured on the upper lead and voltage is measured between the lower two leads. AC ammeter and voltmeter will not register with switch in the OFF position.

7. **Lamp Test** — press to test the controller indicator lamps.

8. **Generator Master Switch** — dual function of controller reset and generator operation switch. Refer to "Starting, Stopping, and Resetting Procedure" sections following.

9. **Alarm Horn** — horn sounds if any fault or pre–alarm condition exists. The Alarm Horn can only be silenced with the generator master switch in the AUTO position. See "Resetting Procedure" following.

10. **Alarm Silence** — disconnects alarm horn during servicing and/or maintenance (generator master switch must be in the AUTO position). Alarm Horn switches at all locations (controller, remote annunciator, or A/V alarm) must be restored to normal position after fault shutdown is corrected to avoid reactivating alarm horn. See "Resetting Procedure" following.

FUSES, METERS, AND ADJUSTMENTS

11. **Hourmeter** — records generator set total operating hours for reference in scheduling maintenance.

12. **Frequency Meter** — measures frequency (Hz) of generator output voltage.

13. **AC Voltmeter** — measures voltage across output leads indicated.

14. **AC Ammeter** — measures amperage from output leads indicated by selector switch.

15. **Oil Pressure** — measures engine oil pressure.

16. **Water Temperature** — measures engine coolant temperature.

17. **DC Voltmeter** — measures voltage of starting battery(ies).

18. **Voltage Adjustment Pot.** — used to "fine–tune" generator output voltage. See Section 10. "Generator Reconnection."

19. **Fuses** — located on controller main circuit board.

- **3 Amp. Remote Annunciator (F1)** — protects remote annunciator circuit, A/V Alarm, and Isolated Alarm Kit (if equipped).

- **3–Amp Controller (F2)** — protects controller circuit board, speed sensor, and lamp circuit board.

- **15–Amp. Engine and Accessories (F3)** — protects engine/starting circuitry and accessories.

20. **Controller TB1 Terminal Strip** – allows connection of generator accessories such as emergency stop switch, remote start/stop switch, audio–visual alarms, etc. Crank mode selection (cyclic or continuous) is also made on the TB1 terminal strip. Refer to Figure 2–3 for identification of TB1 terminals and connection of accessories.

CIRCUIT BOARD TERMINAL IDENTIFICATION (TB1)

1 Ground — Emergency Stop Relay (K4) – Connect Emergency Stop Across Terminals TB1–1 and 1A.
1A Emergency Stop Relay (K4) Coil; Negative – Connect Emergency Stop Across Terminals TB1–1 and 1A.
56 Not Used
Not Used
42A Battery Voltage (Fuse #1 Protected) – Accessory Power Supply; Customer May also Provide Separate Accessory Power Source
2 Ground Terminal
9 Crank Mode Selection (open — cyclic crank; ground — continuous crank) Connect TB1–2 to TB1–9 for Continuous Cranking; Leave TB1–9 open for cyclic cranking. See "Crank Mode Selection" Following
48 Emergency Stop Indicator *
3 Remote Start Ground – Connect Remote Start Switch to TB1–3 and TB1–4
4 Remote Start – Connect Remote Start Switch to TB1–3 and TB1–4
26 Auxiliary Indicator *
12 Overcrank Indicator *
39 Overspeed Indicator *
38 Low Oil Pressure Indicator *
36 High Engine Temperature Indicator *
60 System Ready Indicator *
80 Not In Auto Indicator *
40 Prealarm High Engine Temperature Indicator *
41 Prealarm Low Oil Pressure Indicator *
32 Common Fault/Prealarm Line – AV Alarm or Common Fault Relay Activated by HET, LOP, LWT, OC, OS, and AUX Faults
63 Low Fuel – Connect Fuel Level Sensor to TB1–63 to Activate Fault Lamp (If Used)
61 Battery Charger Fault – Connect Battery Charger to TB1–61 to Activate Fault Lamp (If Used)
62 Low Battery Volts – Connect Battery Charger to TB1–62 to Activate Fault Lamp (If Used)
35 Low Water Temperature – Connect LWT Sensor (Prealarm Kit) to TB1–35 to Activate AUX/LWT Lamp

* Indicators may be customer supplied lamps and/or Kohler AV Alarms, Annunciators, Dry Contact Kits, etc. A dry contact kit must be used for any external connections.

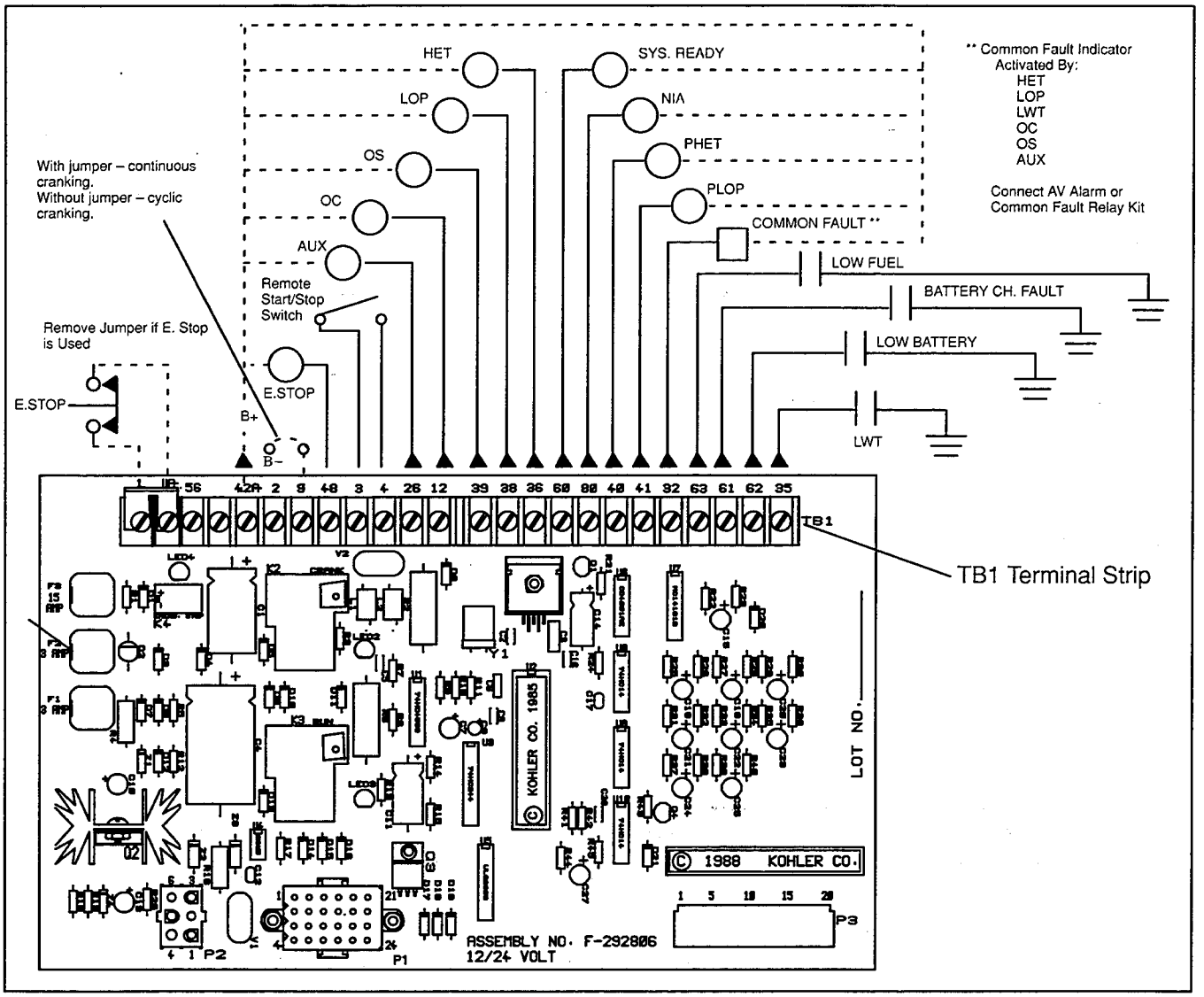


Figure 2–3. Controller TB1 Terminal Strip

STARTING PROCEDURE

"LOCAL" STARTING

To start the generator set at the controller, move the generator master switch to the RUN position.

NOTE

The alarm horn will sound whenever the generator master switch is not in the AUTO position.

NOTE

The microprocessor controller is equipped with a transient Start/Stop function to avoid accidental cranking of the rotating engine. If the generator master switch is momentarily placed in the OFF/RESET position then quickly returned to RUN, the genset will slow to 249 rpm and recrank before returning to rated speed.

NOTE

The microprocessor controller is equipped with an automatic restart function. The genset will attempt to restart if the engine speed drops below 13 Hz (390 rpm). Failure to correct the cause of the decreased engine speed will result in an overcrank condition.

"AUTO" (Remote) STARTING

To allow start–up by automatic transfer switch or remote start–stop switch (connected to controller terminals TB1–3 and TB1–4) move the generator master switch to the AUTO position.

CRANK MODE SELECTION

The microprocessor controller provides up to 45 seconds of continuous cranking or 75 seconds of cyclic cranking (crank 15 seconds, rest 15 seconds, crank 15 seconds, etc.) before overcrank shutdown. Cranking mode (cyclic or continuous) selection is made on the controller circuit board terminal strip. For cyclic cranking, leave circuit board terminal TB1–9 open. Continuous cranking is achieved by running a jumper between circuit board terminal TB1–2 (ground) and terminal TB1–9.

STOPPING PROCEDURE

"NORMAL" STOPPING

1. Disconnect load from generator set and allow it to run without load for 5 minutes.

NOTE

Run the generator at no load for 5 minutes prior to stopping to insure adequate cooling of the set.

2. Move generator master switch to the OFF/RESET position. The engine will stop.

NOTE

If engine stop is signaled by a remote switch or Automatic Transfer Switch, the generator set will continue running during a 5 minute cool–down cycle.

"EMERGENCY" STOPPING

Move generator master switch to the OFF/RESET position or activate remote emergency stop (if equipped) for immediate shutdown. If the emergency stop switch is activated, the controller LOW WATER TEMPERATURE/AUXILIARY lamp will light and the unit will shut down. If equipped, remote annunciator and/or audio–visual alarms will signal an emergency stop.

NOTE

The Emergency Stop Switch(s) are to be used for emergency shutdowns only. Use the generator master switch to stop the generator set under normal circumstances.

CIRCUIT PROTECTION

An optional line circuit breaker (sized for generator output) is available to protect the generator from damage due to overload or short circuits. If the circuit breaker trips, reduce the load and switch the breakers back to the "ON" position. With the breaker in the "OFF" position, the generator will run but there will be no output voltage.

NOTE

If the generator circuit breaker trips repeatedly, see Section 4. General Troubleshooting for possible causes.

The engine and controller circuitry is protected by fuses F1 (3 Amp.), F2 (3 Amp.) and F3 (15 Amp.) on the controller circuit board. (See "Fuses" earlier in this section.) If the generator will not crank or accessories will not work, and the battery/connections appear okay, one of these fuses may be "blown." The controller meters and lights are protected by fuses V7, V8, and V9 on the AC terminal block (TB2). If the controller lights and meters are not functioning, check the condition of the V7, V8, and V9 fuses. If a fuse is replaced then "blows" again, see Section 4. General Troubleshooting for possible causes.

RESETTING PROCEDURE – REMOTE EMERGENCY STOP

1. Investigate cause of emergency stop and correct problem(s).

2. Reset remote emergency stop switch by replacing glass face on switch.

NOTE

The controller LOW WATER TEMP. /AUXILIARY lamp will light if the generator master switch is in the RUN or AUTO position during the resetting procedure.

3. Toggle generator master switch to OFF/ RESET and then to RUN or AUTO to resume operation. The generator set will not crank until the resetting procedure is completed.

FAULT SHUTDOWNS

The generator will shut down automatically under the following fault conditions. The generator set will not run until the fault condition has been corrected. The shutdown switches will automatically reset when the problem is corrected or the generator set cools (if high engine temperature was the fault).

NOTE

Low Oil Pressure, High Engine Temperature, and Low Coolant Level Shutdowns will not function during the first 30 seconds after start–up. If the cause of the shutdown is not corrected, the generator can be restarted (after controller reset) and will run approximately 30 seconds before shutting down again. See "Resetting Procedure – Fault Shutdown" for resetting procedure.

Overcrank – Shutdown occurs after 45 seconds of continuous cranking or after 75 seconds of cyclic cranking (crank 15 seconds, reset 15 seconds, crank 15 seconds, etc. for a total of 75 seconds). Shutdown occurs after 15 seconds if engine or starter will not turn (locked rotor).

Overspeed – Generator will shut down immediately if governed frequency exceeds 70 Hz (2100 rpm) on 50 and 60 Hz models.

High Engine Temperature – Shutdown occurs approximately 5 seconds after fault. Fault occurs when engine coolant temperature reaches 230°F (103°C). High engine temperature shutdown will not function during first 30 seconds after start–up.

Low Oil Pressure – Shutdown occurs approximately 5 seconds after fault. Fault occurs when engine oil pressure drops to 7.1 psi (49 kPa). Low oil pressure shutdown will not function during the first 30 seconds after start–up.

Overvoltage – (if equipped) Generator will shut down after approximately two seconds of voltage 15% or more over nominal voltage. LOW WATER TEMP./AUXILIARY lamp will light.

Low Coolant Level – Shutdown occurs approximately 5 seconds after fault. Fault occurs when the engine coolant falls below the "safe" range in the radiator. The LOW WATER TEMP./AUXILIARY lamp will light upon shutdown. The generator set will not run until coolant is added to reach the specified level and the controller is reset. (The low coolant level shutdown is inhibited during the first 30 seconds after start–up.)

NOTE

Sensitive equipment may suffer damage in less than one second of an overvoltage condition. On–line equipment requiring faster shutdowns should have its own overvoltage protection.

RESETTING PROCEDURE – FAULT SHUTDOWN

Use the following procedure to restart the genset after a FAULT shutdown. Refer to "Emergency" Stopping earlier in this section to reset the generator after an EMERGENCY stop.

1. Move controller alarm horn switch to the SILENCE position. If equipped, audio visual alarm(AV) or annunciator alarm horn and lamp are activated. Move AV/annuniciator alarm switch to SILENCE to stop alarm horn. AV/annunciator lamp stays lit. (The AV alarm uses one lamp to indicate a fault shutdown; the appropriate fault lamp will light on the remote annunciator to indicate a fault condition.)

2. Disconnect generator set from load with line circuit breaker or automatic transfer switch.

3. Correct cause of fault shutdown. See "Safety Precautions" section of this manual before proceeding.

4. Start generator set by moving the generator master switch to OFF/RESET and then to the RUN position. If equipped, AV/annuniciator alarm horn sounds and lamp goes out.

5. Verify that cause of shutdown has been corrected by test operating generator set.

6. Reconnect generator to load via line circuit breaker or automatic transfer switch.

7. Move generator master switch to AUTO position for start–up by remote transfer switch or remote start/stop switch. If equipped, move AV/ annunciator alarm switch to NORMAL.

8. Move controller alarm horn switch to the NORMAL position.

NOTE

Controller alarm horn can only be silenced with generator master switch in the AUTO position.

Section 3. Scheduled Maintenance

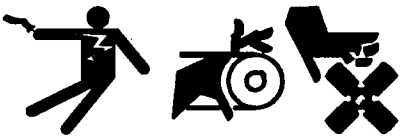
GENERAL

Schedule routine maintenance using the Service Schedule following and the hourmeter located on the generator controller. If the generator will be subject to extreme operating conditions, service the unit more frequently. Instructions to perform most of the scheduled services are provided in the following pages.

Refer to the *Generator Operation Manual* for general maintenance procedures and the *Engine Service Manual* for engine overall procedures not provided in this manual. If the service schedule in this generator service manual differs from that of the generator operation manual, use the service schedule which provides the more stringent requirements.

Items in the maintenance schedule marked with an asterisk (*) should be performed more often if the generator set is operated in dirty, dusty conditions. Items identified with asterisks (**) should only be performed by an Authorized Kohler Service Dealer.

⚠ WARNING



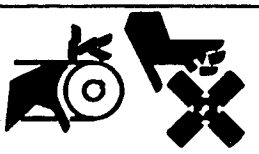
Accidental starting.
Can cause severe injury or death.

Disconnect battery cables before working on generator set (negative lead first and reconnect it last).

Accidental starting can cause severe injury or death. Turn Generator Master Switch to OFF position, disconnect power to battery charger, and remove battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator. The generator set can be started by automatic transfer switch or remote start/stop switch unless these precautions are followed.

Exposed moving parts can cause severe injury or death. Keep hands, feet, hair, and clothing away from belts and pulleys when unit is running. Replace guards, covers, and screens before operating generator set.

⚠ WARNING



Rotating parts.
Can cause severe injury or death.

Do not operate generator set without all guards, screens, or covers in place.

⚠ WARNING

Hazardous voltage. **Moving rotor.**

Can cause severe injury or death.

Do not operate generator set without all guards and electrical enclosures in place.

Flying projectiles can cause severe injury or death. Retorque all crankshaft and rotor hardware after servicing. When making adjustments or servicing generator set, do not loosen crankshaft hardware or rotor thru–bolt. If rotating crankshaft manually, direction should be clockwise only. Turning crankshaft bolt or rotor thru–bolt counterclockwise can loosen hardware and result in serious personal injury from hardware or pulley flying off engine while unit is running.

NOTE

HARDWARE DAMAGE! Engine and generator may make use of both American Standard and metric hardware. Be sure to use the correct size tools to prevent rounding of bolt heads and nuts.

NOTE

The items listed in the service schedule must be performed at the designated intervals for the life of the generator. For example, an item to be serviced "Every 100 Hours or 3 Months" must also be serviced after 200 hours or 6 months, 300 hours or 9 months, etc. The generator will eventually accumulate enough hours to

warrant a complete overhaul. The exact time at which extensive service will be necessary cannot be predicted. However, rough operation, lack of power, and excessive oil use indicate serious generator set problems. As part of a preventative maintenance program, service the engine (clean cylinder head, inspect valves, check compression, etc.) and generator (replace bearing, inspect wiring, remove debris, etc.) at the earliest indication that a serious problem exists.

SERVICE SCHEDULE

	Before Starting	After 50 Hrs./ One Month (Break-In Period)	Every 100 Hrs./ 3 Months	Every 300 Hrs./ 6 Months	Every 500 Hrs./ Yearly
FUEL SYSTEM					
Check the fuel level	X				
Fill fuel tank	X				
Remove sediment from fuel tank	X				
Replace the fuel filter element		X		X	
Check the fuel injection timing **					X
Check governor operation and adjust **					X
Check the fuel injection spray condition **					X
LUBRICATION SYSTEM					
Check the oil level in crankcase	X				
Replace the oil in crankcase *		X	X		
Replace the lube oil filter element *		X	X		
COOLING SYSTEM					
Check coolant level	X				
Adjust the tension of water pump belt		X	X		
Change coolant					X
Clean radiator fins, inspect hoses			X		
AIR CLEANER					
Replace the air cleaner element *				X	
Clean the breather pipe *			X		
ELECTRICAL SYSTEM					
Verify proper operation of gauges (if equipped)	X				
Check the electrolyte level in the battery	X				
Check the electrical connections		X			
Check the battery specific gravity			X		
Adjust battery charging alternator belt		X	X		
CYLINDER HEAD					
Check for leakage of water and oil	X	X			
Retighten all major nuts and bolts		X			X
Check tightness mounting bolts/vibro mounts				X	
Retighten the cylinder head bolts**					X
Adjust intake/exhaust valve clearance **				X	
GENERATOR					
Blow dust out of generator *					X

* Service more frequently if operated in dusty areas

** Should be performed by an Authorized Kohler Service Dealer

ENGINE LUBRICATION

OIL SELECTION

The selection of engine oil is very important to a diesel engine. If an unsuitable oil is used or an oil change is neglected, the engine may be damaged. Oil must meet the American Petroleum Institute (API) classification of CD, CD/CC, or CC. Avoid mixing different brands of oils and lubricants; oils of different manufacturers may be incompatible and deteriorate when mixed. Refer to Table 3–1 to select the proper grade oil for the temperature range in which the generator set will be operated.

NOTE

Failure to observe these standards may cause inadequate lubrication/oil pressure and cold–starting difficulties.

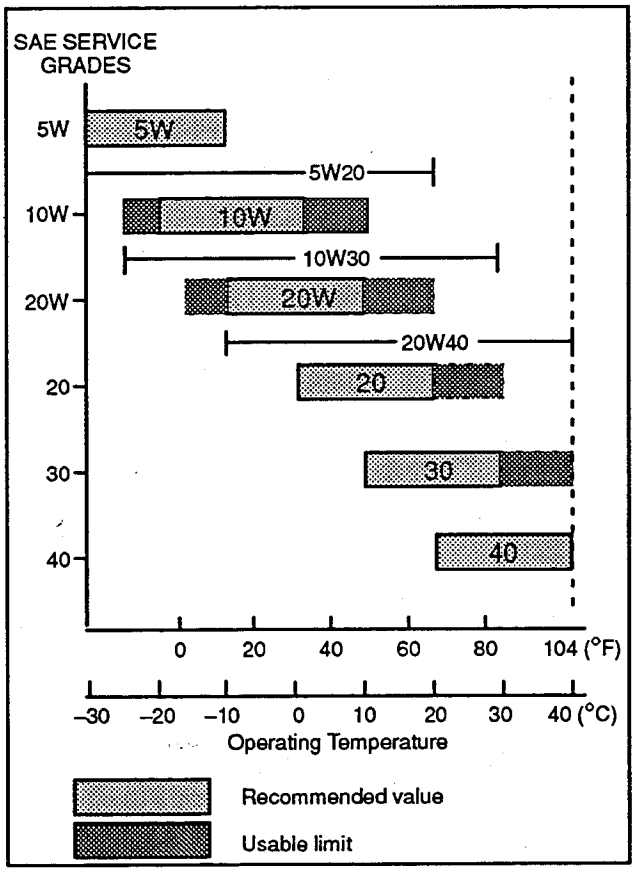


Table 3–1. Engine Oil Selection

FUEL SYSTEM

SPECIFICATIONS

Use clean, good quality No. 2–D (DIN 51 601) diesel fuel. The fuel must meet the requirements of the American Society of Testing and Materials (ASTM) diesel fuel classification D975 (Federal Specification W–F–800a). Cleanliness of the fuel is especially important with diesel engines which have easily clogged precision fuel injectors and pumps. See chart following for fuel specifications.

United States
ASTM/D975 No. 2 Diesel
United Kingdom
BS2869 Class A1 or Class A2
Other Considerations:
Sulfur Content ..... Less than 0.5%
Sediment and Water Content ..... Not to exceed 0.1%
Cetane Number ..... Greater than 45
Pour Point ..... At least 10°F (5.6° C) below the lowest outside air temperature

NOTE

Never store diesel fuel in galvanized containers; diesel fuel and the galvanized coating react chemically to produce flaking which quickly clogs filters or causes failure of the fuel pump or injectors. Do not run the generator set out of fuel. Air will be drawn into the fuel lines and the entire system will have to be bled before the unit can be restarted.

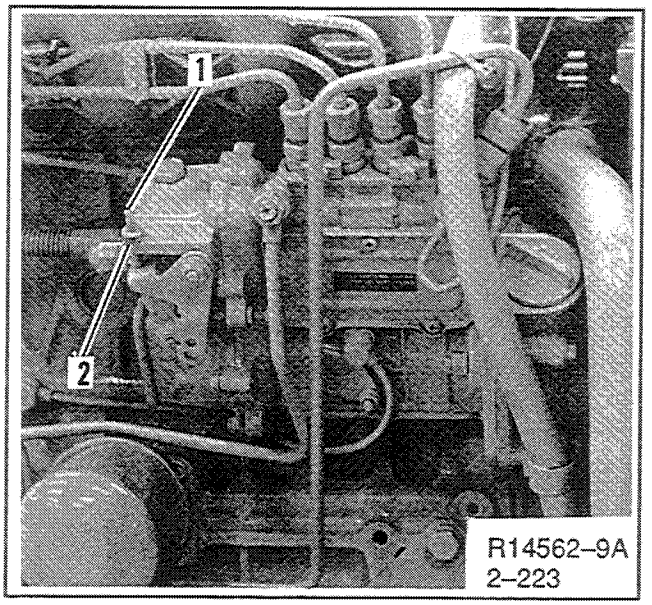
NOTE

Avoid storing fuel over long periods of time. Take special precautions to keep all dirt, water, and other contaminants out of the fuel. Storage tanks containing diesel fuel contaminated with water may cause the formation of "microbes" which will form a slime which will clog fuel filters and lines.

GOVERNOR

The centrifugal, mechanical–type governor serves to keep engine speed constant by automatically adjusting the amount of fuel supplied to the engine according to changes in the load. No regular service is required on the unit. The governor is adjusted during run–in at the factory and further adjustment should not be needed unless the generator is reconnected for a different frequency, varying load conditions are encountered, or if poor governor control develops after extended usage.

60 Hz. generator sets are designed to operate at 60 Hz., (1800 rpm) under full load and 63 Hz. (1890 rpm) under no load. 50 Hz. generator sets are designed to operate at 50 Hz. (1500 rpm) under full load and 52.5 Hz. (1575 rpm) at no load. To check speed, use a frequency meter or hand tachometer. See Figure 3–1. Loosen locking nut on speed adjusting screw. Turn screw in counterclockwise direction to increase speed/frequency or in clockwise direction to decrease speed/frequency. Tighten lock nut to secure screw at new setting.



1. Speed Adjusting Screw
2. Locking Nut

Figure 3–1. Mechanical Governor

COOLING SYSTEM

⚠ WARNING

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

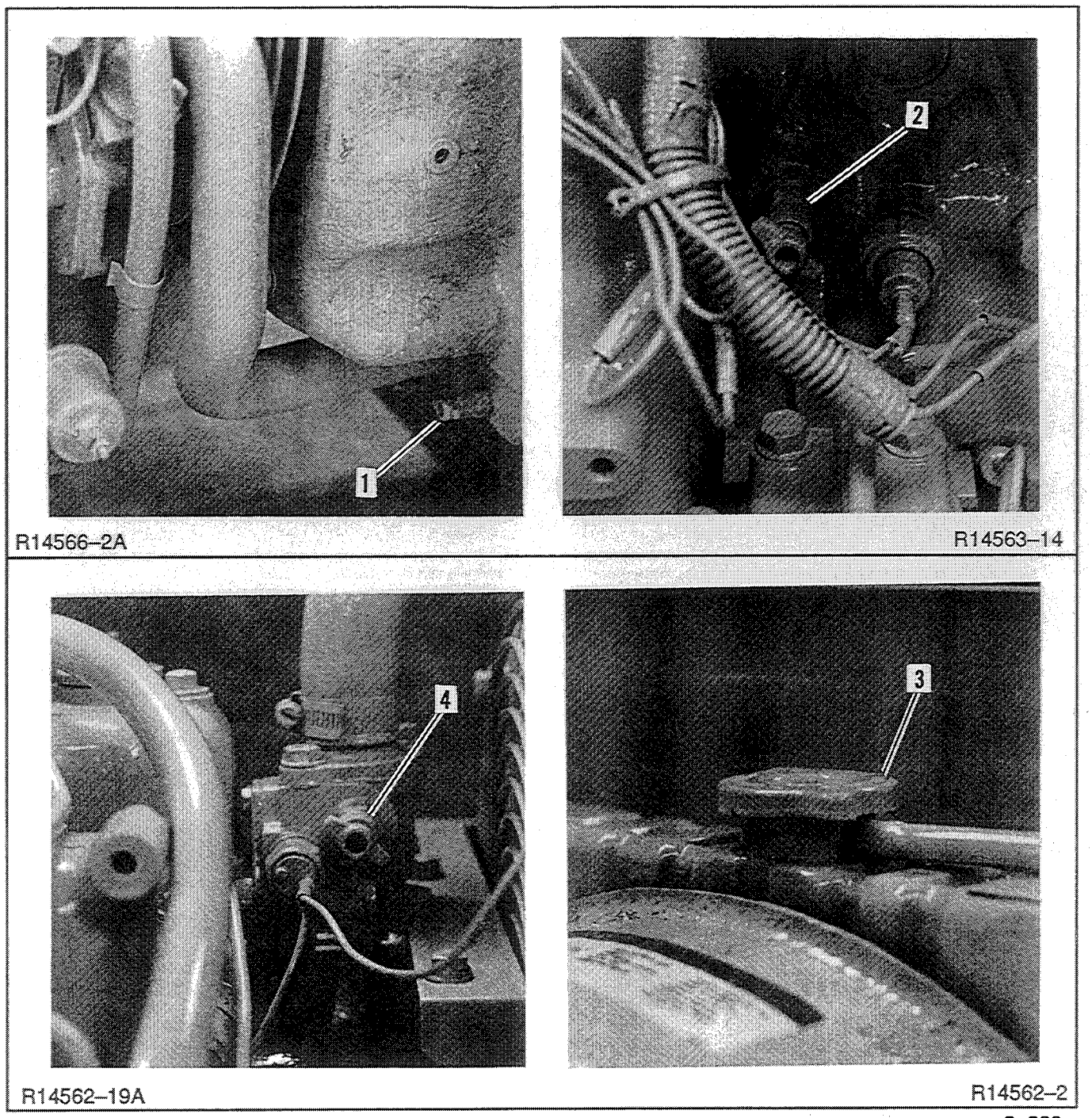
Before removing pressure cap stop generator, allow to cool and loosen pressure cap to relieve pressure.

Hot coolant can cause severe burns and personal injury. Allow engine to cool and release pressure from cooling system before opening pressure cap. To release pressure, cover the pressure cap with a thick cloth then turn it slowly counterclockwise to the first stop. After pressure has been completely released and the engine has cooled, remove cap. If generator set is equipped with a coolant recovery tank, check coolant level at tank.

NOTE

The cooling system may be drained by opening the petcock on the bottom of the radiator, removing the drain plug on the engine block and removing the radiator cap. To refill the cooling system, close drain plug and petcock and fill radiator to the proper level with the recommended coolant mixture. See Figure 3–2. Replace radiator cap and operate the engine until the thermostat opens and the radiator upper hose becomes hot. Stop the engine and add coolant to the radiator to just below the overflow tube on the filler neck. Replace radiator cap. Cooling system capacity for each model is found in Section 1. Specifications.

Use only a permanent–type coolant that meets specifications. A coolant solution of 50% etheylene glycol and 50% clean, softened water is recommended to inhibit corrosion and prevent freezing to –34°F (–37°C). Do not use alcohol or methanol antifreeze or mix them with the coolant. The coolant system is equipped with an air bleed feature.



1. Cooling System Drain
2. Engine Block Drain
3. Cooling System Fill
4. Thermostat Housing Air Bleed Petcock

2–223

Figure 3–2. Cooling System Drain/Fill/Air Bleed Locations

NOTE

Be sure coolant is at proper level before operating the generator set. When refilling the cooling system, allow several minutes for complete refill of all air cavities in the radiator and engine block.

To prevent generator shutdown and/or damage due to overheating, service the cooling system at the intervals specified in the maintenance schedule. Inspect the exterior of the radiator for obstructions; remove all dirt and foreign material with a soft brush or cloth (to avoid damaging radiator fins). If available, clean radiator with compressed air or a stream of water in direction opposite normal air flow. Check all hoses and connections for leaks and replace any hoses that are cracked, frayed, or feel spongy. When coolant level checks are made, check condition of radiator cap rubber seal; replace if cracked or deteriorating. Remove dirt and other debris from radiator cap and filler neck.

GENERATOR SERVICE

Under normal conditions, generator service will not be required on a regular basis. If operating under extremely dusty and dirty conditions, use DRY compressed air to blow dust out of the generator. Do this with the generator running and direct the stream of air through openings in the generator end bracket. This service should be performed every 500 hours or one year of operation.

The end bracket bearing should be replaced every 10,000 hours of operation. Service more frequently if bearing inspection indicates excessive rotor end play or bearing damage from corrosion or heat build–up. The end bracket bearing is sealed and requires no additional lubrication. All generator service should be performed by an Authorized Kohler Service Dealer.

STORAGE PROCEDURE

If the generator set is to be out of service for a considerable length of time (three months or longer), perform the following steps before placing the set in storage.

1. Drain the oil (while still warm) from the crankcase and then refill with proper viscosity oil.
2. Drain fuel from fuel tank to prevent accumulated moisture with the fuel.
3. Check engine coolant protection.
4. Disconnect battery (negative lead first) and place in storage.
5. Seal all openings in engine with non–absorbent adhesive tape. Mask off all areas to be used for electrical contact (cover all pin connectors and terminals).
6. Clean exterior surface of the generator. Spread a light film of oil over unpainted metallic surfaces which could rust or corrode.

Section 4. General Troubleshooting

Use the following tables as a quick reference in troubleshooting individual problems. Generator set faults are listed by specific groups and include likely causes and remedies. The source of more detailed information needed to correct a problem is indicated. These sources include various sections of this manual, the Operation Manual, the Installation Manual, and the Engine Service Manual. Contact an Authorized Kohler Service Dealer for manual part numbers.

Corrective action and testing in many cases requires knowledge of electrical and electronic circuits. It is recommended that service only be done by Authorized Kohler Service Dealers. Improper repair by unqualified personnel can lead to additional failures.

ENGINE

Problem	Possible Cause	Corrective Action/Reference
Unit Will Not Crank	Weak or dead battery	Recharge or replace battery
	Reversed or poor battery connections	Check connections
	Defective starter/starter solenoid	Rebuild or replace. See Engine Service Manual.
	Defective controller start/stop switch (local or remote)	Test function; replace if defective See Section 5 or 6. Controller Troubleshooting.
	Fuse blown in controller	Replace fuse; if fuse blow again, check circuit and components. See Section 2. Operation and Section 5 or 6. Controller Troubleshooting.
	Open in wiring, terminals, pin, circuit board, etc.	Check continuity. See Section 5 or 6. Controller Troubleshooting and Section 11. Wiring Diagrams
	Defective circuit board	Check circuit board operation. See Section 5 or 6. Controller Troubleshooting.
	Overcrank shutdown	Check engine fuel supply. Shutdown occurs after 30 seconds of continuous cranking (relay controller) or 45 seconds of continuous cranking or 75 seconds of cyclic cranking (5–light controller). Cyclic cranking available on 5 Light Microprocessor Controller only.

ENGINE – Continued

Problem	Possible Cause	Corrective Action/Reference
Cranks But Will Not Start	Out of fuel	Replenish fuel supply
	Air cleaner clogged	Clean or replace filter element. See Generator Operation Manual.
	Defective fuel solenoid	See Section 8. Component Testing
	Defective fuel pump	See Engine Service Manual
	Clogged fuel filter	Replace fuel filter. See Generator Operation Manual.
	Air in fuel system	Bleed air from system. See Generator Operation Manual
	Bad fuel mixture	Replace fuel
	Water, dirt in fuel system	Drain, flush fuel system
	Dirty, faulty fuel injectors	See Engine Service Manual
	Faulty ground (–) connection	Clean and retighten
	Weak or dead battery	Recharge or replace. See Generator Operation Manual.
	Poor engine compression	See Engine Service Manual
	Blown voltage regulator fuse	Replace fuse. If fuse "blows" again, see Section 8. Component Testing.
	Oil viscosity too heavy for ambient temperature	Use proper viscosity oil. See Engine Service Manual.
	Defective controller circuit board	See Section 5 or 6. Controller Troubleshooting
	Open in wiring, terminals, pin, circuit board, etc.	Check continuity. Section 5 or 6. Controller Troubleshooting and Section 11. Wiring Diagrams.
Engine Knocks	Faulty fuel injector(s)	See Engine Service Manual
	Air in fuel injectors	Bleed air from system. See Generator Operation Manual
	Improper fuel	Use proper fuel; consult fuel supplier
	Incorrect fuel injection timing	See Engine Service Manual
	Improper cylinder top clearance	See Engine Service Manual
	Defective piston or piston ring	See Engine Service Manual
	Defective crankshaft bearing or piston pin bearing	See Engine Service Manual
	Improper valve clearance	See Engine Service Manual

ENGINE – Continued

Problem	Possible Cause	Corrective Action/Reference
Starter Motor Does Not Work Properly	Loose or corroded connections	Clean and tighten connections
	Battery not fully charged	Check battery electrolyte level and specific gravity. Recharge battery if necessary. See Generator Operation Manual
	Defective starter solenoid	Test starter solenoid. See Section 8. Component Testing. Replace solenoid, if required.
	Defective starter motor	Rebuild or replace starter motor. See Engine Service Manual.
	Engine lube oil viscosity too heavy for ambient temperature	Use proper viscosity oil. See Generator Operation Manual
	Defective start/stop switch	Test/replace switch. See Section 8. Component Testing.
	Defective wiring	Check wiring. Section 11. Wiring Diagrams.
	Battery cables undersize	Select proper size cable. See Section 1. Specifications.

ENGINE – Continued

Problem	Possible Cause	Corrective Action
Engine Runs Irregularly or Stalls Frequently	Vent in fuel tank obstructed	Remove obstruction
	Clogged fuel filter	Replace fuel filter element. See Generator Operation Manual
	Water, dirt, or air in fuel system	Drain, flush, bleed fuel system. See Generator Operation Manual
	Dirty or faulty fuel injectors	See Engine Service Manual
	Faulty governor linkage or governor incorrectly adjusted	See Section 3, Governor and/or Generator Operation Manual
	Defective fuel feed pump	Replace fuel pump. See Engine Service Manual.
	Improper valve clearance	See Engine Service Manual
	Defective valve spring(s)	See Engine Service Manual
	Poor engine compression	See Engine Service Manual
	Air intake restriction	Check air intake
	Dirty air cleaner	Check and clean air cleaner element
	Stale or bad fuel	Replace fuel
	Improper cooling (Check hoses for blockage and components for function.)	Inspect cooling system. See Generator Operation Manual.
	Engine overloaded	Reduce electrical load
	Carbon build–up	Clean carbon from cylinder heads. See Engine Service Manual.
	Engine malfunction	Troubleshoot engine. See Engine Service Manual.

ENGINE – Continued

Problem	Possible Cause	Corrective Action/Reference
Stops Suddenly	Out of fuel	Replenish fuel supply
	Air cleaner clogged	Clean or replace air cleaner element. See Generator Operation Manual
	Fuse blown in controller	Replace fuse. If fuse "blows" again, see Section 2. Operation and Section 5 or 6. Controller Troubleshooting.
	High engine temperature (HET) shutdown	Check engine coolant level, loose fan belt, radiator obstructions, etc. See Section 2. Operation & Generator Operation Manual.
	Low oil pressure (LOP) shutdown	Check engine lube oil level. See Section 2. Operation & Generator Operation Manual.
	Overcrank shutdown	See Section 2. Operation and Section 8. Component Testing.
	Overspeed shutdown	See Section 2. Operation and Section 8. Component Testing.
	Low coolant level (LCL) shutdown	Add coolant. See Section 2. Operation and Generator Operation Manual.
	Defective fuel pump	See Engine Service Manual
	Clogged fuel filter	Replace filter. See Generator Operation Manual.
	Defective fuel solenoid	See Section 8. Component Testing
	Remote emergency stop switch activated (if equipped)	See Section 2. Operation, Resetting
	Engine overheated (hot engine only)	Check air intake, oil level, cooling system. See Generator Operation Manual.
	Defective temperature safety shutdown switch	See Section 8. Component Testing
	Defective low oil pressure safety shutdown switch	See Section 8. Component Testing

ENGINE – Continued

Problem	Possible Cause	Corrective Action/Reference
Lacks Power	Air cleaner clogged	Clean or replace air cleaner element. See Generator Operation Manual
	Generator overloaded	Reduce load
	Bad or stale fuel	Replace fuel
	Engine not running at rated rpm	Check engine speed. See Section 3. Scheduled Maintenance, Governor.
	Governor defective or misadjusted	Check engine speed. See Section 3. Scheduled Maintenance, Governor.
	Improper cooling	Check engine coolant level, loose fan belt, radiator obstructions, etc. See Generator Operation Manual.
	Fuel line restriction	Inspect fuel lines
	Dirty fuel filter	Replace fuel filter. See Generator Operation Manual.
	Improper valve clearance	See Generator Operation Manual or Engine Service Manual
	Dirty or faulty fuel injectors	See Engine Service Manual
	Incorrect fuel injection timing	See Engine Service Manual
	Poor engine compression	See Engine Service Manual
	Fuel tank vent obstructed	Remove obstruction
Engine Overheats	Improper cooling	Check engine coolant level, loose fan belt, radiator obstructions, thermostat, etc. See Generator Operation Manual, Cooling and Engine Service Manual.
	Clogged air cleaner	Clean or replace air cleaner element. See Generator Operation Manual
	Generator set overloaded	Reduce load

ENGINE – Continued

Problem	Possible Cause	Corrective Action/Reference
Engine Emits Black or Gray Exhaust Smoke	Improper type of fuel	Use proper fuel. See Generator Operation Manual.
	Clogged or dirty air cleaner	Clean or replace air cleaner element. See Generator Operation Manual.
	Defective fuel injection pump	See Engine Service Manual
	Faulty fuel injectors	See Engine Service Manual
	Incorrect fuel injection timing	See Engine Service Manual
	Improper valve clearance	See Generator Operation Manual or Engine Service Manual
	Lube oil level too high	Remove surplus lube oil
	Improper grade engine lube oil	Use proper viscosity oil. See Generator Operation Manual.
Low Lube Oil Pressure	Low lube oil level	Add engine lube oil. See Generator Operation Manual.
	Improper lube oil viscosity	Replace with lube oil of proper viscosity. See Generator Operation Manual
	Defective lube oil pump	See Engine Service Manual
	Worn engine components	See Engine Service Manual
High Lube Oil Consumption	Too light viscosity oil	Use proper viscosity oil. See Generator Operation Manual.
	Oil leakage from engine	Check for leakage in lines, around gaskets, drain plug, etc.
	Clogged breather system	Clean breather system. See Generator Operation Manual.
	Defective piston ring, cylinder liner, valve guide, valve seat, etc.	See Engine Service Manual

ENGINE – Continued

Problem	Possible Cause	Corrective Action/Reference
High Fuel Consumption	Improper type fuel	Use proper fuel. See Generator Operation Manual.
	Clogged or dirty air cleaner element	Clean or replace air cleaner element. See Generator Operation Manual
	Engine overloaded	Reduce load
	Improper valve clearance	See Engine Service Manual
	Incorrect fuel injection timing	See Engine Service Manual
	Poor engine compression	See Engine Service Manual
	Fuel leakage	Check for leakage at fuel tank, fuel lines, connections, etc.
No Battery Charging Output	Loose or corroded connections	See Generator Operation Manual
	Sulfated or worn–out battery	See Generator Operation Manual
	Defective battery charging alternator	Rebuild or replace alternator. See Engine Service Manual.
	Loose alternator belt	Retighten alternator belt. See Generator Operation Manual.

GENERATOR

Problem	Possible Cause	Corrective Action/Reference
No AC Output	Circuit breaker open or defective (if equipped)	Reset circuit breaker to ON position. Check for voltage on line side.
	Circuit breaker tripping due to overload on generator set	Reduce load
	No battery voltage to voltage regulator during cranking: "+" and "–" terminals on regulator	Check for DC voltage at voltage regulator terminals + and –. See Section 8. Component Testing.
	Open wiring, terminal, or pin in build–up circuit or voltage regulator circuit	Check continuity. See Section 8. Component Testing and Section 11. Wiring Diagrams.
	Defective rotor/exciter armature (open, shorted, or grounded windings)	Check voltage and continuity. See Section 8. Component Testing.
	Defective stator/exciter field (open, grounded, or shorted windings)	Check voltage and continuity. See Section 8. Component Testing.
	Defective or misadjusted voltage regulator	Excite rotor separately and check for AC output. Readjust voltage regulator. See Section 8. Component Testing.
	Defective circuit board K4 relay (field flashing) (relay controller only)	Test/replace relay controller circuit board. See Section 5. Controller Troubleshooting.
	Defective K1 relay (field flashing) (5 Light controller only)	Test/replace K1 relay. See Section 6. Controller Troubleshooting.
	Defective rectifier module	Test/replace rectifier module. See Section 8. Component Testing

GENERATOR – Continued

Problem	Possible Cause	Corrective Action/Reference
Low Output or Excessive Drop in Voltage	Engine speed too low	Check engine speed. See Section 3. Scheduled Maintenance, Governor.
	Generator overloaded	Reduce load
	Defective voltage regulator	Test/readjust voltage regulator. See Section 8. Component Testing.
	Voltage regulator improperly adjusted	Test/readjust voltage regulator. See Section 8. Component Testing.
	Defective rotor/exciter armature	Test and/or replace. See Section 8. Component Testing.
	Defective stator/exciter field	Test and/or replace. See Section 8. Component Testing.
	Defective rectifier module	Test and/or replace. See Section 8. Component Testing.
High Generator Output Voltage	Engine speed too high	Check engine speed. See Section 3. Scheduled Maintenance, Governor
	Defective voltage regulator	Test/readjust voltage regulator. See Section 8. Component Testing
	Voltage regulator improperly adjusted	Readjust voltage regulator. See Section 8. Component Testing.
	Loose voltage regulator connections (including stator sensing leads).	Check voltage regulator connections. See Section 8. Component Testing.

Section 5. Troubleshooting Relay Controller (& Related Engine Components)

DESCRIPTION

This section covers the controller troubleshooting procedure for generators equipped with local or remote relay controller and related engine components. Refer to Section 2. Relay Controller Operation to identify controller external components. Refer to Figure 5–1 to identify the internal components of the relay controller.

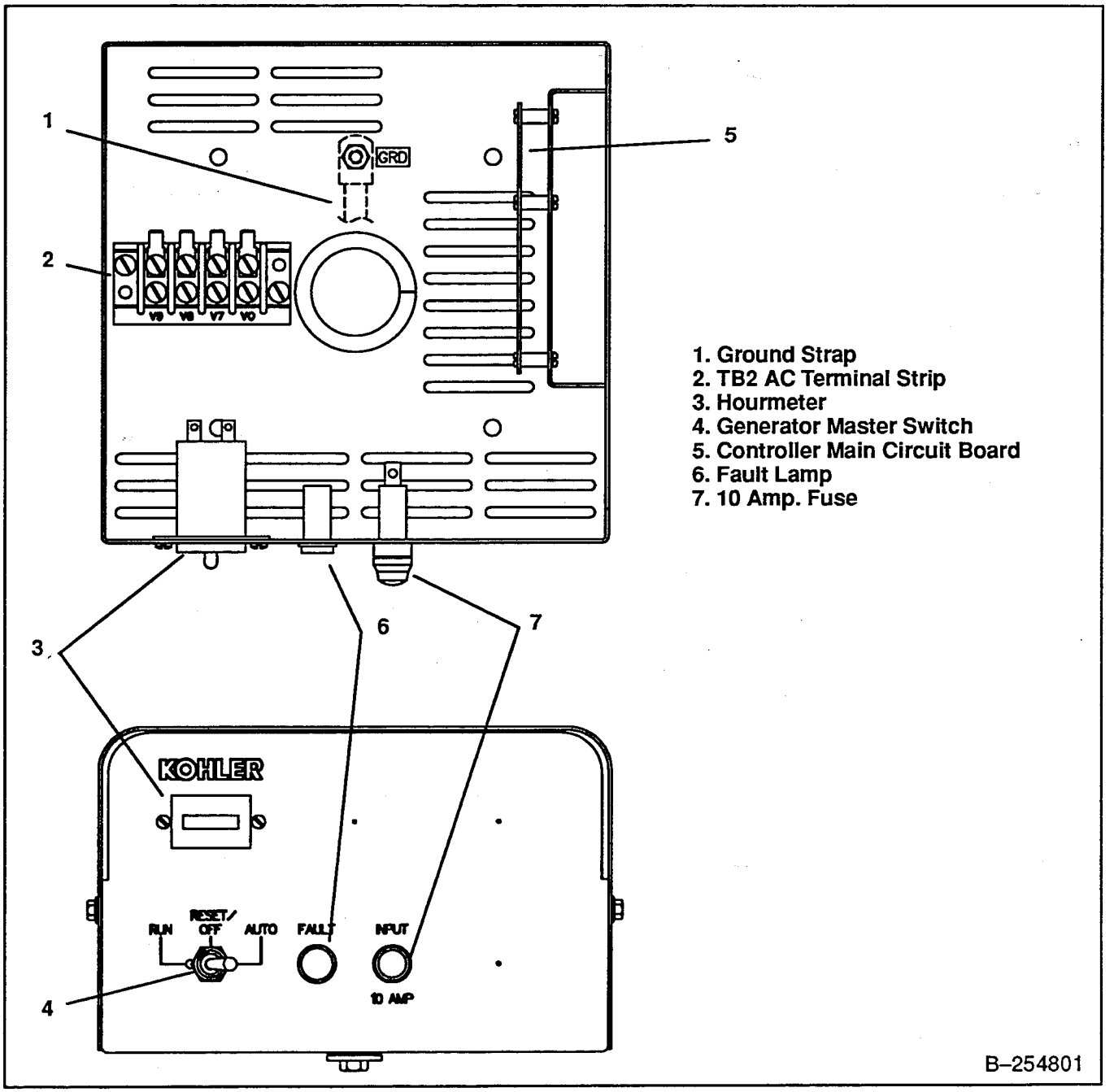


Figure 5–1. Relay Controller Internal Components

SEQUENCE OF OPERATION

This section covers the controller sequence of operation during generator start, run, stop, and fault shutdown modes. Use this section as a starting point for controller fault identification. The LED's on the controller circuit board are intended to assist in the troubleshooting process. An illuminated LED indicates that the respective relay is receiving power; the LED does not indicate that the relay is energized. (Additional relay test procedures are covered later in this section.) Refer to the diagrams in Figure 5–2 and Figure 5–3 to assist in the troubleshooting procedure.

STARTING

- Close the start/stop switch between N and 47 local.
- K2 relay is energized (LED 2 lights). Normally–open K2 (A) contacts close to energize engine components (fuel pump, fuel solenoid, governor system, hourmeter, and gauges [if so equipped]) and K4 relay (LED 4 lights).
- Normally–open K4 (B) contacts close to supply field flash current to rotor and energize K5 relay. K5 relay normally–open contacts (C) close to energize S relay. S relay normally–open contacts close to energize starter motor.
- When engine comes up to speed normally–closed low oil pressure switch contacts open.

NOTE

Fault shutdowns are inhibited during start–up until K3 is energized.

RUNNING

- When proper AC output is obtained from generator 7–10 (V0–V7) winding or engine speed reaches 1100 rpm, K3 relay is energized (LED 3 lights). K3 normally–closed contacts (D) open to deenergize K4 relay. K4 normally–open contacts (B) open to de–energize K5 relay and disconnect field flash circuit. K5 normally–open contacts (C) open to de–energize C relay. C relay normally–open contacts open to de–energize starter motor.

NOTE

AC output must be obtained within 30 seconds or generator will shut down on overcrank fault.

- K3 normally–open contacts (E) close to energized fault shutdown circuit after a 5 second delay.

STOPPING

- Move start/stop switch to open circuit between N and 47. K2 relay is deenergized (LED 2 goes out) and K2 contacts (A) open to deenergize engine components. Generator stops.

LOW OIL PRESSURE (LOP) SHUTDOWN

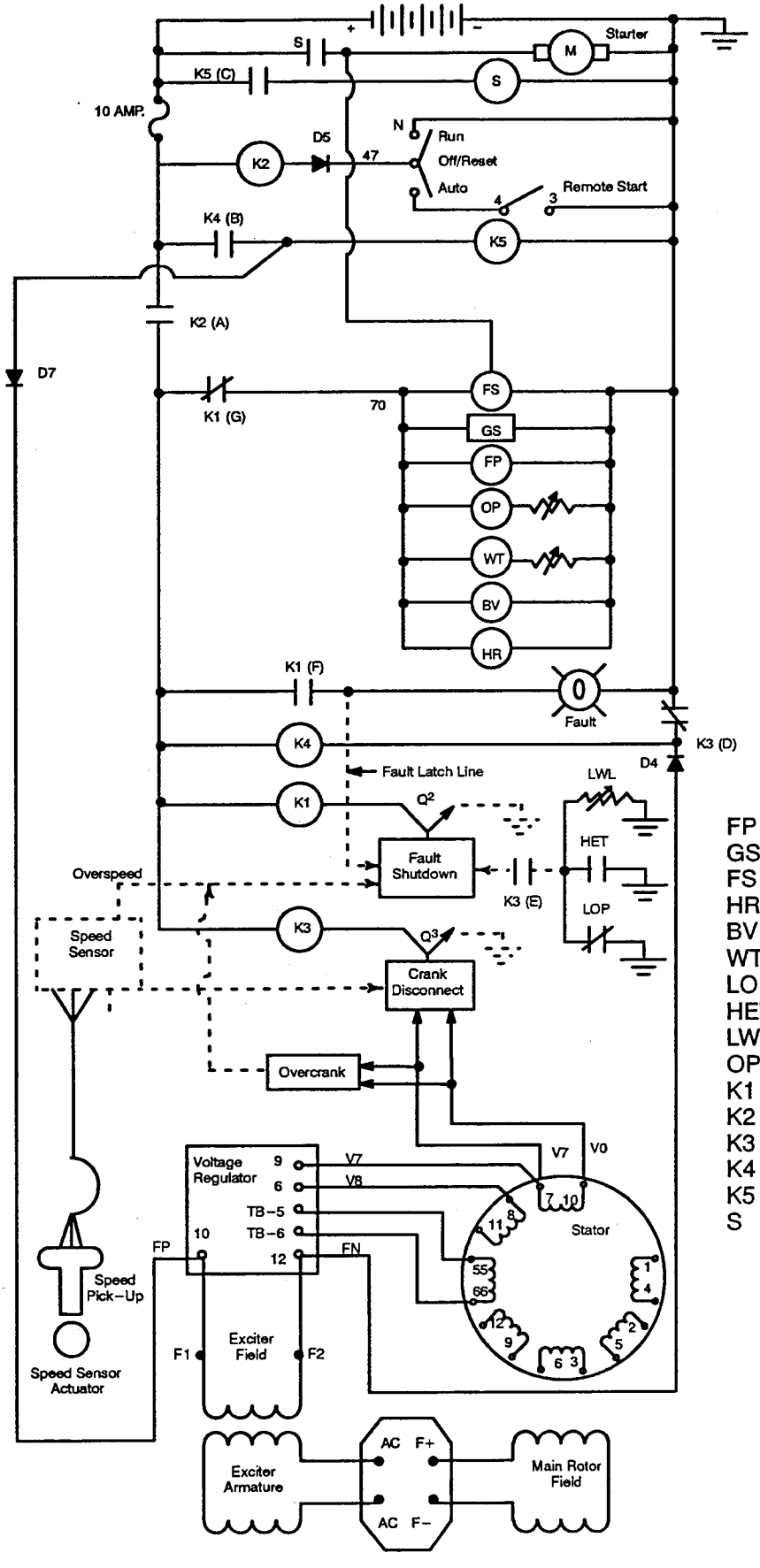
- Five to eight seconds after engine lube oil pressure falls below 7.1 psi (49 kPa) and LOP switch contacts close, the K1 relay is energized (LED 1 lights). Normally open K1 contacts (F) close and fault lamp lights. Normally–closed K1 contacts (G) open to de–energize engine components. Generator shuts down. (Fault shutdown is latched and generator master switch must be moved to off/reset before set can be restarted.)

HIGH ENGINE TEMPERATURE (HET) SHUTDOWN

- Five to eight seconds after the engine operating temperature reaches 230°F (110°C) and HET switch contacts close, K1 relay is energized (LED 1 lights). Normally open K1 contacts (F) close and fault lamp lights. Normally–closed K1 contacts (G) open to deenergize engine components. Generator shuts down. (Fault shutdown is latched and generator master switch must be moved to off/reset before set can be restarted.)

LOW WATER LEVEL (LWL) SHUTDOWN

- Five to eight seconds after the engine coolant level falls below the safe range and LWL sensor decreases circuit resistance, K1 relay is energized (LED 1 lights). Normally open K1 contacts (F) close and fault lamp lights. Normally–closed K1 contacts (G) open to deenergize engine components. Generator shuts down. (Fault shutdown is latched and generator master switch must be moved to off/reset before set can be restarted.)



NOTE

- Overcrank, Overspeed, LWL, HET, LOP drive the fault shutdown circuit.
- Fault latch provided by K1 normally–open contacts.
- Overcrank shutdown is only driven by AC.
- Crank disconnect driven by AC and speed sensor input.
- Relays K1, K2, K3, and K4 are part of the controller circuit board and their electrical connections and circuits are simplified in this diagram.
- Fault latch line, fault shutdown, crank disconnect, overcrank, overspeed, and speed sensor (dotted lines) are part of the controller circuit board and their electrical connections and circuits are simplified in this diagram.

FP	Fuel Pump
GS	Governor System (optional)
FS	Fuel Solenoid
HR	Hourmeter
BV	Battery Volts (optional)
WT	Water Temperature (optional)
LOP	Low Oil Pressure
HET	High Engine Temperature
LWL	Low Water Level
OP	Oil Pressure (optional)
K1	Fault Shutdown
K2	Engine Run Relay
K3	Crank Disconnect/Flash Relay
K4	Crank Relay
K5	Starter Relay
S	Starter Solenoid

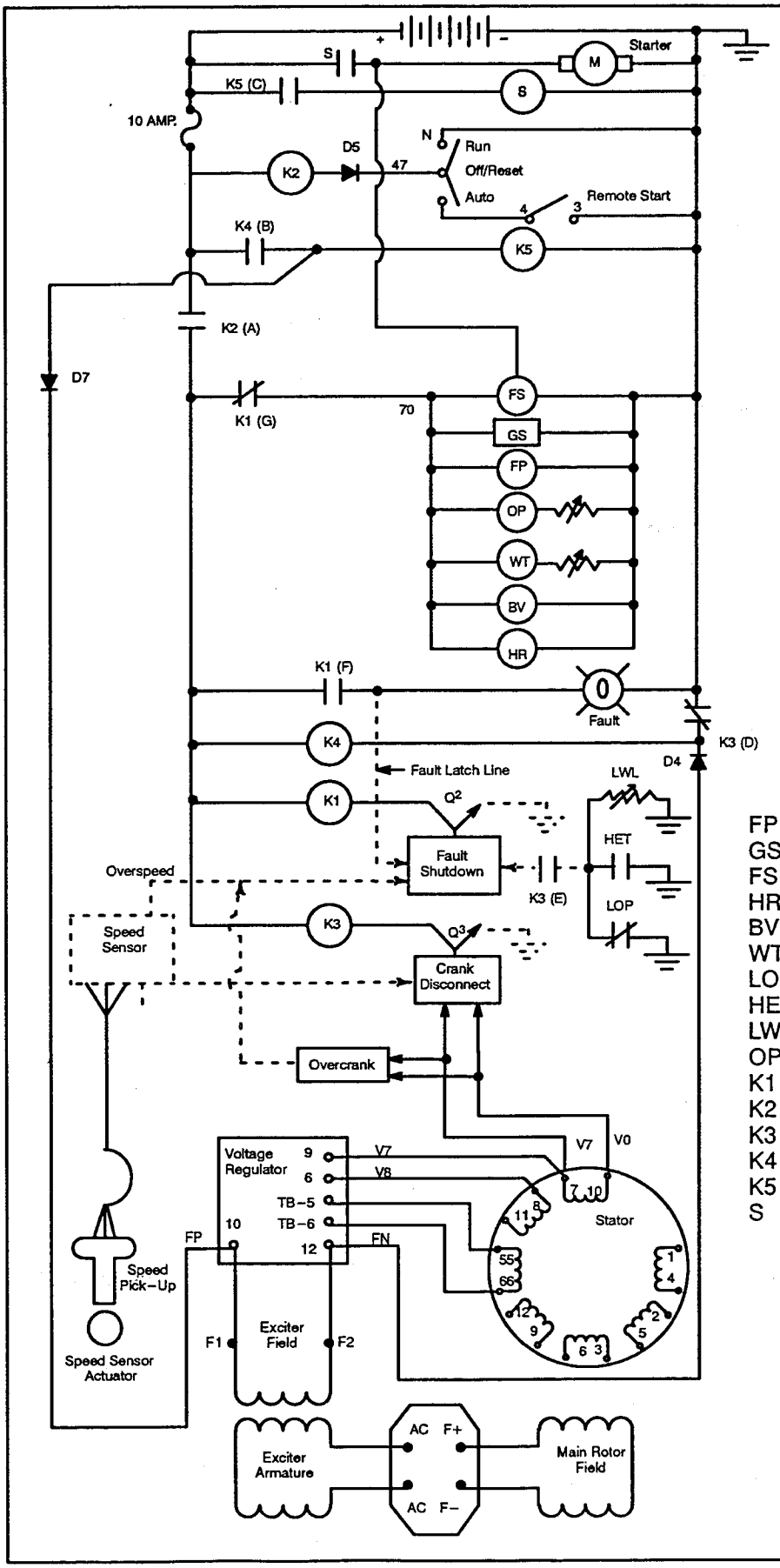
Figure 5–2. Sequence of Operation Diagram (Relay Controller)

OVERSPEED SHUTDOWN

When engine speed exceeds 70 Hz (2100 rpm) on 50/60 Hz sets, K1 relay is energized (LED 1 lights). Normally open K1 contacts (F) close and fault lamp lights. K1 normally–closed (G) contacts open to deenergize engine components. Generator shuts down. (Fault shutdown is latched and generator master switch must be moved to off/reset before set can be restarted.)

OVERCRANK SHUTDOWN

If the generator does not start after three crank cycles (crank – rest, crank – rest, crank), the K1 relay is energized (overcrank). Normally open K1 contacts (F) close and the fault lamp will light. K1 normally–closed contacts open to deenergize engine components. Generator shuts down. (Fault shutdown is latched and generator master switch must be moved to off/reset before set can be restarted.)



NOTE

- Overcrank, Overspeed, LWL, HET, LOP drive the fault shutdown circuit.
- Fault latch provided by K1 normally–open contacts.
- Overcrank shutdown is only driven by AC.
- Crank disconnect driven by AC and speed sensor input.
- Relays K1, K2, K3, and K4 are part of the controller circuit board and their electrical connections and circuits are simplified in this diagram.
- Fault latch line, fault shutdown, crank disconnect, overcrank, overspeed, and speed sensor (dotted lines) are part of the controller circuit board and their electrical connections and circuits are simplified in this diagram.

FP	Fuel Pump
GS	Governor System (optional)
FS	Fuel Solenoid
HR	Hourmeter
BV	Battery Volts (optional)
WT	Water Temperature (optional)
LOP	Low Oil Pressure
HET	High Engine Temperature
LWL	Low Water Level
OP	Oil Pressure (optional)
K1	Fault Shutdown
K2	Engine Run Relay
K3	Crank Disconnect/Flash Relay
K4	Crank Relay
K5	Starter Relay
S	Starter Solenoid

Figure 5–2. Sequence of Operation Diagram (continued) (Relay Controller)

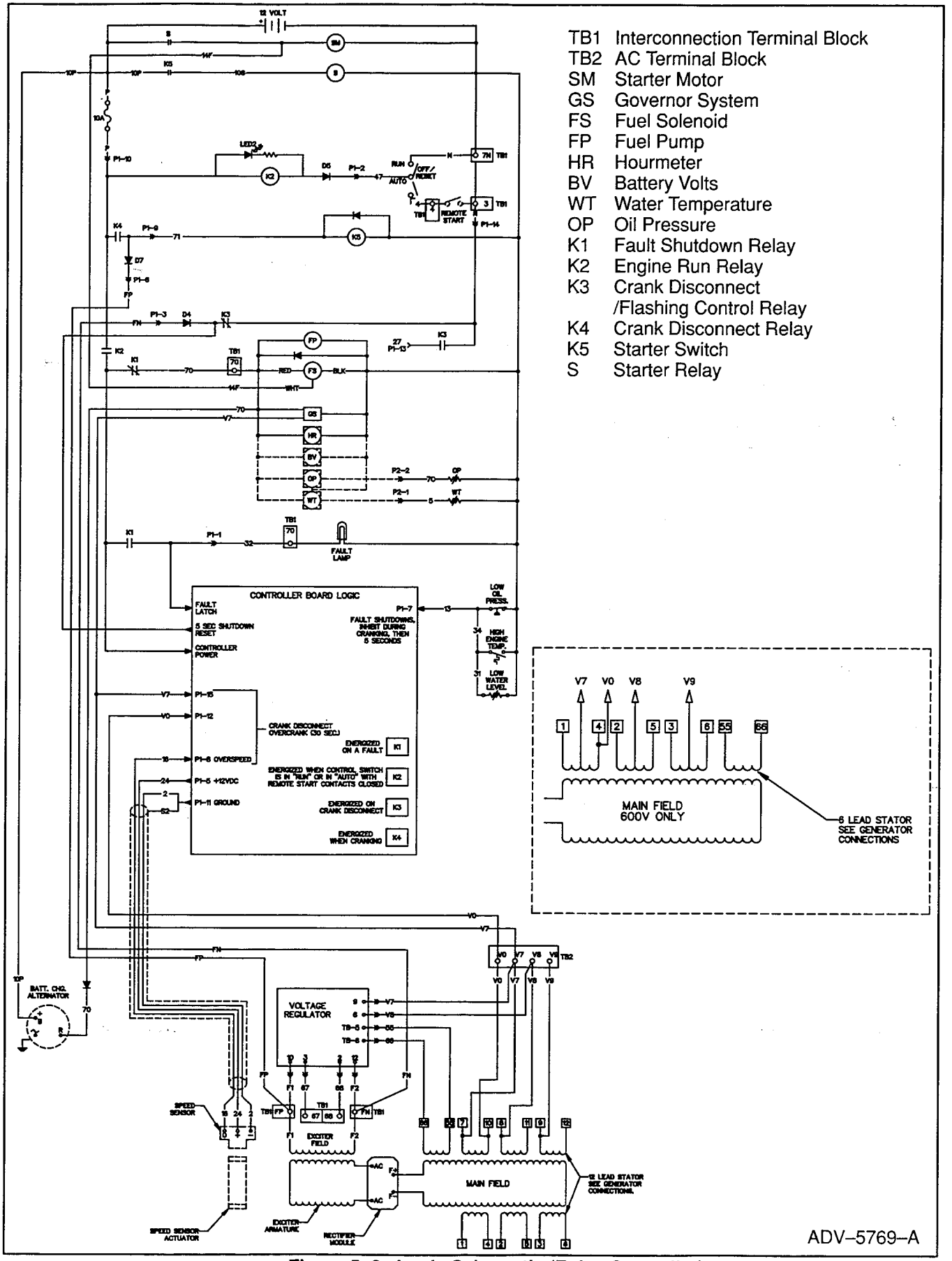
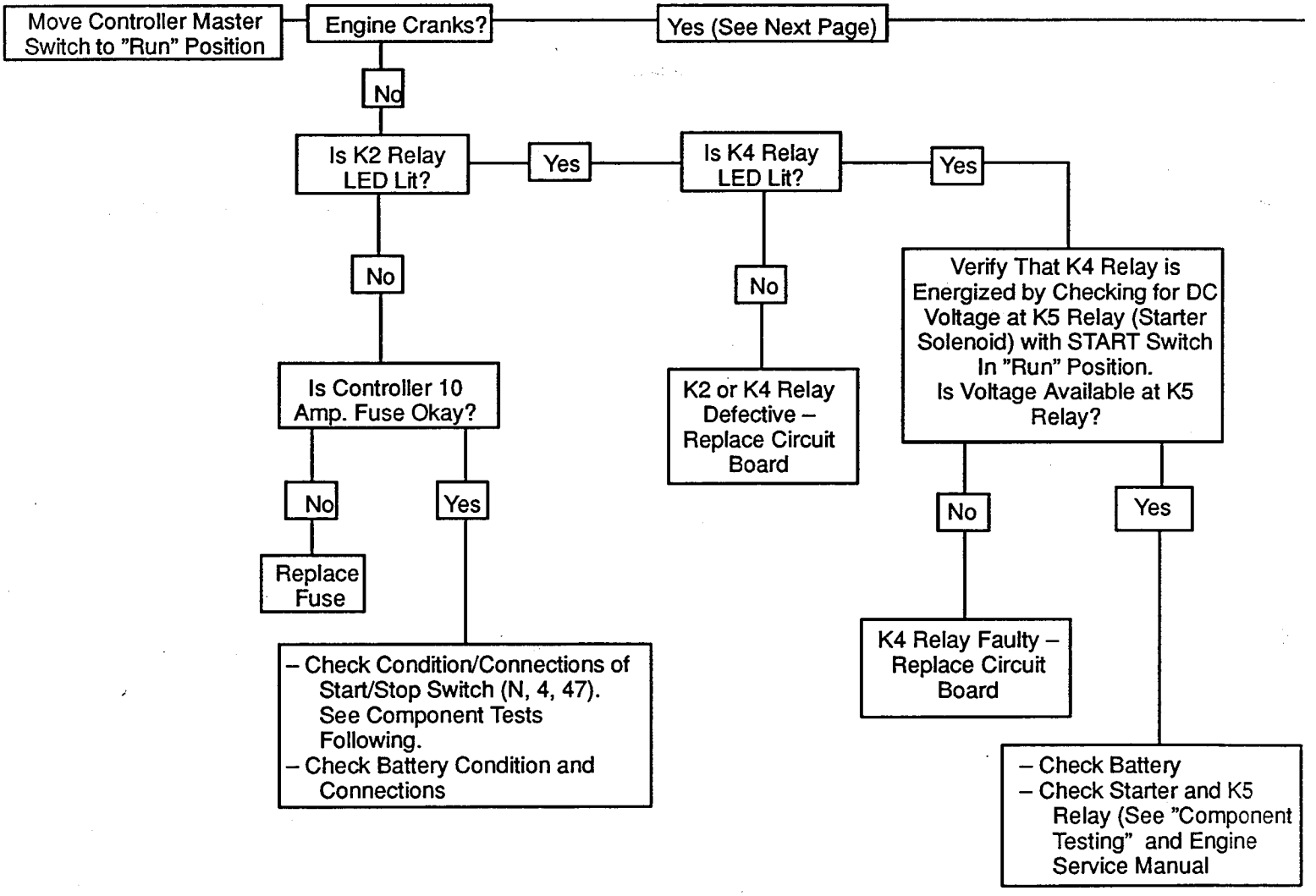
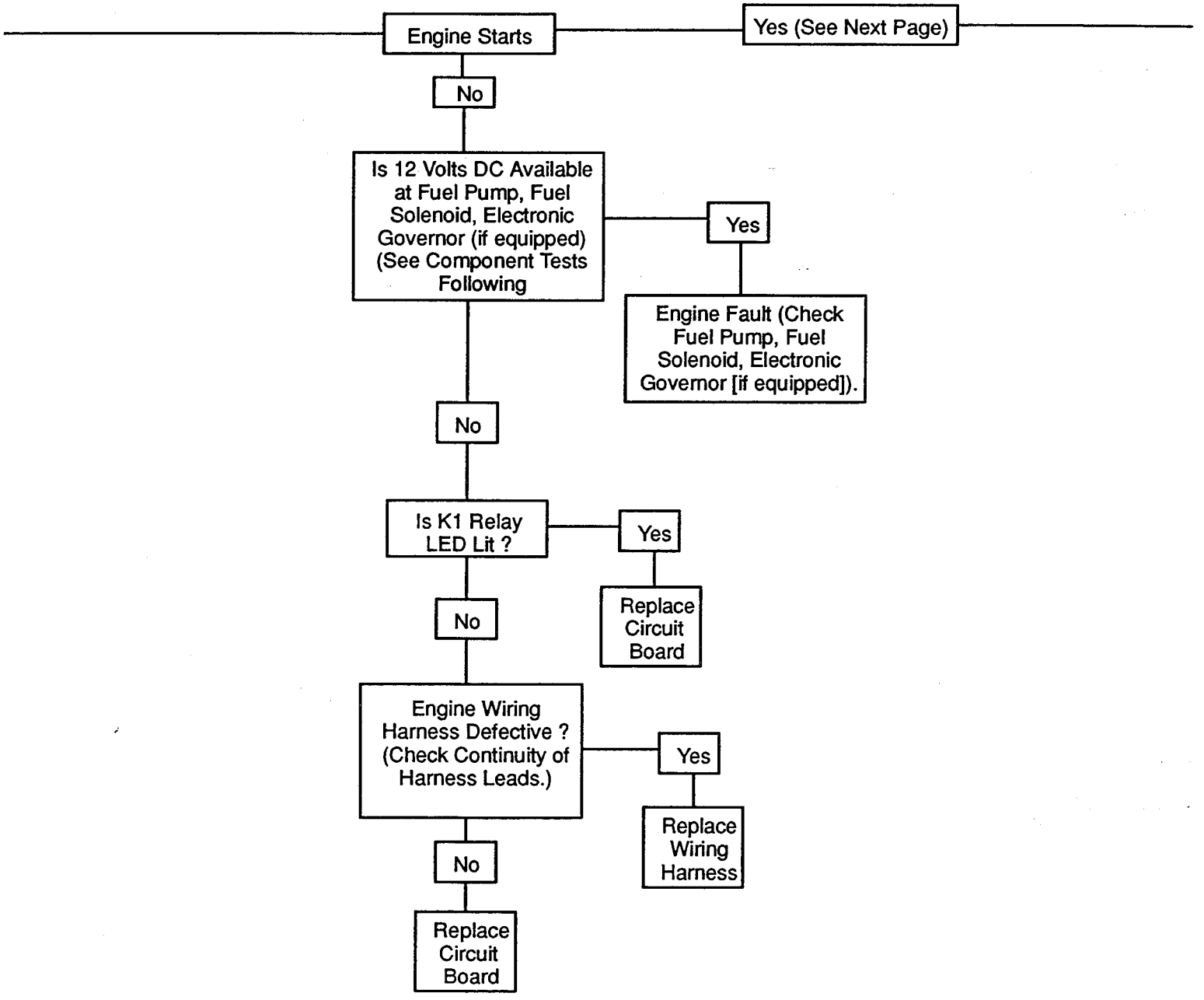


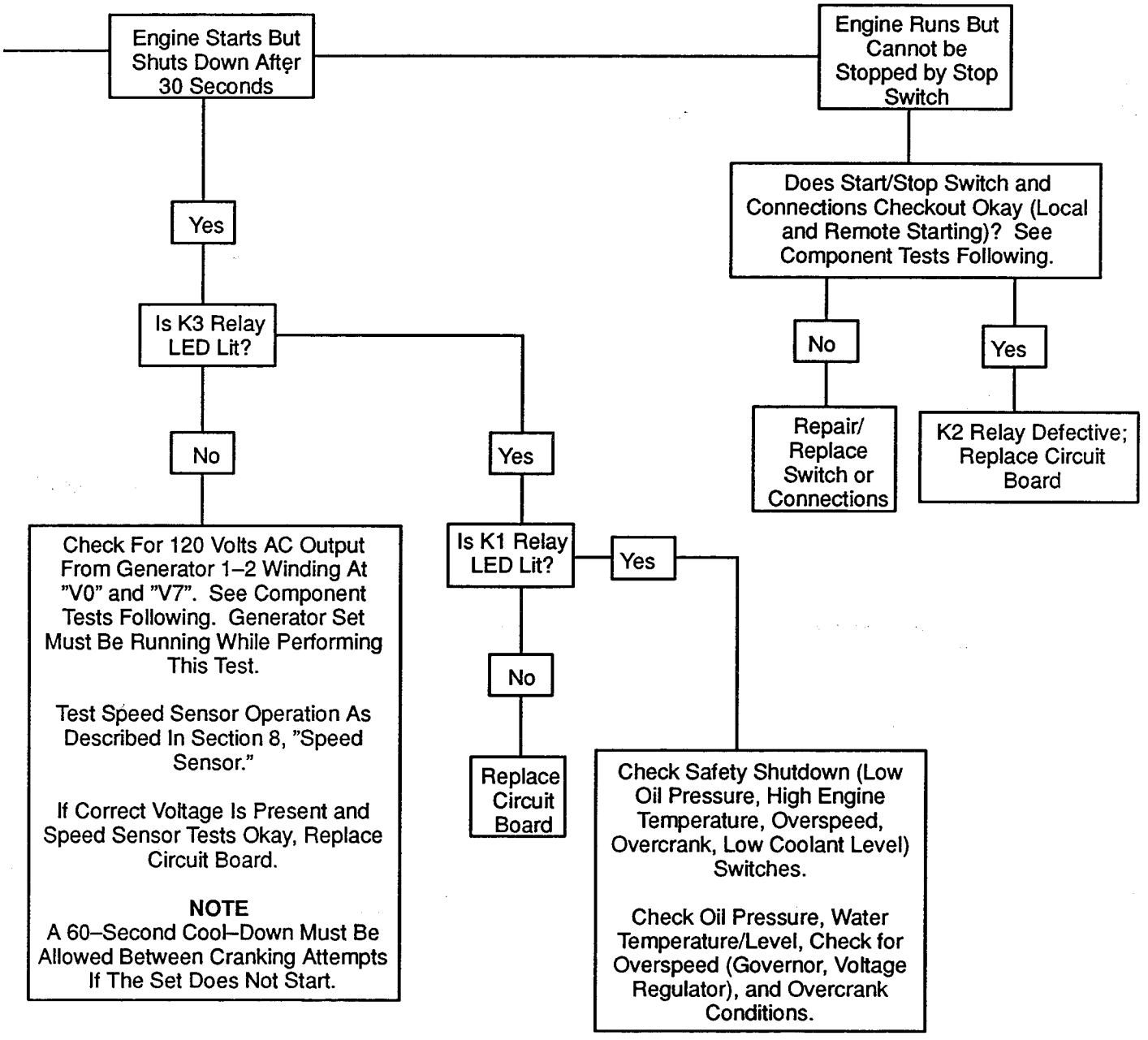
Figure 5–3. Logic Schematic (Relay Controller)

CONTROLLER CIRCUIT BOARD TESTING

Use the following flow chart as an aid in troubleshooting the main circuit board and the entire generator set. If the prescribed remedy does not correct the problem, the circuit board may have to be replaced. The controller circuit board is equipped with LED's (light emitting diodes) to indicate relay coil power and aid in circuit board and generator fault detection. When the K1, K2, K3, or K4 relays are receiving power, the corresponding LED will light. The LED does not indicate whether the relay coil is energized. This conclusion can only be reached through analysis of generator faults and by performing a continuity test on the relay coil (covered later in this section).

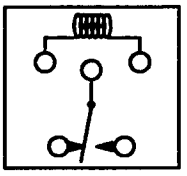


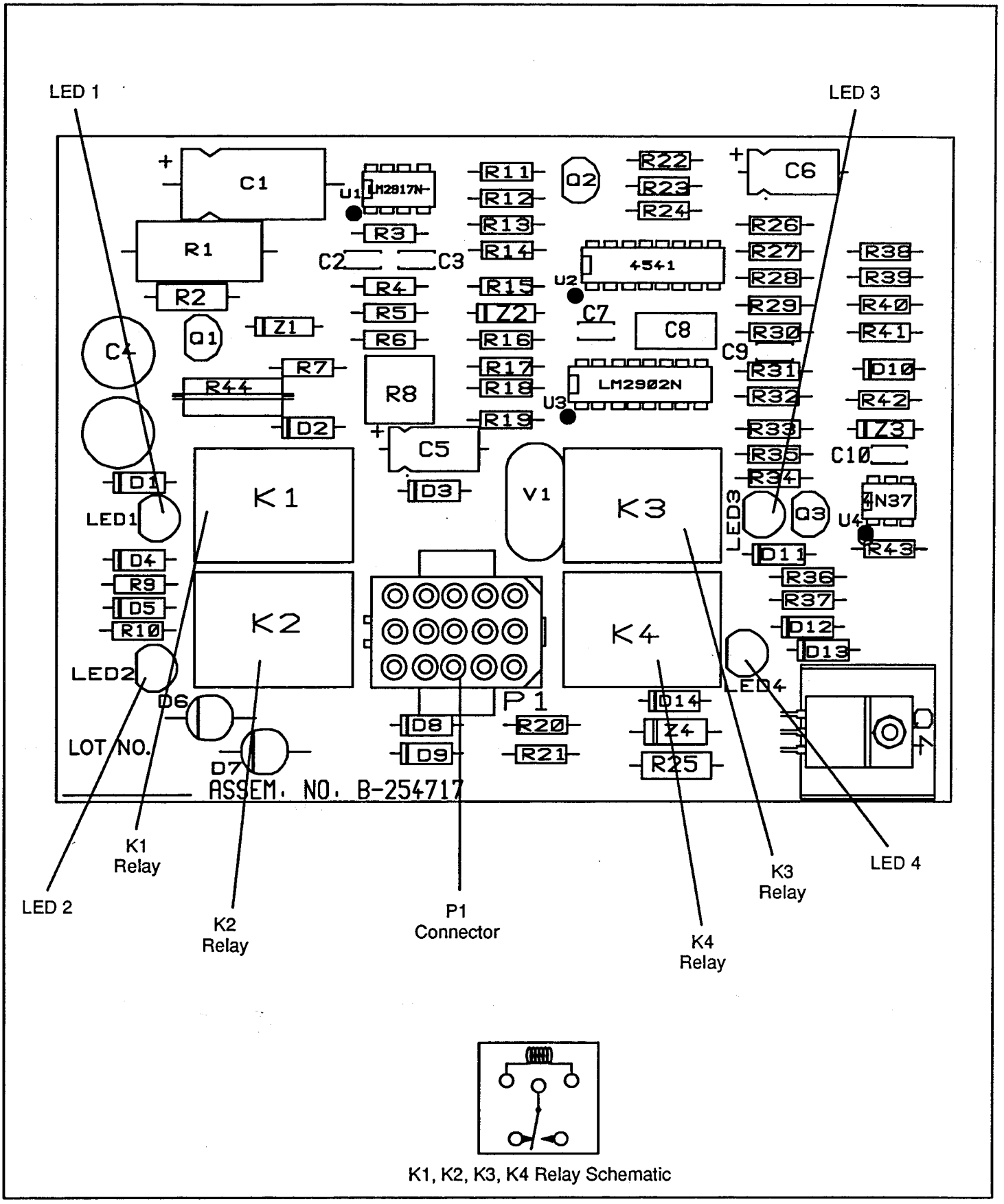

Engine Starts
Yes (See Next Page)
No
Is 12 Volts DC Available at Fuel Pump, Fuel Solenoid, Electronic Governor (if equipped) (See Component Tests Following
Yes
Engine Fault (Check Fuel Pump, Fuel Solenoid, Electronic Governor [if equipped]).
No
Is K1 Relay LED Lit ?
Yes
Replace Circuit Board
No
Engine Wiring Harness Defective ? (Check Continuity of Harness Leads.)
Yes
Replace Wiring Harness
No
Replace Circuit Board


Engine Starts But Shuts Down After 30 Seconds
Engine Runs But Cannot be Stopped by Stop Switch
Yes
Does Start/Stop Switch and Connections Checkout Okay (Local and Remote Starting)? See Component Tests Following.
Is K3 Relay LED Lit?
No
Yes
No
Yes
Repair/ Replace Switch or Connections
K2 Relay Defective; Replace Circuit Board
No
Yes
Is K1 Relay LED Lit?
Yes
Check For 120 Volts AC Output From Generator 1–2 Winding At "V0" and "V7". See Component Tests Following. Generator Set Must Be Running While Performing This Test.
Test Speed Sensor Operation As Described In Section 8, "Speed Sensor."
If Correct Voltage Is Present and Speed Sensor Tests Okay, Replace Circuit Board.
NOTE
A 60–Second Cool–Down Must Be Allowed Between Cranking Attempts If The Set Does Not Start.
No
Replace Circuit Board
Check Safety Shutdown (Low Oil Pressure, High Engine Temperature, Overspeed, Overcrank, Low Coolant Level) Switches.
Check Oil Pressure, Water Temperature/Level, Check for Overspeed (Governor, Voltage Regulator), and Overcrank Conditions.

CONTROLLER CIRCUIT BOARD TESTING (Continued)

It is possible to check controller circuit board relays without removing the relay from the board. These checks should be made prior to installing a new board and attempting start–up. Most of the tests are referenced in Section 4, General Troubleshooting. Use a high quality multimeter and follow the manufacturer's instructions. To obtain accurate readings when testing, remove all circuit board connectors and conformal coating (transparent insulation) from component terminals. Use the following chart and the controller circuit board illustration (Figure 5–4).

Component	Ohmmeter Connection	Remarks	Results
K1, K2, K3, K4 Relay Coil	K1 Coil Terminals (See relay schematic below) 	Ohmmeter on R x 10 scale	If good, approx. 400 ohms. Low resistance (continuity) – shorted coil. High resistance – open coil



K1, K2, K3, K4 Relay Schematic

Figure 5–4. Controller Circuit Board Testing

ENGINE/GENERATOR COMPONENTS

With the generator set battery connected, the wiring harness and some engine/generator components can be checked. Place the controller master switch or remote start/stop switch in the prescribed position and check for voltage at each component using a voltmeter. This will verify that the switches function and voltage is present at each component.

Component	Voltmeter Connections	Procedure
Hourmeter and wiring	Red test clip to hourmeter (+) terminal. Black test clip to hourmeter (–) terminal.	Voltmeter setting 12 Volts DC or greater. Start generator set. 12 Volt DC reading indicates wiring harness is okay. Hourmeter will function if good.
Fault Lamp and wiring	Red test clip to fault lamp (+) terminal. Black test clip to fault lamp (–) terminal.	Voltmeter setting 12 Volts DC or greater. Start generator set. Connect a jumper from LOP (low oil pressure) switch to ground to cause LOP shutdown. 12 Volt DC reading indicates wiring harness is okay. Fault lamp should light if good.
Stator "10–7" winding (control winding)	V0 and V7 terminals in controller	Voltmeter setting 150 Volts AC or greater. Start generator set and allow to reach rated speed. Reading of 120 Volts AC (approx.) indicates stator "1–2" winding is good.
Governor Actuator (optional)	None	Disconnect actuator harness and apply 12 Volts DC to actuator. If good, actuator will extend. Actuator should retract when DC is removed.
Water Temperature Gauge (if equipped)	Red test lead to positive side (wire 70) of gauge. Black test lead to generator ground connection.	Start generator set to test voltage. Battery voltage (approx. 12 Volts DC) should be read. If no voltage, check controller circuit board and wiring. If voltage is present at gauge, stop set and check continuity of wiring between gauge and ground. (Resistance of sender will be read during continuity check. See Section 8. Component Testing and Adjustment – Meter Senders (optional). If wiring tests okay, replace gauge.
Oil Pressure Gauge (if equipped)	Red test lead to positive side (wire 70) of gauge. Black test lead to generator ground connection.	Start generator set to test voltage. Battery voltage (approx. 12 Volts DC) should be read. If no voltage, check controller circuit board and wiring. If voltage is present at gauge, stop set and check continuity of wiring between gauge and ground. (Resistance of sender will be read during continuity check. See Section 8. Component Testing and Adjustment – Meter Senders (optional). If wiring tests okay, replace gauge.

Component	Voltmeter Connections	Procedure
Voltmeter (if equipped)	Red test lead to positive side (wire 70) of gauge. Black test lead to generator ground connection.	Start generator set. Battery voltage (approx. 12 Volts DC) should be read. If no voltage, check controller circuit board and wiring. If voltage is present, stop set and check continuity of wiring between meter and ground. If wiring tests okay, replace meter.

To further check generator set components, disconnect the battery and remove wiring harness plugs from the controller circuit board. Use an ohmmeter to check continuity and to isolate defective components. Use the following chart and Figure 5–6.

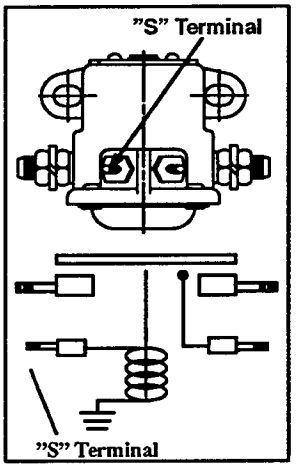
NOTE

Before performing ohmmeter checks, disconnect generator set battery to prevent damage to the ohmmeter.

Hazardous voltage can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Do not contact electrical connections with tools or jewelry while adjustments are made. Remove wristwatch, rings, and jewelry that can cause short circuits.

Component	Ohmmeter Connections	Procedure	Results
Controller Master Switch	P1–2 (47) and P1–14 (N)	Ohmmeter on R x 1 scale. Place master switch in RUN position	If good – zero ohms (continuity). Any resistance other than zero indicates defective switch.
	P1–2 (47) and P1–14 (N)	Ohmmeter on R x 1 scale. Place master switch in OFF/ RESET position	If good – no reading (infinity). Any other reading indicates defective switch.
Hourmeter	(+) and (–) terminals	Ohmmeter on R x 1 scale	If good – continuity No continuity – replace hourmeter.
P1 wiring harness	P1–14 and ground	Ohmmeter on R x 1 scale	If good – zero ohms. Any other reading indicates a poor ground connection.
	P1–12 and P1–15 (1 and 2 stator leads)	Ohmmeter on R x 1 scale	If good – continuity (zero ohms).

RELAY CONTROLLER

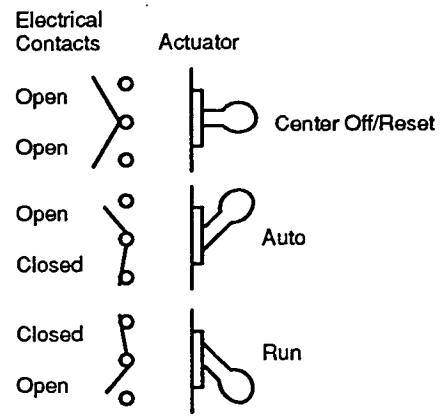
Component	Ohmmeter Connections	Procedure	Results
Controller 10 Amp. fuse and wiring	P1–10 and battery positive (+) cable	Ohmmeter on R x 1 scale.	If good – zero ohms. No continuity – open circuit and/or blown fuse.
Voltage regulator circuit 10 Amp. fuse	J11–5 and stator lead 55 at fuse holder	Ohmmeter on R x 1 scale.	If good, zero ohms. No continuity – blown fuse or open wiring.
K5 relay coil (starter relay) 	K5 "S" terminal and relay base (ground)	Ohmmeter on R x 1 scale.	If good – 3–4 ohms. Low resistance – shorted K5 relay coil and/or wiring. High resistance – open K5 relay coil and/or wiring.

Component	Ohmmeter Connections	Procedure	Results
High Engine Temperature (HET) Switch *	P1–7 and ground (engine block)	Ohmmeter on R x 1 scale. **Low Oil Pressure (LOP) and Low Water Level (LWL) switches disconnected.**	If good, open circuit (infinity). Any other reading indicates defective switch and/or wiring.
Low Oil Pressure (LOP) Switch *	P1–7 and ground (engine block)	Ohmmeter on R x 1 scale. **High Engine Temperature (HET) and Low Water Level (LWL) switches disconnected.**	If good, zero ohms (continuity). No reading, defective switch and or wiring.
Low Water Level (LWL) Switch *	P1–7 and ground (engine block)	Ohmmeter on R x 1 scale. **High Engine Temperature (HET) and Low Oil Pressure switches disconnected.**	If good, 30–80 ohms with engine cold and LWL switch immersed in coolant. Any other reading, replace LWL switch.

* See Fault Shutdown Test Procedure following.

Control Master Switch Electrical Contacts and Corresponding Actuator Position

NOTE: Controller switch electrical connections are reversed from position of switch.



Legend

FS	Fuel Solenoid
FP	Fuel Pump
HR	Hourmeter
K5	Starter Relay
M	Starter Motor
LWL	Low Water Level Sensor
HET	High Exhaust Temperature Switch
LOP	Low Oil Pressure Switch
S	Starter Solenoid

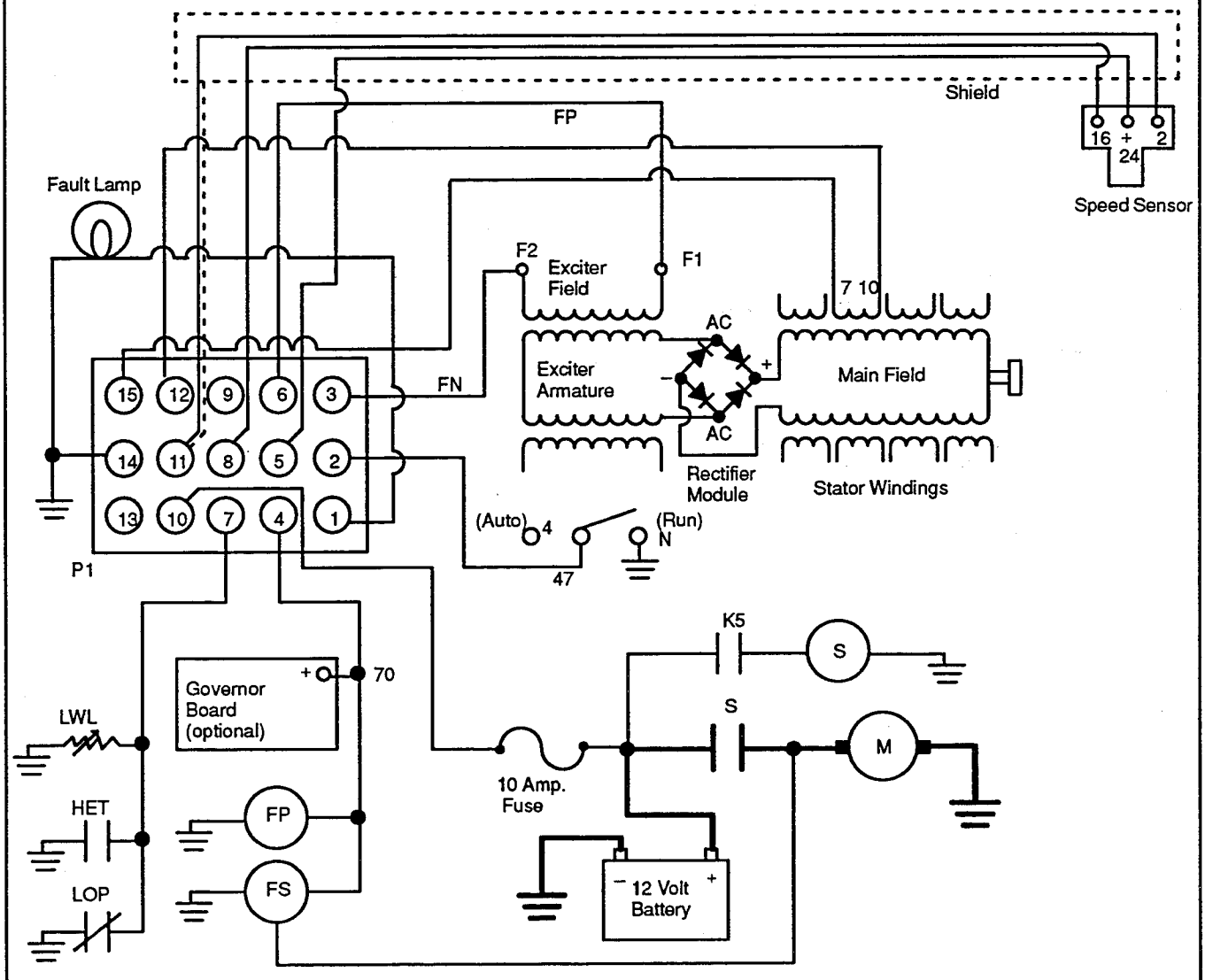


Figure 5–6. 12–Lead Generator Wiring Harness Schematic

FAULT SHUTDOWN TEST PROCEDURE

Proper operation of the generator overspeed, overcrank, low coolant level, low oil pressure, and high engine temperature shutdowns can be verified by performing the following tests with the generator set running. If these tests are inconclusive, test individual shutdown circuit components (circuit board, wiring harness, switch, etc.) as described earlier in this section.

⚠ WARNING

Hazardous voltage.

Moving rotor.

Can cause severe injury or death.

Do not operate generator set without all guards and electrical enclosures in place.

Exposed moving parts can cause severe injury or death. Keep hands, feet, hair, and clothing away from belts and pulleys when unit is running. Replace guards, covers, and screens before operating generator set.

Hazardous voltage can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Do not contact electrical connections with tools or jewelry while adjustments are made. Remove wristwatch, rings, and jewelry that can cause short circuits.

Overspeed Shutdown

Start generator set and manually adjust engine speed (by moving governor linkage) to exceed rated engine rpm (1800 rpm). Generator should shut down and fault lamp will light at engine speed between 68 and 71 Hz.

Low Oil Pressure (LOP) Shutdown

Connect a jumper wire from the LOP switch (lead 13) to generator set ground. See Section 8. Engine Safety Shutdown Switches. Start generator set. After approximately 5–8 seconds the generator set should shut down and the fault lamp will light.

Low Water Level (LWL) Shutdown

Connect a jumper wire from LWL sensor (lead 31) to generator set ground. See Section 8. Engine Safety Shutdown Switches. Start generator set. After approximately 5–8 seconds, the generator set should shut down and the fault lamp will light.

High Engine Temperature (HET) Shutdown

Connect a jumper from the HET switch (lead 34) to the generator set ground. See Section 8. Engine Safety Shutdown Switches. Start generator set. After approximately 5–8 seconds, the generator set should shut down and the fault lamp will light.

Overcrank Shutdown

Disconnect lead between starter solenoid K20 and starter motor at K20 terminal. Move controller master switch to the RUN position. Generator set will simulate cranking for 8 seconds and then the generator set fault lamp will light.

Section 6. Troubleshooting 5 Light Microprocessor Controller

(and Related Engine Components)

INTRODUCTION

Troubleshooting the microprocessor controller and related engine components is done through a combination of methods including fault detection flow charts and Fast Check diagnostic testing. These methods are described in the following pages. To identify external features, see Section 2 – "5 Light Microprocessor Controller Operation." Refer to Figure 6–1 to identify controller internal components. Refer to Figure 6–2 to identify controller circuit board components. Figure 6–3 is a logic schematic showing input/output circuits for reference in troubleshooting the controller.

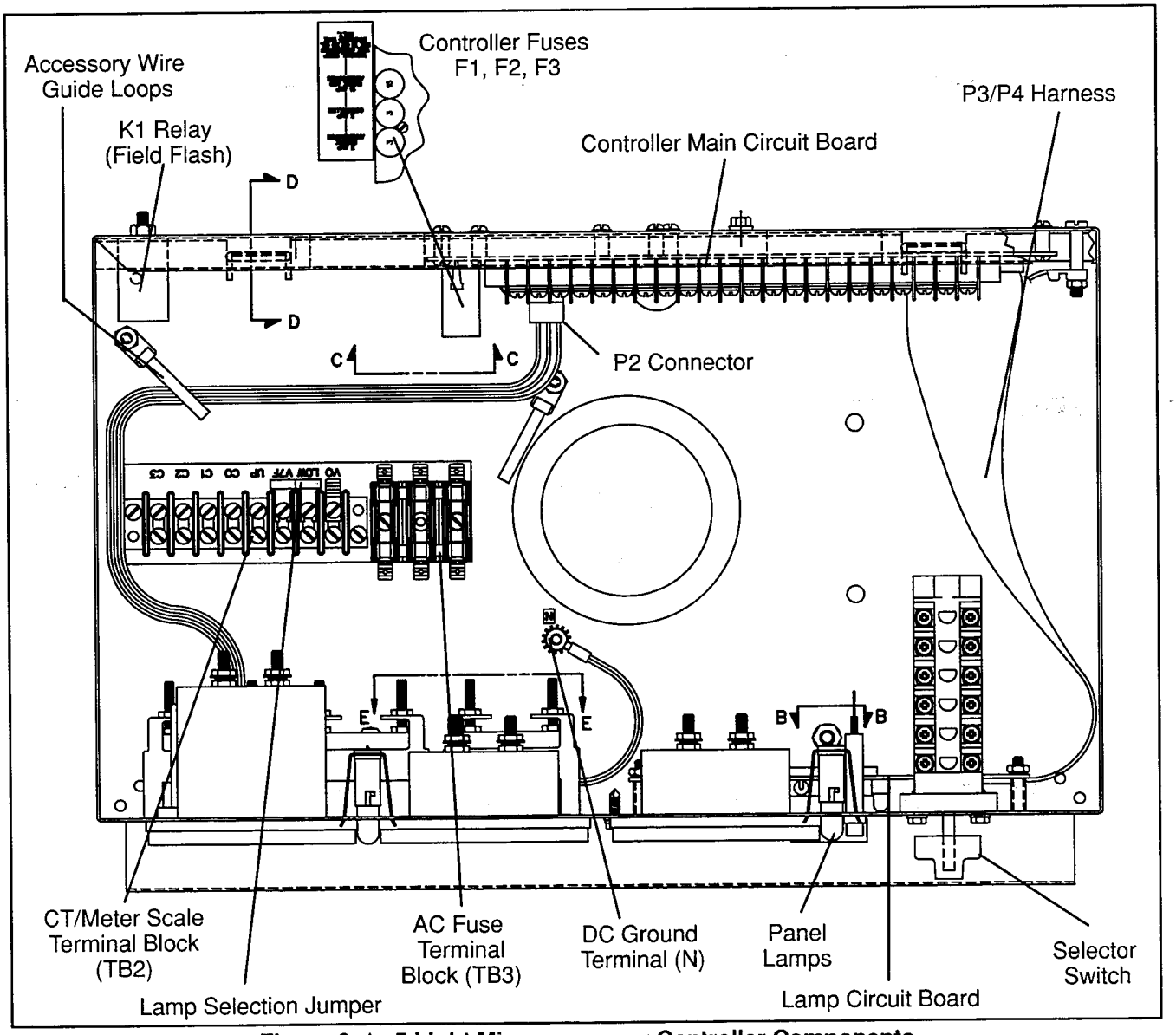
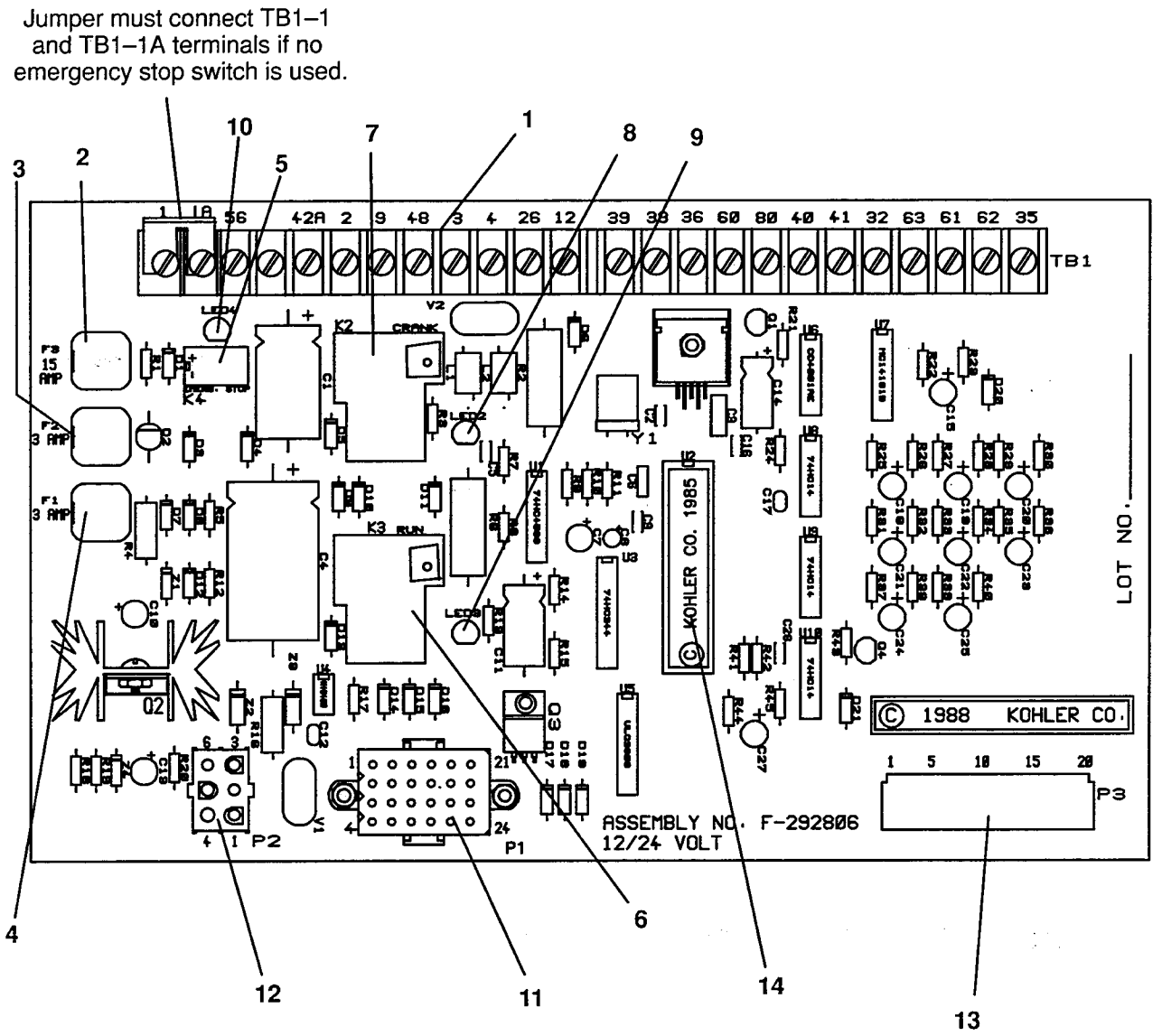


Figure 6–1. 5 Light Microprocessor Controller Components



1. TB1 Terminal Strip (Accessories)
2. Fuse – 15 Amp. (F3) Engine and Accessories
3. Fuse – 3 Amp. (F2) Controller
4. Fuse – 3 Amp. (F1) Remote Annunciator
5. K4 Relay (Emergency Stop Relay)
6. K3 Relay (Run Relay)
7. K2 Relay (Crank Relay)
8. LED 2
9. LED 3
10. LED 4
11. P1 Connector (DC Harness)
12. P2 Connector (AC Harness)
13. P3 Connector (Control Panel Harness)
14. Microcomputer Chip (U6)

F–292806–B

Figure 6–2. 5–Light Microprocessor Controller Circuit Board Components

5 LIGHT MICROPROCESSOR CONTROLLER

CIRCUIT BOARD TERMINAL IDENTIFICATION (TB1)

1. 1 — Ground — Emergency Stop Relay (K4)
2. 1A — Emergency Stop Relay (K4) Coil; Negative
3. 56 — Air Damper
4. Not Used
5. 42A — Battery Voltage (Fuse #1 Protected)
6. 2 — Ground
7. 9 — Crank Mode (open — cyclic crank; ground — continuous crank)
8. 48 — Emergency Stop Indicator
9. 3 — Remote Start Ground
10. 4 — Remote Start (Active Low*)
11. 26 — Auxiliary Indicator
12. 12 — Overcrank Indicator
13. 39 — Overspeed Indicator
14. 38 — Low Oil Pressure Indicator
15. 36 — High Engine Temperature Indicator
16. 60 — System Ready Indicator
17. 80 — Not In Auto Indicator
18. 40 — Prealarm High Engine Temperature Indicator
19. 41 — Prealarm Low Oil Pressure Indicator
20. 32 — Common Fault/Prealarm Line
21. 63 — Low Fuel (Active Low*)
22. 61 — Battery Charger Fault (Active Low*)
23. 62 — Low Battery Volts (Active Low*)
24. 35 — Low Water Temperature

P1 CONNECTOR PINS

1. Output to K1 Relay (Crank Relay), Wire 71
2. Ground for Speed Sensor, Wire 2
3. Output to Safeguard Breaker Terminal, Wire 70
4. Not Used
5. Ground (–), Wire N
6. Speed Sensor Shield Ground, Wire S2
7. Output to Governor System (GS), Wire 70
8. Battery Positive to Speed Sensor, Wire 24
9. Input from Speed Sensor, Wire 16
10. Not Used
11. Not Used
12. Input from Battery Positive (P)
13. Not Used
14. Input from Water Level Switch, Wire 31
15. Not Used
16. Not Used
17. Not Used
18. Not Used
19. Not Used
20. Not Used
21. Input from High Engine Temperature Switch, Wire 34
22. Input from Low Oil Pressure Switch, Wire 13
23. Not Used
24. Not Used

P2 CONNECTOR PINS

1. Output to Oil Pressure Sender, Wire 70
2. Input from Overvoltage Board, Wire 30
3. Input for AC Crank Disconnect and Instrumentation, Wire V7
4. Not Used
5. Input for AC Crank Disconnect and Instrumentation, Wire V0
6. Engine Ground, Wire 2

P3 CONNECTORS PINS

1. Output to Low Water Temperature/Aux Indicator (E.Stop), Wire 48
2. Output to Low Water Temperature/Aux Indicator, Wire 26
3. Output to Overcrank Indicator, Wire 12
4. Output to Overspeed Indicator, Wire 39
5. Output to Low Oil Pressure Indicator, Wire 38
6. Output to High Engine Temperature Indicator, Wire 36
7. Not Used
8. Voltage (+) to Front Panel, Wire 24
9. Not Used
10. Not Used
11. Not Used
12. Output to Low Water Temperature/Aux Indicator, Wire 35
13. Not Used
14. Not Used
15. Not Used
16. Not Used
17. Input from Generator Master Switch, RUN position, Wire 47
18. Input from Generator Master Switch, OFF/RESET position, Wire 43
19. Input from Generator Master Switch, AUTO position, Wire 46
20. Ground (–), Front Panel, Wire 2

P4 CONNECTORS PINS

1. Input to Low Water Temperature/Aux Indicator (E. Stop), Wire 48
2. Input to Low Water Temperature/Aux Indicator, Wire 26
3. Input to Overcrank Indicator, Wire 12 **
4. Output to Overspeed Indicator, Wire 39 **
5. Input to Low Oil Pressure Indicator, Wire 38 **
6. Input to High Engine Temperature Indicator, Wire 36 **
7. Not Used
8. Voltage (+) to Front Panel, Wire 24
9. Not Used
10. Not Used
11. Not Used
12. Input to Low Water Temperature/Aux Indicator, Wire 35 **
13. Not Used
14. Not Used
15. Not Used
16. Not Used
17. Output from Generator Master Switch, RUN position, Wire 47
18. Output from Generator Master Switch, OFF/RESET position,Wire 43
19. Output from Generator Master Switch, AUTO position, Wire 46
20. Ground (–), Front Panel

* Active low circuits may be checked for proper operation by placing ground on terminals so designated.

** Common alarm triggered by High Engine Temperature, Low Oil Pressure, Low Water Temperature, Overcrank, Overspeed , and Auxiliary Faults.

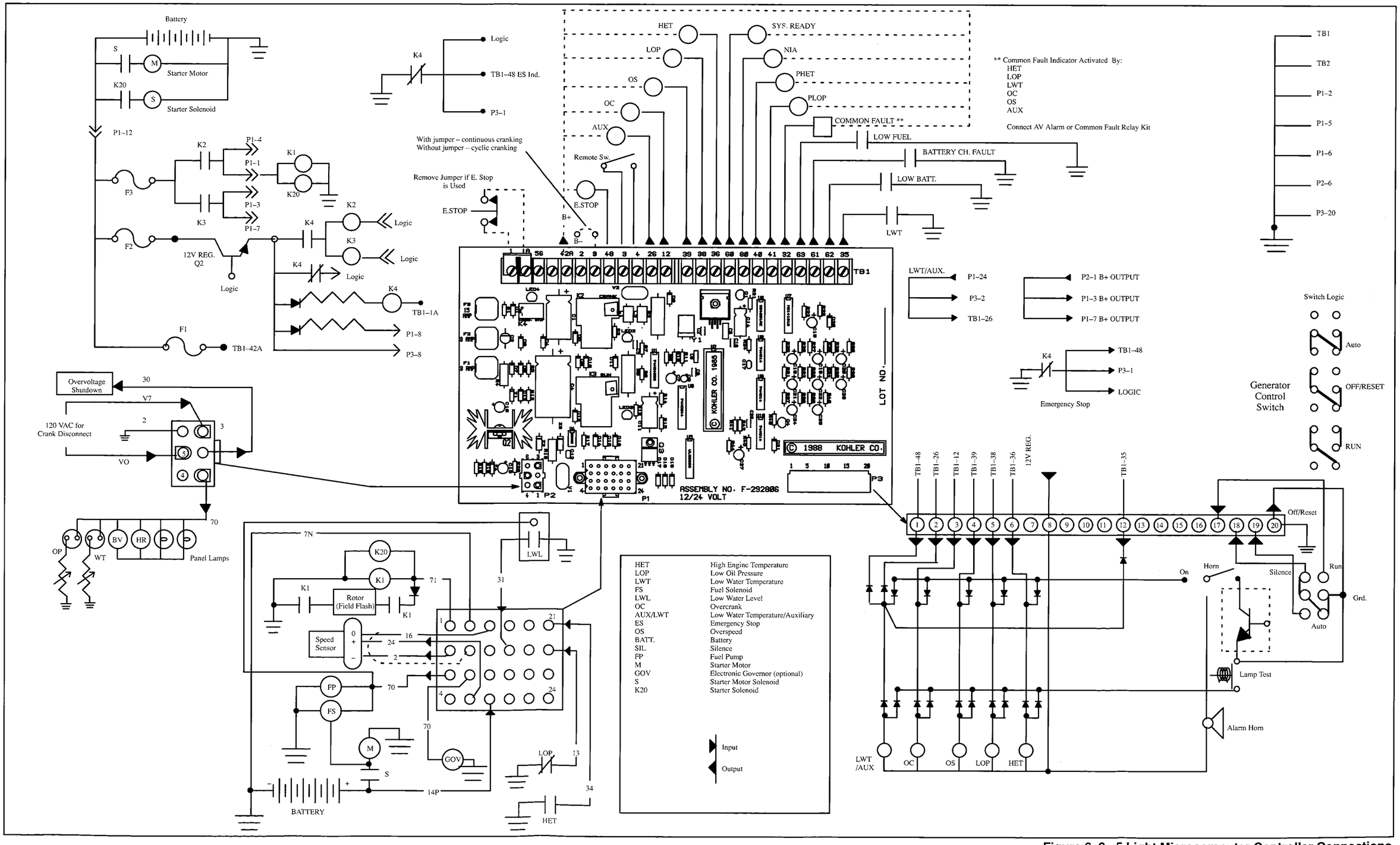


Figure 6–3. 5 Light Microcomputer Controller Connections

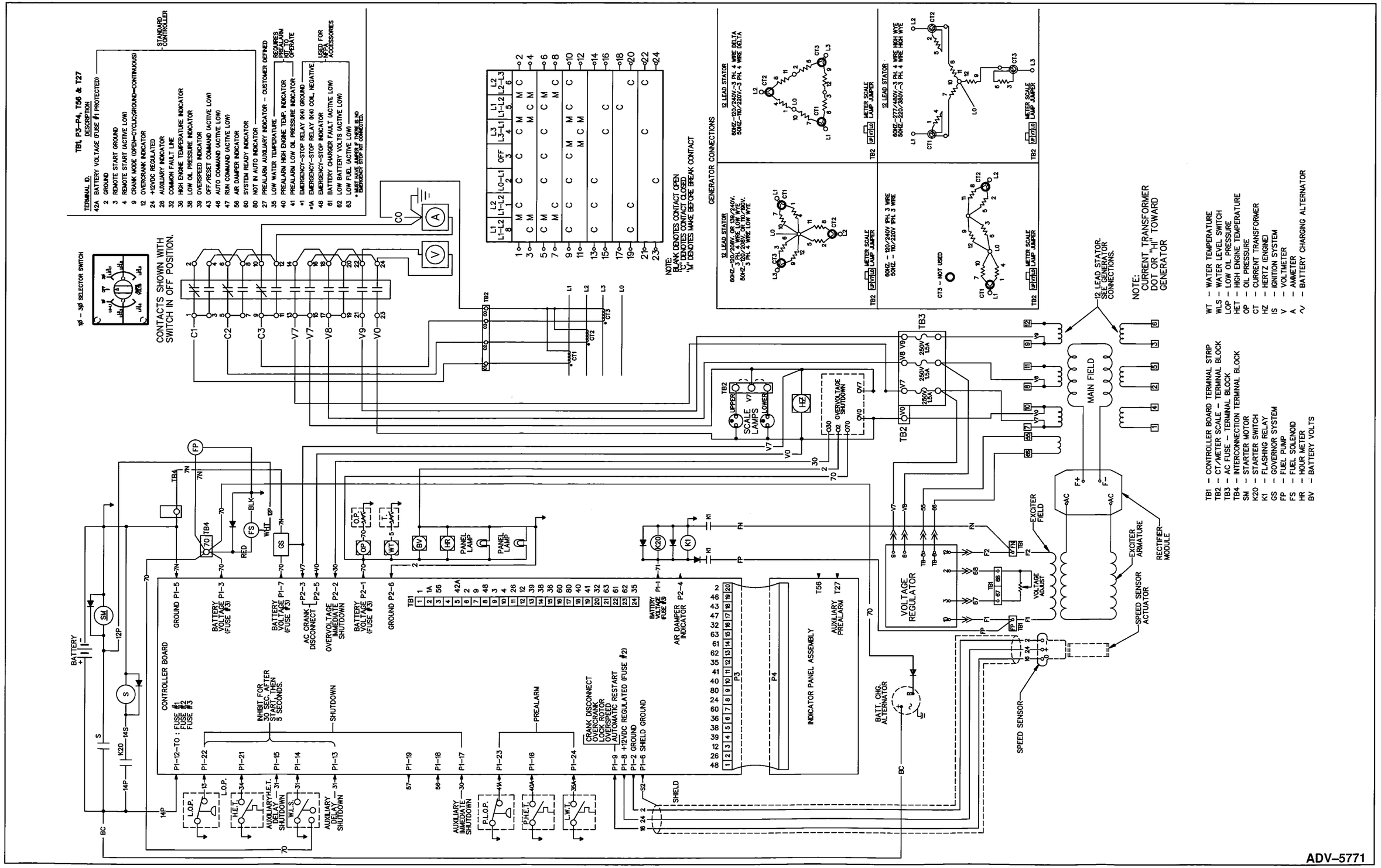


Figure 6–4. Logic Schematic, 5 Light Microprocessor Controller – 1–Phase/3–Phase

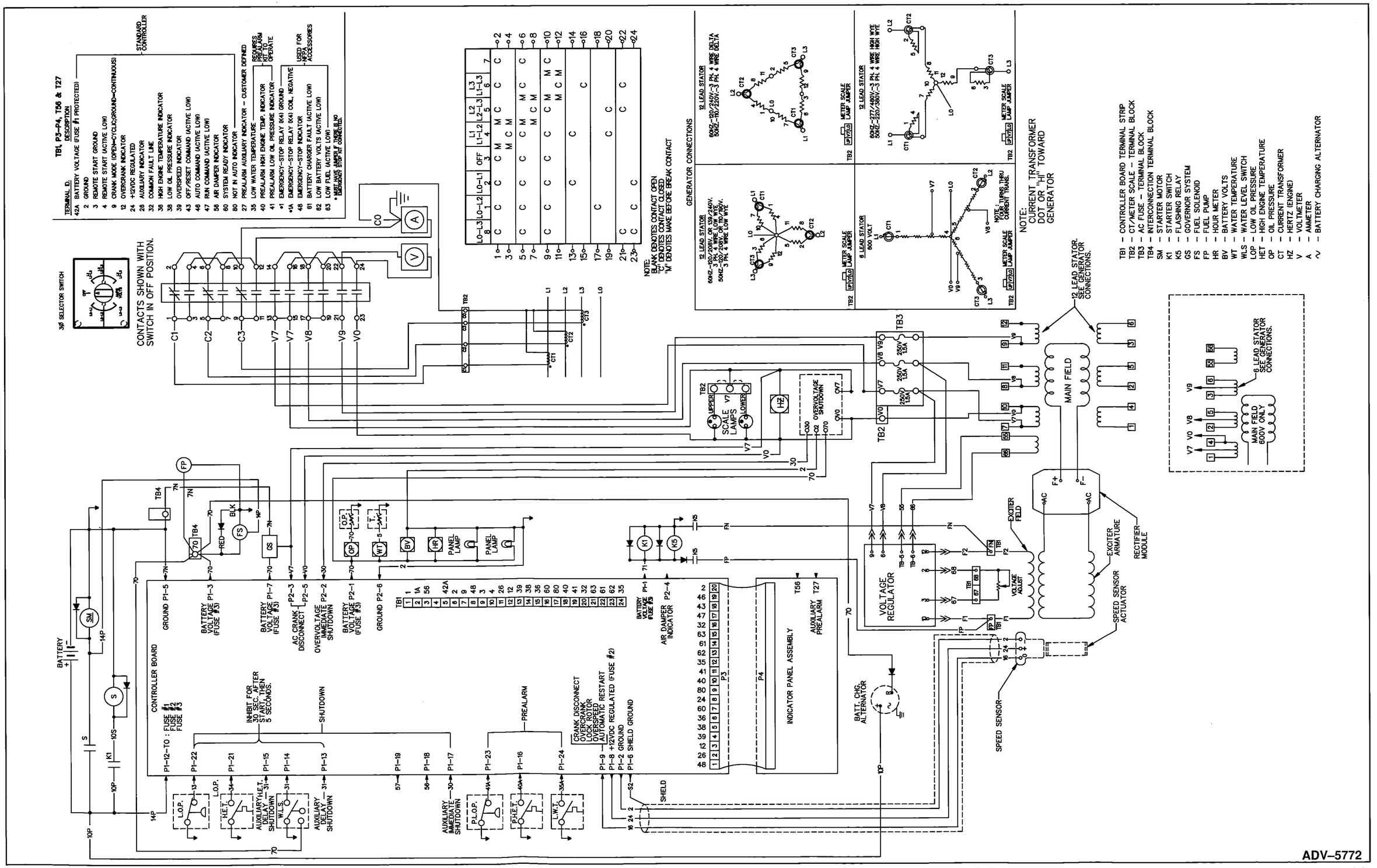


Figure 6–5. Logic Schematic, 5 Light Microprocessor Controller – 3–Phase/600–Volt

FAULT SHUTDOWNS — 5 LIGHT MICROPROCESSOR CONTROLLER

If the generator set will not start or stops running due to a fault shutdown (fault lamp lit), refer to the following chart to identify fault conditions. Consult the Engine Service Manual for detailed information on correcting engine related faults. To reset the set after a fault shutdown, see Section 2. Microprocessor Controller (5 Light), "Resetting Procedure – Fault Shutdown."

Indicator	Fault Condition
High engine temperature lamps lights	Engine coolant temperature above 218°F (103°C).
	Cooling system malfunction.
Low oil pressure lamp lights	Engine oil pressure drops to 7.1 psi (49 kPa).
Overspeed lamp lights	Governed frequency in excess of 70 Hz. (50 and 60 Hz. models).
Overcrank lamp lights	More than 45 seconds of continuous cranking.
	Locked rotor.
Overcrank lamp flashes	Speed sensor signal absent longer than one second.
Low water temp./auxiliary lamp lights	Engine coolant below "safe" range in radiator.
	Overvoltage condition (if overvoltage equipped) – output voltage 15% above nominal voltage (for one second or longer).
	Activated by fault sensing devices connected to auxiliary immediate shutdown port (P1–17).
Emergency stop (if equipped)	Emergency stop switch activated.
	Emergency stop switch disconnected from controller terminals TB1–1 or 1A.

RELAY DESCRIPTIONS

A description of the relays used on sets with 5 light microprocessor controllers is given below. This information is useful in troubleshooting the generator and should be used in conjunction with the troubleshooting flow charts on the following pages.

K20 Relay (Starter Solenoid)

Energizes starter; K20 relay located on skid. See Figure 6–6.

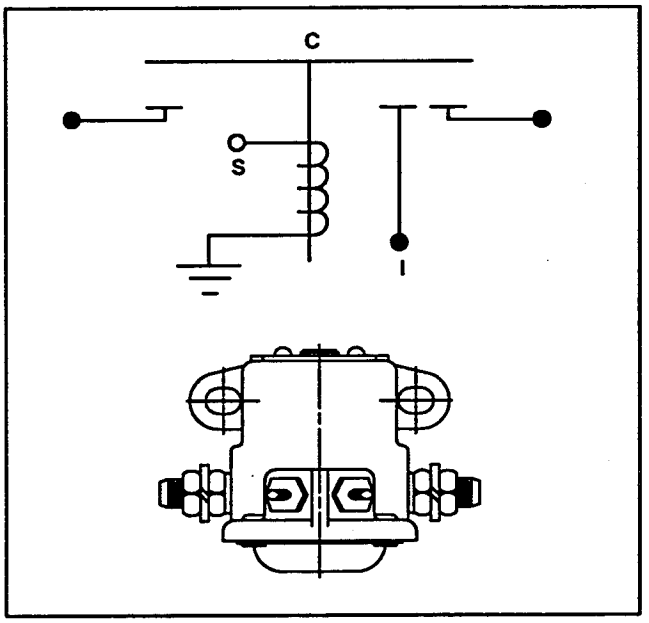


Figure 6–6. K20 Starter Solenoid

K2 Relay (Crank Relay)

Energizes K1 Relay. LED 2 lights when energized during crank mode. K2 relay located on controller circuit board.

K3 Relay (Run Relay)

Energizes fuel pump, fuel solenoid, water solenoid (city water cooling) and meters/gauges.

Energizes engine safety shutdowns after time delay. LED 3 lights when energized during crank and run modes. K3 relay located on controller circuit board.

K4 Relay (Emergency Stop Relay)

The K4 relay is energized continuously except during emergency stop conditions. LED 4 is lit at all times except during emergency stop. K4 relay located on controller circuit board. If emergency stop kit is connected (local or remote), remove jumper from circuit board TB1–1 and 1A. If no emergency stop kit is connected, a jumper must connect terminals TB1–1 and 1A.

K1 Relay (Field Flashing Relay)

Provides field flashing current to main field (rotor) during start–up. The K1 relay is located in the controller and is only energized during cranking. See Figure 6–7.

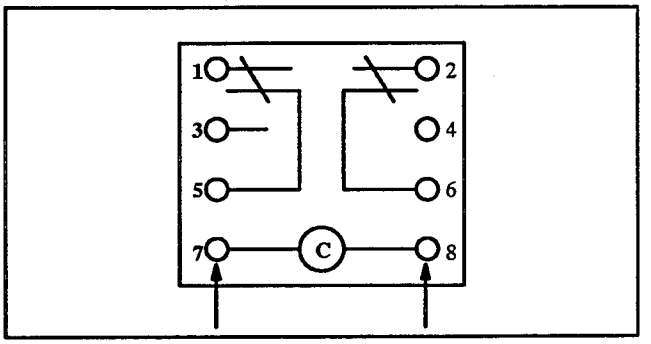
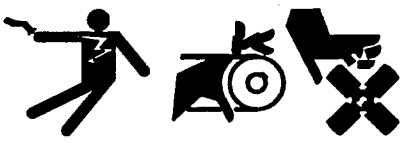


Figure 6–7. K1 Flashing Relay

TROUBLESHOOTING

Use the following charts as a quick reference in troubleshooting specific generator set problems. Consult the first chart for aid in locating the cause of blown fuses. In the successive charts, generator faults are listed by specific groups and correlated with possible causes and corrective action. Troubleshooting using the "Fast Check" follows. Before beginning any troubleshooting procedure, read all safety precautions at the beginning of this manual and those included in the text. Do not neglect these precautions.

⚠ WARNING



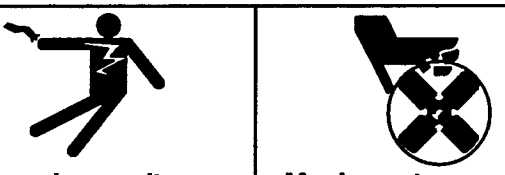
Accidental starting.
Can cause severe injury or death.

Disconnect battery cables before working on generator set (negative lead first and reconnect it last).

Accidental starting can cause severe injury or death. Turn Generator Master Switch to OFF position, disconnect power to battery charger, and remove battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator. The generator set can be started by automatic transfer switch or remote start/stop switch unless these precautions are followed.

Hazardous voltage can cause severe injury or death. Perform electrical service only as prescribed in equipment manual. Be sure that generator is properly grounded. Never touch electrical leads or appliances with wet hands, when standing in water, or on wet ground as the chance of electrocution is especially prevalent under such conditions. Wiring should be inspected at the interval recommended in the service schedule — replace leads that are frayed or in poor condition. The function of a generator set is to produce electricity and wherever electricity is present, there is the hazard of electrocution.

⚠ WARNING



Hazardous voltage. **Moving rotor.**

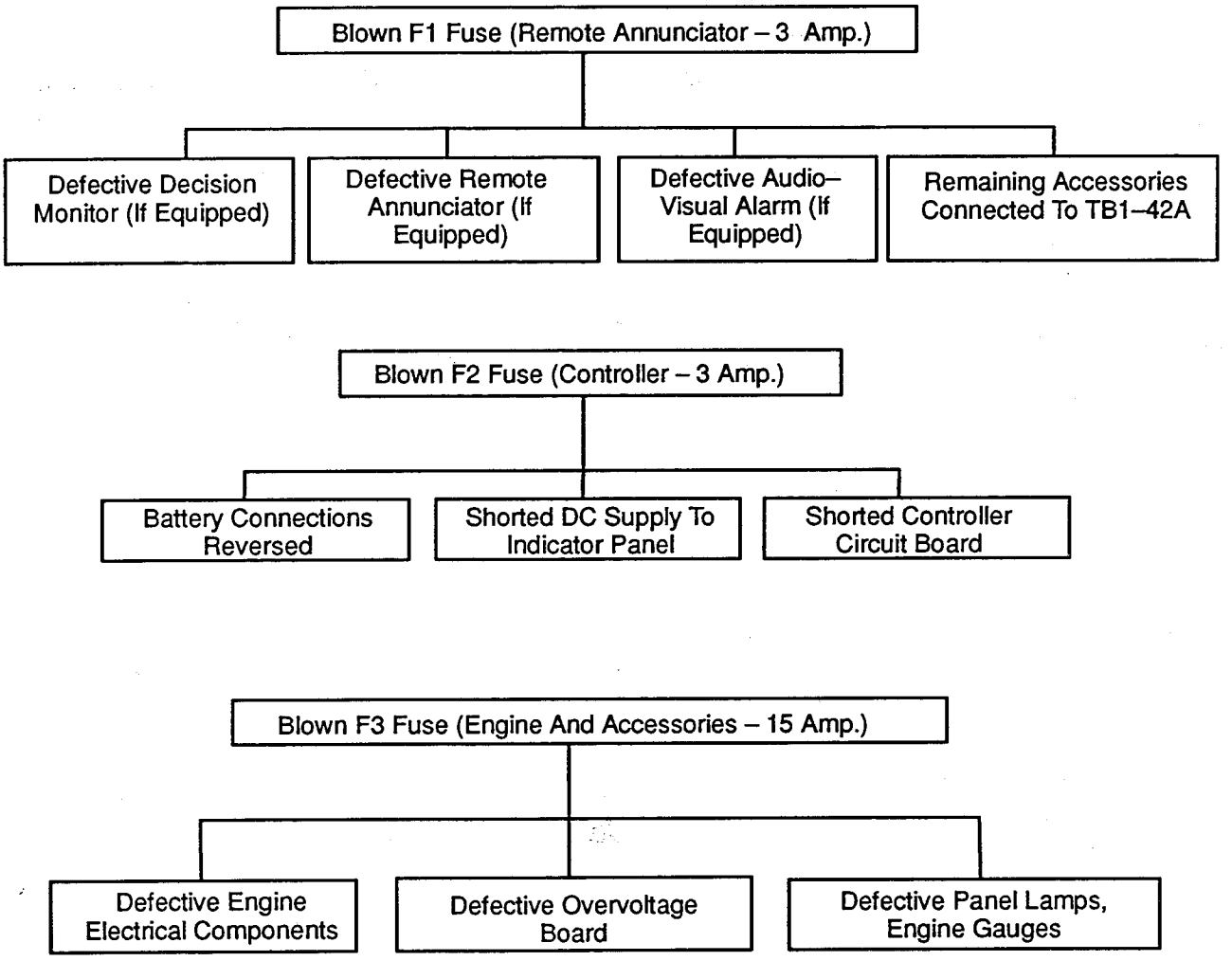
Can cause severe injury or death.

Do not operate generator set without all guards and electrical enclosures in place.

NOTE

If starting unit by remote switch, verify proper operation of remote switch before troubleshooting controller. Test remote switch operation by placing generator master switch in the AUTO position and running a jumper between terminals 3 and 4 on controller circuit board. If the generator does not start, proceed with the controller troubleshooting procedure outlined in the following pages.

The chart below lists the possible causes of blown controller fuses F1, F2, and F3. If a fuse is blown, replace it and resume operation. If the fuse blows again, use the chart to identify the faulty component(s).



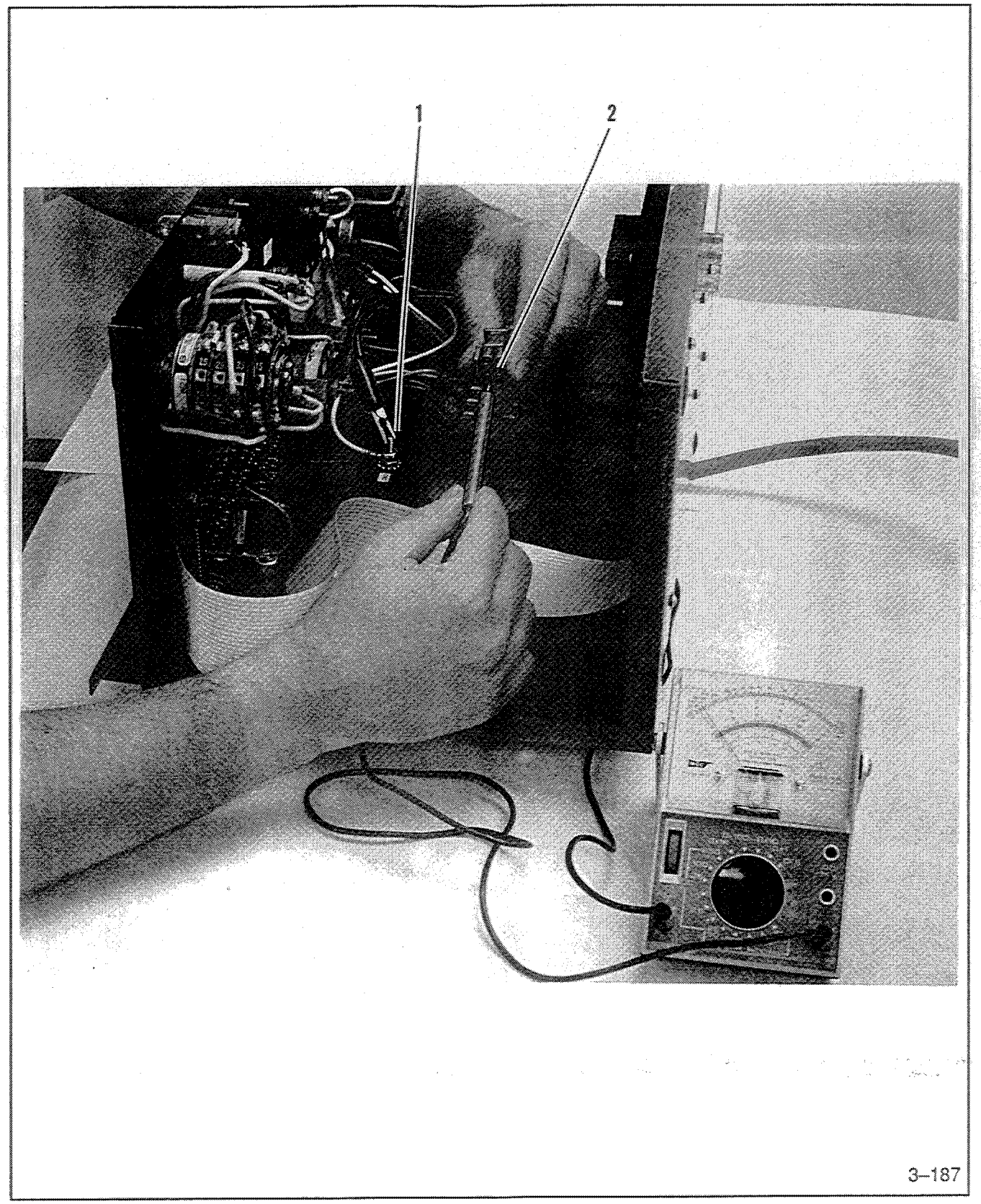
To quickly check the condition of the components listed under F3, use an ohmmeter to read resistance between the designated terminal and ground. See Figure 6–8. With ohmmeter on the R x 1 scale, a reading of less than one ohm (continuity) indicates that component may be defective. Isolate the defective component and repair or replace.

Gauges – Connector P2, socket 1 to ground

Overvoltage – Connector P2, socket 2 to ground

Crank – Connector P1, socket 1 to ground

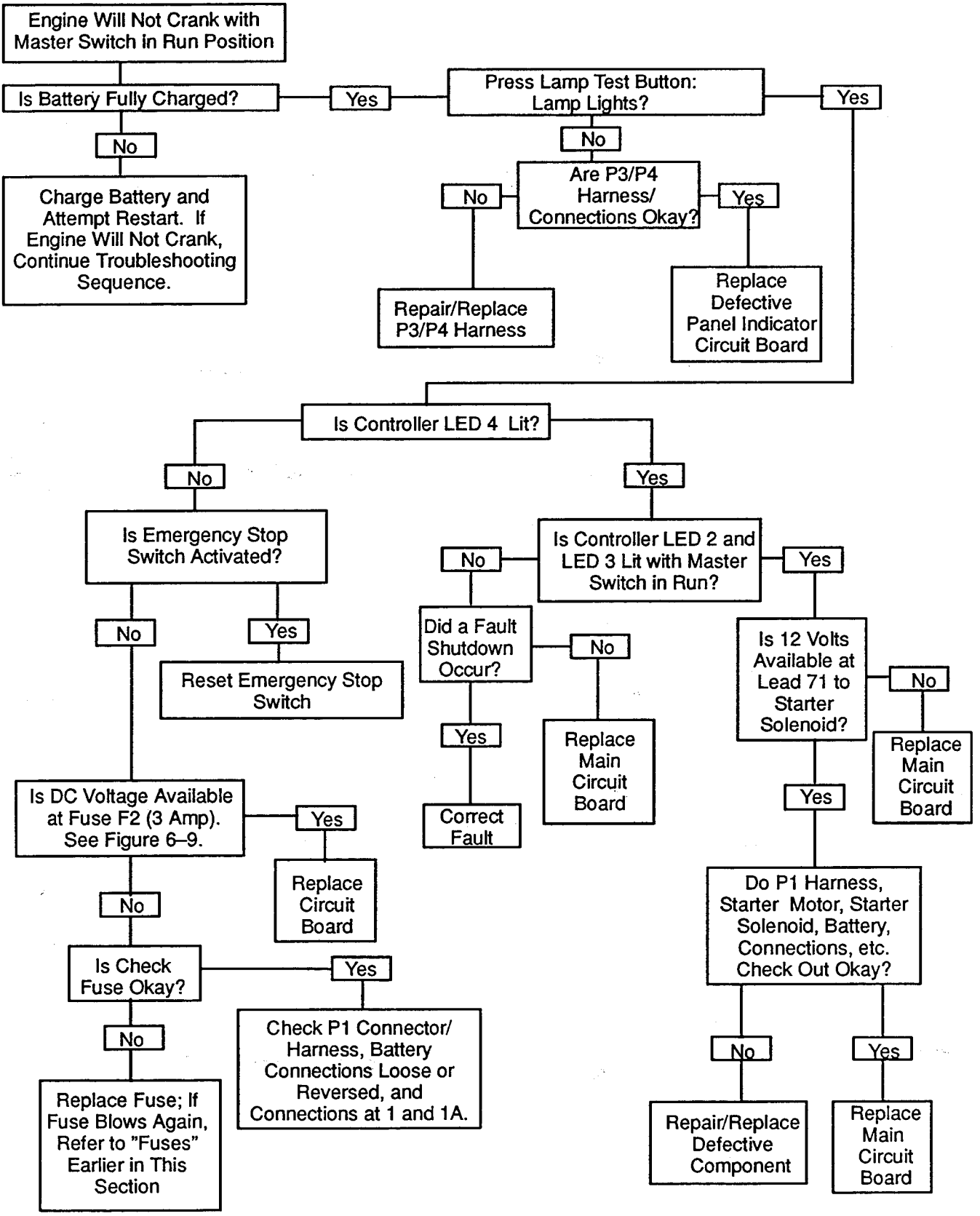
Engine Run – Connector P1, socket 3 to ground

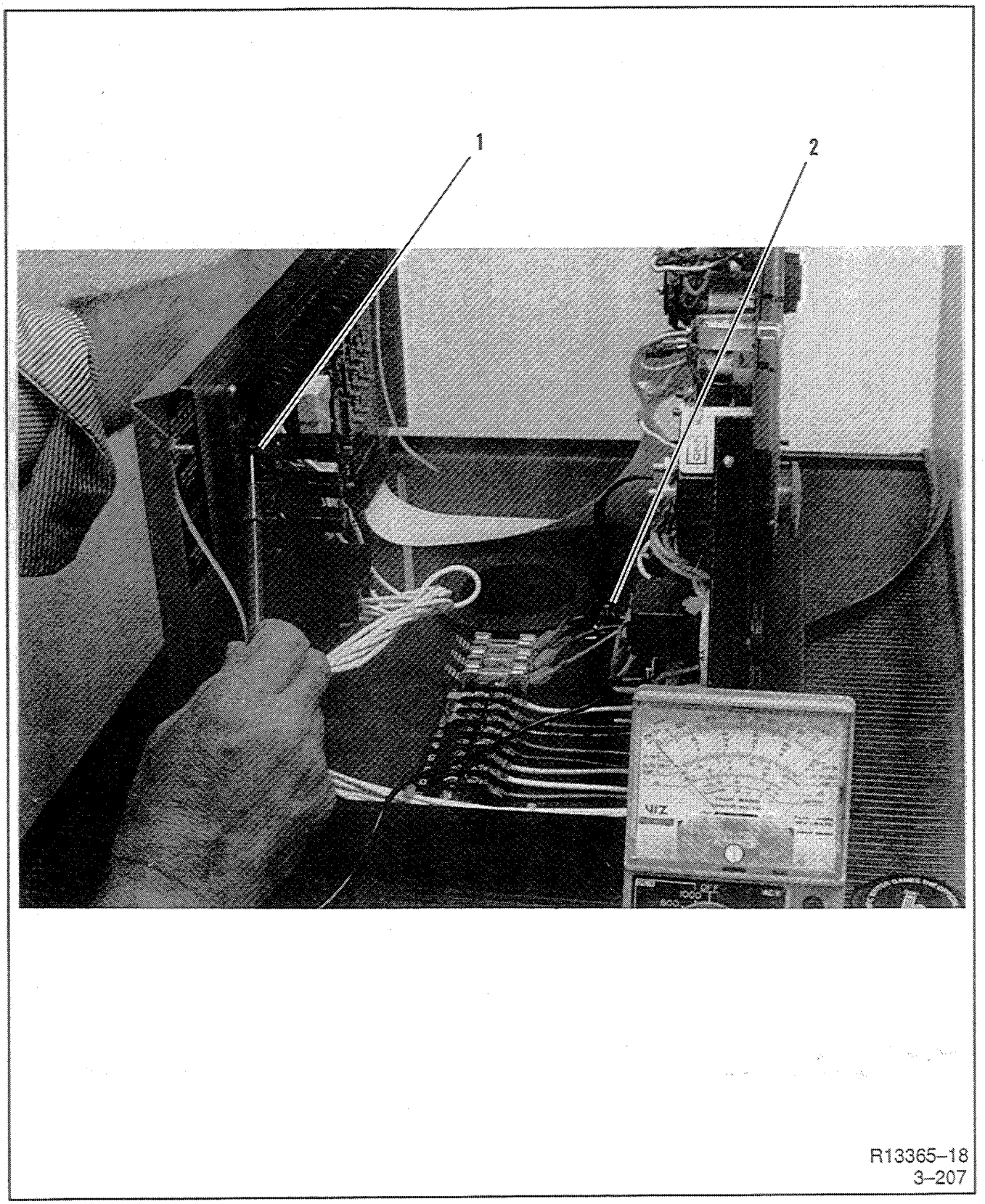


1. Ground Connection
2. P2 Connection

Figure 6–8. Checking P1/P2 Components

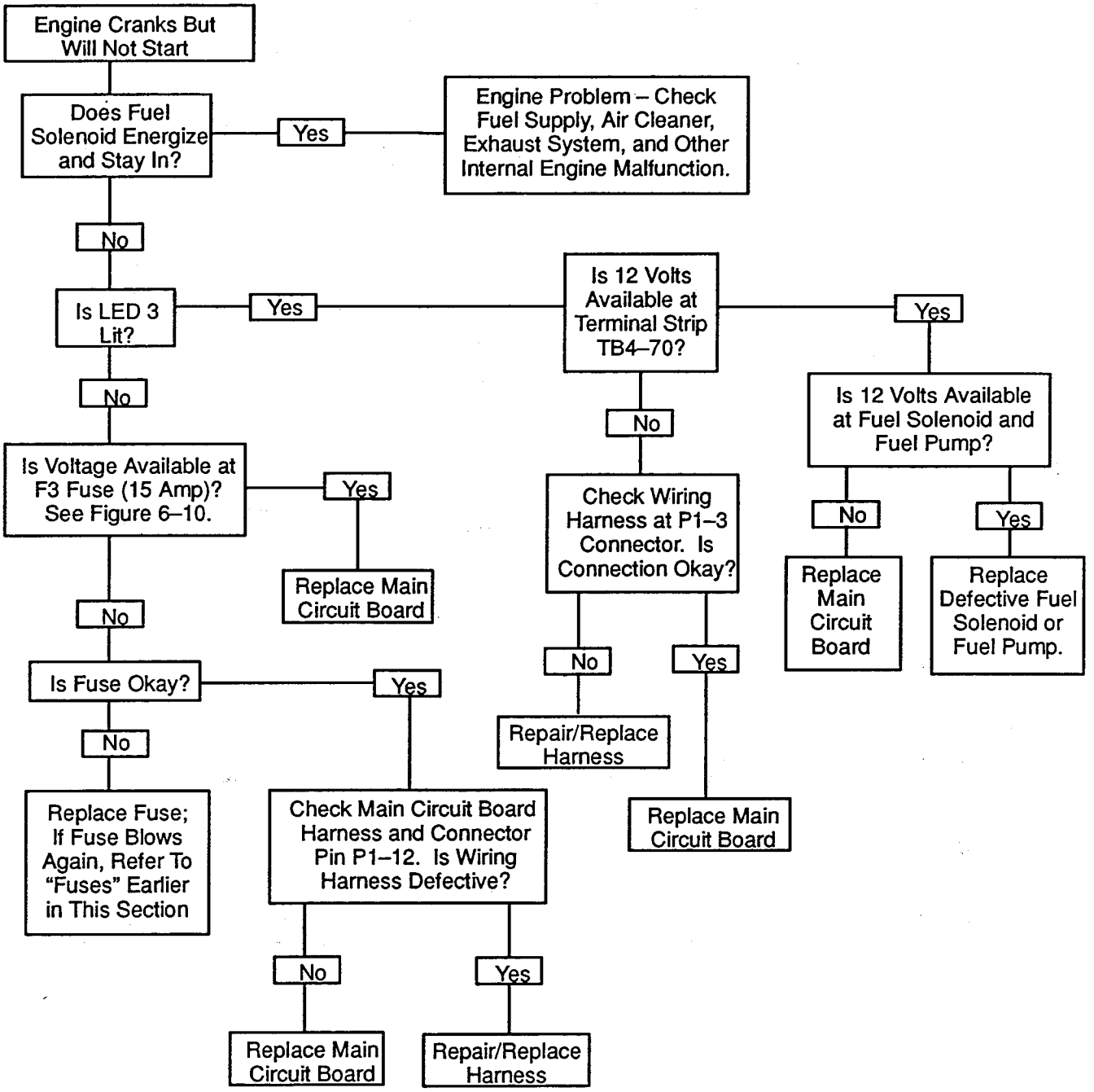
5 LIGHT MICROPROCESSOR CONTROLLER

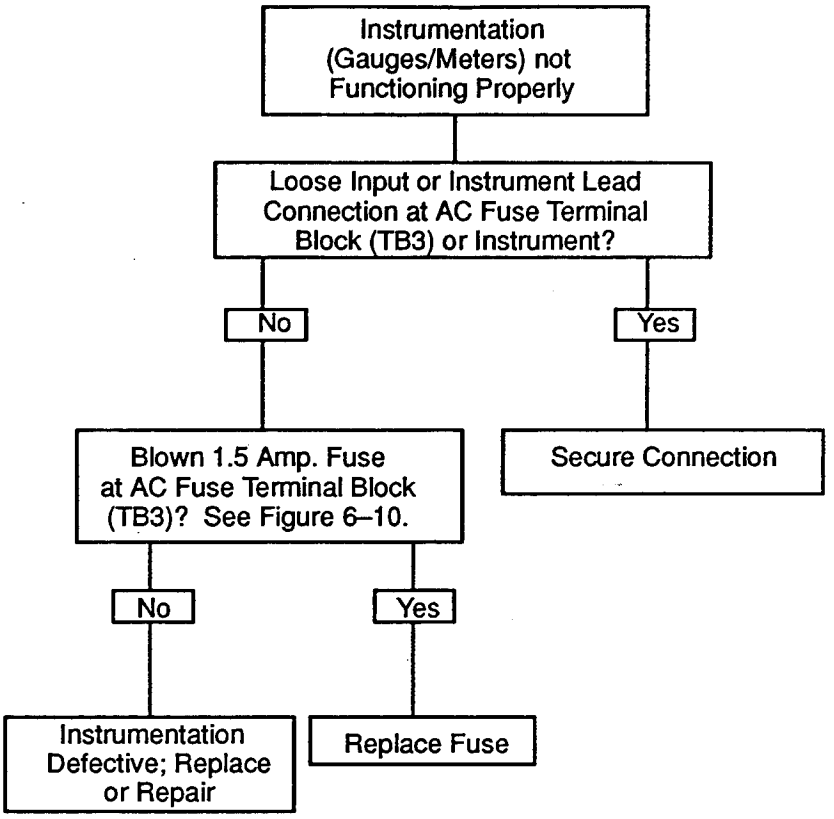




1. Fuse Terminal
2. Ground Connection

Figure 6–9. Checking Condition of Fuse


Engine Cranks But Will Not Start
Does Fuel Solenoid Energize and Stay In?
Yes
Engine Problem – Check Fuel Supply, Air Cleaner, Exhaust System, and Other Internal Engine Malfunction.
No
Is LED 3 Lit?
Yes
Is 12 Volts Available at Terminal Strip TB4–70?
Yes
Is 12 Volts Available at Fuel Solenoid and Fuel Pump?
No
Is Voltage Available at F3 Fuse (15 Amp)? See Figure 6–10.
Yes
Replace Main Circuit Board
No
Check Wiring Harness at P1–3 Connector. Is Connection Okay?
No
Repair/Replace Harness
Yes
Replace Main Circuit Board
No
Replace Main Circuit Board
Yes
Replace Defective Fuel Solenoid or Fuel Pump.
No
Is Fuse Okay?
Yes
No
Replace Fuse; If Fuse Blows Again, Refer To "Fuses" Earlier in This Section
Check Main Circuit Board Harness and Connector Pin P1–12. Is Wiring Harness Defective?
No
Replace Main Circuit Board
Yes
Repair/Replace Harness



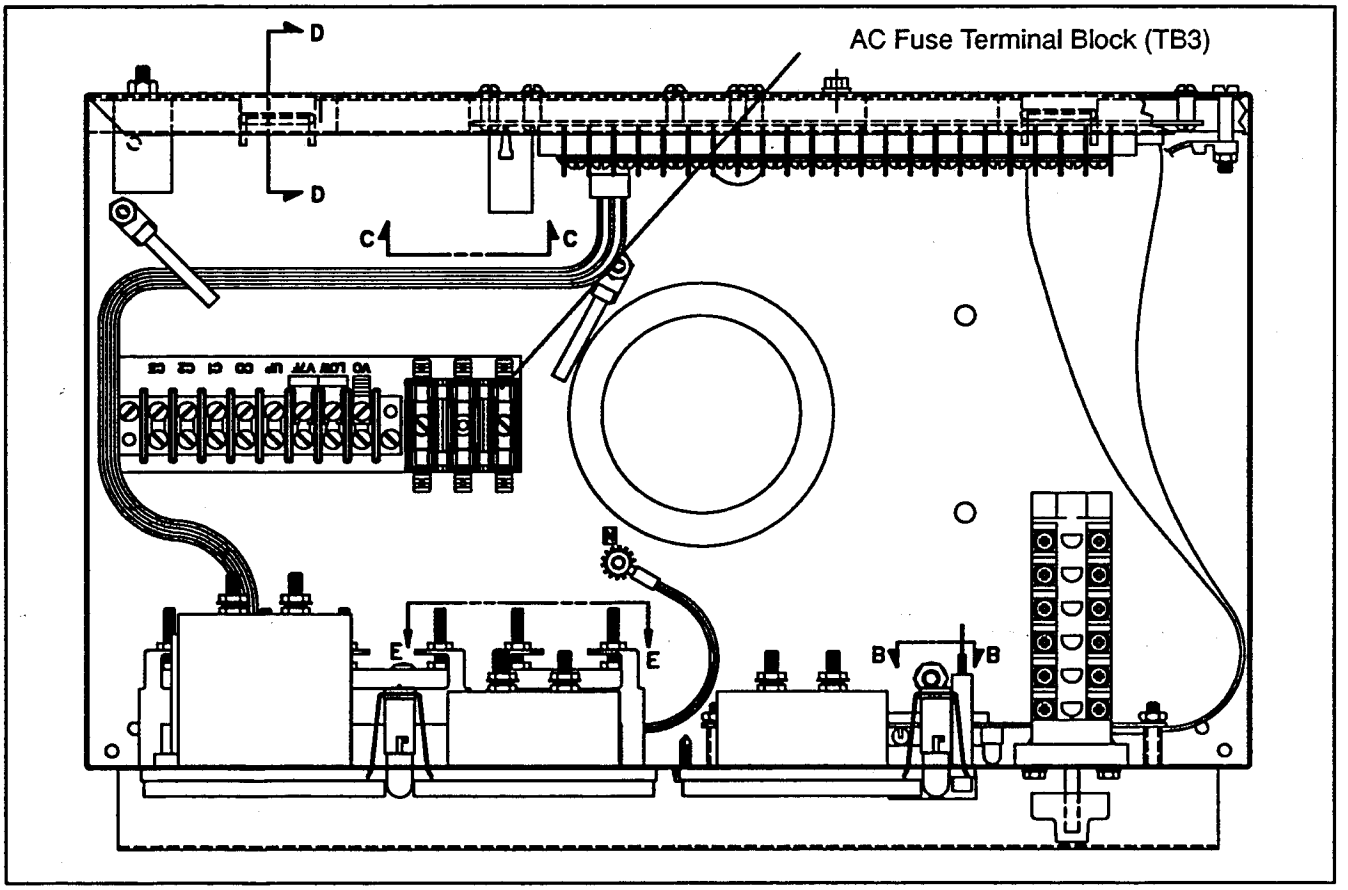
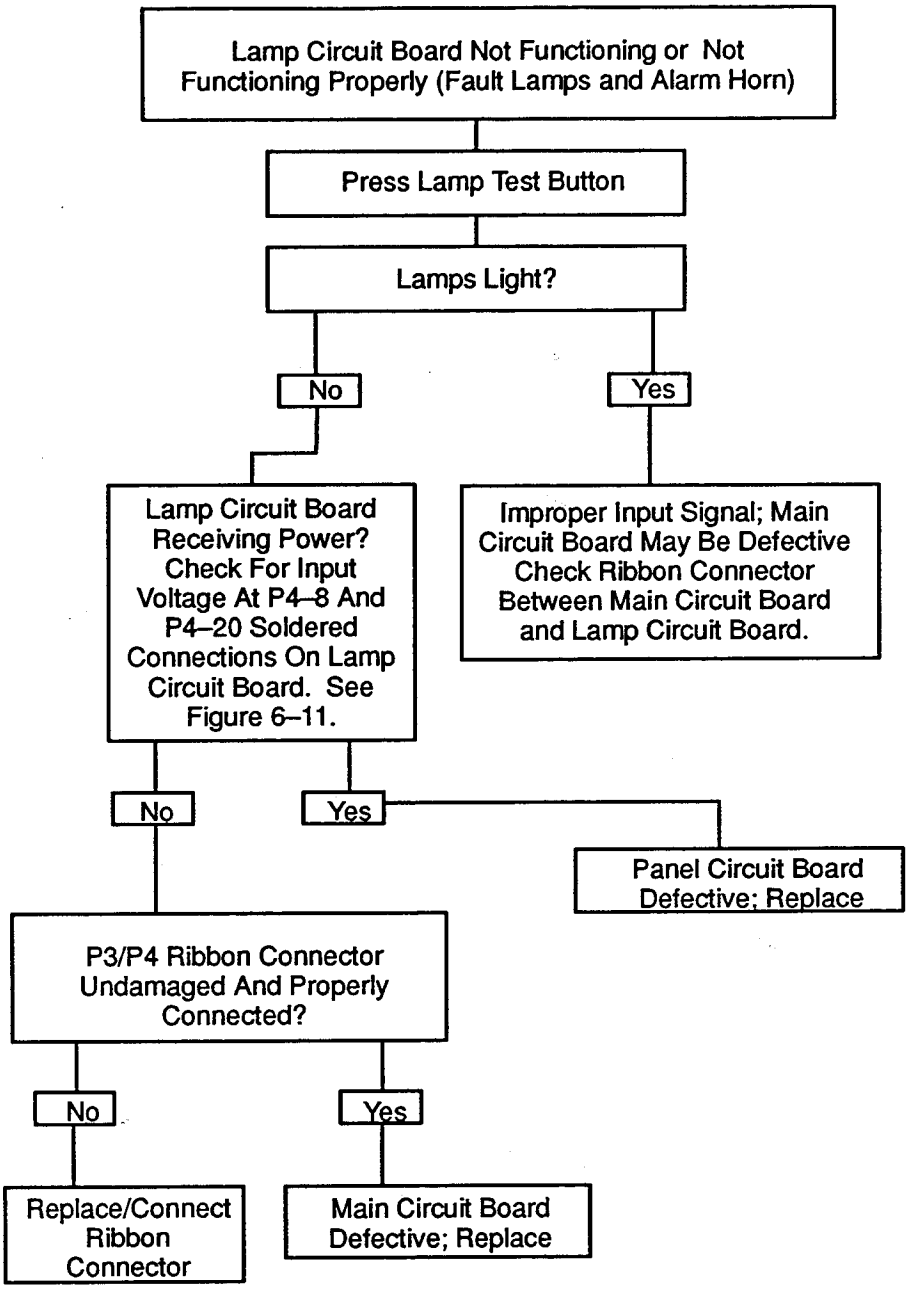
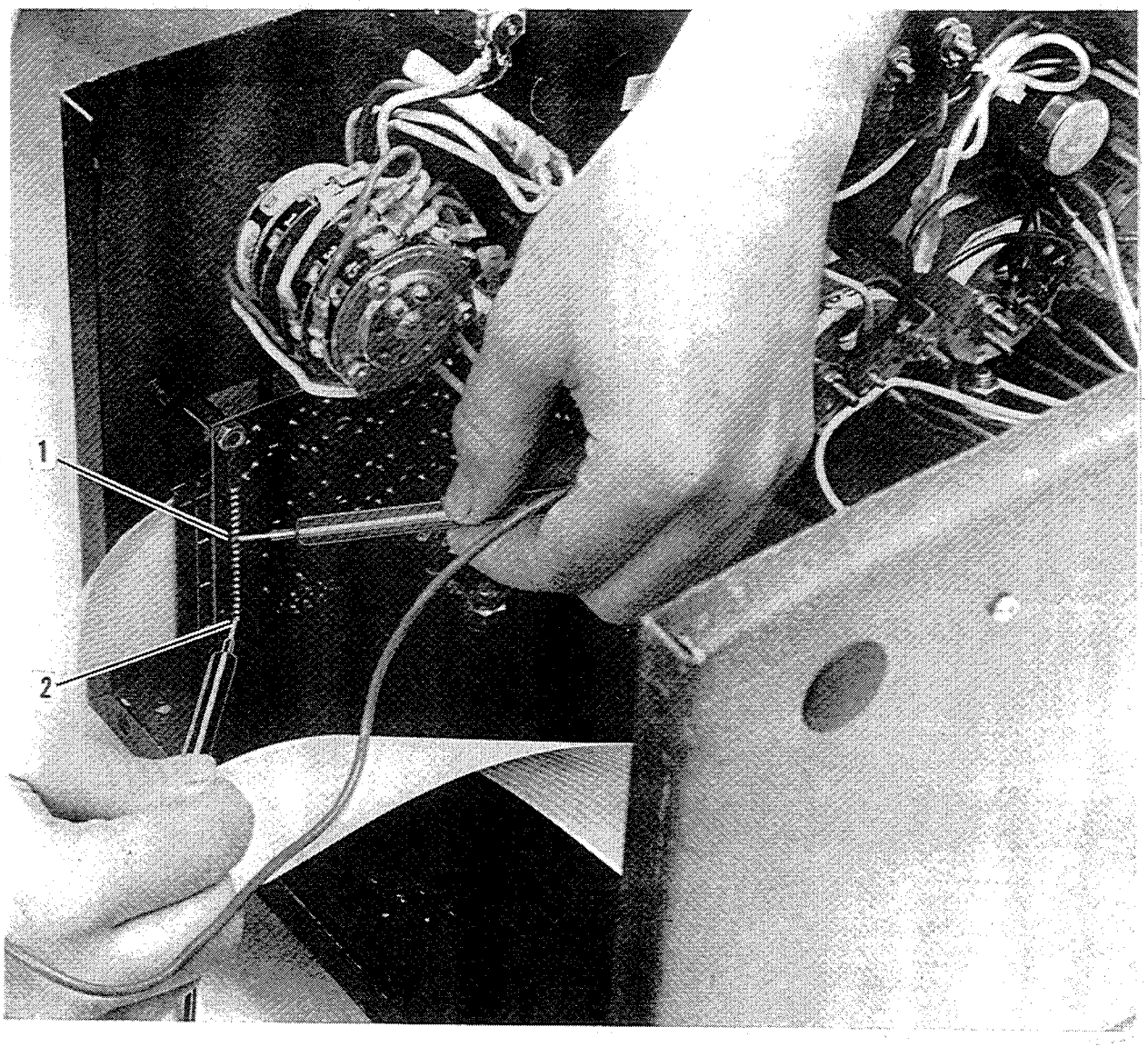


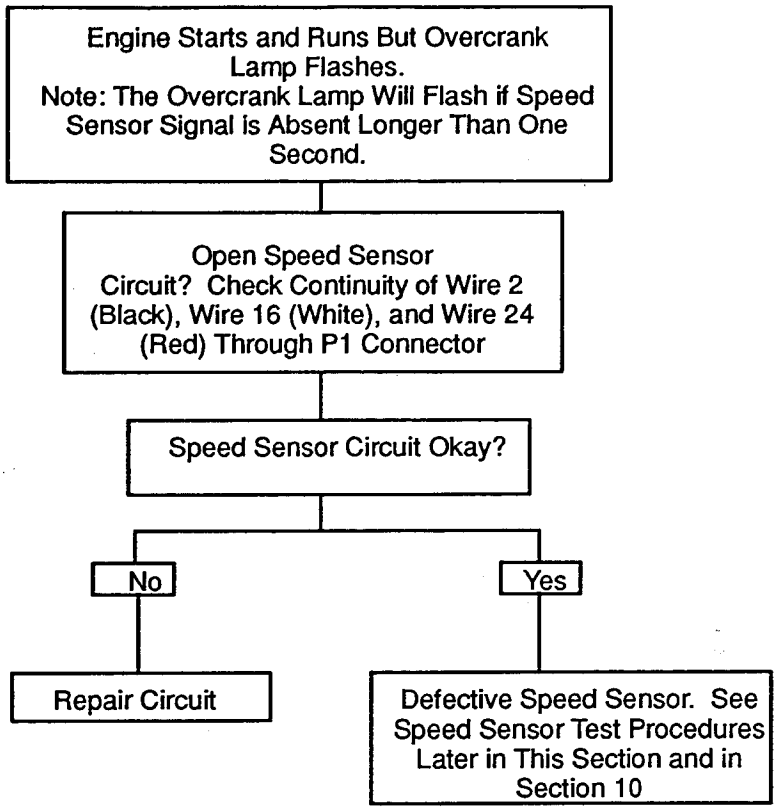
Figure 6–10. AC Fuse Terminal Block (TB3)


Lamp Circuit Board Not Functioning or Not Functioning Properly (Fault Lamps and Alarm Horn)
Press Lamp Test Button
Lamps Light?
No
Yes
Lamp Circuit Board Receiving Power? Check For Input Voltage At P4–8 And P4–20 Soldered Connections On Lamp Circuit Board. See Figure 6–11.
Improper Input Signal; Main Circuit Board May Be Defective Check Ribbon Connector Between Main Circuit Board and Lamp Circuit Board.
No
Yes
Panel Circuit Board Defective; Replace
P3/P4 Ribbon Connector Undamaged And Properly Connected?
No
Yes
Replace/Connect Ribbon Connector
Main Circuit Board Defective; Replace



1. P4–8 (+) Connection
2. P4–20 (–) Connection

Figure 6–11. Checking Input to Lamp Circuit Board


Engine Starts and Runs But Overcrank Lamp Flashes.
Note: The Overcrank Lamp Will Flash if Speed Sensor Signal is Absent Longer Than One Second.
Open Speed Sensor Circuit? Check Continuity of Wire 2 (Black), Wire 16 (White), and Wire 24 (Red) Through P1 Connector
Speed Sensor Circuit Okay?
No
Yes
Repair Circuit
Defective Speed Sensor. See Speed Sensor Test Procedures Later in This Section and in Section 10

FAST CHECK FEATURES AND OPERATION

The Fast Check is an engine simulator for testing and troubleshooting the 5 Light Microprocessor Controller.

FEATURES (FIGURE 6–12)

Engine conditions are simulated by the following engine switch position:

- **OFF** — locked engine (starter energized but not turning).
- **CRANK** — engine cranking, but not started.
- **RUN** — engine running

1. Toggle Switches
2. Indicator Lamps
3. Engine Switch
4. Overspeed Button

Figure 6–12. Fast Check Simulator

Indicator Lamps:

IGN. — (ignition) lamp shows:

— battery voltage supplied to fuel pump, fuel solenoid, and water valve (city water cooled sets)

— lights during cranking and running

CRK. — (crank) lamp shows:

— battery voltage switched to starter (engine not necessarily turning)

— lights only during "on-crank" cycles

REG. — (regulator) lamp shows:

— battery voltage supplied to generator's AC voltage regulator

— lights only during cranking and running

BATT. — (battery) lamp:

— lights when test battery(ies) or DC power supply is live and properly connected.

NOTE

L.O.P., H.W.T. and OVERSPEED simulate malfunctions causing engine shut-down. L.O.P. and H.W.T. circuits will start timing after "engine" has been running for 30 seconds. "Engine" shut-down should occur 5 seconds after pushing fault switch.

Switches:

L.O.P. — low oil pressure

H.W.T. — high water (engine) temperature

OVERSPEED — simulates a 70 Hz overspeed condition

L.F. — low fuel (not used for testing)

L.W.T. — low engine water temperature

A.O.P. — anticipatory (low) oil pressure

A.W.T. — anticipatory (high) water temperature

OPERATION

The Fast Check can be used to test the 5 Light Controller on the generator set when troubleshooting start-up problems, or to test and troubleshoot the controller when removed from the generator set.

To operate the Fast Check the following equipment is required:

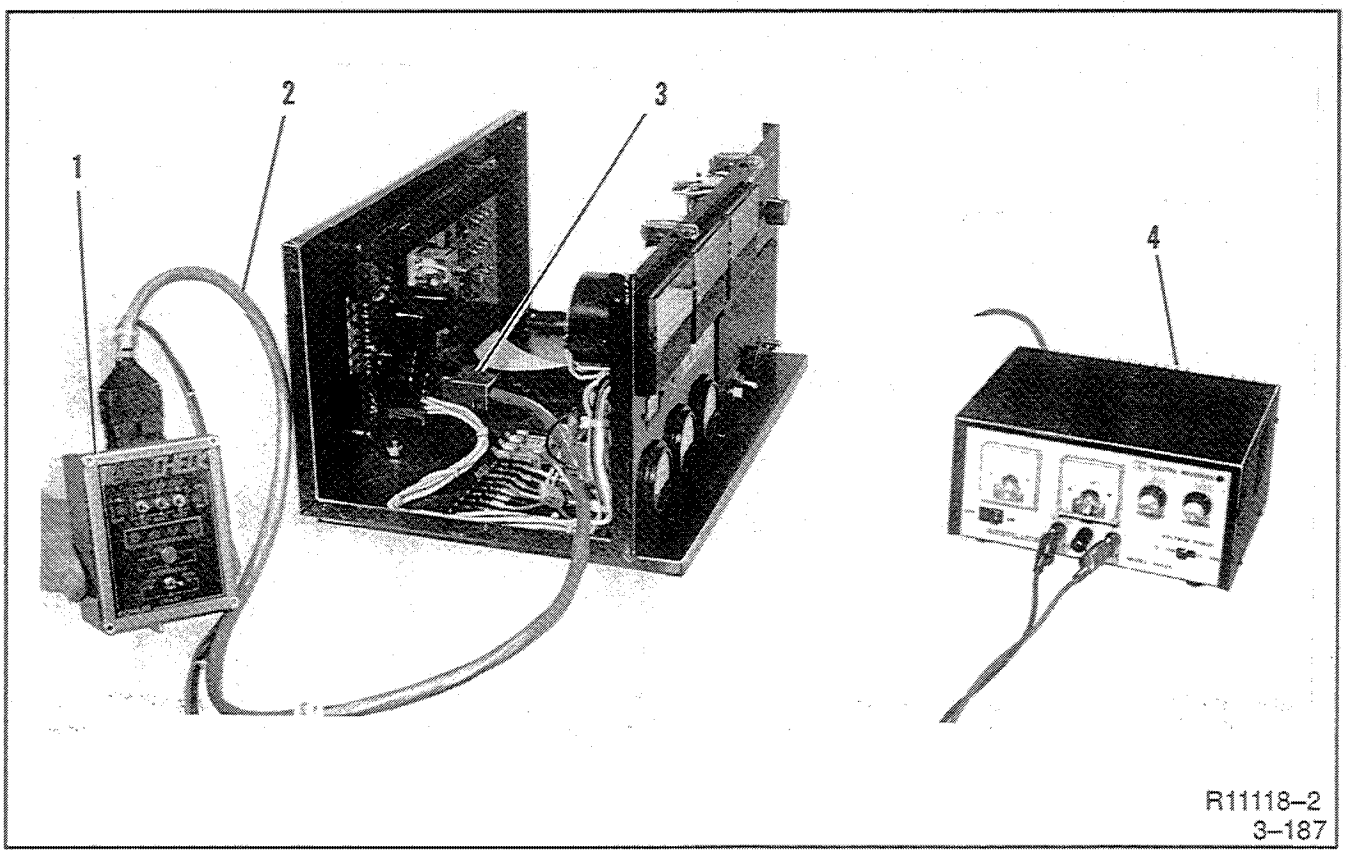
- Fast Check simulator (A-291930) and harness (255915)
- Variable low-voltage DC power supply; 0 to 30 Volt, 3 Amp. minimum current, 0.5% maximum output voltage ripple at 30 Volts DC. A 12–Volt battery can also be used to operate the Fast Check.

To Connect/Operate the Fast Check Tester:

1. Unplug DC engine harness from DC harness connector (P1). See Figure 6–13.
2. Connect Fast Check harness to DC harness connector (P1) and top of Fast Check.
3. Move controller master switch to OFF/RESET position.
4. Move Fast Check engine switch to OFF.
5. Clip red (+) and black (–) harness leads to battery(ies) or DC power supply of proper voltage for generator set (12–Volt). The generator set battery(ies) may be used if accessible and fully charged.

NOTE

Due to the absence of AC output, the LOW WATER TEMP./ AUXILIARY lamp will flash during controller testing.



1. Fast Check
2. Fast Check Wiring Harness
3. DC Harness Connector
4. DC Power Supply

Figure 6–13. Fast Check Connections

6. Move Fast Check engine switch to CRANK. Fast Check IGN., CRK., and REG. lamps should light. Fast Check will simulate cyclic cranking (15 seconds on, 15 seconds off, 15 seconds on, etc.) until engine switch is moved to RUN or Overcrank shutdown appears on Fast Check.

7. Move Fast Check engine switch to RUN, CRK. lamp should go out and REG. and IGN. lamps should stay on.

8. Simulate engine malfunctions by pressing Fast Check fault switches. Corresponding fault lamp on controller should light during each simulated engine malfunction.

NOTE
Leave Fast Check engine switch in RUN position for at least 30 seconds before pushing toggle switches. Toggle Generator Master Switch to OFF/RESET and Fast Check engine switch to OFF, then back to RUN after simulated fault shutdowns.

9. Procedures to test Overcrank circuitry, speed sensor circuitry, and generator condition indicators are described later in this section.

Overcrank

To test the controller's ability to:

- Detect a locked engine.
- Stop a start-up attempt if the starter locks or will not engage.

1. Move Fast Check engine switch to OFF.
2. Move Generator Master Switch to OFF and then move switch to RUN.
3. IGN., CRK., and REG. lamps on Fast Check should light for approximately 5 seconds and then go out. 5 seconds later the IGN., CRK., and REG. lamps should relight for 5 seconds before going out again (15 seconds total elapsed time). Controller OVERCRANK lamp lights. Check for operating voltage between TB1– 42A (+) and TB1– 12 (–).
4. This test verifies the proper operation of the entire overcrank circuit. If the OVERCRANK shutdown fails to function, check the speed sensor and related circuitry.

Controller Speed Sensor Circuitry

To test speed sensor output, refer to Section 8, "Speed Sensor." To check the controller's ability to respond to signals from the speed sensor perform the following test:

1. Move generator master switch to OFF/RESET position.
2. Move Fast Check engine switch to OFF position.
3. Move generator master switch to RUN position. Observe IGN., CRK., and REG. lamps light.
4. Within 5 seconds, move Fast Check engine switch to RUN.
5. If CRK. lamp goes out on Fast Check, the controller speed sensor circuitry is functioning properly.

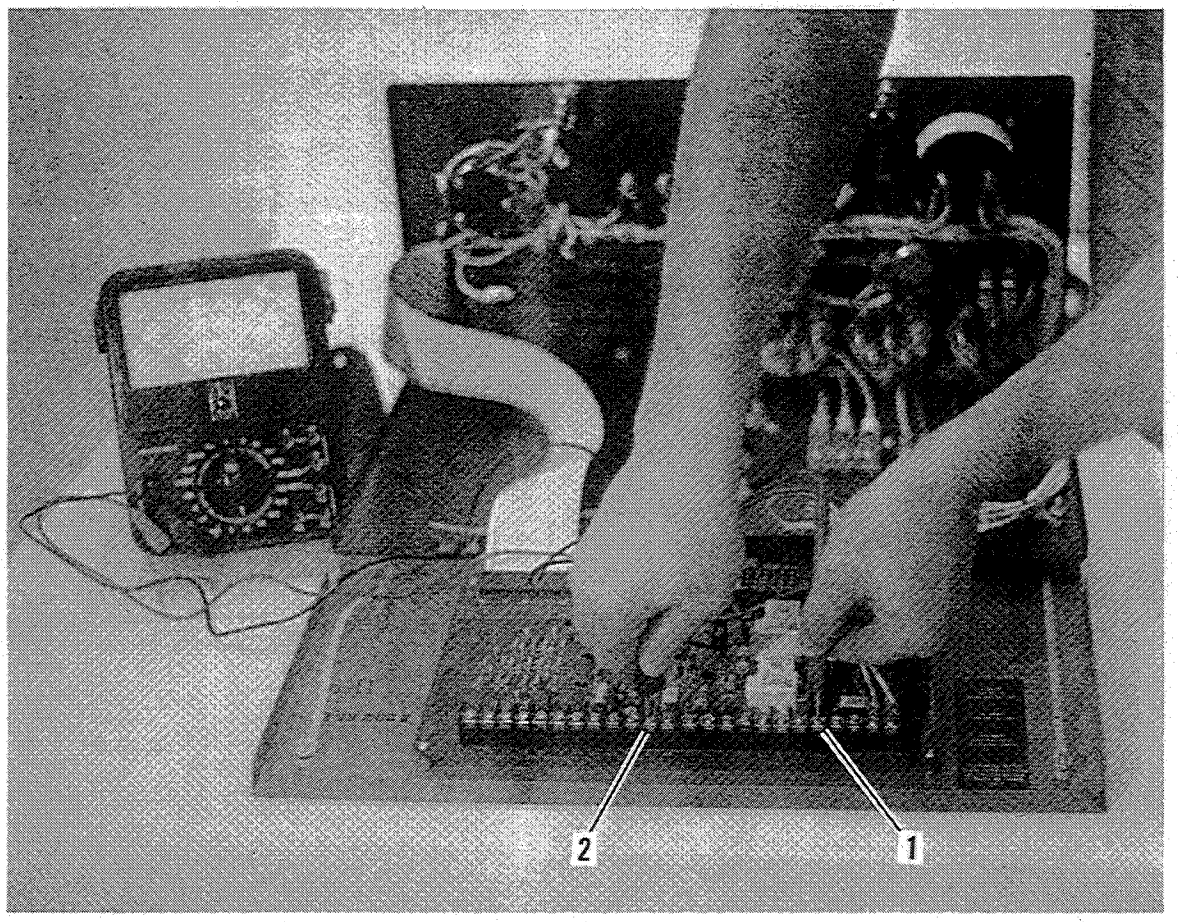
Generator Condition Indicator Terminals
(TB1 Terminal Strip)

Remote accessories (AV alarm, Decision Monitor, Alarm Contact Kits, etc.) may be connected to the controller TB1 terminal strip to signal the condition of the generator set. (Your set may not be equipped with the sending devices necessary to operate all generator condition indicators.) If remote accessories will not operate, test for output voltage at the TB1 terminal strip. To test the operation of each indicator, move the generator master switch and Fast Check engine switch the position indicated (see chart on following page). Check for voltage at the prescribed test points with the Fast Check toggle in the position prescribed. Test point voltage should be slightly less than the voltage being supplied to the controller (12–Volts). If proper voltage is not detected at the test point, remote accessories (A—V alarm, Decision Monitor, Isolated Alarm Contacts, etc.) will not function. Test point connections are shown in Figure 6–14.

NOTE
When checking controller test point voltage, place negative (–) lead of voltmeter on terminal designated in table and voltmeter positive (+) lead on TB1– 42A.

NOTE
Due to the absence of AC output, the Low Water Temperature/AUX. lamp will flash during controller testing.

NOTE
Leave Fast Check engine switch in the RUN position for at least 30 seconds before pushing toggle switches. Toggle Generator Master Switch to OFF/RESET position. Move Fast Check engine switch to OFF position. Move generator master switch to RUN position. Observe IGN., CRK., and REG. lamps light. Within 5 seconds, move Fast Check engine switch to RUN.



1. TB1–42A (+)
2. TB1– (see Chart)

Figure 6–14. Indicator Lamp Test Connections

Indicator	Switch Position/Remarks	Check for Presence of 12 Volts DC Between:
System Ready	Master Switch in AUTO position; engine switch in OFF position	TB1–42A(+) and TB1–60 (–)
High Engine Temperature (H.E.T.)	Master Switch in RUN position; engine switch in RUN position; hold toggle switch to H.W.T. for at least 5 seconds	TB1– 42A (+) and TB1–36 (–)
Low Oil Pressure (L.O.P.)	Master Switch in RUN position; engine switch in RUN position; hold toggle switch to L.O.P for at least 5 seconds	TB1– 42A (+) and TB1–38 (–)
Auxiliary (AUX.)	Master Switch in RUN position; engine switch in RUN position; wait 10 seconds. Flashing AUX.lamp indicates proper operation of all Auxiliary functions	TB1– 42A (+) and TB1–26 (–)
Low Water Temp. (L.W. T.)	Master Switch in RUN position; engine switch in RUN; hold toggle switch to L.W.T.	TB1– 42A (+) and TB1–35 (–)
Emergency Stop (local/remote)	Master Switch in RUN position; engine switch in RUN position; remove switch lead connected to controller terminals TB1–1 or 1A.	Not Applicable
Not in Auto	Master Switch in RUN or OFF/ RESET; engine switch in any position	TB1–42A (+) and TB1–80 (–)
Pre (High) Engine Temperature (A.W.T.)	Master Switch in RUN position; engine switch in RUN; hold toggle to A.W. T.	TB1–42A (+) and TB1–40 (–)
Pre (Low) Oil Pressure (A.O.P.)	Master Switch in RUN position; engine switch in RUN; hold toggle to A.O.P.	TB1–42A (+) and TB1–401(–)
Low Fuel	Generator Master Switch in OFF/ RESET; engine switch in RUN position Ground controller terminal TB 63 to test. If Low Fuel Lamp lights, circuit is functioning properly	Not Applicable

Indicator	Switch Position/Remarks	Check for Presence of 12 Volts DC Between:
Battery Charger Fault (if battery charger equipped)	Generator Master Switch in OFF/ RESET; engine switch in RUN position Ground controller terminal TB1–61 to test. If Battery Charger lamp lights, circuit if functioning properly	Not Applicable
Low Battery Volts (if battery charger equipped)	Generator Master Switch in OFF/ RESET; engine switch in RUN Ground controller terminal TB1–62 to test. If Low Battery Volts lamp lights, circuit if functioning properly	Not Applicable
Common Fault Line	Master Switch in RUN position; engine switch in RUN; hold toggle switch to L.W.T., H.W.T., or L.O.P.	TB1– 42A (+) and TB1–32 (–)
Overspeed	See "Controller Speed Sensor Circuitry" earlier in this section	Not Applicable
Overcrank	See "Overcrank" earlier in this section	Not Applicable

ENGINE/GENERATOR COMPONENTS

With the generator set battery connected, the wiring harness and some engine/generator components can be checked. Place the controller master switch or remote start/stop switch in the prescribed position and check for voltage at each component using a voltmeter. This will verify that the switches function and voltage is present at each component.

Component	Voltmeter Connections	Procedure
Hourmeter and wiring	Red test clip to (+) terminal. Black test clip to (–) terminal.	Voltmeter setting 12 Volts DC or greater. Start generator set. 12 Volt DC reading indicates wiring harness is okay. Hourmeter will function if good.
Stator "1–2" winding (control winding)	V0 and V7 terminals in controller	Voltmeter setting 120 Volts AC or greater. Start generator set and allow to reach rated speed. Reading of 120 Volts AC (approx.) indicates stator "1–2" winding is good.

Component	Voltmeter Connections	Procedure
Governor Actuator	None	Disconnect actuator harness and apply 12 Volts DC to actuator. If good, actuator will extend. Actuator should retract when DC is removed.
Water Temperature Gauge (if equipped)	Red test lead to positive side (wire 70) of gauge. Black test lead to generator ground connection.	Start generator set to test voltage. Battery voltage (approx. 12 Volts DC) should be read. If no voltage, check controller circuit board and wiring. If voltage is present at gauge, stop set and check continuity of wiring between gauge and ground. (Resistance of sender will be read during continuity check. See Section 8. Component Testing and Adjustment, Meter Senders (optional). If wiring tests okay, replace gauge.
Oil Pressure Gauge (if equipped)	Red test lead to positive side (wire 70) of gauge. Black test lead to generator ground connection.	Start generator set to test voltage. Battery voltage (approx. 12 Volts DC) should be read. If no voltage, check controller circuit board and wiring. If voltage is present at gauge, stop set and check continuity of wiring between gauge and ground. (Resistance of sender will be read during continuity check. See Section 8. Component Testing and Adjustment, Meter Senders (optional). If wiring tests okay, replace gauge.
Voltmeter (if equipped)	Red test lead to positive side (wire 70) of gauge. Black test lead to generator ground connection.	Start generator set. Battery voltage (approx. 12 Volts DC) should be read. If no voltage, check controller circuit board and wiring. If voltage is present, stop set and check continuity of wiring between meter and ground. If wiring tests okay, replace meter.

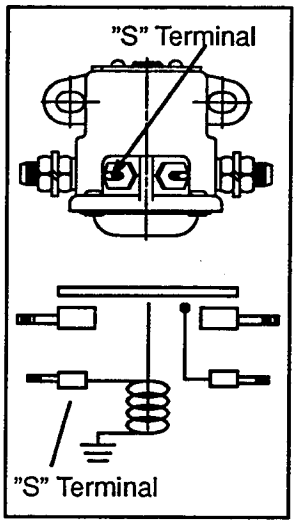
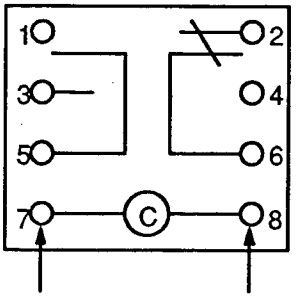
To further check generator set components, disconnect the battery and remove wiring harness plugs from the controller circuit board. Use an ohmmeter to check continuity and to isolate defective components. Use the following chart and the appropriate wiring diagram in Section 11. Wiring Diagrams.

NOTE

Before performing ohmmeter checks, disconnect generator set battery to prevent damage to the ohmmeter.

Hazardous voltage can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Do not contact electrical connections with tools or jewelry while adjustments are made. Remove wristwatch, rings, and jewelry that can cause short circuits.

Component	Ohmmeter Connections	Procedure	Results
Remote Switch Light (if equipped)	(+) and (–) terminals	Ohmmeter on R x 1 scale	If good – continuity No continuity – replace light.
Hourmeter	(+) and (–) terminals	Ohmmeter on R x 1 scale	If good – continuity No continuity – replace hourmeter.
P1 wiring harness	P1–5 and ground	Ohmmeter on R x 1 scale	If good – zero ohms. Any other reading indicates a poor ground connection.
P2 wiring harness	P2–6 and ground	Ohmmeter on R x 1 scale	If good – zero ohms. Any other reading indicates a poor ground connection.

Component	Ohmmeter Connections	Procedure	Results
Voltage regulator circuit 10 Amp. fuse	P11–5 and stator lead 55 at fuse holder	Ohmmeter on R x 100 scale	If good, zero ohms. No continuity – blown fuse or open wiring.
K20 relay coil (starter relay) 	K20 "S" terminal and relay base (ground)	Ohmmeter on R x 1 scale.	If good – 3–4 ohms. Low resistance – shorted K20 relay coil and/or wiring. High resistance – open K20 relay coil and/or wiring.
K1 relay coil – (field flashing relay). See Figure 6–1 for location. 	K1 relay terminals "7" and "8"	Disconnect and remove relay from controller Ohmmeter on R x 1 scale.	If good – 160 ohms (approx.). Low resistance – shorted relay coil. High resistance – open relay coil.

Component	Ohmmeter Connections	Procedure	Results
Low Water Level (LWL) Sensor *	P1–14 (or J6–1) and ground (engine block)	Ohmmeter on R x 1 scale. Apply 12 Volts DC (+) to red lead and (–) to black lead.	If good, open circuit (infinity) with engine cold and LWL sensor immersed in coolant. Any other reading, replace LWL sensor.
High Engine Temperature (HET) Switch *	P1–21 and ground (engine block)	Ohmmeter on R x 1000 scale.	If good, open circuit (infinity) with engine cold. Any other reading indicates defective switch and/or wiring.
Low Oil Pressure (LOP) Switch *	P1–22 and ground (engine block)	Ohmmeter on R x 1000 scale.	If good, zero ohms (continuity). No reading, defective switch and or wiring.

* See "Fault Shutdown Test Procedure" section following

Fault Shutdown Test Procedure

Proper operation of the generator overspeed, overcrank, low coolant level, low oil pressure, and high engine temperature shutdowns can be verified by performing the following tests with the generator set running. If these tests are inconclusive, test individual shutdown circuit components (circuit board, wiring harness, switch, etc.) as described earlier in this section.

Exposed moving parts can cause severe injury or death. Keep hands, feet, hair, and clothing away from belts and pulleys when unit is running. Replace guards, covers, and screens before operating generator set.

⚠ WARNING

Hazardous voltage.

Moving rotor.

Can cause severe injury or death.

Do not operate generator set without all guards and electrical enclosures in place.

Hazardous voltage can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Do not contact electrical connections with tools or jewelry while adjustments are made. Remove wristwatch, rings, and jewelry that can cause short circuits.

Overspeed

Start generator set and manually adjust engine speed (by moving throttle linkage) to exceed rated engine rpm (1800 rpm). Generator will shut down and fault lamp will light at engine speed between 68 and 71 Hz.

Low Oil Pressure (LOP) Shutdown

Connect a jumper wire from the LOP switch (lead 13) to the generator set ground. See Section 8. Engine Safety Shutdown Switches. Start generator set. After approximately 25–35 seconds the generator set should shut down, alarm horn will sound, and the "Low Water Temp/Aux" lamp will light.

Low Water Level (LWL) Shutdown

Connect a jumper wire from LWL sensor (lead 31) to generator set ground. See Section 8. Engine Safety Shutdown Switches. Start generator set. After approximately 25–35 seconds, the generator set should shut down, the alarm horn will sound, and the "Low Water Temp/Aux" lamp will light.

High Engine Temperature (HET) Shutdown

Connect a jumper from the HET switch (lead 34) to the generator set ground. See Section 8. Engine Safety Shutdown Switches. Start generator set. After approximately 25–35 seconds, the generator set should shut down, the alarm horn will sound, and the "High Engine Temperature" lamp will light.

Overcrank Shutdown

Disconnect lead between starter solenoid K20 and starter motor at K20 terminal. Move controller master switch to the RUN position. Generator set will simulate cranking for 15 seconds then rest for 15 seconds. After the third crank/rest cycle, the generator set alarm horn will sound and the "Overcrank" lamp will light. If the controller is set for continuous cranking, overcrank shutdown will occur after 45 seconds of continuous simulated cranking.

Section 7. Generator Troubleshooting

THEORY OF OPERATION 12–LEAD GENERATORS

The12–lead models utilize a wound field brushless excited generator to produce AC current. When the start switch is activated, the exciter field is initiallymagnetized by DC current from the battery. When the exciter armature is rotated within the magnetized exciter field windings, an electrical current develops within the exciter armature. As the engine speeds up, exciter armature output increases. Exciter armature current (converted to DC by the rectifier module) magnetizes the generator main field. The main field rotating within the stator windings imparts AC current in the stator windings. As the main field increases in strength (as supplied by exciter armature), generator output also increases. The voltage regulator monitors output voltage through stator leads 7 and 8 to supply the correct amount of DC current (rectified by the voltage regulator) to the exciter field to meet the generator load requirements. Exciter field current (other than start–up) is supplied by stator windings 55 and 66 through the voltage regulator. See Figure 7–1.

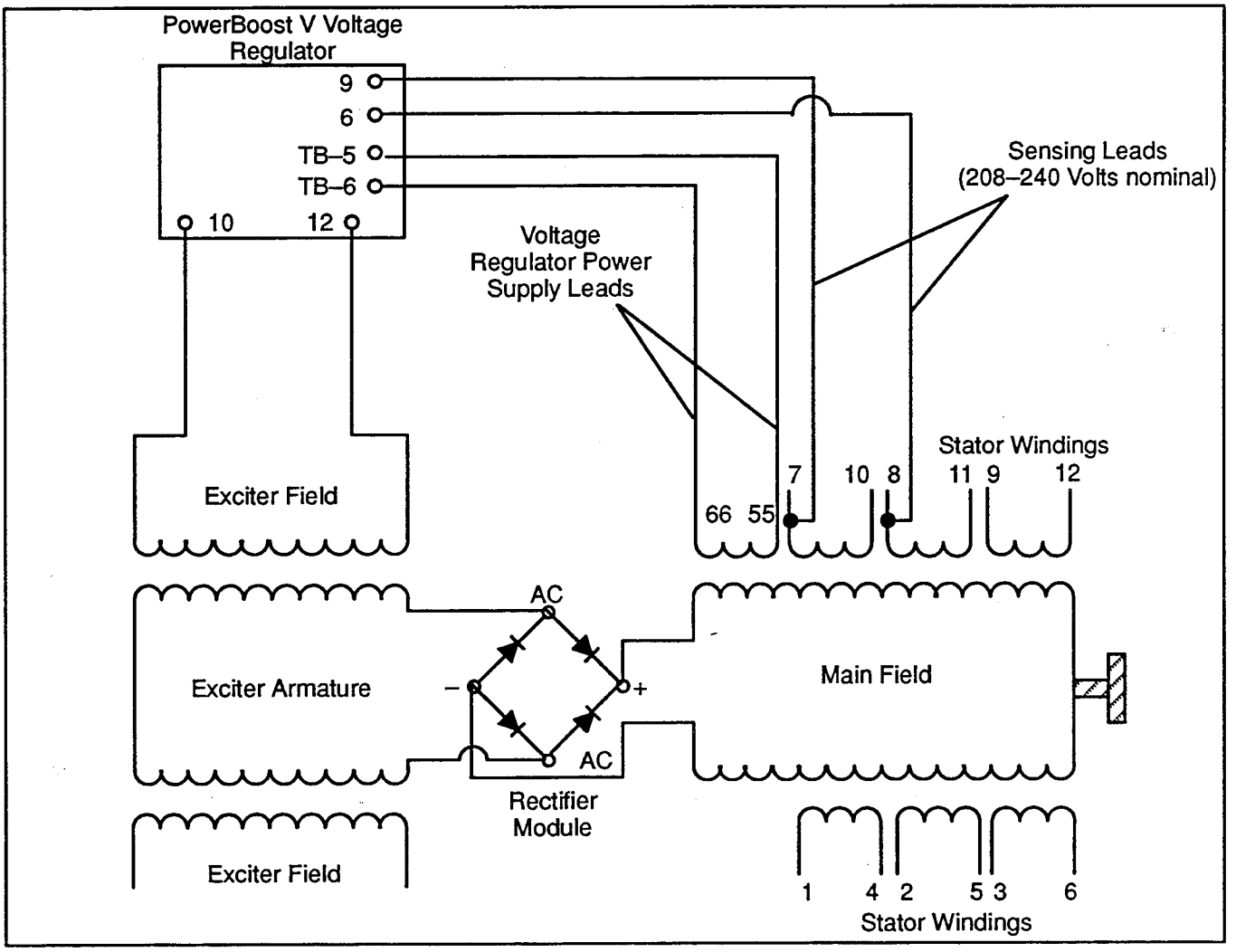


Figure 7–1. 12–Lead Generator Schematic

TROUBLESHOOTING 12–LEAD GENERATOR MODELS

To determine the cause of no or low AC output on 12–lead generator sets, refer to the troubleshooting flow chart (Figure 7–2) and the separate excitation procedure following. Before beginning the troubleshooting procedures, read all safety precautions at the beginning of this manual. Additional safety precautions are included with the tests; OBSERVE THESE PRECAUTIONS!

Begin the troubleshooting procedure by separately exciting the generator. The generator field (rotor) may be excited (magnetized) using an outside power source (12 Volt automotive battery). In the separate excitation test, you will be duplicating the role of the voltage regulator in providing excitation current to the exciter field. By separately exciting the generator to determine the presence of a faulty voltage regulator, it is possible to determine if a running fault exists in the rotor and/or stator. A generator component that appears good while static (stationary) may exhibit a running open or short while dynamic (moving). This fault can be caused by centrifugal forces acting on the windings while rotating or insulation breakdown as temperatures increase. The flow chart in Figure 7–2 summarizes the troubleshooting procedure.

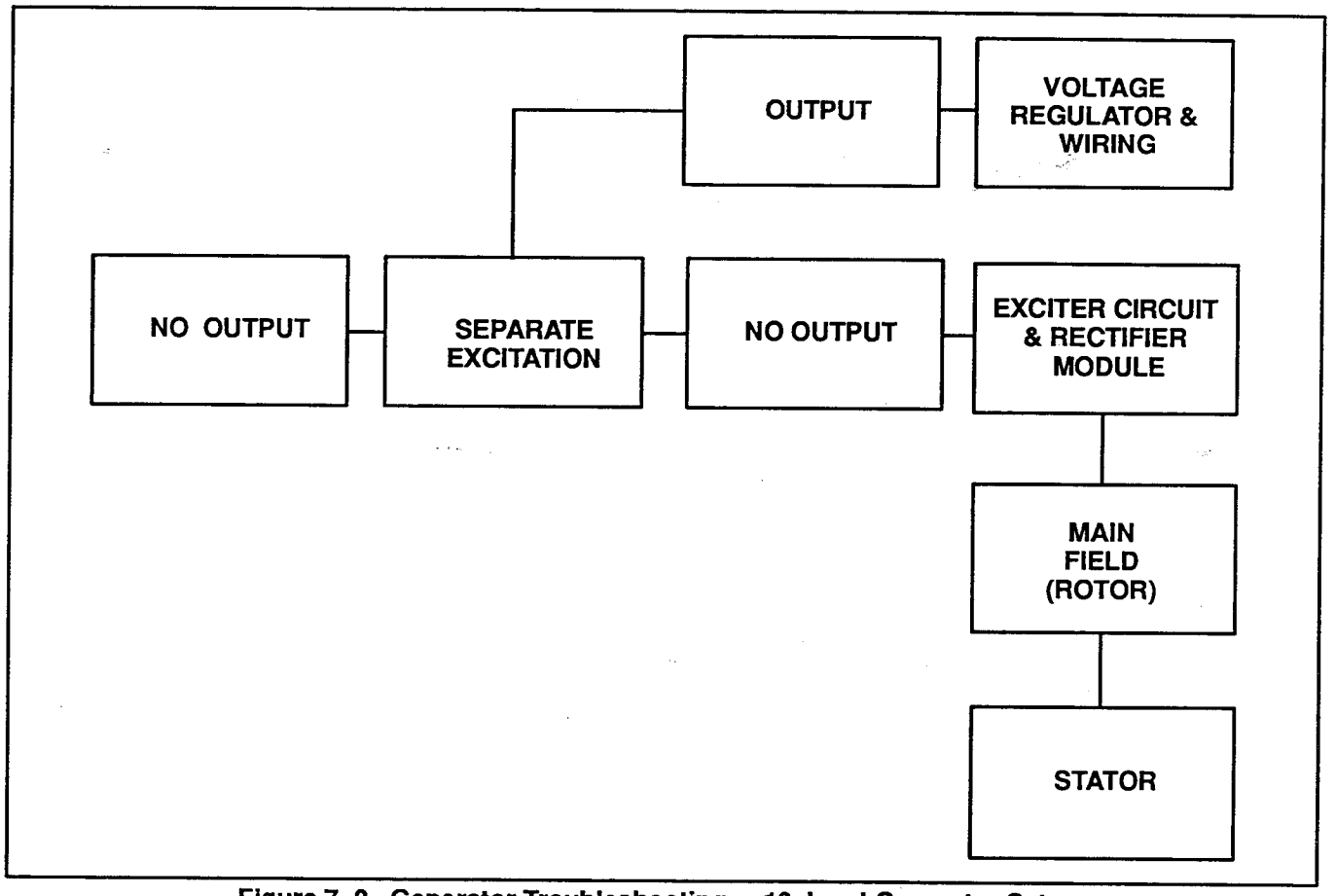


Figure 7–2. Generator Troubleshooting – 12–Lead Generator Sets

Hazardous voltage can cause severe injury or death. Perform electrical service only as prescribed in equipment manual. Be sure that generator is properly grounded. Never touch electrical leads or appliances with wet hands, when standing in water, or on wet ground as the chance of electrocution is especially prevalent under such conditions. Wiring should be inspected at the interval recommended in the service schedule — replace leads that are frayed or in poor condition. The function of a generator set is to produce electricity and wherever electricity is present, there is the hazard of electrocution.

Hazardous voltage can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Do not contact electrical connections with tools or jewelry while adjustments are made. Remove wristwatch, rings, and jewelry that can cause short circuits.

SEPARATE EXCITATION – 12–LEAD GENERATORS

1. Disconnect all leads from voltage regulator. See Figure 7–3.

2. Remove exciter field F1 and F2 leads from terminal strip TB1 (relay controller) or TB4 (5 light controller).

3. Connect separate excitation circuit as shown in Figure 7–4. (Connect an ammeter and a 10 Amp. fuse in series with F1.) Note and record the ammeter reading.

4. The approximate ammeter reading should be battery voltage divided by specified rotor resistance. Specified rotor resistance values are found in Section 1. Specifications.

Example:

$$\frac{\text{12 Volts (Battery Voltage)}}{\text{5.1 Ohms (Rotor Resistance)}} = \text{2.4 Amps. Rotor Current}$$

5. Start engine and check that ammeter remains stable. An increasing meter reading indicates a shorted rotor. A decreasing meter reading to zero or unstable reading suggests a running open. Refer to Section 8, Component Testing and Adjustment. If ammeter is stable proceed to Step 6.

6. Check for AC output across stator leads (See Section 8. Stator) and compare to readings found in Section 1. Specifications. If readings vary considerably from those listed, a faulty stator is likely. (Refer to Section 8. Stator for further information.)

7. If rotor and stator test good in prior steps, the voltage regulator is probably defective. If there is no generator output during normal operation but output is available when the set is separately excited, the voltage regulator is probably defective.

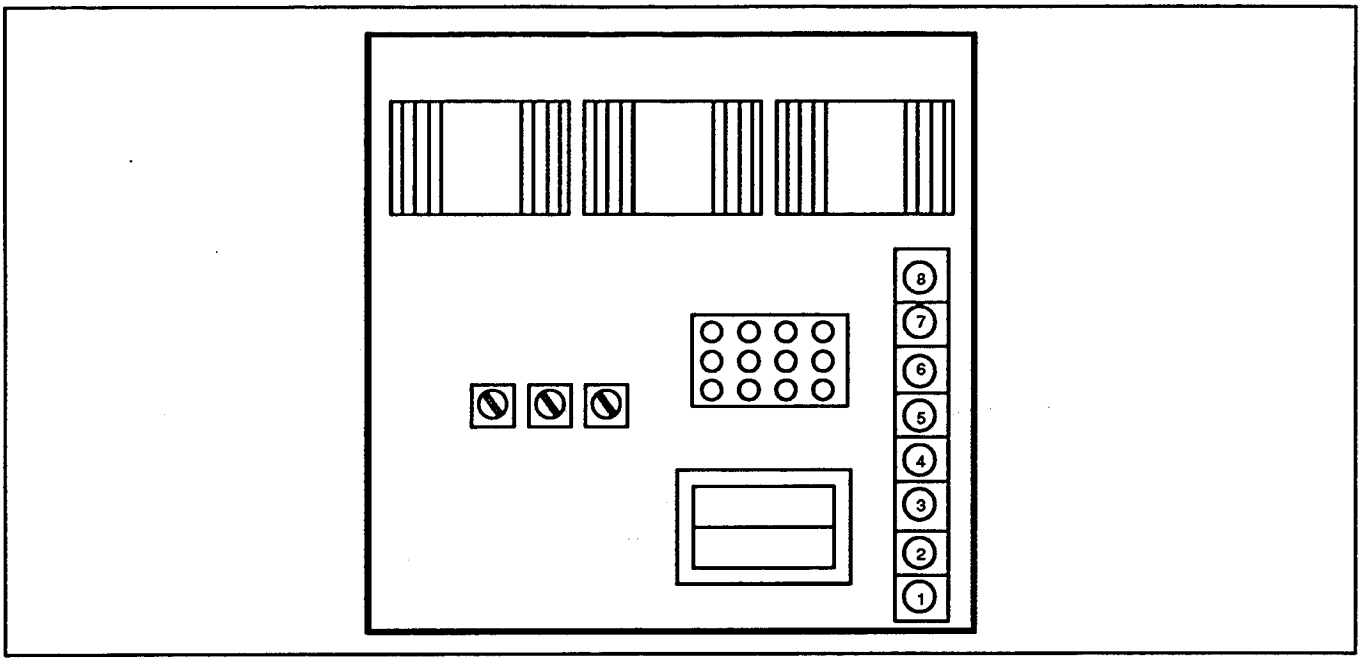


Figure 7–3. PowerBoost V Voltage Regulator

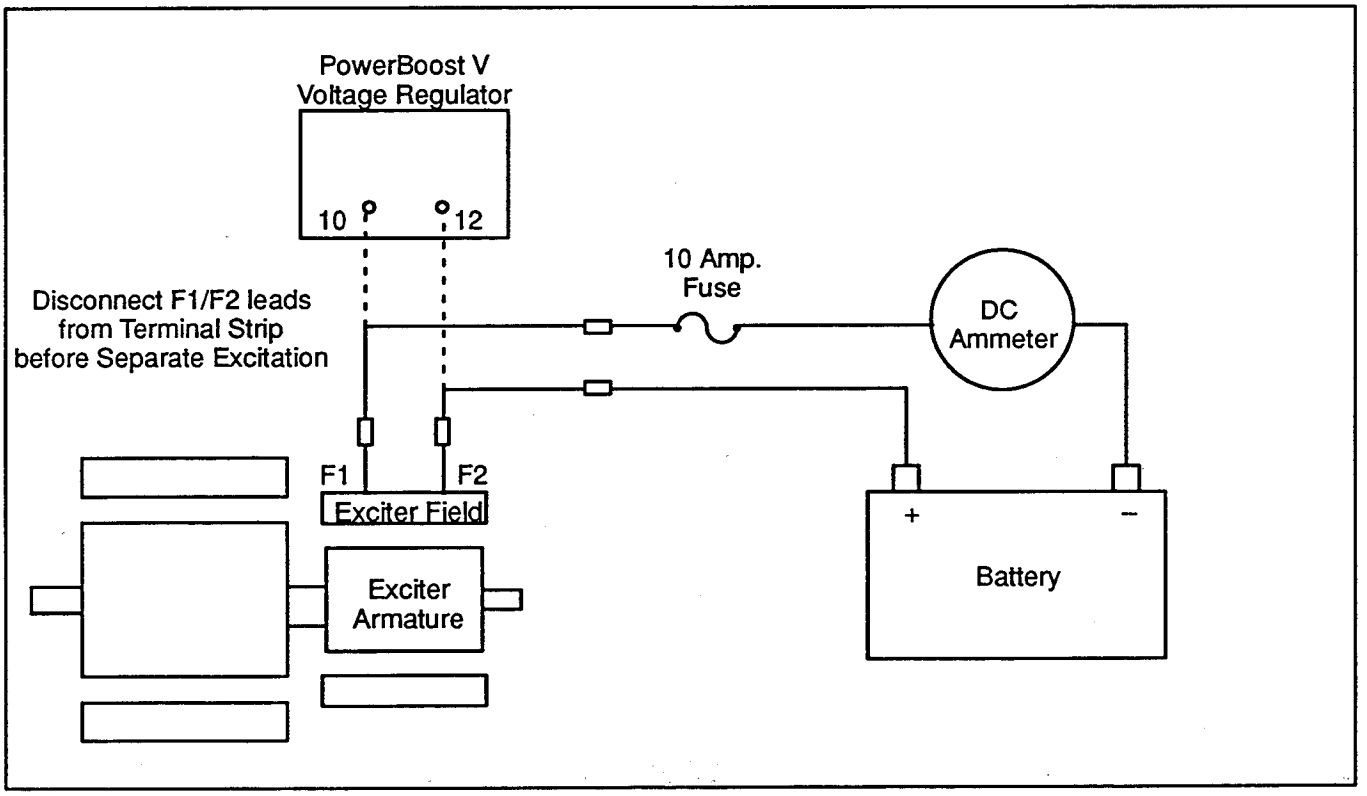


Figure 7–4. Separate Excitation Connections

Section 8. Component Testing and Adjustment

Use this section as a guide for checking generator components for improper operation and performing component adjustment. (Refer to Section 7, "Generator Troubleshooting" to determine which component may be defective. Follow the safety precautions at the beginning of this manual during all test procedures. Additional safety precautions are included with the tests; OBSERVE THESE PRECAUTIONS!

VOLTAGE REGULATOR TEST – POWERBOOST V

The voltage regulator used on these models is PowerBoost V. See Figure 8–1.

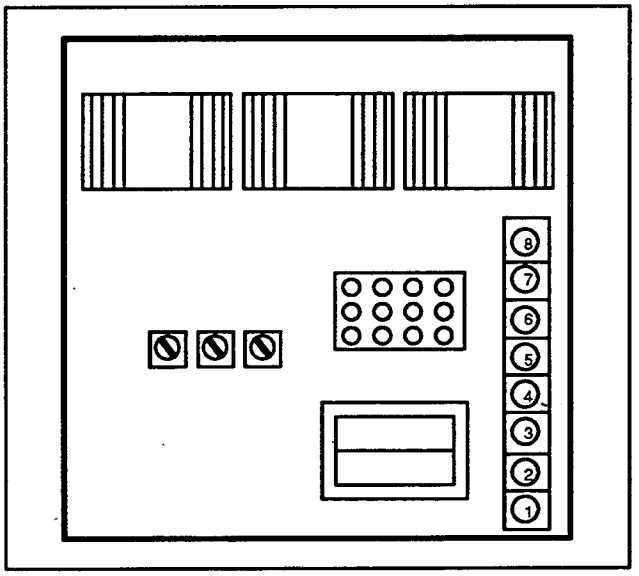


Figure 8–1. PowerBoost V Voltage Regulator

The PowerBoost V voltage regulator monitors output voltage magnitude to control current to the generator exciter field. The voltage regulator has an underfrequency unloading feature which is referred to as Volts–per–Hz (V/Hz.). To determine if the voltage regulator is functioning properly, reduce engine speed (Hz) and watch for a corresponding drop in AC voltage. AC voltage should remain constant until engine speed drops below 57.5 Hz (on 60 Hz models) or 47.5 Hz (on 50 Hz models). When frequency drops below 57.5/47.5 Hz, AC voltage should decline. To further check the voltage regulator for proper function, perform the following test to check regulator output. To test the voltage regulator the following components will be needed:

- Step–up Transformer, 1:2, 120 to 240 Volts (1.0 Amp. minimum)
- Variable Transformer, 0–140 Volts (1.0 Amp. minimum)
- 120 Volt, 100 watt Lamp
- AC Voltmeter 250 Volt (minimum)
- 1 Amp. Fuse
- 1 SPST Switch, 1 Amp. (minimum)
- 120 Volt AC Plug
- #14 AWG Copper Wire (minimum)

⚠ WARNING

Hazardous voltage. **Moving rotor.**

Can cause severe injury or death.

Do not operate generator set without all guards and electrical enclosures in place.

Hazardous voltage can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Do not contact electrical connections with tools or jewelry while adjustments are made. Remove wristwatch, rings, and jewelry that can cause short circuits.

Hazardous voltage can cause severe injury or death. Perform electrical service only as prescribed in equipment manual. Be sure that generator is properly grounded. Never touch electrical leads or appliances with wet hands, when standing in water, or on wet ground as the chance of electrocution is especially prevalent under such conditions. Wiring should be inspected at the interval recommended in the service schedule — replace leads that are frayed or in poor condition. The function of a generator set is to produce electricity and wherever electricity is present, there is the hazard of electrocution.

Hazardous voltage can cause severe injury or death. The heat sink of the voltage regulator contains high voltage. Do not touch voltage regulator heat sink when testing or electrical shock will occur.

TEST PROCEDURE

1. Connect components as shown in Figure 8–2.

2. Turn variable transformer setting to zero. Plug in variable transformer. Plug in power source to terminals 5 and 6.

3. Turn variable transformer on. Turn SPST switch on. Slowly increase variable transformer voltage. The lamp should go on. Continue to increase variable transformer voltage and when the preset voltage is reached (observe voltmeter) the lamp will turn off and continue to stay off as voltage is further increased. The preset voltage is determined by the setting of the **Volts** adjustment pot. on the voltage regulator. The preset voltage for a 120/240 Volt system is 240 Volts, for a 110/220 Volt system it would be 220 Volts, etc. If the voltage regulator functions as described, the voltage regulator is okay.

   If the lamp does not turn on, turn the voltage regulator **Volts** adjustment pot. to the approximate midpoint and repeat test. If the lamp fails to go on after adjusting the **Volts** pot., replace the voltage regulator. A voltage regulator testing bad as described would cause a generator to have a no/low voltage condition.

   If the lamp fails to turn off as voltage is increased, turn the voltage regulator **Volts** adjustment pot. to the approximate midpoint and repeat test. If the lamp fails to go off after adjusting the **Volts** pot., replace the voltage regulator. A voltage regulator testing bad as described would cause a generator to have a high voltage condition.

4. Turn variable transformer to zero and unplug AC cord. Turn SPST switch off and unplug cord.

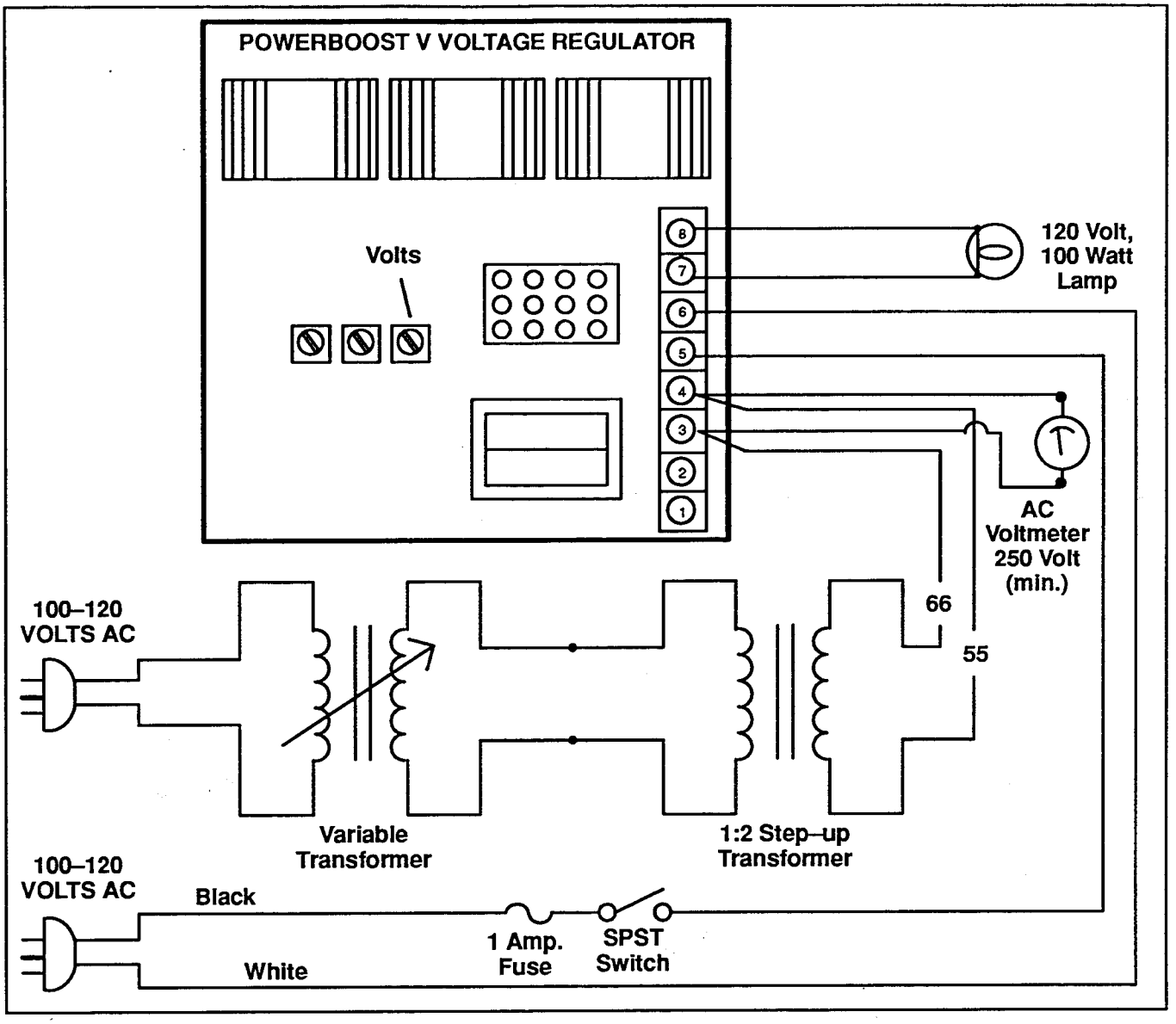


Figure 8–2. PowerBoost V Voltage Regulator Test

VOLTAGE REGULATOR ADJUSTMENT

The PowerBoost V voltage regulator monitors generator output to control current flow to the generator field. PowerBoost V maintains generator output under load until the generator engine speed drops to a pre–set level (factory setting 57.5 Hz on 60 Hz models and 47.5 Hz on 50 Hz models). At this point (under factory settings) the regulator allows generator voltage and current to drop to a level sufficient to handle load. When the generator speed returns to normal (60 Hz or 50 Hz) as load is accepted, generator output also returns to normal. The voltage regulator is factory set for proper generator operation under a variety of load conditions. Under normal circumstances, no further adjustment is necessary. However, if the regulator is replaced, has been tampered with, or voltage/frequency reconnection has been done, readjust according to the following procedure. Voltage regulator components are identified in Figures 8–3 and 8–4 and described in the following paragraphs.

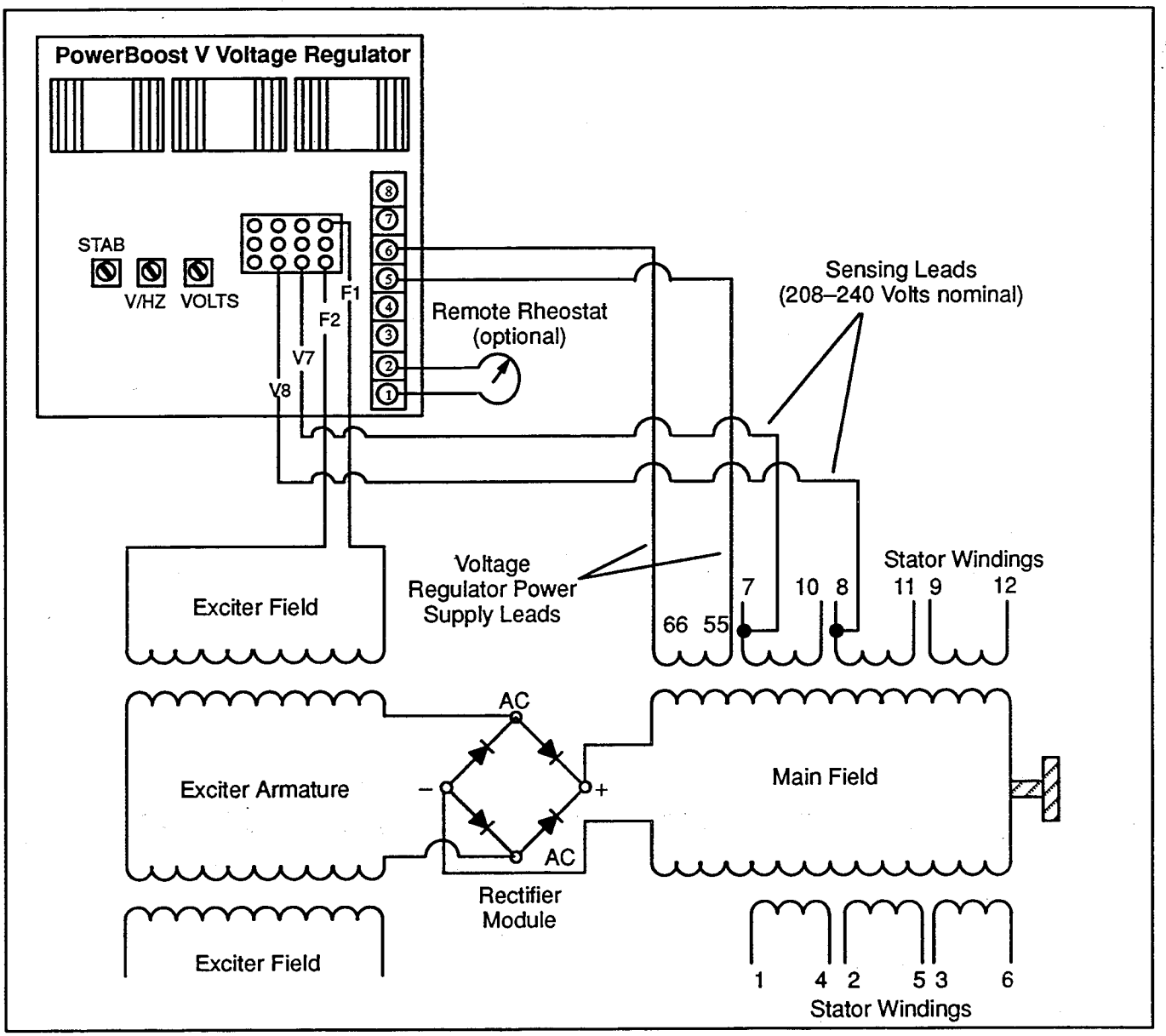


Figure 8–3. PowerBoost V Voltage Regulator

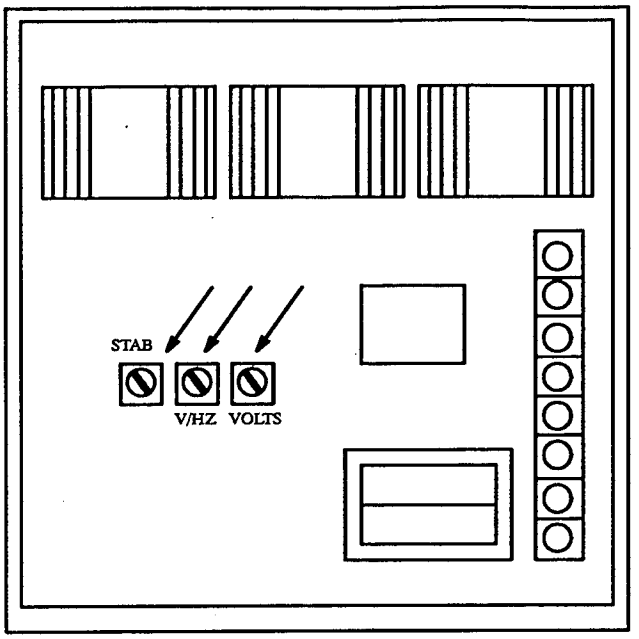


Figure 8–4. PowerBoost V Adjustments

NOTE

The voltage regulator is located in the generator junction box and is serviceable by removing four screws

Voltage Adjustment Pot. – Adjusts generator output within range of 190–270 Volts (line–to–line).

NOTE

A customer–provided rheostat may be connected across regulator terminals 1 and 2 to adjust generator output voltage from a location remote from the set. The rheostat (10k ohms, 1/2 watt minimum) will provide a 5 Volt adjustment range.

Stability Pot. – "Fine–tunes" regulator to reduce light flicker.

Volts/Hz Pot. – Adjustment determines engine speed (Hz) at which generator output voltage will begin to drop.

Hazardous voltage can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Do not contact electrical connections with tools or jewelry while adjustments are made. Remove wristwatch, rings, and jewelry that can cause short circuits.

Hazardous voltage can cause severe injury or death. The heat sink of the voltage regulator contains high voltage. Do not touch voltage regulator heat sink when testing or electrical shock will occur.

ADJUSTMENT PROCEDURE

1. With generator set off, turn remote rheostat (if equipped) to mid–point. Turn **Voltage, Volts/Hz, and Stability pots.** fully counterclockwise. Connect voltmeter to AC circuit or an electrical outlet.
2. Start generator set. **Rotate Voltage Adjustment pot.** clockwise (increase voltage) or counterclockwise (decrease voltage) until desired output voltage is achieved.
3. Rotate **Stability pot.** clockwise until minimum light flicker is obtained.
4. Readjust **Voltage Adjustment pot.** (if necessary).
5. **Mechanical Governor:**
   Adjust engine speed to desired cut–in frequency (factory setting 57.5–58 Hz. for 60 Hz. models or 47.5–48 Hz. for 50 Hz. models) as measured on frequency meter. See Section 3. Governor.

   Electronic Governor:
   Adjust engine speed to desired cut–in frequency by installing a jumper on the electronic governor circuit board "–2.5Hz/Freq" terminals. See Electronic Governor (optional) later in this section. When a jumper is placed across these terminals, generator frequency will drop by 2.5 Hz. The recommended cut–in frequency is 57.5 Hz for 60 Hz operation and 47.5 Hz for 50 Hz operation (as measured on frequency meter).
6. Rotate **Volts/Hz. Adjustment pot.** clockwise until voltage level begins to drop (as measured on voltmeter). When set to these specifications, the generator will attempt to maintain normal output until engine speed drops below the frequency set in step 5 (as load is applied).
7. **Mechanical Governor:**
   Readjust engine speed to normal (63 Hz./1890 rpm for 60 Hz. or 52.5 Hz./1575 rpm for 50 Hz.) See Section 3. Governor.

   Electronic Governor:
   Remove jumper from governor circuit board "–2.5/Freq." terminals.
8. Readjust **Voltage Adjustment pot.** (if necessary).
9. Readjust **Stability pot.** (if necessary).
10. Use remote rheostat (if equipped) to make final voltage adjustments. STOP GENERATOR SET.

EXCITER FIELD

The exciter field is magnetized by DC from the battery. When the exciter armature is rotated within the magnetized exciter field windings, an electrical current develops within the exciter armature. Test the exciter field according to the following procedure.

1. Disconnect generator starting battery (negative lead first) and power to battery charger (if equipped). Disconnect exciter leads F1 and F2 at TB2 terminal strip.

2. Check exciter field resistance by connecting an ohmmeter across exciter field F1 and F2. See Figure 8–5. The resistance reading for a cold exciter field is found in Section 1. Specifications. A low reading indicates an internal short and a high reading indicates an open winding. Repair or replace exciter field if ohmmeter readings indicate exciter field is defective. If resistance test proves inconclusive, perform a megohmmeter test on exciter field as described in the next step.

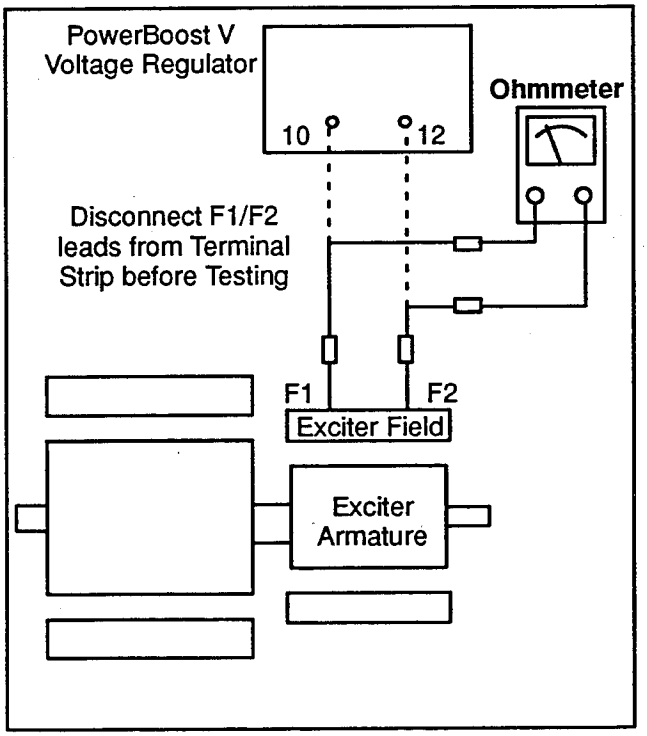


Figure 8–5. Checking Exciter Field Resistance

Hazardous voltage can cause severe injury or death. Perform electrical service only as prescribed in equipment manual. Be sure that generator is properly grounded. Never touch electrical leads or appliances with wet hands, when standing in water, or on wet ground as the chance of electrocution is especially prevalent under such conditions. Wiring should be inspected at the interval recommended in the service schedule — replace leads that are frayed or in poor condition. The function of a generator set is to produce electricity and wherever electricity is present, there is the hazard of electrocution.

Hazardous voltage can cause severe injury or death. Follow instructions of test equipment manufacturer when performing high voltage test on rotor or stator. Improper test procedure can damage equipment or lead to future generator failures.

3. Check exciter field for a grounded condition. Using a megohmmeter, apply 500 Volts DC to F1 or F2 lead and exciter field frame. See Figure 8–6. (Follow the instructions of the megohmmeter manufacturer when performing this test.) A reading of approximately 500K ohms (1/2 megohm) and higher indicates the field winding is good. A reading of less than 500K ohms (approximately) indicates deterioration of winding insulation and possible current flow to ground. Repair or replacement of the exciter field is necessary.

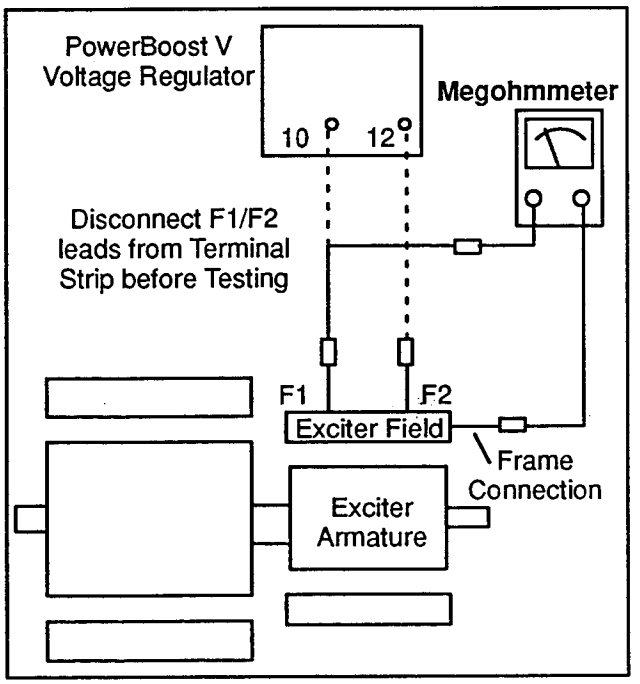


Figure 8–6. Megohmmeter Connections on Exciter Field

EXCITER ARMATURE

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. (The generator must be disassembled prior to performing this test.)

1. With generator disassembled, disconnect armature leads from rectifier module AC terminals.

2. With an ohmmeter on the R x 1000 scale, check resistance across exciter armature leads. See Figure 8–7. The armature resistance is found in Section 1. Specifications. No continuity indicates an open armature winding. If the resistance test proves inconclusive, perform a megohmmeter test on the exciter armature as described in the next step.

NOTE

Most ohmmeters will not provide accurate readings when measuring less than one ohm. The exciter armature can be considered good if a low resistance reading is obtained (continuity) and there is no evidence of shorted windings (heat discoloration).

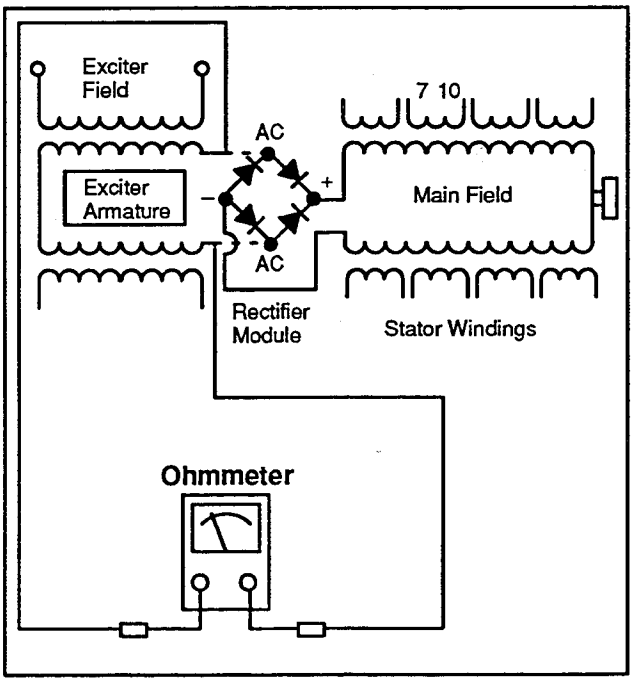


Figure 8–7. Exciter Armature Ohmmeter Test

Hazardous voltage can cause severe injury or death. Perform electrical service only as prescribed in equipment manual. Be sure that generator is properly grounded. Never touch electrical leads or appliances with wet hands, when standing in water, or on wet ground as the chance of electrocution is especially prevalent under such conditions. Wiring should be inspected at the interval recommended in the service schedule — replace leads that are frayed or in poor condition. The function of a generator set is to produce electricity and wherever electricity is present, there is the hazard of electrocution.

Hazardous voltage can cause severe injury or death. Follow instructions of test equipment manufacturer when performing high voltage test on rotor or stator. Improper test procedure can damage equipment or lead to future generator failures.

3. Check exciter armature for a grounded condition. Using a megohmmeter, apply 500 Volts DC to either armature lead and armature frame. (Follow the instructions of the megohmmeter manufacturer when performing this test.) See Figure 8–8. A reading of approximately 500K ohms (1/2 megohm) and higher indicates the exciter armature is good. A reading of less than 500K ohms (approximately) indicates deterioration of winding insulation and possible current flow to ground. Repair or replacement of the exciter armature is necessary.

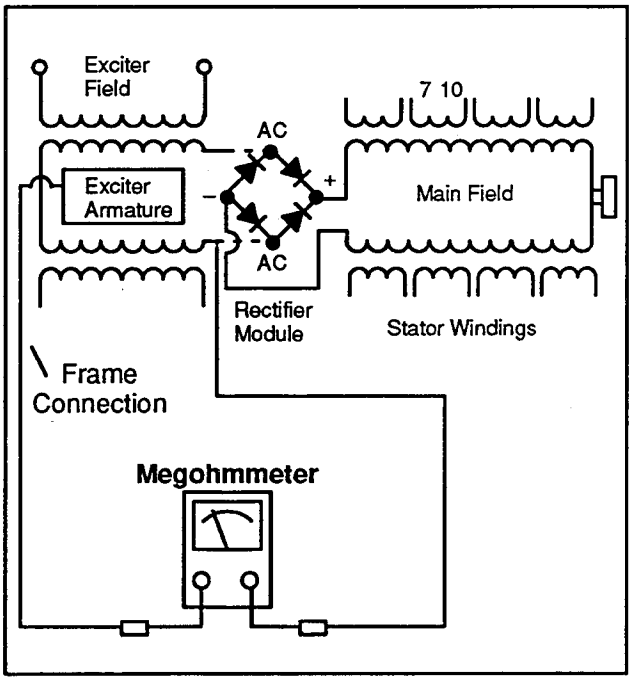


Figure 8–8. Megohmmeter Connections on Exciter Armature

RECTIFIER MODULE

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

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

2. Using an ohmmeter on the R x 100 scale, check resistance between rectifier diodes (as shown in Figure 8–9. To test CR3, for example, place ohmmeter leads on rectifier terminals B3 and B4. The ohmmeter should show a low resistance in one direction and, upon reversing ohmmeter leads, a high resistance in the other direction. Replace the rectifier module if any of the diodes tests different than described.

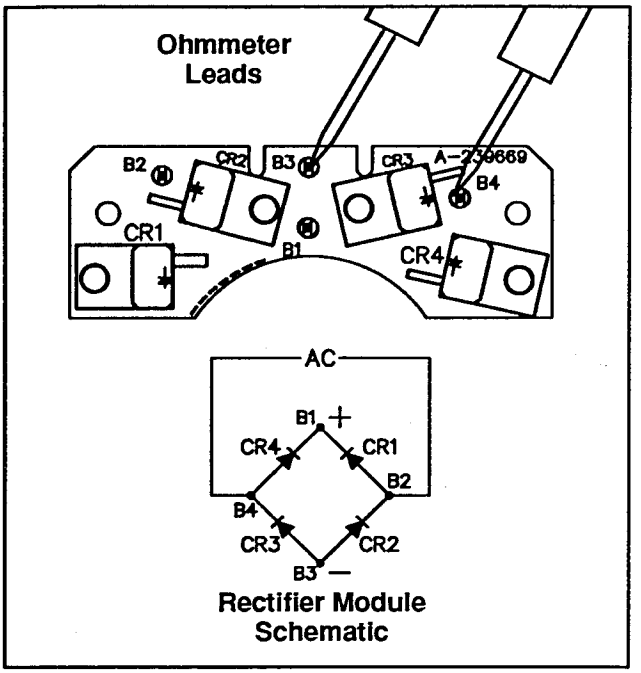


Figure 8–9. Testing Rectifier Module

GENERATOR MAIN FIELD

The generator main field (magnetized by DC from the rectifier module) rotating within the stator windings induces AC in the stator windings. Test generator main field as described in the following steps. (The generator must be disassembled prior to performing this test.).

1. With the generator disassembled, disconnect generator main field windings from rectifier module B2 and B4 terminals (F+ and F–).

2. Check main field resistance by connecting an ohmmeter across main field F+ and F– leads. See Figure 8–10. The resistance reading for a cold main field is found in Section 1. Specifications. A low reading indicates an internal short and a high reading indicates an open winding. Repair or replace main field if ohmmeter readings indicate main field is defective. If the resistance test proves inconclusive, perform a megohmmeter test on the main field as described in the next step.

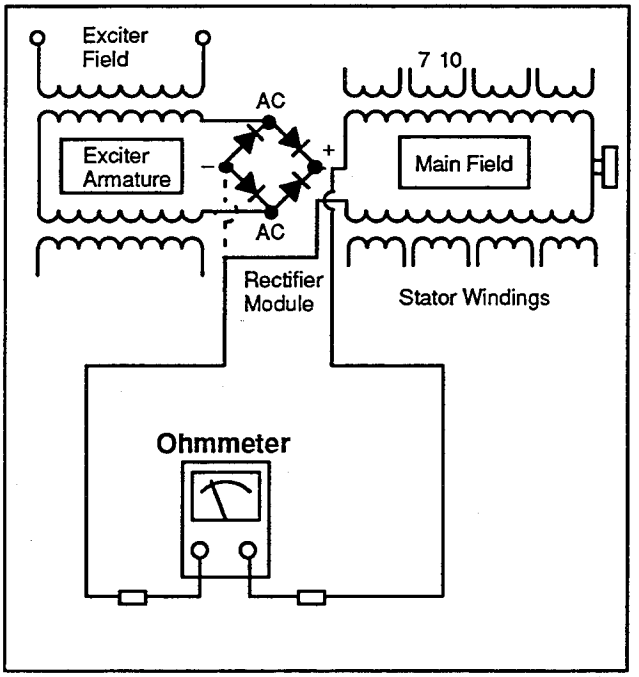


Figure 8–10. Ohmmeter Connections on Main Field

Hazardous voltage can cause severe injury or death. Follow instructions of test equipment manufacturer when performing high voltage test on rotor or stator. Improper test procedure can damage equipment or lead to future generator failures.

3. Check main field for a grounded condition. Using a megohmmeter, apply 500 Volts DC to either field lead and main field frame. (Follow the instructions of the megohmmeter manufacturer when performing this test.) See Figure 8–11. A reading of approximately 500K ohms (1/2 megohm) and higher indicates the main field is good. A reading of less than 500K ohms (approximately) indicates deterioration of winding insulation and possible current flow to ground. Repair or replacement of the main field is necessary.

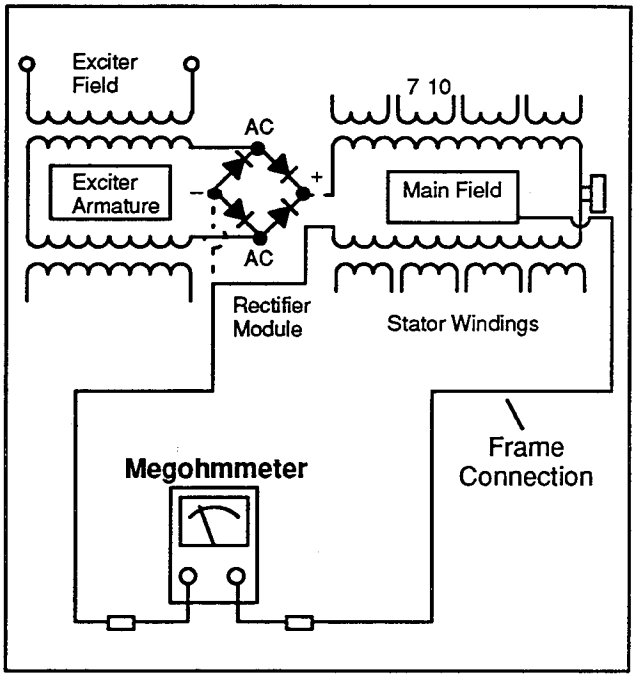


Figure 8–11. Megohmmeter Connections on Main Field

STATOR

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.

1. Disconnect generator starting battery (negative lead first) and power to battery charger (if equipped).

2. Check the generator output leads for proper connections (see Section 11. Wiring Diagrams).

3. Check condition of V0, V7, V8, and V9 at stator, terminal strip TB2 (relay controller) or TB3 (5 Light controller), and at voltage regulator.

4. Use an ohmmeter to check continuity of V7, V8, and V9 leads between stator and voltage regulator. No continuity (low resistance) indicates an open lead. Repair any open leads.

5. Inspect stator for evidence of shorted windings (heat discoloration). If the stator shows signs of heat discoloration, test stator windings as described in the following steps before replacing stator.

6. Disconnect all stator leads to isolate windings. To check stator continuity, set ohmmeter on R x 1 scale. Contact the red and black ohmmeter leads; adjust ohmmeter to zero ohms. Check stator continuity by connecting meter leads to stator leads as shown in Figures 8–12 and 8–13.

   - There should be continuity between leads 1 and 4, 2 and 5, 3 and 6, etc.
   - There must be no continuity between winding 1–4 and any other winding. This statement also applies to windings 2–5, 3–6, 7–10, etc.
   - There must be no continuity between any stator lead and ground on stator housing or frame laminations.

7. Contact ohmmeter leads and readjust ohmmeter to zero ohms. Check cold resistance of stator windings by connecting meter leads to stator leads 1–4, 2–5, 3–6, etc. Typical stator winding resistances are shown in Section 1. Specifications. If the stator resistance test proves inconclusive, perform a megohmmeter test on stator as described in the next step.

NOTE

Most ohmmeters will not provide accurate readings when measuring less than one ohm. The stator can be considered good if a low resistance reading (continuity) is obtained and there is no evidence of shorted windings (heat discoloration).

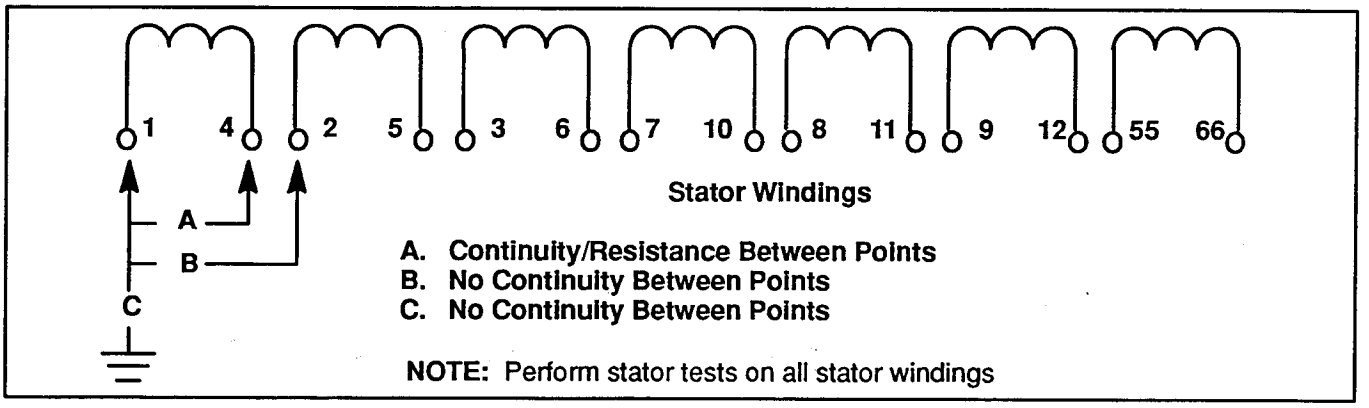


Figure 8–12. Stator Winding Test

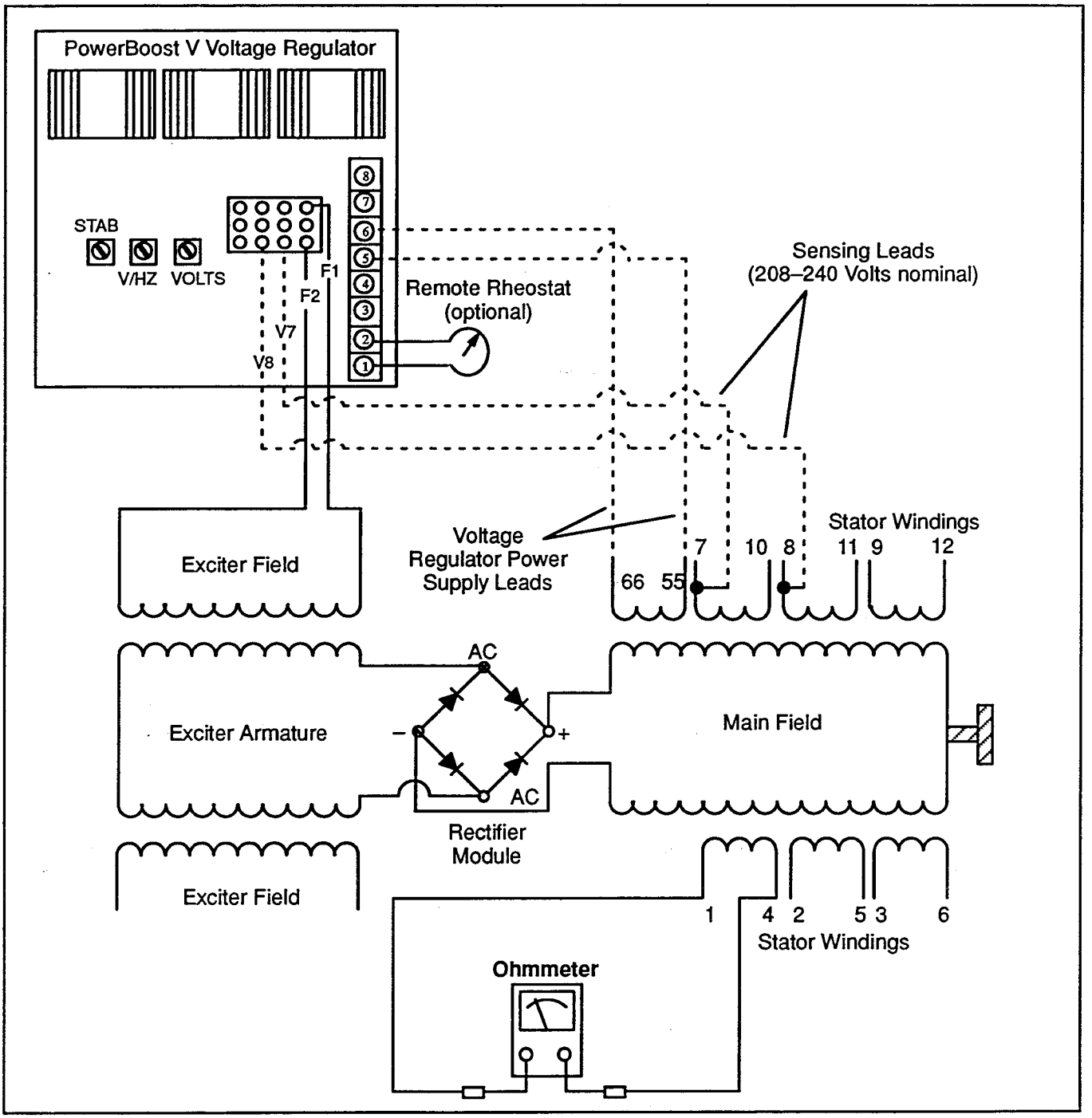


Figure 8–13. Stator Ohmmeter Connections

Hazardous voltage can cause severe injury or death. Follow instructions of test equipment manufacturer when performing high voltage test on rotor or stator. Improper test procedure can damage equipment or lead to future generator failures.

8. Check stator for a grounded condition. Using a megohmmeter, apply 500 Volts DC to any stator lead from each winding and stator frame. See Figure 8–14. (Follow the instructions of the megohmmeter manufacturer when performing this test.) Repeat test on other leads until all stator windings have been tested. A reading of approximately 500K ohms (1/2 megohm) and higher indicates the stator is good. A reading of less than 500K ohms (approximately) indicates deterioration of winding insulation and possible current flow to ground. Repair or replacement of the stator is necessary.

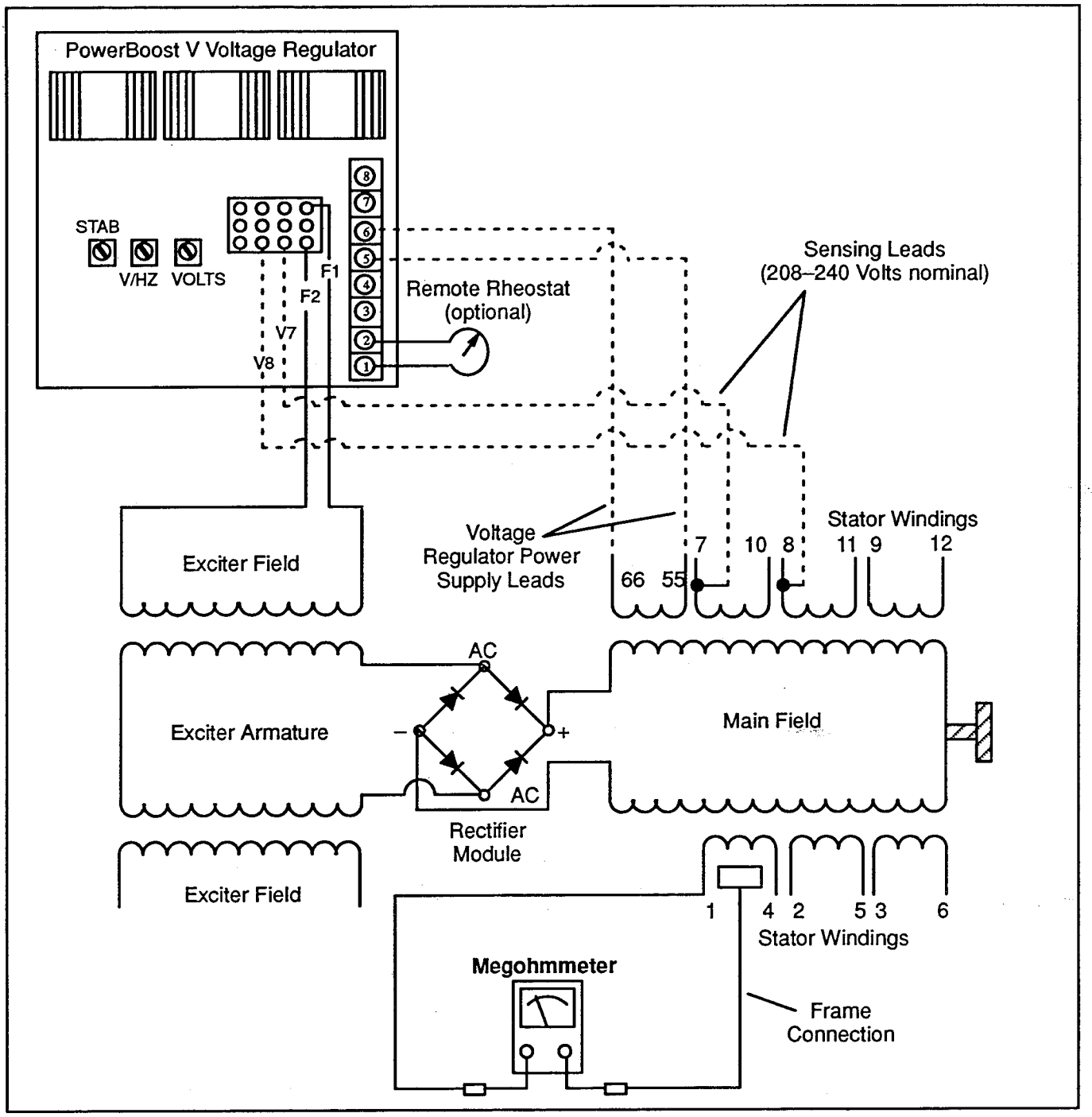
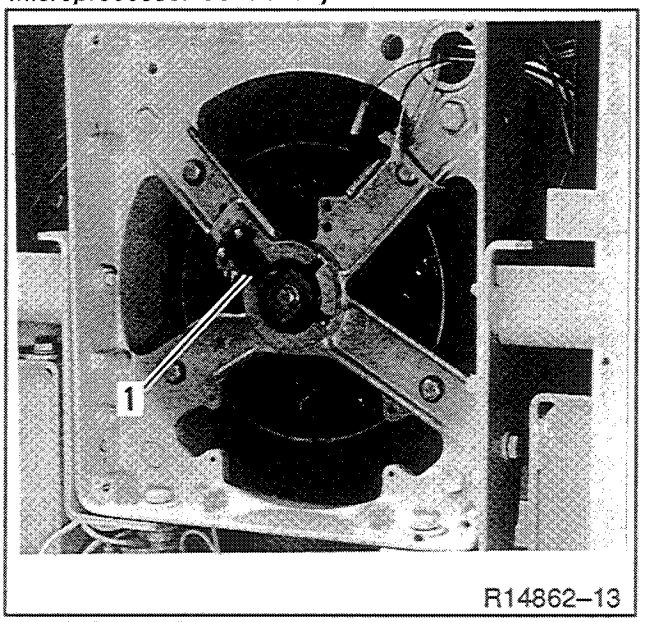


Figure 8–14. Megohmmeter Connections on Stator

SPEED SENSOR (OVERSPEED/OVERCRANK SHUTDOWN)

The speed sensor monitors engine speed (frequency) to signal overspeed and overcrank conditions. Location of the speed sensor is shown in Figure 8–15. To determine if the speed sensor is emitting a signal, follow the procedure outlined below. (Additional speed sensor test information for models equipped with 5 light controllers is included in Section 6. 5 Light Microprocessor Controller.)



1. Speed Sensor

Figure 8–15. Generator Speed Sensor

1. With generator master switch in OFF or OFF/RESET position, connect a DC voltmeter between positive (+) lead (wire 24) at speed sensor and ground (wire 2). Voltmeter should read approximately 12 Volts DC.

2. With generator set running, connect DC voltmeter negative (–) probe to "0" terminal (wire 16 – white) on speed sensor. Place voltmeter positive (+) probe on positive (+) terminal (wire 24 – red). Voltmeter should indicate approximately 12 Volts DC.

If speed sensor is emitting a signal, check continuity of speed sensor leads (wires 2, 16, and 24). If the speed sensor is not emitting a signal, test the speed sensor through the following procedure:

SPEED SENSOR TEST PROCEDURE

1. Remove speed sensor from end bracket. Connect speed sensor, voltmeter, and DC voltage source as shown in Figure 8–16.

2. Touch sensing surface with a flat piece of iron or steel – contact surface area of iron or steel piece should be at least 1/4 cubic inch (4.1 cm).

3. Voltmeter test reading should equal source voltage.

4. Remove iron or steel from sensing surface – voltmeter should should indicate no voltage.

5. Reinstall speed sensor to end bracket using all original hardware. When properly installed, air gap between speed sensor and actuator should be 0.030 in. (0.76 mm) +/–0.010 in. (0.25 mm).

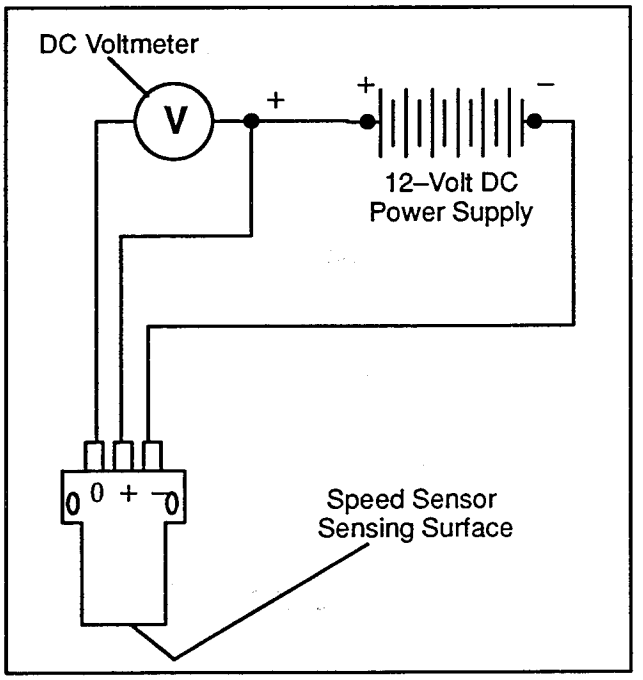
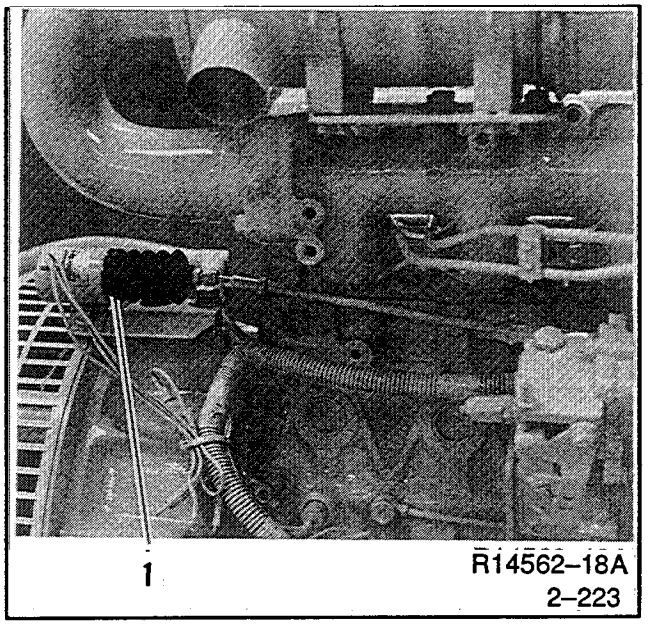


Figure 8–16. Speed Sensor Test

FUEL SOLENOID

The fuel solenoid (Figure 8–17) serves to pull the injector pump lever to the "fuel on" position when energized. The fuel solenoid is spring loaded to return the fuel injector pump to the "fuel off" position when de–energized.



1. Fuel Solenoid

Figure 8–17. Fuel Solenoid

These models make use of a three–lead fuel solenoid. This solenoid has a white lead (14P) which energizes the "pull–in" coil only during cranking. During the operation the red lead energizes the "hold" coil and the black lead is the common ground.

Current (Amps.) and resistance readings are shown in Table 8–1. Resistance readings can be taken to determine if the solenoid windings are open or shorted. These tests must be made with fuel solenoid disconnected from engine wiring harness.

Fuel Solenoid	Readings
"pull–in" (Black – White [14P])	50 Amps.
"hold" (Black – Red)	1.0 Amp.
Black–White (14P) leads	0.12–0.26 Ohms
Black–Red leads	11–13 Ohms

Table 8–1. Fuel Solenoid Readings

In addition to the ohmmeter and ammeter tests, check for smooth, non–binding movement of the plunger. It is important that the linkage between the fuel solenoid and the fuel injection pump lever be properly adjusted to allow the solenoid plunger to fully compress. Improper adjustment may cause burn–out of the "pull–in" coil.

If the fuel solenoid is removed or the setting is believed incorrect, readjust according to the following procedure. Do not modify solenoid linkage during reconnection.

1. Remove linkage to allow fuel solenoid plunger to be manually compressed.

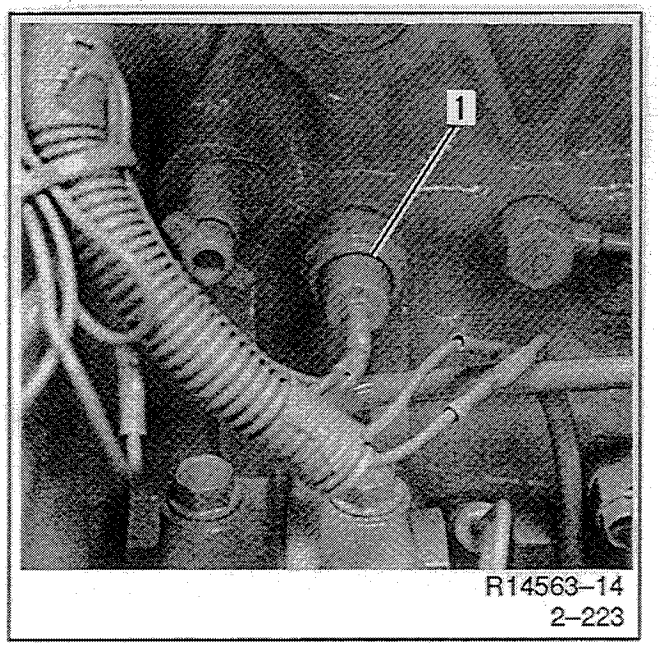
2. With fuel solenoid fully compressed, align linkage and check injection pump lever for travel. Fuel solenoid should fully compress and injection pump lever should be 1/16 in. (1.6 mm) before lever contacts (internal full open) stop.

3. If alignment is not correct, check linkage and mounting brackets. Loosen locknuts and adjust ball joint length in or out to attain proper alignment. Tighten locknuts.

ENGINE SAFETY SHUTDOWN SWITCHES

LOW OIL PRESSURE (LOP) SHUTDOWN

The low oil pressure (LOP) shutdown feature protects the engine against internal damage if the oil pressure drops below 7.1 psi (49 kPa) due to oil pump fault or other engine malfunction. The LOP shutdown does not protect the set from damage due to operating with oil level below the safe range — IT IS NOT A LOW OIL LEVEL SHUTDOWN. The only protection against running out of oil is to check the oil level regularly and add oil as needed. Location of the LOP shutdown switch is shown in Figure 8–18.



1. LOP Switch

Figure 8–18. Low Oil Pressure (LOP) Shutdown Switch

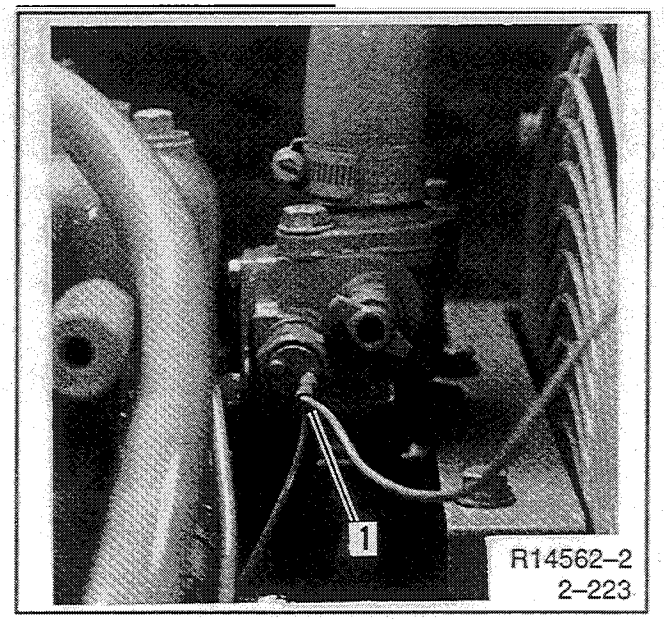
If unit shuts down, remove lead from LOP switch and insulate terminal on lead. Reset controller and attempt restart. A successful restart attempt indicates a faulty LOP shutdown switch.

NOTE

Verify proper engine oil pressure before performing test and/or replacing LOP shutdown switch.

HIGH ENGINE TEMPERATURE (HET) SHUTDOWN

The engine will automatically shut down after the engine temperature reaches 230° F (110° C). Fault shutdown time delay is dependent upon generator controller – refer to Section 2. Operation, Fault Shutdowns (Relay Controller) or Fault Shutdowns (5 Light Controller) for specific information on fault shutdown time delays. The engine cannot be restarted until the cause of the shutdown has been corrected (or the engine has cooled) and the controller is reset. Location of the shutdown switch is shown in Figure 8–19. Location of HET switch may be on opposite side of thermostat housing when a water temperature sender is installed.



1. HET Switch

Figure 8–19. High Engine Temperature (HET) Shutdown Switch

NOTE

The High Engine Temperature (HET) shutdown is not a low coolant level switch. Engine coolant level must be maintained for the HET shutdown switch to function.

If unit shuts down, remove lead from HET switch and insulate terminal on lead. Reset controller and attempt restart. A successful restart attempt indicates a faulty HET shutdown switch.

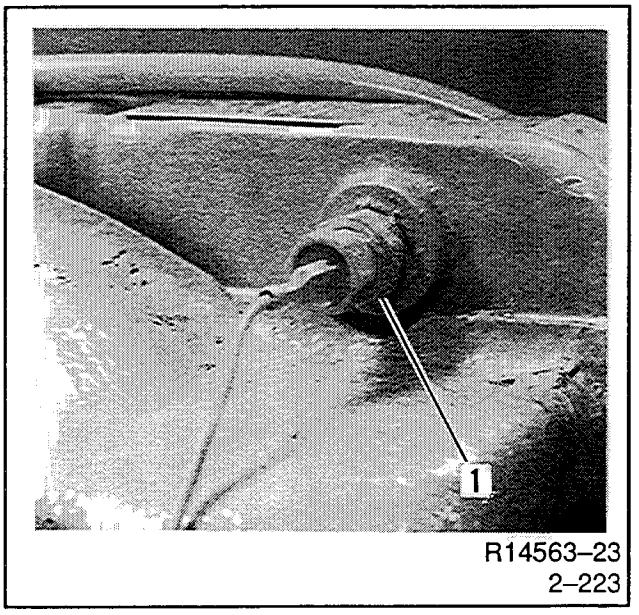
NOTE

Verify proper engine coolant level, water pump belt tension, and operating temperature of 175–195° F (77–91° C) before performing test and/or replacing HET shutdown switch.

LOW WATER LEVEL (LWL) SHUTDOWN SENSOR

If the engine water (coolant) level falls below the "safe" range in the radiator the generator will automatically shut down. The generator set will not run until coolant is added to reach the specified level and the controller is reset. Location of the low coolant level shutdown sensor is shown in Figure 8–20a or Figure 8–20b. Refer to Section 2. Operation, Fault Shutdowns (Relay Controller) or Fault Shutdowns (5 Light Controller) for specific information on fault shutdown time delays.

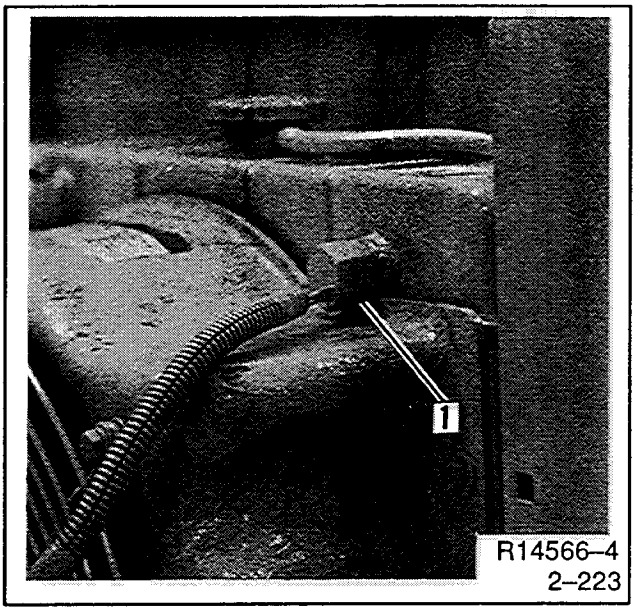
The relay controller models make use of a single terminal sensor which provides a low resistance connection to ground when water (coolant is not present at the tip. The sensor will provide a high resistance connection to ground when water (coolant) is present at the tip of the sensor.



1. LWL Sensor

Figure 8–20a. Low Water Level (LWL) Shutdown Sensor (Relay Controller)

The 5 light microprocessor controller models make use of a three lead sensor. The red lead connects to battery positive and the black lead connects to battery negative when the unit is running. The blue lead provides a connection to ground when water (coolant) is not present at the tip. The sensor is *open* when water (coolant) is present at the tip of the sensor.



1. LWL Sensor

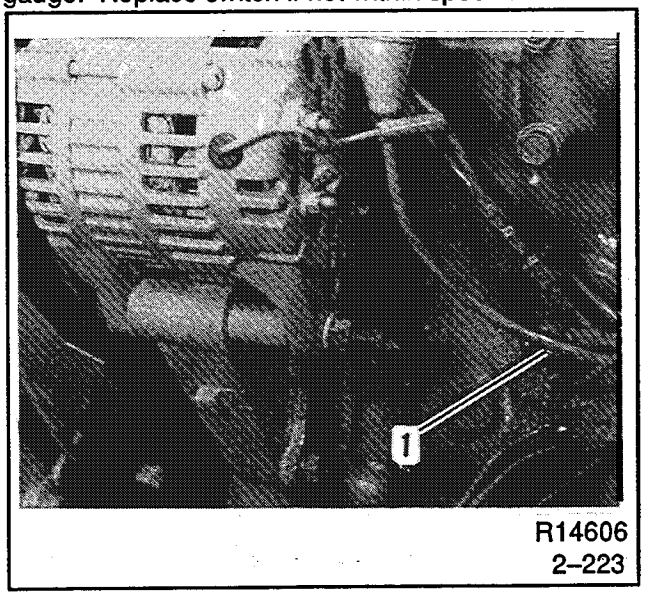
Figure 8–20b. Low Water Level (LWL) Shutdown Sensor (5 Light Microprocessor Controller)

PRE–ALARM SWITCHES (OPTIONAL)

The pre–alarms or anticipatory alarms are only available as an option with generator sets equipped with the 5 light microprocessor controller and (optional) remote annunciator. The alarms will provide a visual alert of approaching shutdown conditions on the remote annunciator. The pre–alarm switches will NOT shut down the unit.

ANTICIPATORY LOW WATER TEMPERATURE SWITCH

The anticipatory low water temperature switch (see Figure 8–21) closes when temperatures fall below 60° F (16° C) +/–5° F (3° C). The switch opens when temperatures rise above 80° F (16° C) +/–5° F (3° C). This switch warns of impending low water temperatures which indicate possible problems with cold weather starting. The causes for this switch to close include failure of the block heater or block heater power turned off. If remote annunciator lamp is ON and the switch is suspected to be defective, check function of switch with specifications given using controller water temperature gauge. Replace switch if not within specifications.

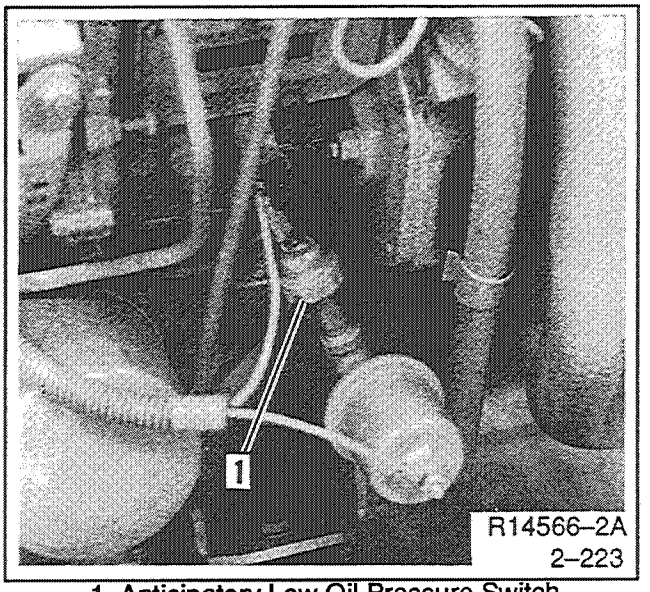


1. Anticipatory Low Water Temp. Switch

Figure 8–21. Anticipatory Low Water Temperature Switch

ANTICIPATORY LOW OIL PRESSURE SWITCH

The anticipatory low oil pressure switch (see Figure 8–22) closes when oil pressure drops below 8 psi (55 kPa). This switch warns of impending low oil pressure which indicate possible lubrication problem. The causes for this switch to close include failure of the oil pump, inadequate oil level, improper oil viscosity, or oil change interval neglect. If remote annunciator lamp is ON and the switch is suspected to be defective, check function of switch with specifications given using controller oil pressure gauge or a separate mechanical oil pressure gauge. Replace switch if not within specifications.

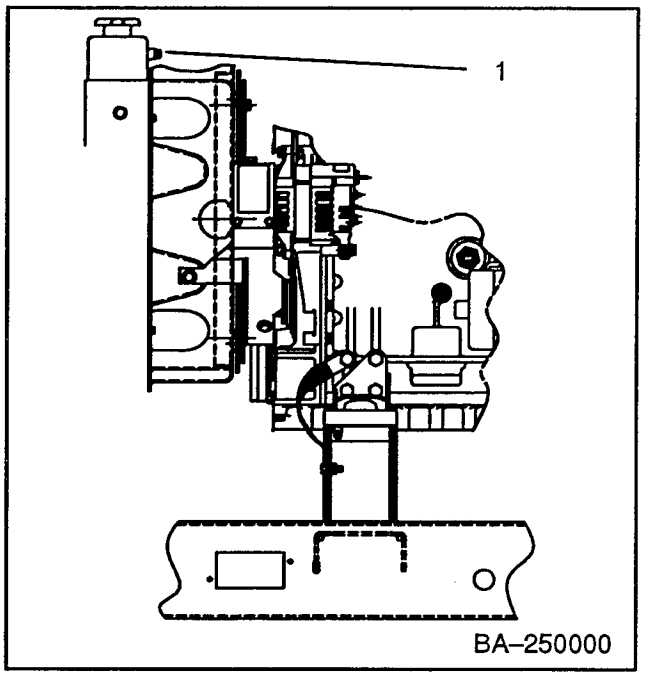


1. Anticipatory Low Oil Pressure Switch

Figure 8–22. Anticipatory Low Oil Pressure Switch

ANTICIPATORY HIGH ENGINE TEMPERATURE SWITCH

The anticipatory high engine temperature switch (see Figure 8–23) closes when temperatures rise above 218° F (103° C) +/–7° F (4° C). This switch warns of impending high engine temperatures which indicate possible problems with engine overheating. The causes for this switch to close include thermostat failure, air inlet blockage, inadequate lubrication, cooling system blockage, improper engine timing, etc. If remote annunciator lamp is ON and the switch is suspected to be defective, check function of switch with specifications given using controller water temperature gauge. Replace switch if not within specifications.



1. Anticipatory High Engine Temp. Switch

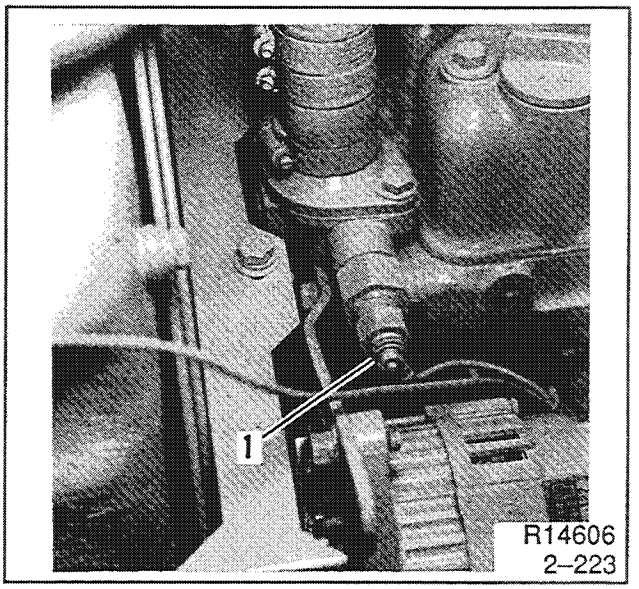
Figure 8–23. Anticipatory High Engine Temperature Switch

METER SENDERS (OPTIONAL)

Some generators may be equipped with water temperature and oil pressure senders to activate controller–mounted meters.

WATER TEMPERATURE SENDER

To test the water temperature sender, connect one ohmmeter lead to the sender terminal and the other ohmmeter lead to ground. See Figure 8–24 for sender location and the chart below for sender resistance at different water temperatures. Start the generator set and check the sender resistance. As water temperature increases, a corresponding change in sender resistance should occur. Replace the sender if resistance readings vary greatly from those shown. Generally, a sender can be presumed good if the sender resistance value changes with temperature. A defective sender will either test open (no reading) or shorted (continuity).



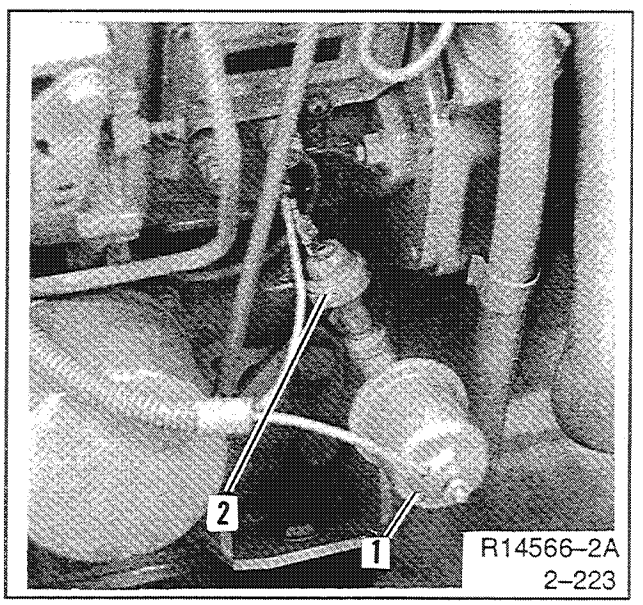
1. Water Temperature Sender

Figure 8–24. Water Temperature Sender Location

Temperature	Resistance +/–10%
100°F (38°C)	450 ohms
160°F (71°C)	130 ohms
220°F (104°C)	47 ohms

OIL PRESSURE SENDER

To test the oil pressure sender, connect one ohmmeter lead to the sender terminal and the other ohmmeter lead to ground. See Figure 8–25 for sender location and the chart below for resistance of the oil pressure sender at different pressure levels. Start the generator set and check the sender resistance. As oil pressure increases, a corresponding change in sender resistance should occur. Replace the sender if resistance readings vary greatly from those shown. Generally, a sender can be presumed good if the sender resistance value changes with pressure. A defective sender will either test open (no ohmmeter reading) or shorted (continuity).



1. Oil Pressure Sender
2. Anticipatory Low Oil Pressure Switch

Figure 8–25. Oil Pressure Sender Location

Oil Pressure	Resistance
0 psi/kPa	227–257 ohms
25 psi (172 kPa)	138–162 ohms
50 psi (345 kPa)	92–114 ohms
75 psi (517 kPa)	50–80 ohms
100 psi (690 kPa)	21–50 ohms

WATER SOLENOID (OPTIONAL CITY WATER COOLING)

If unit uses city water cooling, a water solenoid is incorporated in the system. See Figure 8–26. This water solenoid opens when the generator sets is running to provide cooling water. When the generator set is shut down, the water solenoid closes and shuts off the utility water supply. The water solenoid has two red leads and one green lead. The red leads connect to 12 Volt DC supply. The red leads can be connected to positive and negative either way as polarity is not a consideration. The green lead connects to the negative ground and is the safety ground.

Should failure of this valve be suspected, check for 12 Volts DC at red lead connected to the battery positive lead (70). If the water solenoid fails to open when 12 Volts DC is applied, replace the water solenoid.

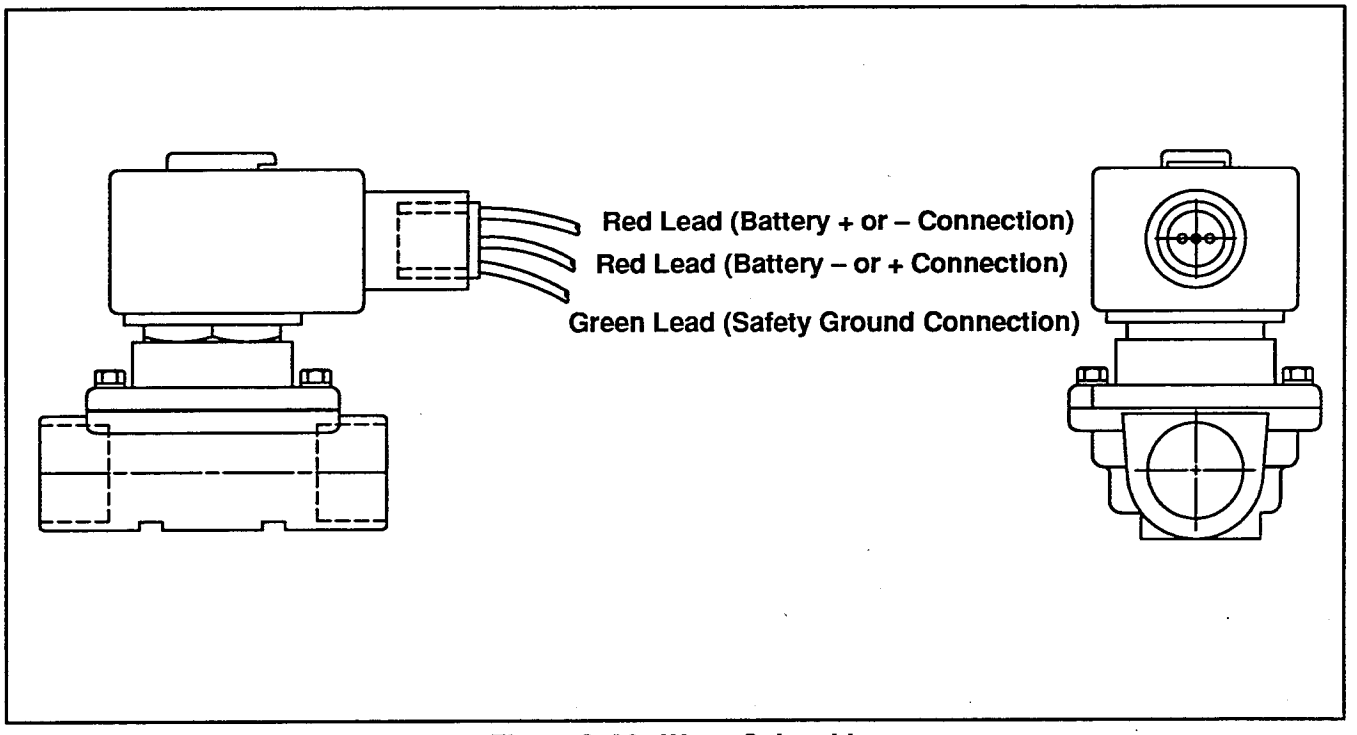
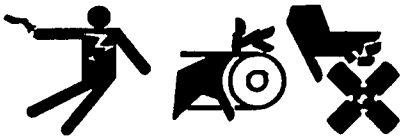


Figure 8–26. Water Solenoid

Section 9. Disassembly/Reassembly

Prior to disassembly, the generator set must be removed from the enclosure, if used. Disconnect battery (negative lead first), fuel line, exhaust system, remote switch, and load leads. In addition to the precautions included in the text, observe all safety precautions listed at the beginning of this manual during the disassembly/reassembly procedure.

⚠ WARNING



Accidental starting.
Can cause severe injury or death.

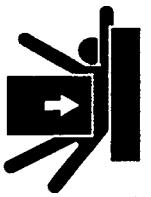
Disconnect battery cables before working on generator set (negative lead first and reconnect it last).

Accidental starting can cause severe injury or death. Turn Generator Master Switch to OFF position, disconnect power to battery charger, and remove battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator. The generator set can be started by automatic transfer switch or remote start/stop switch unless these precautions are followed.

Flying projectiles can cause severe injury or death. Retorque all crankshaft and rotor hardware after servicing. When making adjustments or servicing generator set, do not loosen crankshaft hardware or rotor thru-bolt. If rotating crankshaft manually, direction should be clockwise only. Turning crankshaft bolt or rotor thru-bolt counterclockwise can loosen hardware and result in serious personal injury from hardware or pulley flying off engine while unit is running.

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

⚠ WARNING



Unbalanced weight.
Improper lift can cause severe injury, death, or equipment damage.

Do not use lifting eyes.
Use lifting bars thru holes in skid to lift set.

⚠ WARNING

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

Do not work on generator set until unit is allowed to cool.

NOTE

HARDWARE DAMAGE! Engine and generator may make use of both American Standard and metric hardware. Be sure to use the correct size tools to prevent rounding of bolt heads and nuts.

NOTE

When replacing hardware, do not substitute with inferior grade hardware. Screws and nuts are available in different hardness ratings. American Standard hardware uses a series of markings and metric hardware uses a numeric system to indicate hardness. Check markings on bolt head and nuts for proper identification.

NOTE

Several models are covered in this manual and the procedure for disassembly/reassembly may vary due to product updates and assembly variations. Major differences are noted where appropriate. The model illustrated is a 6ROZ.

DISASSEMBLY

1. Disconnect battery, negative lead first.
2. Remove nine screws securing junction box rear panel and remove panel. See Figure 9–1.

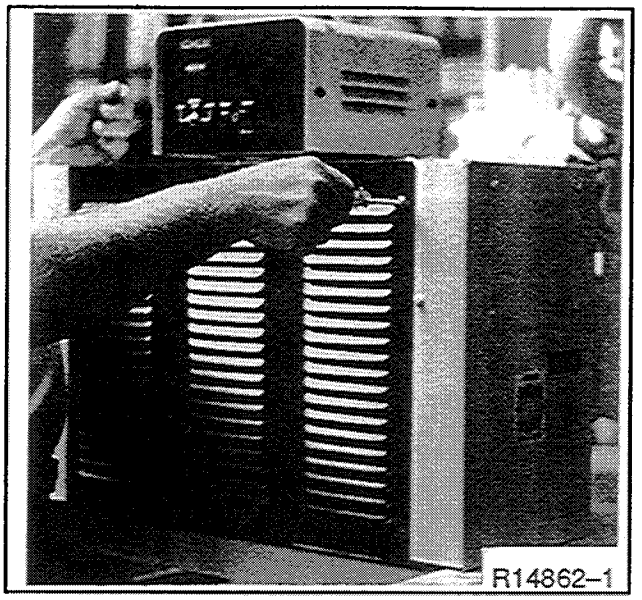


Figure 9–1. Removing Junction Box Rear Panel

3. Remove four screws on junction box and remove side panel, see Figure 9–2. This side panel allows access to the voltage regulator, see Figure 9–3.

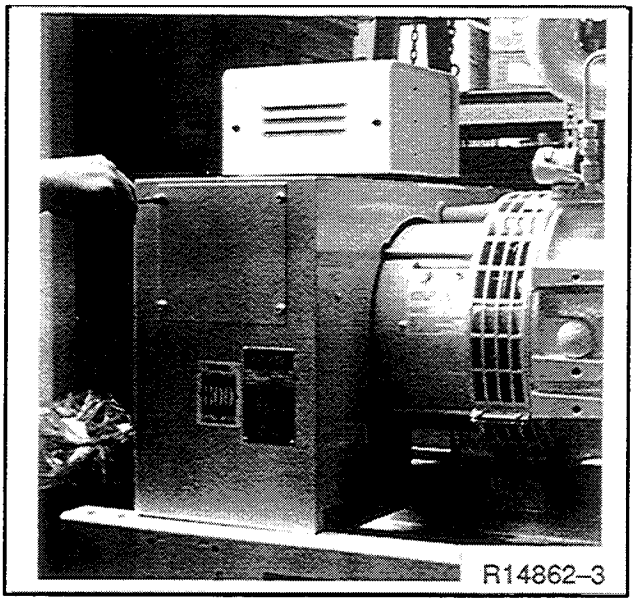


Figure 9–2. Removing Junction Box Side Panel

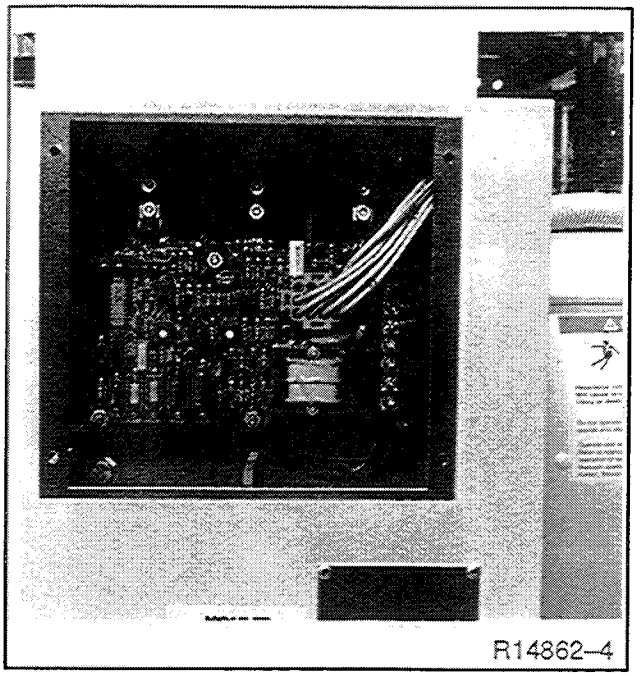


Figure 9–3. Voltage Regulator

4. Remove four mounting screws securing controller cover and remove cover. See Figure 9–4.

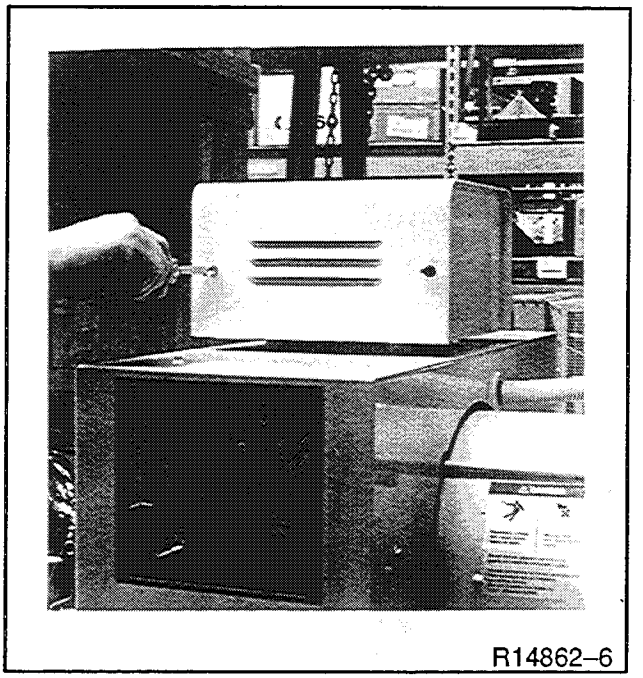


Figure 9–4. Removing Controller Cover

5. Remove four screws attaching end bracket panel and remove panel. See Figure 9–5.

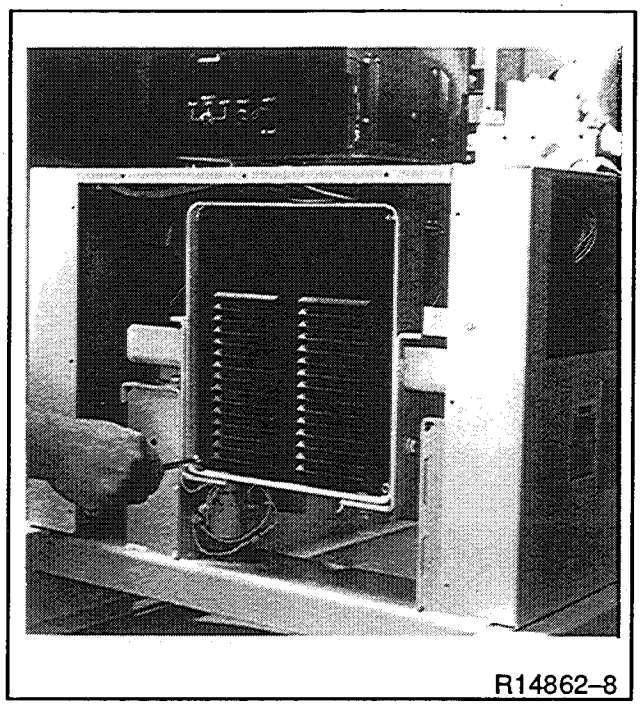


Figure 9–5. End Bracket Panel

6. Disconnect the following leads to allow removal of the junction box. Mark leads, as necessary, for reassembly.

   Disconnect stator leads V0, V7, V8, and V9 in controller at terminal strip. Cut cable tie to release stator leads and leads FP and FN in junction box. Disconnect leads FP and FN from terminal strip in junction box and remove leads from end bracket hole. Disconnect stator leads 55 and 66 at voltage regulator.

   Disconnect leads from magnetic pickup. Note order of leads: black, red, and white (top to bottom). See Figure 9–6. Remove lead from end bracket hole. Disconnect all leads to starter solenoid, see Figure 9–7.

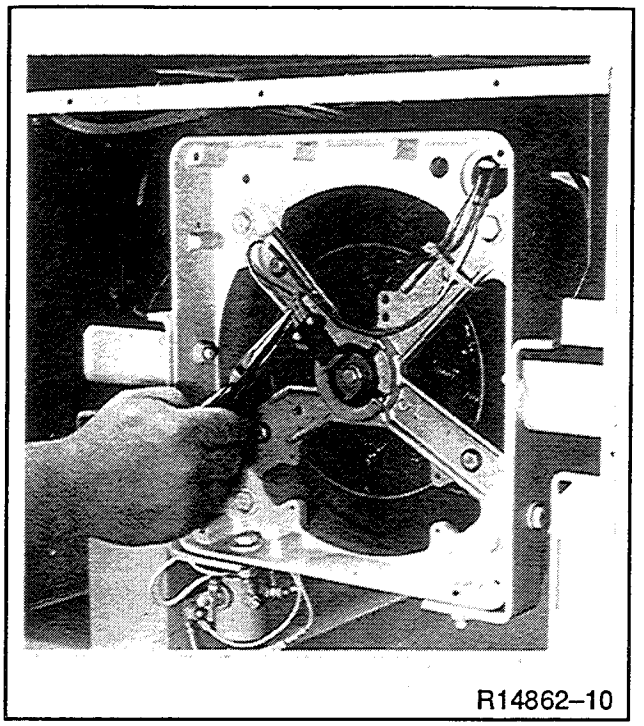


Figure 9–6. Magnetic Pick–up Leads

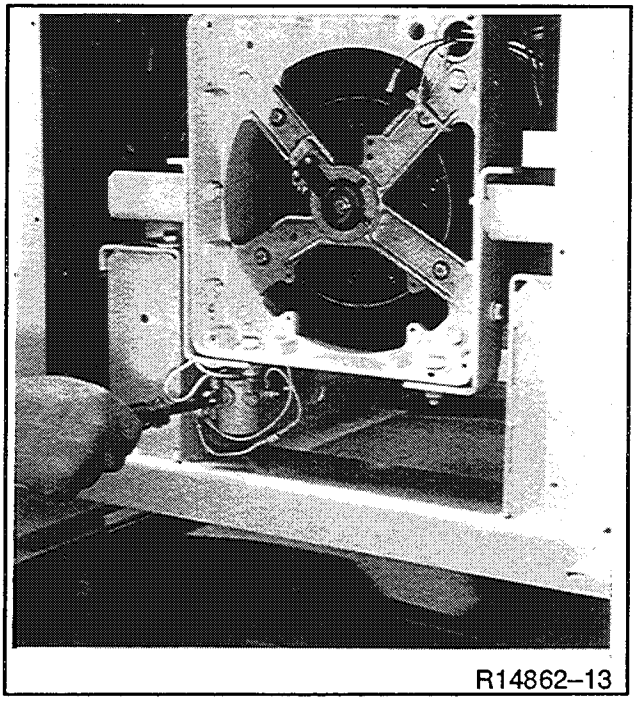


Figure 9–7. Removing Starter Solenoid Leads

7. Remove four screws, flat washers, and nuts attaching junction box to generator skid. See Figure 9–8.

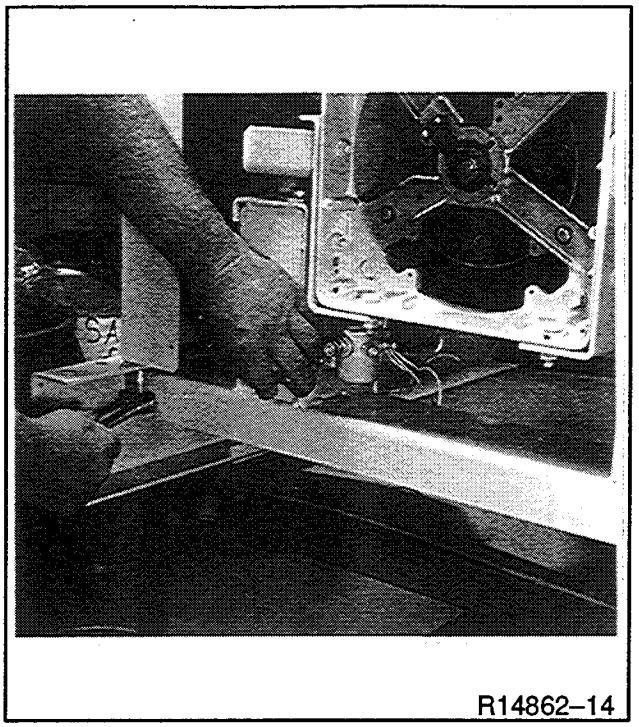


Figure 9–8. Removing Junction Box

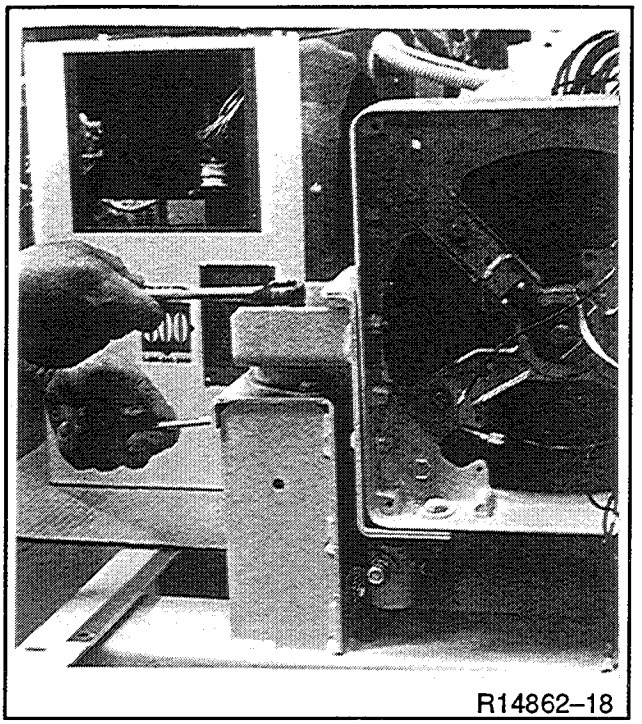


Figure 9–9. Removing Vibromounts

8. Move junction box and controller assembly from generator skid and place to the left–hand side of the generator set.

9. Remove vibromount hardware which consists of a small flat washer under the bolt head and a large flat washer at the lock nut end. See Figure 9–9.

10. With vibromount hardware removed, use a hoist with sling around stator and raise generator end high enough to place a wood block under flywheel housing. Wood block should be rest on skid rails. Lower hoist so that generator rests on wood block. Remove hoist and sling. See Figure 9–10.

NOTE

Hoist capacity should be rated at 1/2 ton or greater.

11. Remove four overbolts and hardened washers securing end bracket to generator adapter, see Figure 9–11.

12. With overbolts removed, use a soft–faced hammer to remove end bracket and exciter field assembly from stator. See Figure 9–12. Use light force blows in a rotating sequence to remove end bracket.

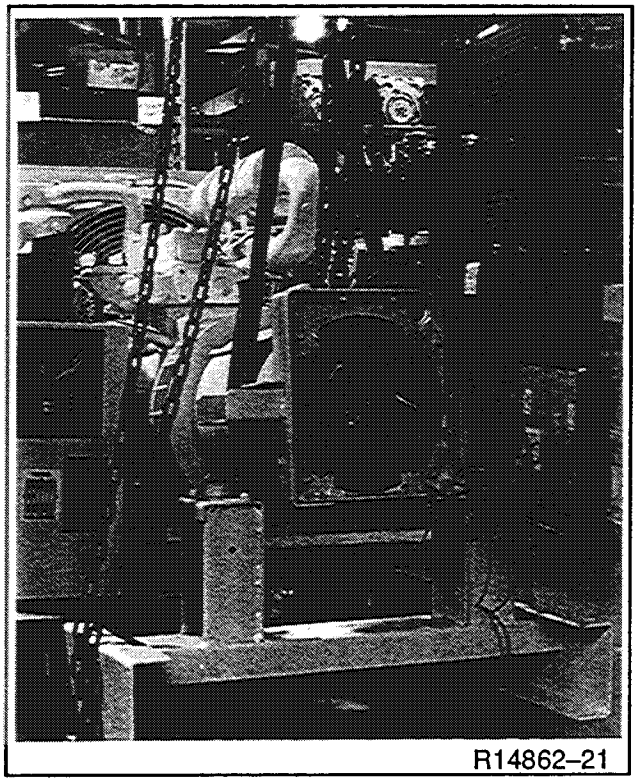


Figure 9–10. Hoisting Generator

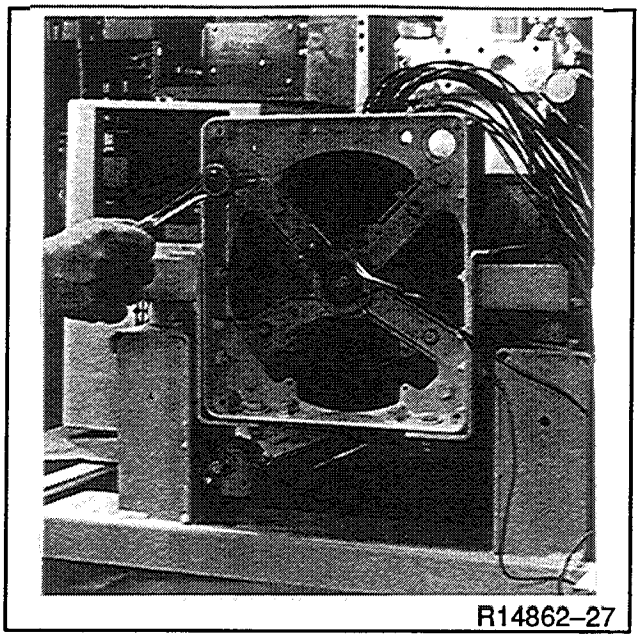


Figure 9–11. Removing Overbolts

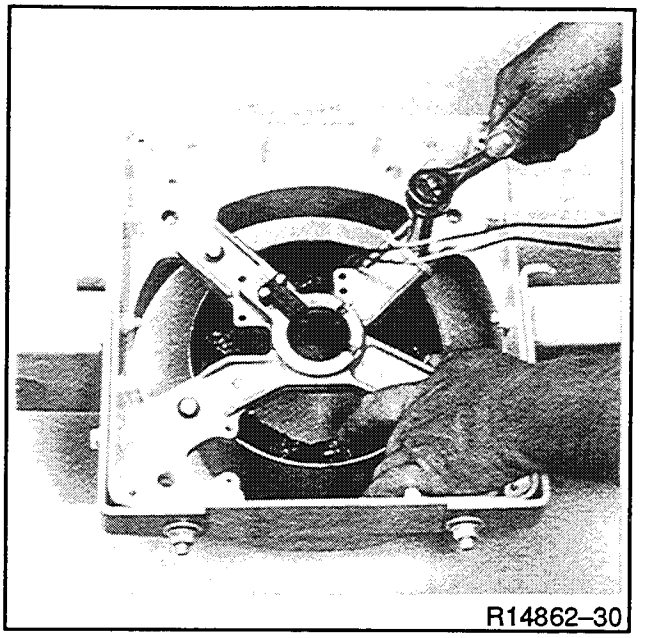


Figure 9–13. Removing Exciter Field

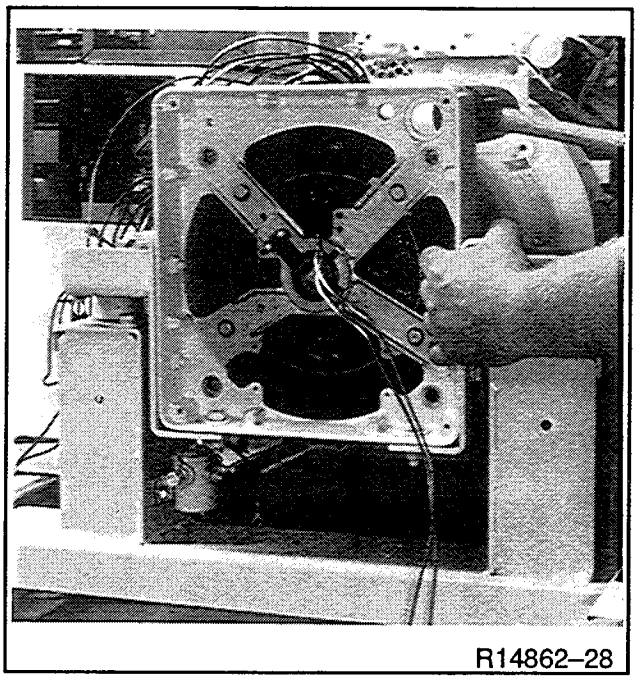


Figure 9–12. Removing End Bracket

13. Remove four screws and hardened washers to remove exciter field from end bracket, see Figure 9–13.

14. Place hoist with sling over stator and gently slide stator over rotor being careful to avoid damaging rotor and/or stator. See Figure 9–14.

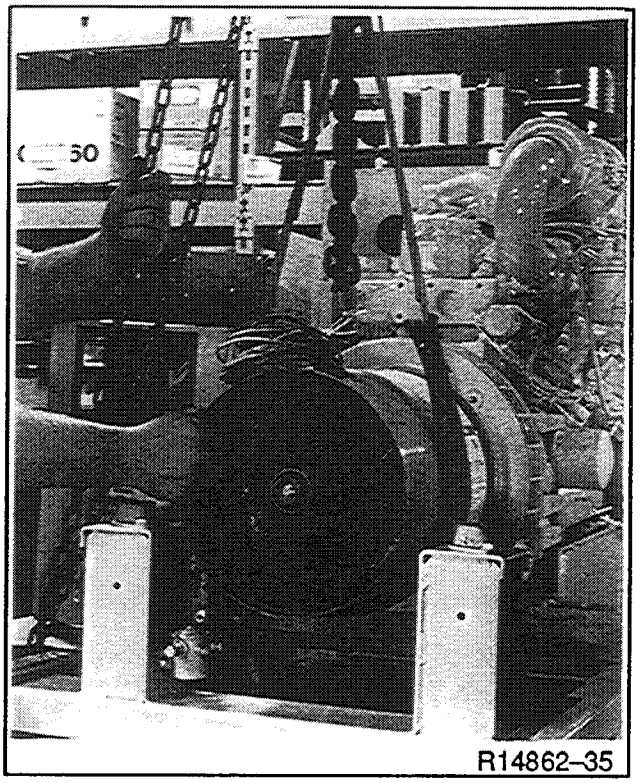


Figure 9–14. Removing Stator

NOTE

Due to the weight of stator, it is recommended that it be placed in a hoist sling during removal to prevent damage to stator and/or rotor.

15. Remove two screws securing fan guard on generator adapter. See Figure 9–15.

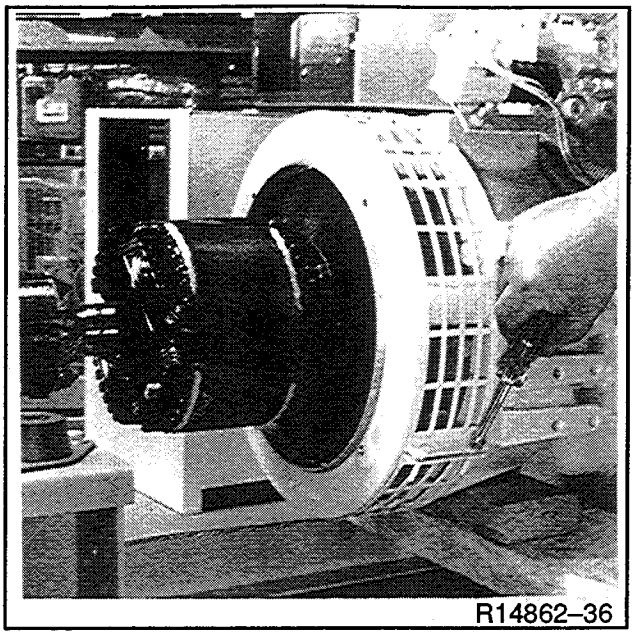


Figure 9–15. Removing Fan Guard

16. Remove four screws and flat washers attaching generator adapter to flywheel housing. See Figure 9–16.

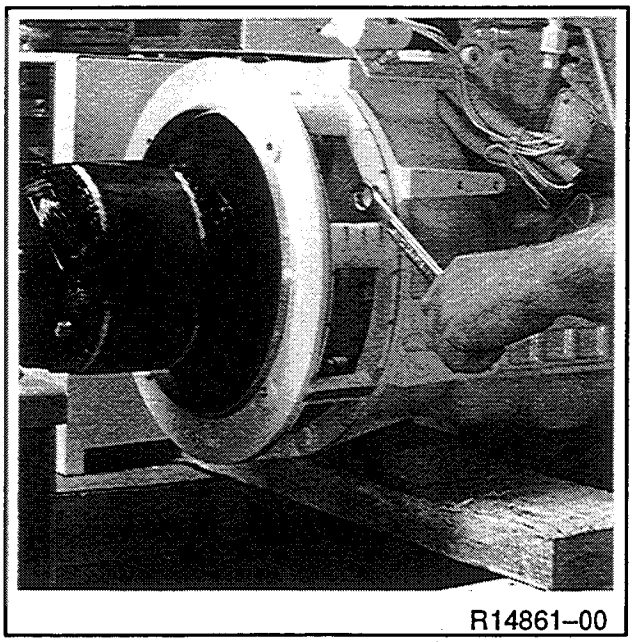


Figure 9–16. Removing Generator Adapter

17. Support rotor assembly using a hoist with sling on rotor or place wood block(s) underneath rotor. **6ROZ/RFOZ and 10ROZ/RFOZ Models:** Remove eight screws and spacers attaching rotor/flex discs to flywheel. See Figure 9–17. **15ROZ/RFOZ Models:** Remove eight nuts and spacers attaching rotor/flex discs to flywheel.

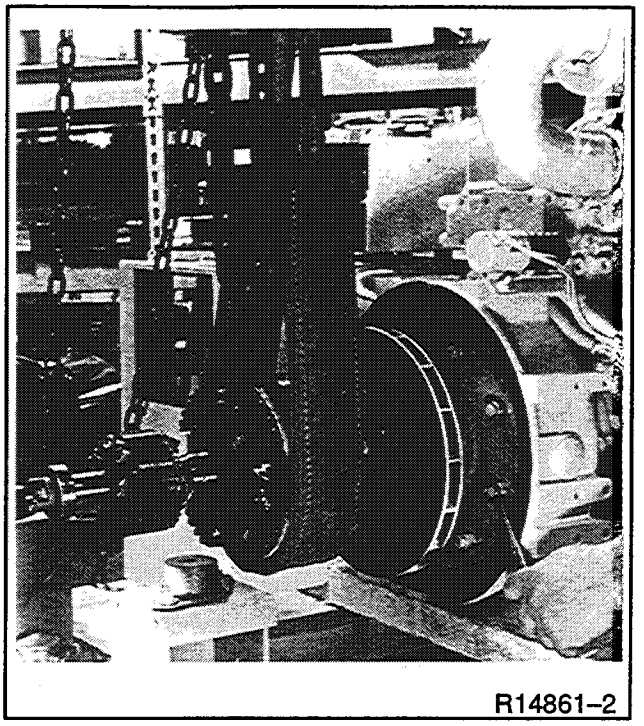


Figure 9–17. Removing Rotor

18. Remove eight screws to detach flex discs (2) from rotor. See Figure 9–18.

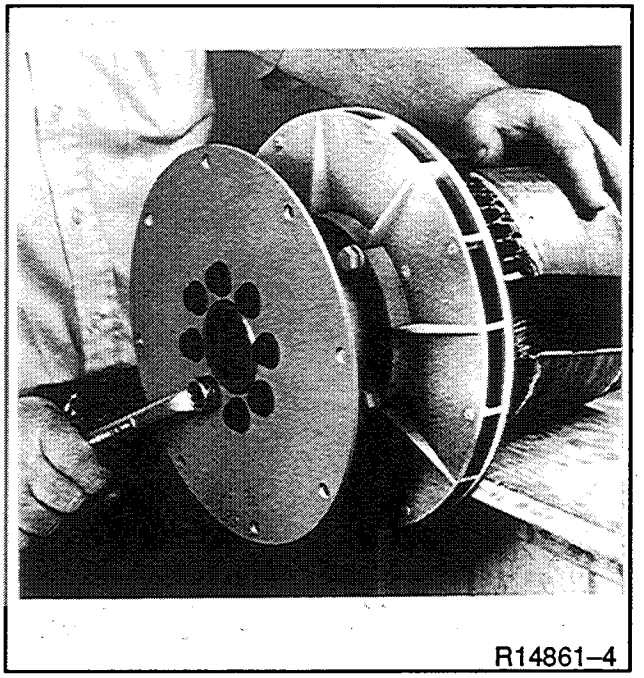


Figure 9–18. Removing Flex Discs (2)

19. Remove rotor fan by removing four screws and flat washers.

20. Remove magnetic pickup actuator by removing one screw and flat washer, see Figure 9–19.

Figure 9–19. Removing Magnetic Pickup Actuator

REASSEMBLY

1. Reinstall magnetic pickup actuator using one screw and flat washer. Torque screw to 8 ft. lbs. (11 Nm).

2. Attach rotor fan to rotor using four screws. Torque screws to 18 ft. lbs. (24 Nm).

3. Install drive discs (2) to rotor using eight screws. Torque screws to 45 ft. lbs. (61 Nm).

4. Support rotor assembly using a hoist with sling on rotor or place wood blocks beneath rotor.

   6ROZ/RFOZ and 10ROZ/RFOZ Models: Secure rotor/drive discs (2) to flywheel with eight bolts and spacers. Torque bolts to 14 ft. lbs. (19 Nm).

   15ROZ/RFOZ Models: Secure drive discs (2) to flywheel with eight nuts and spacers. Torque nuts to 14 ft. lbs. (19 Nm).

5. Install generator adapter to flywheel housing using four screws and flat washers.

   Torque screws to 27 ft. lbs. (37 Nm) on **6ROZ/RFOZ and 10ROZ/RFOZ models.**

   Torque screws to 25 ft. lbs. (34 Nm) on **15ROZ/RFOZ models.**

6. Install fan guard to generator adapter using two screws.

7. Using a hoist with sling or wood blocks to support stator, gently slide stator over rotor and onto generator adapter lip. Stator leads should be to the top.

8. Attach exciter field to end bracket using four screws and hardened washers. Torque bolts to 8 ft. lbs. (11 Nm).

9. Place end bracket/exciter field assembly onto rotor bearing. Align end bracket on stator assembly and rotor bearing.

NOTE

Do NOT attempt to install end bracket to rotor by tightening overbolts. Damage to end bracket and/or generator adapter may result.

NOTE

No lubricant should be used during assembly.

Check that stator shell notches (if used) are to the top and end bracket is properly aligned. Proper alignment of these components is critical for complete assembly of generator set.

Using a hard rubber or dead blow hammer alternately strike end bracket using medium force blows. Use the rotating sequence shown in Figure 9–20 to install end bracket.

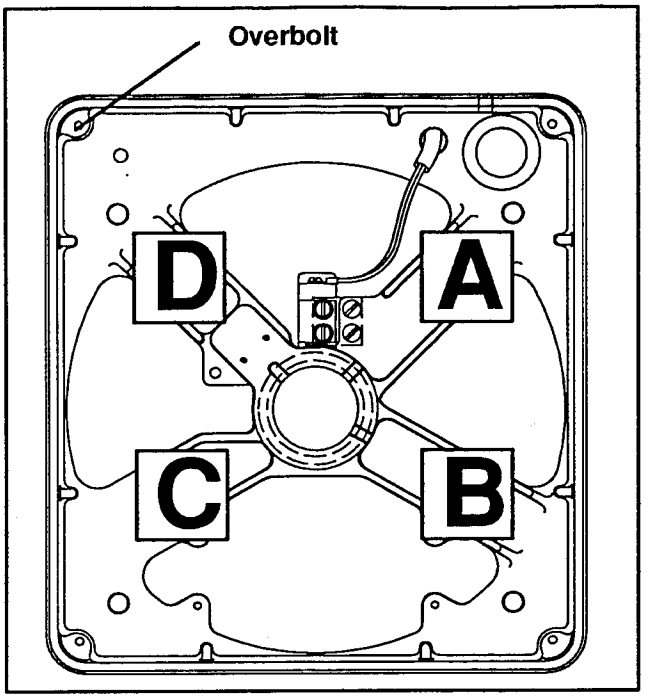


Figure 9–20. Installing End Bracket

10. When end bracket is completely installed in stator assembly, install overbolts and hardened flat washers. Torque overbolts to 216 in. lbs. (24 Nm).

11. Check and adjust magnetic pick–up to actuator air gap. Actuator should be positioned so that raised portion is directly aligned with magnetic pick–up. Air gap should be 0.030 in. (0.76 mm) +/– 0.010 in. (0.25 mm). Rotate actuator 180 degrees and recheck. Air gap should not be less than 0.020 in. (0.051 mm) at the closer end. To adjust, loosen the two magnetic pick–up mounting screws and slide magnetic pick–up (inward or outward) to obtain the proper specification. Tighten magnetic pick–up screws.

12. Raise generator end with hoist, remove wood block, and lower until end bracket assembly rest on vibromounts. Install vibromount hardware as follows: place the small flat washer onto bolt and install into end bracket assembly first and then through vibromount. Place large flat washer on the bolt at the underside of vibromount bracket and secure with lock nut.

13. Relocate junction box and controller assembly over end bracket and generator skid. Secure with four screws, flat washers, and nuts.

14. Reconnect generator leads. Reference the proper wiring diagram. See Section 11. Wiring Diagrams.

    Reconnection of stator leads is dependant upon desired voltage configuration. Use notes taken during disassembly if no changes are required. Otherwise, reference Section 10. Generator Reconnection and Section 11. Wiring Diagrams for further information.

    Reconnect stator leads V0, V7, V8 and V9 to terminal strip in controller. Place leads FP and FN through hole in end bracket and connect to terminal strip in junction box. Reconnect stator leads 55 and 66 to voltage regulator.

15. Reconnect magnetic pick–up leads. Black, red, and white to top (–), middle (+), and bottom (0) terminals respectively.

16. Reconnect leads to starter solenoid. Lead 14S to left–side large terminal. Leads 14P and P to right–side large terminal. Lead 71 to small terminal with diode connected.

17. Install end bracket panel to end bracket using four screws.

18. Relocate controller cover and fasten using four screws.

19. Attach junction box side panel using four screws.

20. Attach junction box rear panel using nine screws.

21. Reconnect all external connections (except battery). They include fuel line, exhaust system, remote switch, and load leads. Reconnect battery, negative lead last.

    Reinstall enclosure, if applicable.

Section 10. Generator Reconnection

The generator may be reconnected to supply a different output voltage than listed on the generator nameplate. Refer to the reconnection procedure that applies to your generator set. Observe the following safety precautions during the reconnection procedure.

⚠ WARNING

Hazardous voltage.

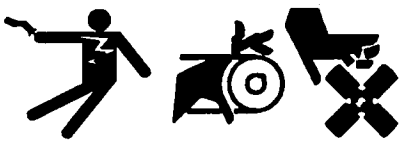
Moving rotor.

Can cause severe injury or death.

Do not operate generator set without all guards and electrical enclosures in place.

Hazardous voltage can cause severe injury or death. Perform electrical service only as prescribed in equipment manual. Be sure that generator is properly grounded. Never touch electrical leads or appliances with wet hands, when standing in water, or on wet ground as the chance of electrocution is especially prevalent under such conditions. Wiring should be inspected at the interval recommended in the service schedule — replace leads that are frayed or in poor condition. The function of a generator set is to produce electricity and wherever electricity is present, there is the hazard of electrocution.

⚠ WARNING



Accidental starting.
Can cause severe injury or death.

Disconnect battery cables before working on generator set (negative lead first and reconnect it last).

Accidental starting can cause severe injury or death. Turn Generator Master Switch to OFF position, disconnect power to battery charger, and remove battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator. The generator set can be started by automatic transfer switch or remote start/stop switch unless these precautions are followed.

12–LEAD RECONNECTABLE GENERATOR SETS

All 12–lead generators can be reconnected to the voltages and phases shown in Figure 10–1. If the set is reconnected to operate at a different voltage, adjust the governor as necessary to achieve an engine speed of 1800 rpm (60 Hz voltages) or 1500 rpm (50 Hz voltages). See Section 3, "Governor" for additional information on governor adjustment. Voltage regulator adjustment may also be required to achieve rated voltage. Observe the following safety precautions during generator reconnection and adjustment.

NOTE

If generator is reconnected to a voltage different than nameplate rating, new voltage should be recorded on the generator set. Voltage change decals for this purpose are available from Kohler Service Parts.

⚠ WARNING

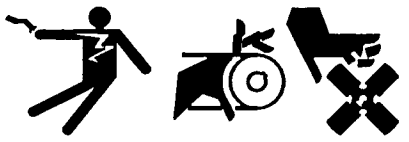
Hazardous voltage.

Moving rotor.

Can cause severe injury or death.

Do not operate generator set without all guards and electrical enclosures in place.

⚠ WARNING



Accidental starting.
Can cause severe injury or death.

Disconnect battery cables before working on generator set (negative lead first and reconnect it last).

Accidental starting can cause severe injury or death. Turn Generator Master Switch to OFF position, disconnect power to battery charger, and remove battery cables (remove negative lead first and reconnect it last) to disable generator set before working on any equipment connected to generator. The generator set can be started by automatic transfer switch or remote start/stop switch unless these precautions are followed.

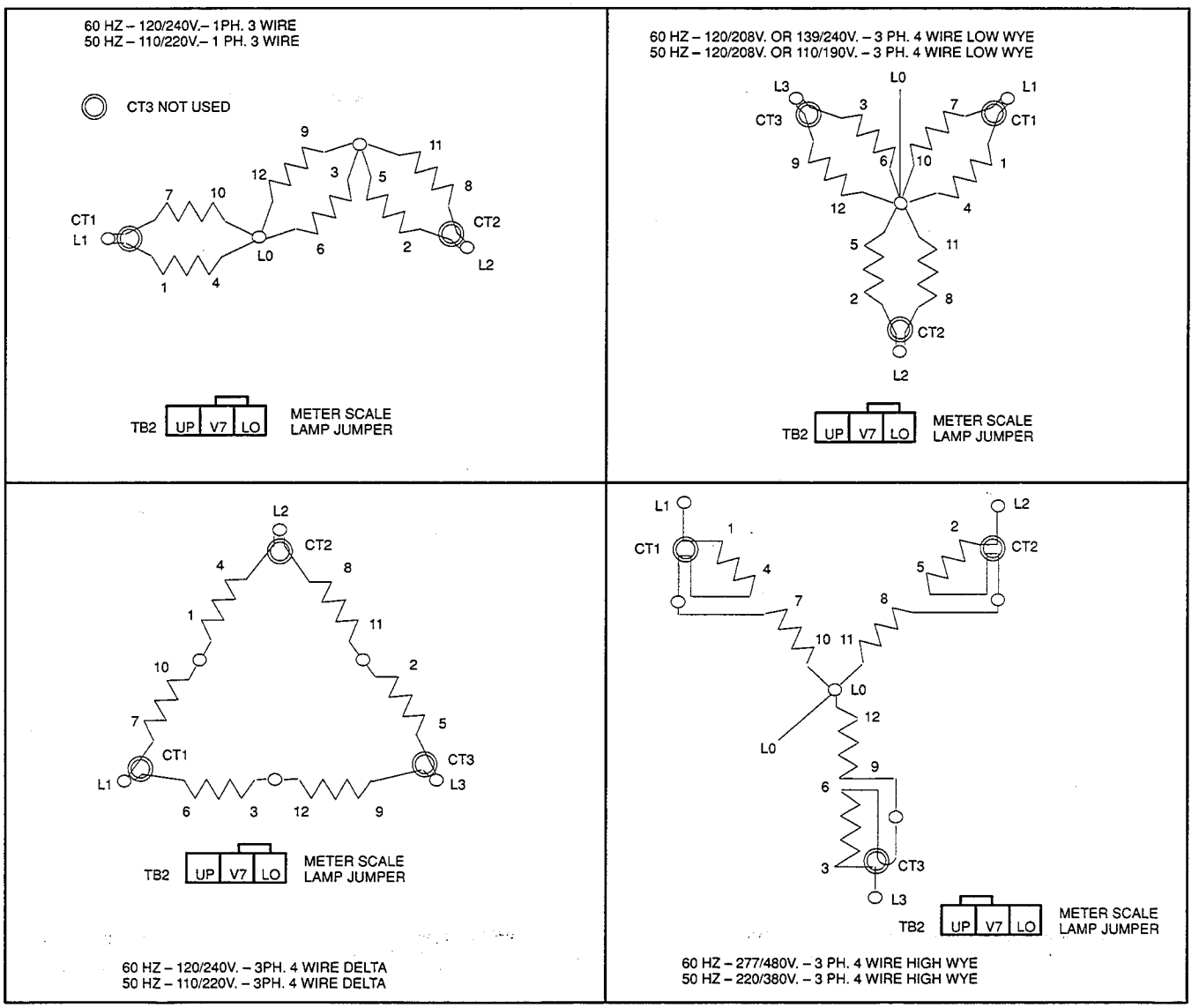


Figure 10–1. 12–Lead Generator Reconnection

12–LEAD RECONNECTION PROCEDURE

NOTE

All 12–lead, three–phase generator sets will derate substantially if reconnected for single–phase voltages. Contact the factory for specific derate information.

1. STOP generator set by moving remote or controller master switch to OFF/RESET.

2. Disconnect engine starting battery, negative (–) lead first. Disconnect power to battery charger (if equipped).

3. Select desired voltage connection from Figure 10–1 and connect leads according to the diagram for the desired phase and voltage.

   Route output leads through current transformers **(5 light controllers only)**

NOTE

Current transformers CT1, CT2, and CT3 should be positioned with "dot" or "HI" mark toward generator set. Current transformers are only used on generator sets equipped with **5 light controllers**.

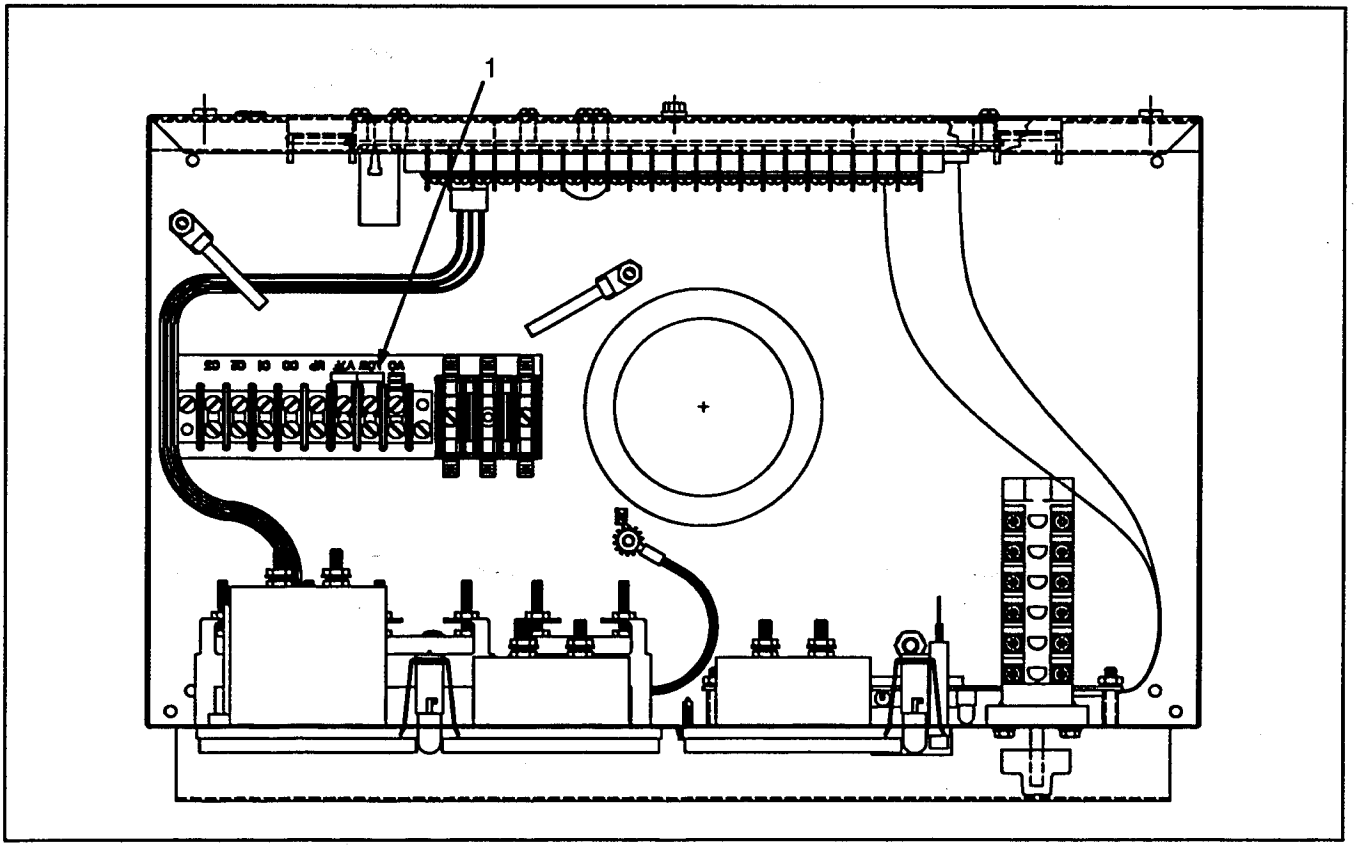
NOTE

Line circuit breakers, transfer switch, and all other accessories must be properly sized for the voltage selected.

4. If generator set is equipped with a **5 light controller**, remove controller cover and reposition meter scale lamp jumper (see Figure 10–2), if necessary, to match meter scale lamps with desired voltage (as shown in Figure 10–1).

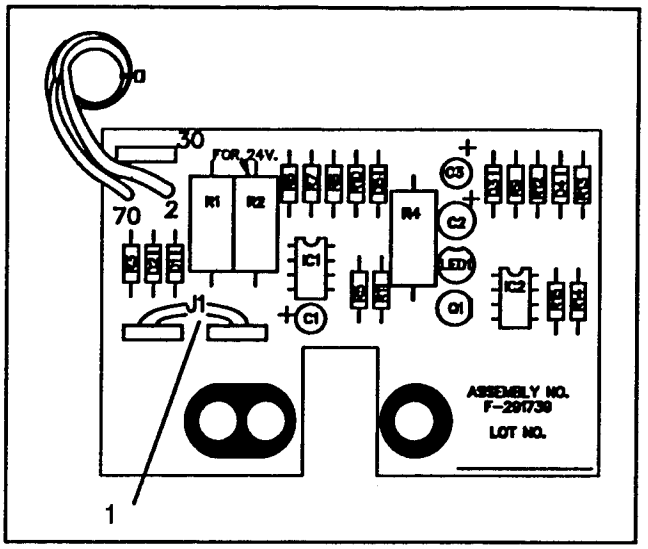
5. If generator set is equipped with the overvoltage kit **(5 light controllers only)**, the J1 jumper must be in place on the overvoltage circuit board if the generator set is connected to 139/240 or 277/480 Volts (3–phase, 4–wire, 60 Hz.). For all other voltages, remove the J1 jumper from the overvoltage circuit board. The overvoltage circuit board (if equipped) is located in the controller. See Figure 10–3 for J1 jumper location on overvoltage circuit board.

6. If the generator set is equipped with a **5 light controller**, turn the meter phase selector switch to the proper position for the desired voltage connection (single–phase or three–phase).



1. Lamp Jumper

Figure 10–2. Meter Scale Lamp Jumper (5 Light Controller only)



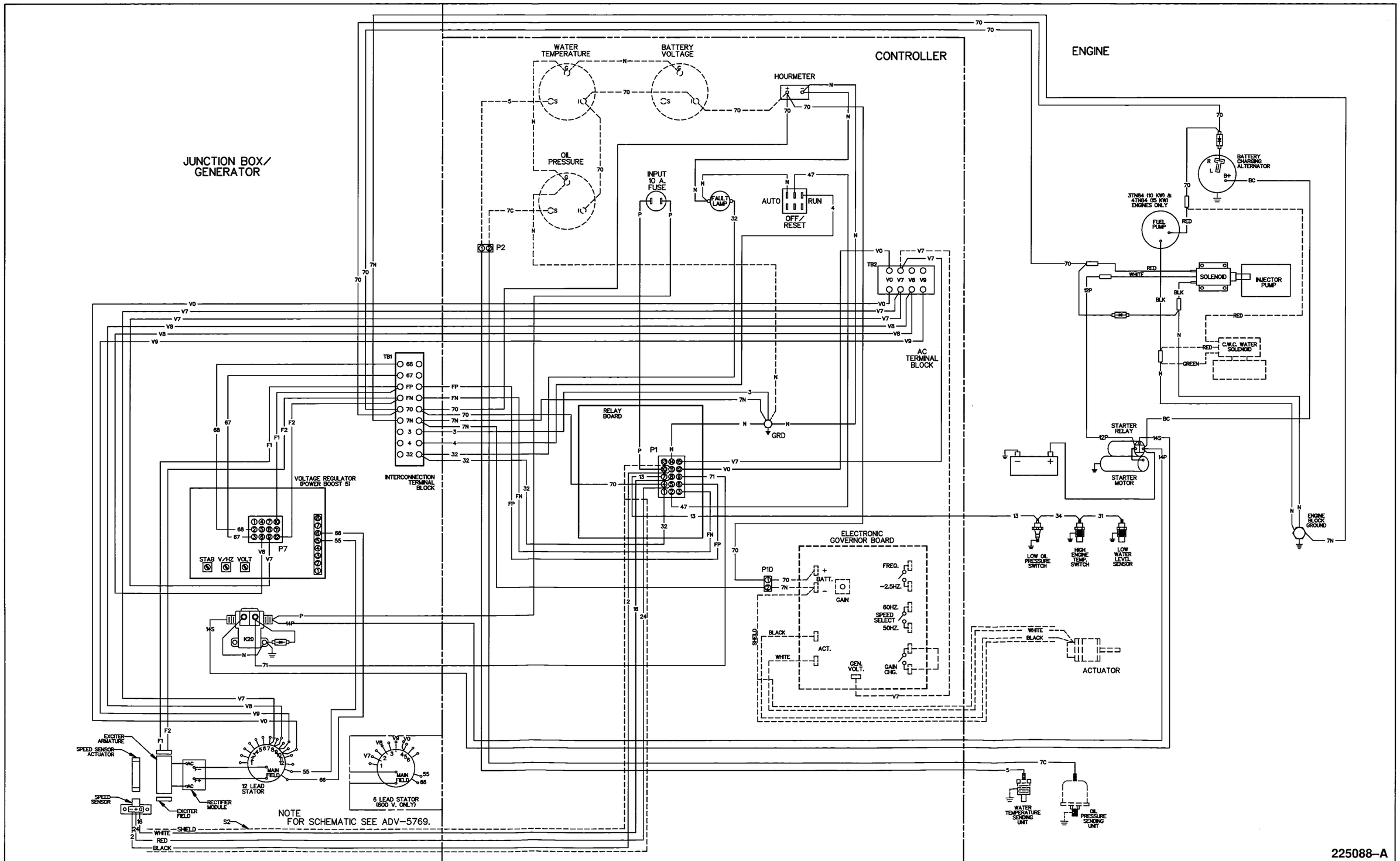
1. J1 Jumper

Figure 10–3 Overvoltage Circuit Board

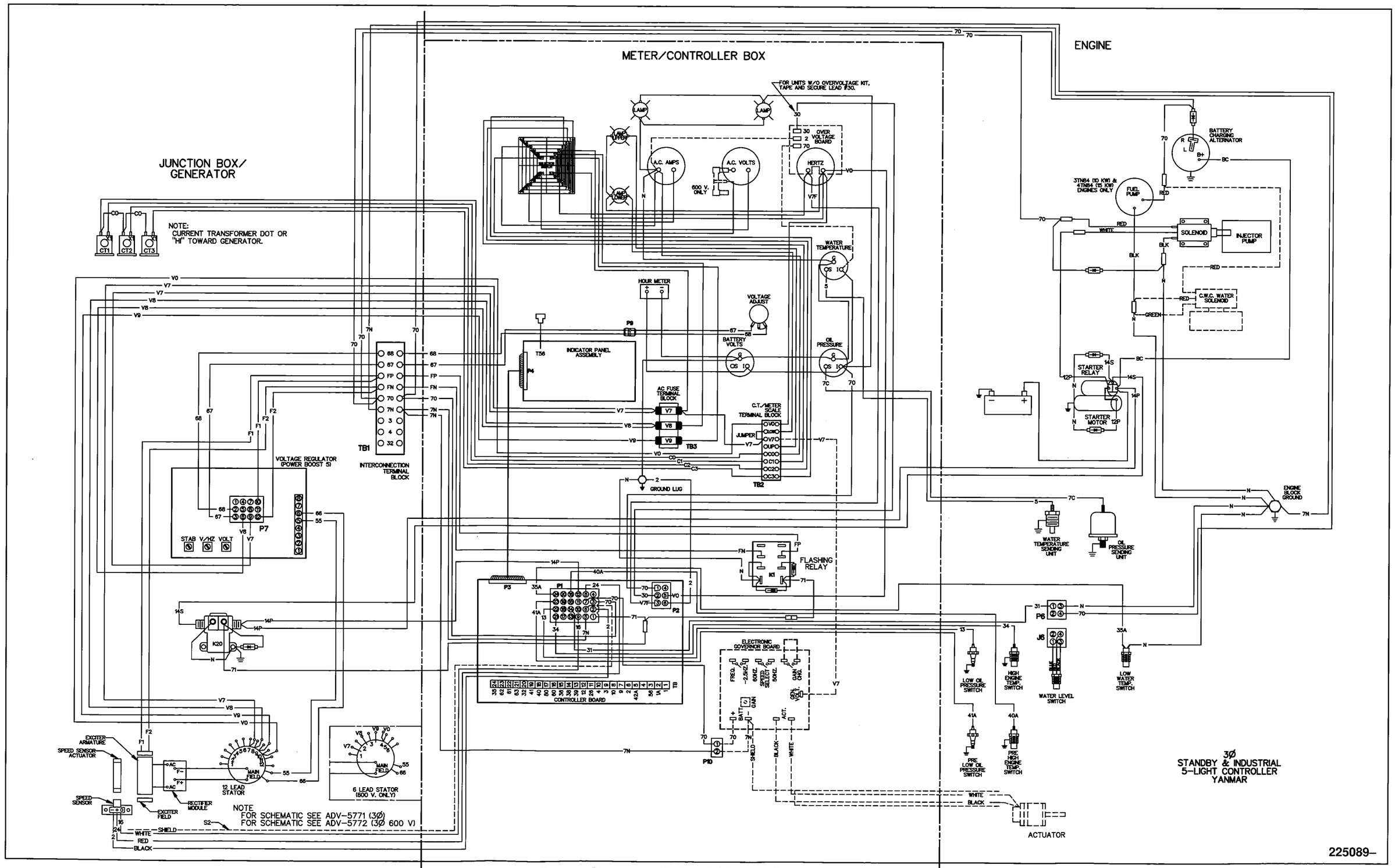
7. Reconnect starting battery, negative lead last.

8. If the generator has been reconnected to obtain a different output voltage or frequency, it may be necessary to adjust the voltage regulator and governor. Reference Section 8. Voltage Regulator Adjustment for proper procedure.

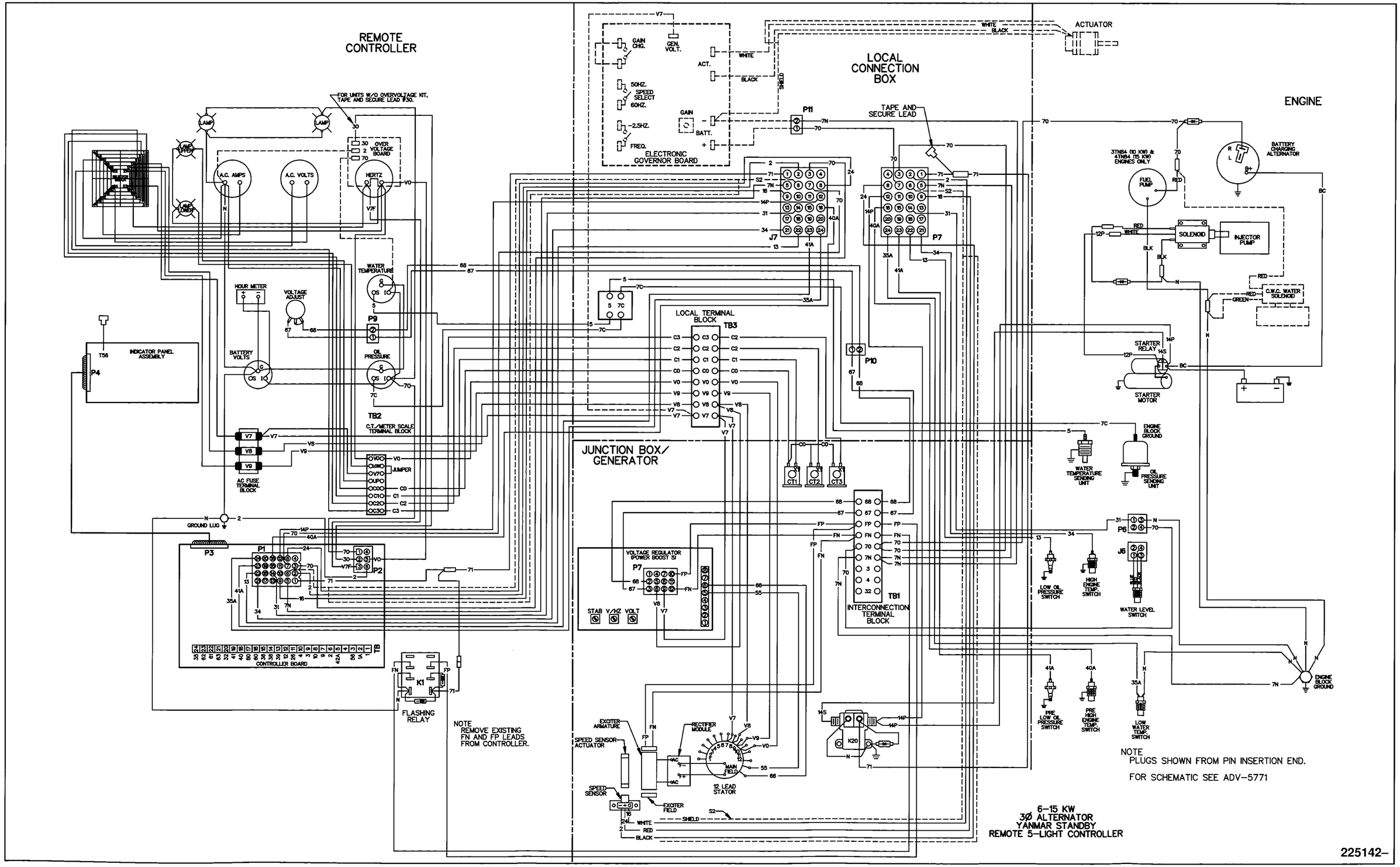
Section 11. Wiring Diagrams



3 Phase Standby and Industrial Relay Controller



3 Phase Standby and Industrial 5–Light Controller



3–Phase Alternator Remote 5–Light Controller

TP–5557 10/92

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