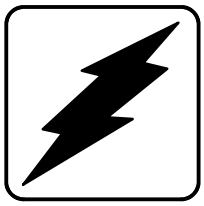
Service

Industrial Generator Sets



Models:

COM-6 (24 vdc)
COM-6 (48 vdc)

ISO 9001
KOHLER GENERATORS
INTERNATIONALLY REGISTERED
U.S.A. Plant ISO Registered

KOHLER®
POWER SYSTEMS

TP-5864 8/98a

Table of Contents

Notes

A generator set, like any other electromechanical device, can pose potential dangers to life and limb if improperly maintained or operated. The best way to prevent accidents is to be aware of potential dangers and act safely. Please read and follow the safety precautions and instructions below to prevent harm to yourself and others. This manual contains several types of safety precautions and instructions which are explained below. SAVE THESE INSTRUCTIONS.

DANGER

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

WARNING

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

CAUTION

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

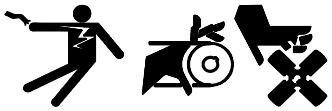
NOTICE

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

Safety decals affixed to the generator set in prominent places advise the operator or service technician of potential hazards and how to act safely. The decals are reproduced in this publication to improve operator recognition. Replace missing or damaged decals.

Accidental Starting

WARNING



Accidental starting.
Can cause severe injury or death.

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

Disabling generator set. Accidental starting can cause severe injury or death. Before working on the generator set or connected equipment, disable the generator set as follows: 1) Turn power conditioner generator set master switch to OFF position. 2) Turn main output breaker OFF. 3) Disconnect power to battery charger. 4) Remove battery cables (remove negative (–) lead first). Reconnect negative (–) lead last when reconnecting battery. Follow these precautions to prevent starting of generator set by site power system or remote start/stop switch.

Battery

WARNING

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

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

Battery acid. Sulfuric acid in batteries can cause severe injury or death. Sulfuric acid in battery 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 acid is splashed in the eyes or on skin, immediately flush the affected area with large quantities of clean water. Continue flushing with water until emergency help arrives. Seek immediate medical aid. Never add acid to a battery after placing the battery in service, as this may result in hazardous spattering of battery acid.

Battery gases. 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 charging. Avoid touching terminals with tools, etc., to prevent burns and 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. Sparks could ignite battery gases or fuel vapors. Ventilate any compartment containing batteries to prevent accumulation of explosive gases. To avoid sparks, do not disturb battery charger connections while battery is charging. Always turn battery charger off before disconnecting battery connections. Remove negative (–) lead first when disconnecting battery. Reconnect negative (–) lead last when reconnecting battery.

Engine Backfire/ Flash Fire

⚠ WARNING

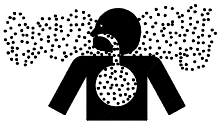
Fire.
Can cause severe injury or death.

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

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

Exhaust System

⚠ WARNING



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

The exhaust system must be leakproof and routinely inspected.

Generator set operation. Carbon monoxide can cause severe nausea, fainting, or death. 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 a potentially occupied building. Avoid breathing exhaust fumes when working on or near the generator set. Carbon monoxide is particularly dangerous because it is an odorless, colorless, tasteless, nonirritating gas that can cause death if inhaled for even a short period of time.

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. Take additional precautions when using the following fuels:

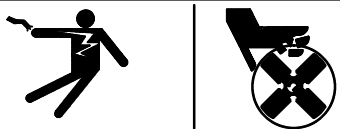
Propane (LP)—Adequate ventilation is mandatory. Propane is heavier than air; install propane gas detectors low in room. Inspect detectors often.

Natural Gas—Adequate ventilation is mandatory. Natural gas rises; install natural gas detectors high in room. Inspect detectors often.

Gas fuel leaks. Explosive fuel vapors can cause severe injury or death. Fuel leakage can cause an explosion. Check LP vapor gas or natural gas fuel system for leakage using a soap-water solution with fuel system test pressurized to 6-8 ounces per square inch (10-14 inches water column). Use a soap solution containing neither ammonia nor chlorine because both prevent bubble formation. A successful test depends on the ability of the solution to bubble.

Hazardous Voltage/ Electrical Shock

⚠ WARNING



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

Operate generator set only with all guards and electrical enclosures in place.

Grounding generator set. Hazardous voltage can cause severe injury or death. Electrocution is possible whenever electricity is present. Open main circuit breakers of all power sources before servicing equipment. Configure the installation to electrically ground the generator set and electrical circuits when in use. Never contact electrical leads or appliances when standing in water or on wet ground, as the chance of electrocution increases under such conditions.

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

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

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

Heavy Equipment

⚠ WARNING

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

Use slings under skid to balance and lift generator set.

Hot Parts

⚠ WARNING

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

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

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

Moving Parts

⚠ WARNING

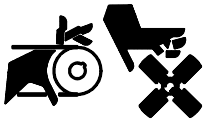
Hazardous voltage.

Moving rotor.

Can cause severe injury or death.

Operate generator set only with 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, and covers in place.

Tightening hardware. Flying projectiles can cause severe injury or death. Retorque all crankshaft and rotor hardware after servicing. Do not loosen crankshaft hardware or rotor thrubolt when making adjustments or servicing generator set. Rotate crankshaft manually in a clockwise direction only. Turning crankshaft bolt or rotor thrubolt counterclockwise can loosen hardware. Loose hardware can cause hardware or pulley to release from engine of generator set and can cause personal injury.

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

Notice

NOTICE

Hardware damage! Engine and generator set may use both American Standard and metric hardware. Use the correct size tools to prevent rounding of bolt heads and nuts.

NOTICE

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 identification.

Notes

Introduction

This manual covers the service of COM-6 generator sets equipped with a microprocessor controller.

All information in this publication represents data available at time of print. Kohler Co. reserves the right to change this literature and the products represented without incurring obligation.

Service Assistance

For Kohler sales and service in the U.S.A. and Canada contact Kohler Company's Service department at:

Phone: 920-565-3381
Fax: 920-459-1646
KOHLER CO., Kohler, Wisconsin 53044 U.S.A.

To ensure supply of correct parts or information, make note of the following identification numbers in the spaces provided:

GENERATOR SET

MODEL, SPEC, and SERIAL numbers are found on the nameplate attached to the generator set.

Model No. _____

Specification No. _____

Serial No. _____

ENGINE

The engine serial number is found on the engine nameplate.

Engine Serial No. _____

Section 1. Specifications

The following tables contain general generator set, engine, and alternator specifications. Refer to the service section and the engine service manual for service details.

1.1 Generator Set Specifications

	24 vdc	48 vdc
Manufacturer	Kohler	
Dimensions—D x W x H—in. (mm)	28 x 38 x 28 (712 x 966 x 712)	
Weight—lbs. dry (kg)	425 (193)	
Rated kW	6	
Rated Voltage (After Rectifier)	26.2 vdc	52.0 vdc
Rated Amps	230	115

DERATION: Refer to Specificaton Sheet for specific ratings and site deration factors.

1.2 Engine Specifications

	24 vdc	48 vdc
Model	CH20	
Make	Kohler	
Cycle	4	
Number Cylinders	2	
Compression Ratio	8.5:1	
Displacement—cu. in. (cc)	38 (624)	
Rated Horsepower (using natural gas fuel)	15	
RPM	1800-3600	
Bore—in. (mm)	3.03 (77)	
Stroke—in. (mm)	2.64 (67)	
Valve Material:		
Intake	Steel	
Exhaust	Stellite®	
Valve Train	Overhead Valve	
Cylinder Block Material	Aluminum w/Cast Iron Liners	
Cylinder Head Material	Aluminum	
Piston Rings	2 Compression, 1 Oil	
Crankshaft Material	Heat Treated, Ductile Iron Casting	
Bearings, Number & Type	2, Replaceable Sleeve	
Governor	Electronic	
Lubrication System	Full Pressure	
Oil Capacity (with filter and cooler)—qts. (L)	2.1 (2.0)	
Oil Type	Mobil 1, 5W-30	
Oil Pressure—psi (kPa)	25-35 (172-241)	
Low Oil Pressure—psi (kPa)	3.5 psi ± 1.5 (24.1 ± 13.8)	
Fuel Type	Factory Set for Natural Gas (Propane Adaptable)	
Fuel Pressure—in. water column (mm water)	7 to 11 (178 to 280)	
Low Fuel Pressure—in. water column	5.5 ± 0.25	
High Engine Temperature—°F (°C)	305 (152)	

Engine Specifications (continued)

	24 vdc	48 vdc
Starting Battery Voltage	12	
Starting Battery Ground	Negative	
Battery Recommendation (min.)	500 CCA at 0°F (see Section 5)	
Spark Plug Type (Kohler Part No.)	24 132 01	
Spark Plug Gap in. (mm)	0.040 (1.02)	
Spark Plug Tightening Torque—ft. lbs (Nm)	18-22 (24.4-29.8)	
Ignition System	Capacitor Discharge	
Engine-driven Battery Charger	15 Amp, Regulated	
Starter Motor	Electric, Solenoid Shift	
Cooling System	Integrated Air Cooling	

1.3 Generator Specifications

	24 vdc	48 vdc
Stator Resistance	0.0028 ohms	0.045 ohms
Excitation Method (Rotor)	Permanent Magnet Brushless	
Frequency—Hz	360-720	
Coupling Type	Direct	
Insulation (Stator)	Class 155, Epoxy Varnish, Vacuum Impregnated	
Winding Material	Copper	
Bearing, Qty. and Type	1, Replaceable Ball	

See Safety Precautions and Instructions at the beginning of this manual before attempting maintenance, repair, or operation of the generator set.

Refer to the Operation and Installation manual for detailed maintenance information.

Have all generator service performed at specified intervals by a trained service technician or an authorized service distributor/dealer.

2.1 Maintenance Schedule

Perform Service at Intervals Indicated (X)	Before Each Attended Start-up	Every 100 Hours or 12 Months*	Every 500 Hours
Check oil level, add oil if needed	X		
Check fuel supply (Natural gas turned on)	X		
Clean cooling air inlets and outlets	X		
Remove loose dirt from compartment	X		
Replace air cleaner		X†	
Change lube oil		X	
Replace lube oil filter		X‡	
Check and tighten electrical connections		X	
Check and tighten mounting bolts and vibromounts		X	
Replace air precleaner		X	
Replace air cleaner element		X	
Clean battery terminals and reconnect		X	
Replace spark plugs			X

* Whichever comes first

† Service more often if operating in dusty or dirty conditions. Check oil cooler fins; clean if necessary.

‡ Change lube oil filter every 200 hours or every 12 months.

2.2 Battery Charger Operation

2.2.1 COM-6 Battery Chargers

The COM-6 generator set has two separate battery charger systems to maintain the engine starting battery.

A 15-amp charger in the engine recharges the battery immediately after starting to quickly restore the battery to full potential.

The second battery charger is a 2-amp float-type charger which maintains the battery charge at full capacity during idle periods. It is located in the controller and powered by a customer-provided AC power cord attached to the rear of the controller.

This 2-amp battery charger is fused on the input AC side and on the output DC side. The control system monitors battery voltage and signals charger malfunctions through the remote cable interface connection.

2.3 Battery Inspection

⚠ WARNING

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

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

Battery acid. Sulfuric acid in batteries can cause severe injury or death. Sulfuric acid in battery 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 acid is splashed in the eyes or on skin, immediately flush the affected area with large quantities of clean water. Continue flushing with water until emergency help arrives. Seek immediate medical aid. Never add acid to a battery after placing the battery in service, as this may result in hazardous spattering of battery acid.

Battery gases. 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 charging. Avoid touching terminals with tools, etc., to prevent burns and 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. Sparks could ignite battery gases or fuel vapors. Ventilate any compartment containing batteries to prevent accumulation of explosive gases. To avoid sparks, do not disturb battery charger connections while battery is charging. Always turn battery charger off before disconnecting battery connections. Remove negative (–) lead first when disconnecting battery. Reconnect negative (–) lead last when reconnecting battery.

Battery inspection requires the following tools:

- Clean, soft cloth
- Digital voltmeter accurate to two decimal places
- Nonmetallic soft-bristled brush (toothbrush)
- NO-OXIDE-A grease or petroleum jelly
- Rubber gloves
- Sodium bicarbonate (baking soda)
- Splash-proof safety goggles
- Two small plastic buckets (one for soda solution and one for clean rinse water)
- Clean water

Start battery inspection procedure

Check for the following:

1. **Cracks or fractures** in the battery case or cover. Replace cracked or fractured battery.
2. **Battery sidewall** bulging 1/4 inch or more per side. Replace the battery if sidewall bulging is evident.
3. **Liquid on cover**, sidewalls, or bottom of battery. Sprinkle a pinch of sodium bicarbonate on the liquid. If the liquid fizzes, it is acid. Replace the battery.
4. **Battery voltage.** Measure open circuit battery voltage according to the following procedure:
   a. Turn off battery charger.
   b. Remove battery cables, negative (–) lead first.
   c. Set the digital voltmeter on the first DC range greater than 14 volts.
   d. Place the positive meter lead on the positive terminal and the negative meter lead on negative terminal. Open circuit voltage less than 11.00 volts indicates a possible short in one or more of the battery cells. Replace the battery. If the reading is above 11.00 volts, continue the battery inspection per step 5.
5. **Corrosion** (whitish material) on terminal posts. Clean corroded terminal posts using the following procedure:
   a. In a plastic bucket, mix 4-8 ounces of sodium bicarbonate with one pint of clean water.
   b. Scrub battery terminal posts and connectors on battery charger leads with a brush dipped in the sodium bicarbonate solution.
   c. After removing corrosion, wipe off terminal posts and connectors with soft cloth wetted with clean water.
   d. Dry the terminal posts and connectors with clean, dry cloth.
   e. Lightly coat terminal posts and connectors with NO-OXIDE-A grease or petroleum jelly.
   f. Reconnect battery charger leads positive (+) lead first, then negative lead last.
   g. Turn charger on.

Use the following charts as a quick reference in troubleshooting problems. The charts list generator set faults by groups and include likely causes and corrections. Have service performed by trained service technicians or authorized service distributors/dealers.

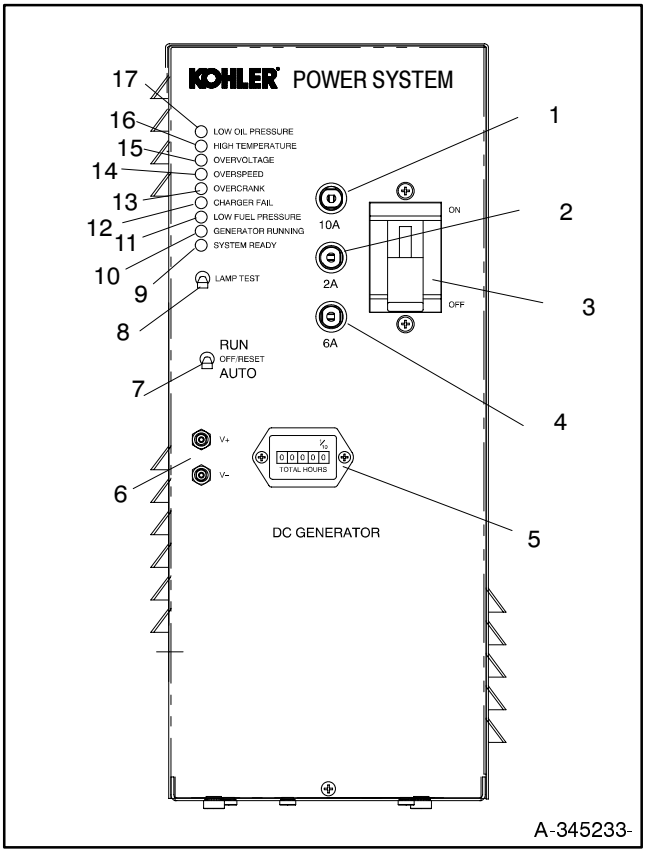
Troubleshooting Chart

Problem	Possible Cause	Corrective Action
Unit does not crank	Weak or dead battery	Recharge or replace battery
	Controller fuse blown	Replace controller fuse
	Engine harness twist-lock connector not fully locked tight	Loosen twist ring; reengage and lock by twisting past detent
	Defective start switch	Replace start switch
	Remote start cable disconnected	Reconnect start cable
	Defective starter solenoid	Replace starter solenoid
	Battery connections loose, dirty or incorrect	Correct, clean, or tighten battery connections
Unit cranks but does not start	Air cleaner clogged	Clean or replace air cleaner
	Faulty spark plug	Replace or regap spark plugs
	Faulty ignition module(s)	Have unit serviced by an authorized Kohler service distributor/dealer
	Fuel control valve adjustment too rich	Requires initialization. See Section 6—Installation—Fuel System Initialization
	Loose spark plug wire connection	Reconnect and/or tighten spark plug wire
	Out of fuel or fuel valve shutoff	Replenish fuel or correct valve shutoff
	Weak or dead battery	Recharge or replace battery
Unit starts hard	Air cleaner clogged	Clean or replace air cleaner element
	Faulty spark plug	Replace or regap spark plugs
	Weak or intermittent ignition module(s)	Have unit serviced by an authorized Kohler service distributor/dealer
Unit stops suddenly	Air cleaner clogged	Clean or replace air cleaner element
	Faulty spark plug	Replace or regap spark plugs
	Fuel starvation	Replenish fuel
	Engine harness twist-lock connector not fully locked tight	Loosen twist ring; reengage and lock by twisting past detent
	Controller fault	Check controller LEDs and correct fault
	Controller fuse blown	Replace fuse
	Emission system fault	Have unit serviced by an authorized Kohler service distributor/dealer

Troubleshooting Chart (continued)

Problem	Possible Cause	Corrective Action
Unit lacks power or operates erratically	Engine harness twist-lock connector not fully locked tight	Loosen twist ring; reengage and lock by twisting past detent
	Air cleaner clogged	Clean or replace air cleaner element
	Insufficient cooling	Inspect and clean cooling system
	Engine overload	Reduce load on generator set
	Faulty spark plug	Replace or regap spark plugs
	Fuel supply problem	Check valves and fuel pressure
	Governor system linkage binding	Clean or remove restriction from linkage
	Emissions system too rich	Requires initialization. See Section 6—Installation—Fuel System Initialization
Unit overheats	Air openings clogged	Clean intake and outlet openings
	Air cleaner clogged	Clean or replace air cleaner element

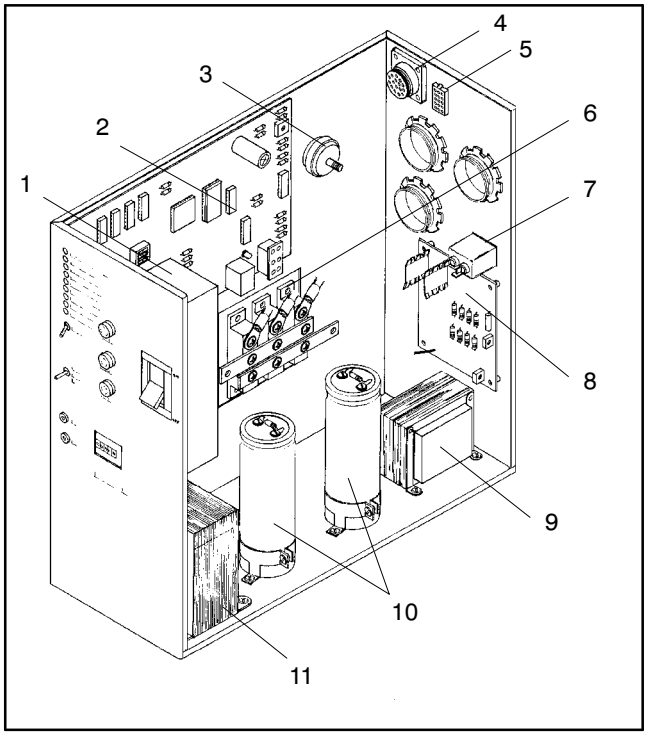
The COM-6 controller includes the main control board, battery charger with transformer, hourmeter, rectifier filter, circuit breaker, control switches, interface connections, main output connections and control/fuse wiring.



1. Controller fuse (F1)
2. Battery charger input fuse (F2)
3. DC circuit breaker
4. Battery charger output fuse (F3)
5. Hourmeter
6. DC voltage test points
7. Master generator switch
8. Lamp-test switch
9. System ready LED
10. Generator running LED
11. Low fuel pressure LED
12. Charger fail LED
13. Overcrank LED
14. Overspeed LED
15. Overvoltage LED
16. High temperature LED
17. Low oil pressure LED

Figure 4-1. COM-6 Controller Exterior

It is important to determine if a generator set failure results from the generator set itself or from the control system. Refer to Figure 4-2.



1. Line circuit breaker (positive connection to bottom of circuit breaker)
2. Main control circuit board
3. Negative (–) terminal post
4. P5 connector to generator set
5. P9 interface connector
6. Rectifier module
7. 120 vac battery charger input receptacle
8. 12 volt battery charger circuit board
9. 12 volt battery charger transformer
10. Capacitors
11. Inductor

Figure 4-2. COM-6 Controller Interior

If an alarm message sent to a remote site results in an on-site service visit, note all lit and unlit LEDs on the controller before attempting service.

The following chart lists problems that indicate possible component or controller failure.

4.1 Controller Troubleshooting

Problem	Corrective Action
Function Failure • Setting the generator master switch to RUN fails to crank the generator set. • Setting the generator master switch to OFF fails to stop the generator set or reset a fault. • Setting the generator master switch to AUTO and applying a remote start signal via the interface connector fails to crank the generator set after preset time delay.	Check the switch. Check 12-volt start battery connections and verify start battery voltage greater than 10 volts. Verify start battery voltage at pins 1 and 10 in the cabinet interface connection (P9). Troubleshoot the controller.
• No DC voltage at test jacks with circuit breaker closed and system batteries connected.	Troubleshoot the controller.
• Hourmeter does not record generator set total operating hours.	Check wiring and replace hourmeter, if needed.
• Controller circuit board fuse F1 blows. • System battery charger fuses F2 or F3 blow.	Replace fuse. Check wiring. Troubleshoot controller.
• System fails to crank or start when there are no fault shutdowns (system ready on).	Troubleshoot controller.
• System ready light and LEDs fail to illuminate.	Replace any blown fuse. Check wiring and starting battery voltage. If problem persists, troubleshoot controller.
Battery Charger Failure • Generator set does not crank or start. • Lamp-test switch fails to illuminate all controller indicator LEDs. • Setting the generator master switch to RUN fails to crank the generator set.	Check battery charger AC power on. Check battery charger voltage at pins 1 and 10 of the cabinet interface connection. Check and replace the battery charger fuses. If problem persists, replace battery charger.

4.2 Controller Fault Shutdowns

Refer to the following chart to identify fault conditions and possible causes if the generator set doesn't start or stops running because of a fault shutdown (fault lamp illuminated.) Consult the engine service manual for detailed information on correcting engine-related faults. To reset the generator set after a fault shutdown, refer to TP-5863 COM-6 Operation/Installation manual, Section 2—Controller Operation, Controller Resetting Procedure (Following Fault Shutdown).

Indicator	Fault Condition/Possible Cause
High Engine Temp LED illuminates	Engine reaches shutdown temperature Very low oil level Air inlet or outlets blocked Cooling system malfunction
Low Oil Pressure LED illuminates	Engine oil pressure drops below low oil pressure limit. Very low oil level
Overspeed LED illuminates	Engine RPM exceeds 3650 Loss of speed (AC) sensing
Overcrank LED illuminates	More than 70 seconds of cyclic cranking Locked rotor (two seconds without rotation or no AC speed sensor input)
Overvoltage LED illuminates	Short-term voltage exceeds 115% of nominal voltage with a 650 millisecond delay or long-term voltage exceeds 105% of nominal voltage with a 15-second delay
Charger Fail LED illuminates	Starting battery voltage below 11.5 volts

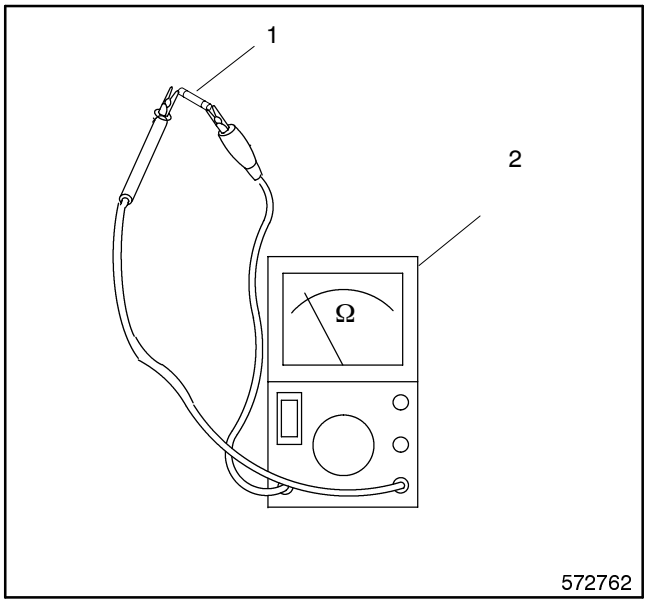
Notes

Consult the first chart for assistance in locating the cause of the blown fuses. The successive charts list generator faults by group and link faults to possible causes and corrective actions. Use flowcharts 5.3 and 5.4 when troubleshooting other generator set problems. Before beginning troubleshooting procedures, read the safety precautions at the beginning of this manual and those included in the text.

5.1 Checking Fuses

The chart in Section 5.2 lists the possible causes of blown controller fuses. Replace blown fuses and resume operation. If the fuse blows again, use the chart to identify the faulty component(s).

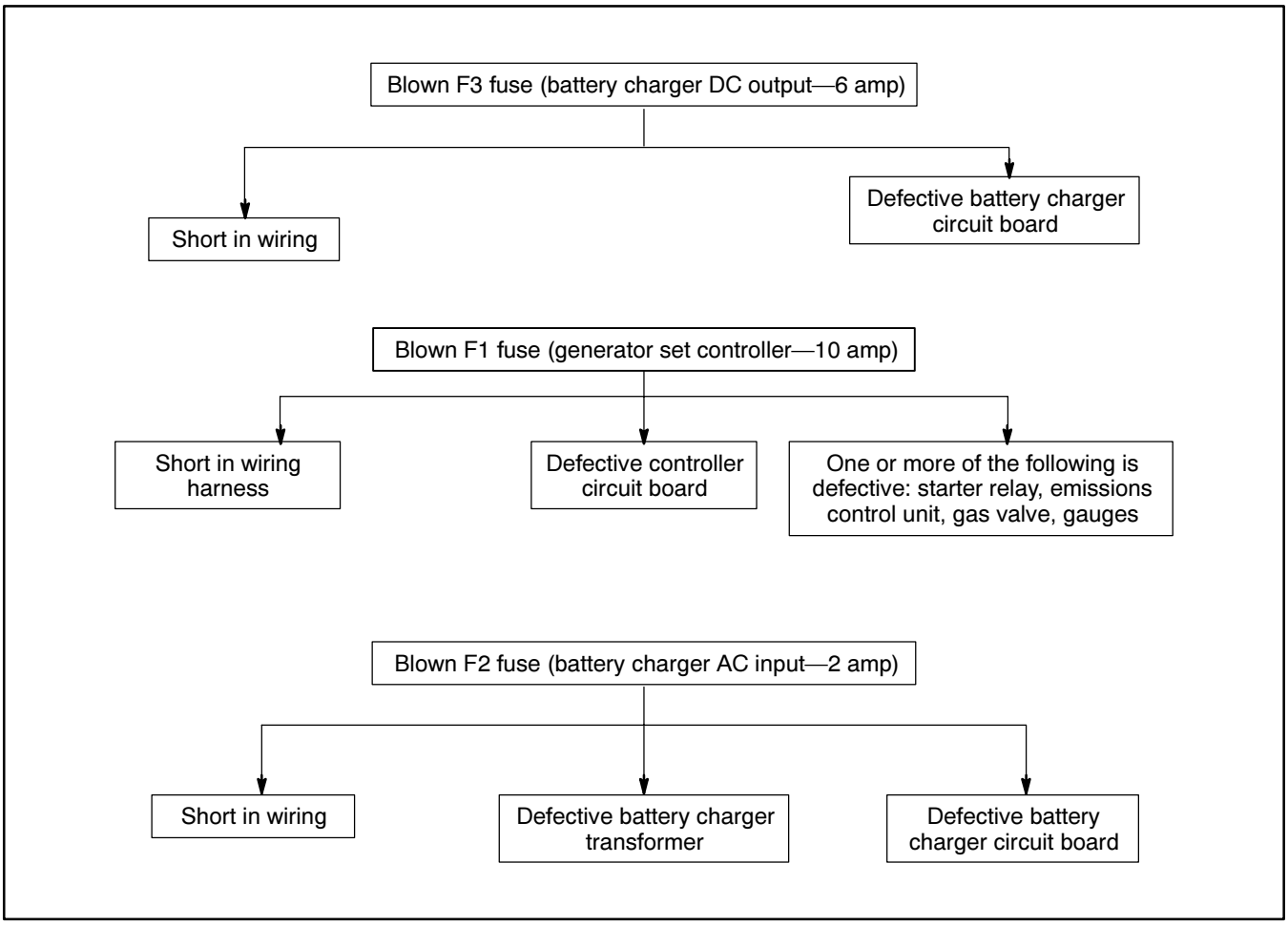
Verify a blown fuse visually or remove the fuse from its socket and verify with an ohmmeter. Remove fuse from the front panel of the controller. Use the ohmmeter to check for continuity in the fuse. See Figure 5-1. No continuity indicates a blown fuse. Replace the fuse.



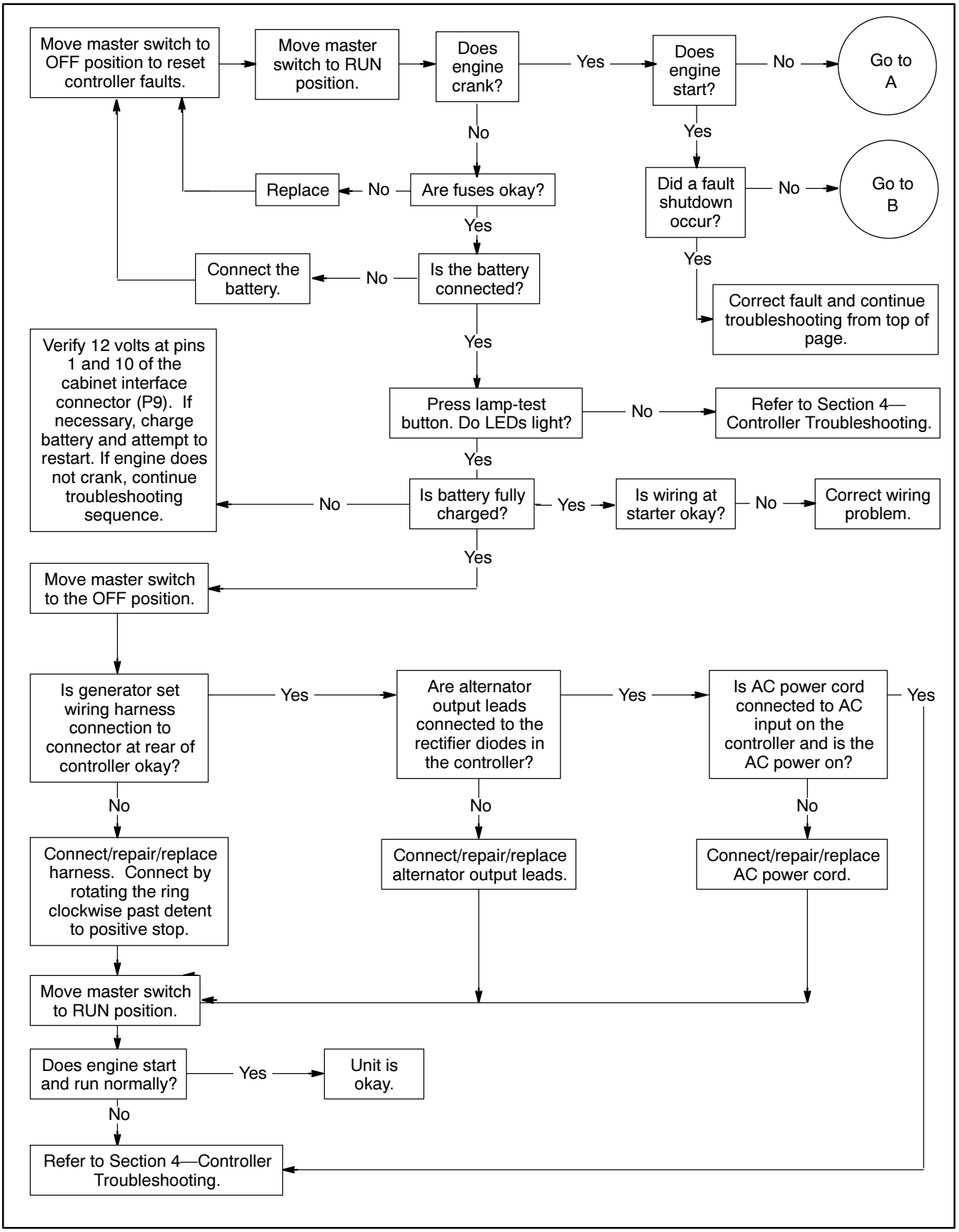
1. Fuse
2. Ohmmeter or continuity tester

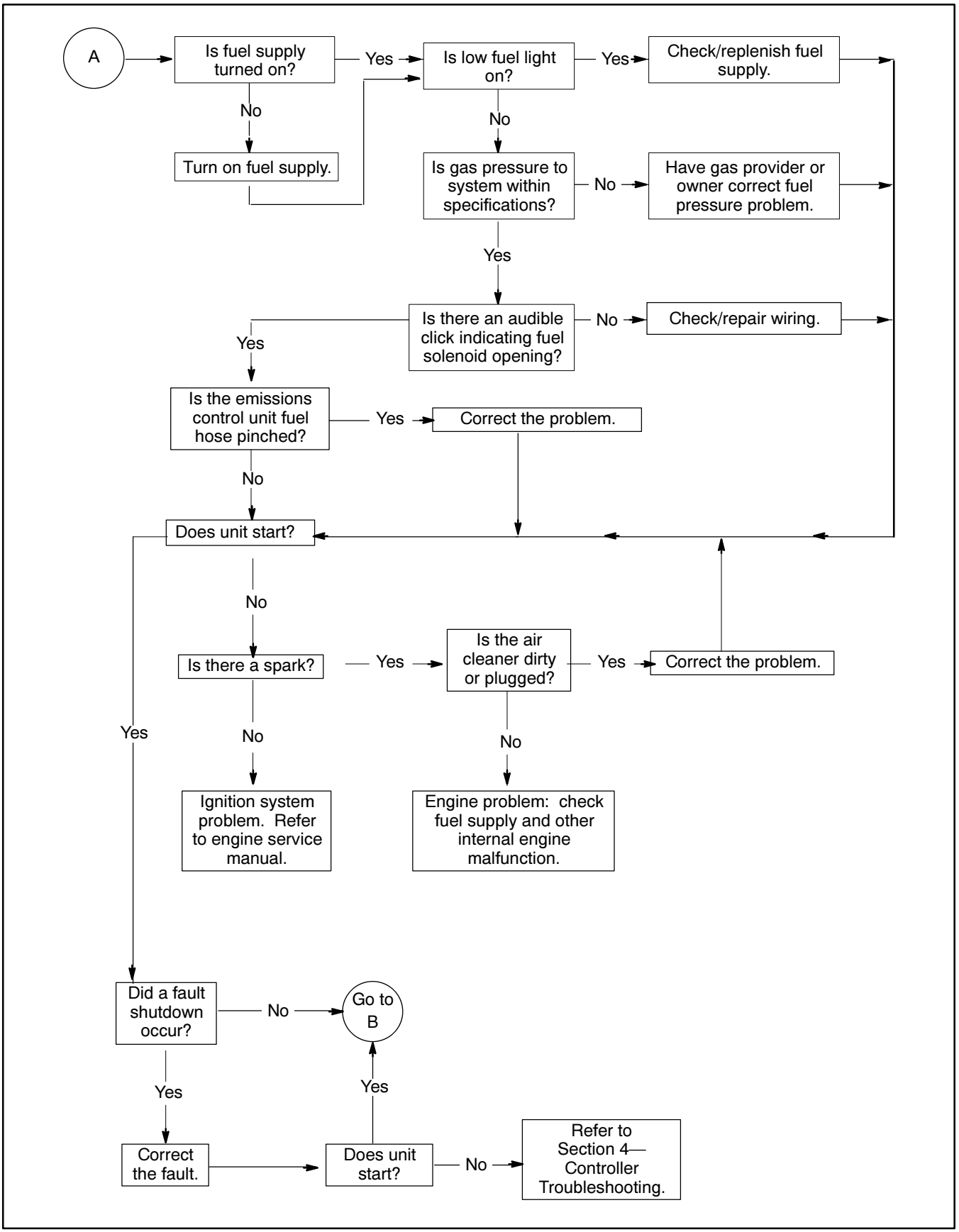
Figure 5-1. Ohmmeter Fuse Test Configuration

5.2 Troubleshooting Microprocessor Fuses

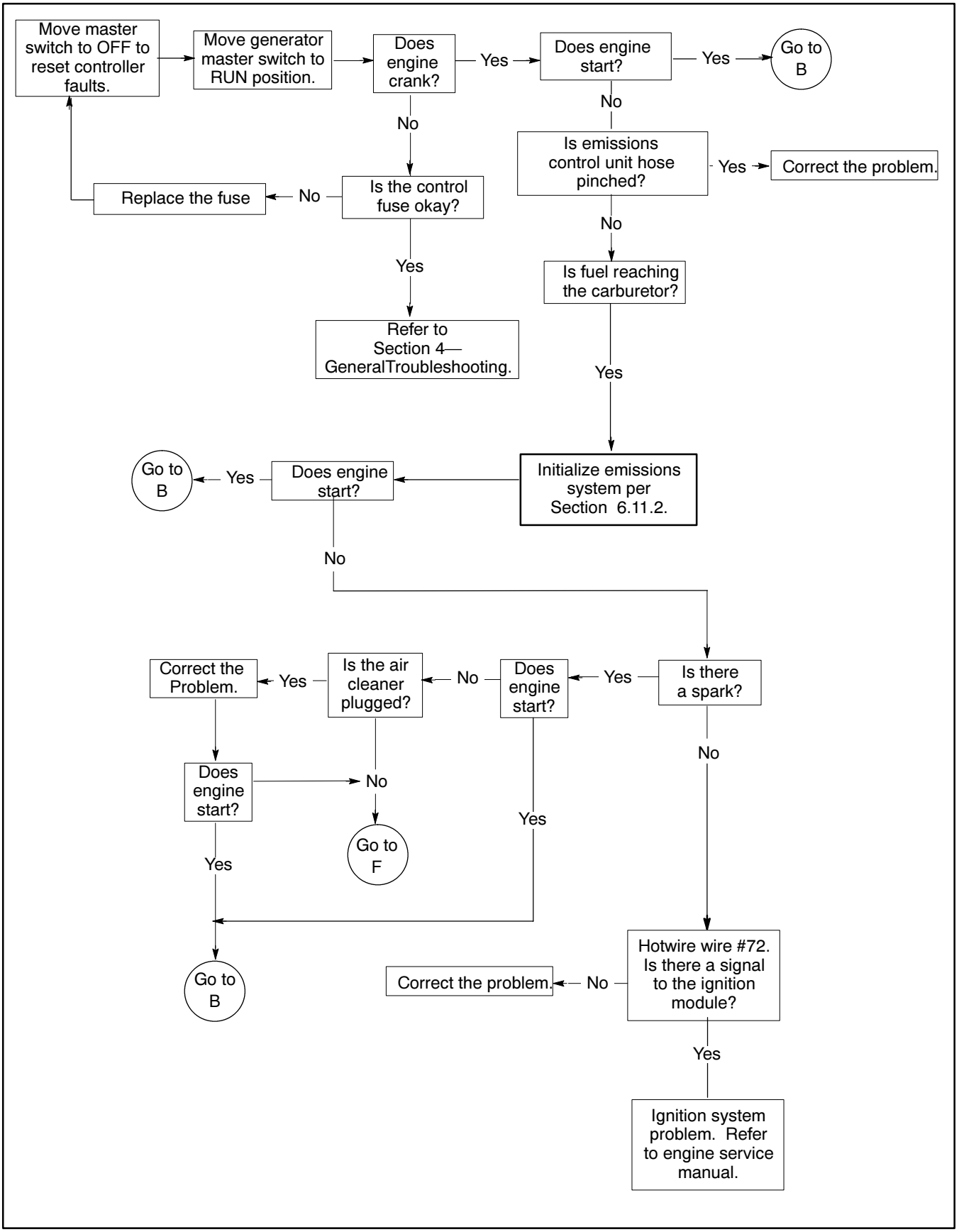


5.3 Genset/Controller System

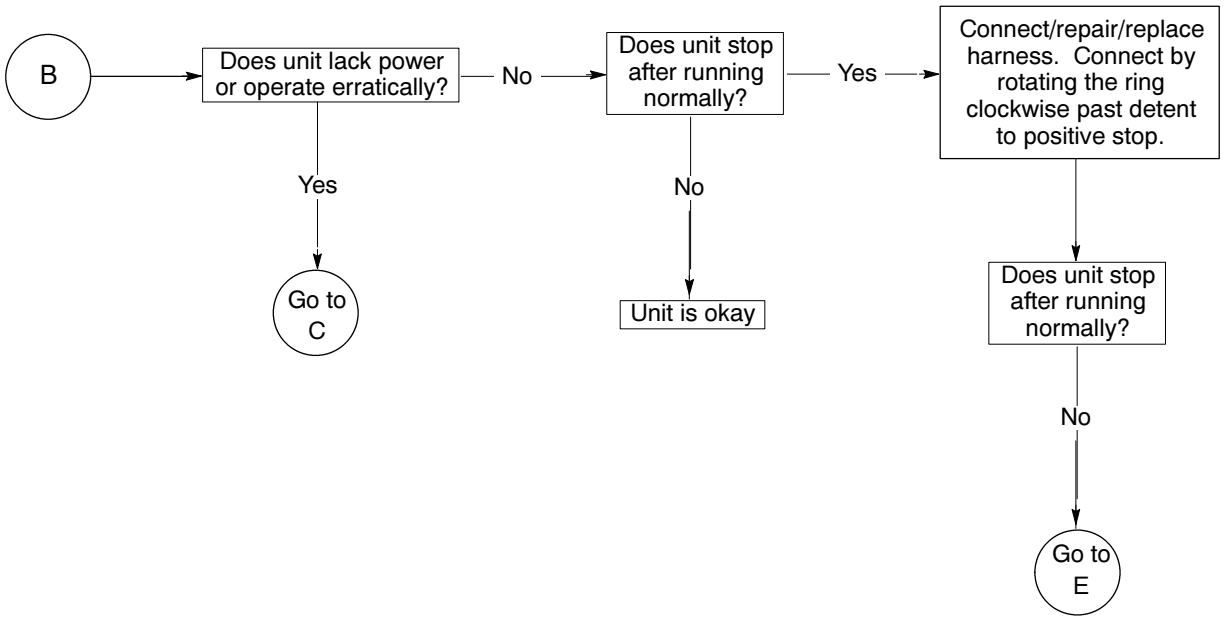



A
Is fuel supply turned on?
Yes
Is low fuel light on?
Yes
Check/replenish fuel supply.
No
Turn on fuel supply.
No
Is gas pressure to system within specifications?
No
Have gas provider or owner correct fuel pressure problem.
Yes
Is there an audible click indicating fuel solenoid opening?
No
Check/repair wiring.
Yes
Is the emissions control unit fuel hose pinched?
Yes
Correct the problem.
No
Does unit start?
No
Is there a spark?
Yes
Is the air cleaner dirty or plugged?
Yes
Correct the problem.
Yes
No
No
Ignition system problem. Refer to engine service manual.
Engine problem: check fuel supply and other internal engine malfunction.
Did a fault shutdown occur?
No
Go to B
Yes
Yes
Correct the fault.
Does unit start?
No
Refer to Section 4— Controller Troubleshooting.

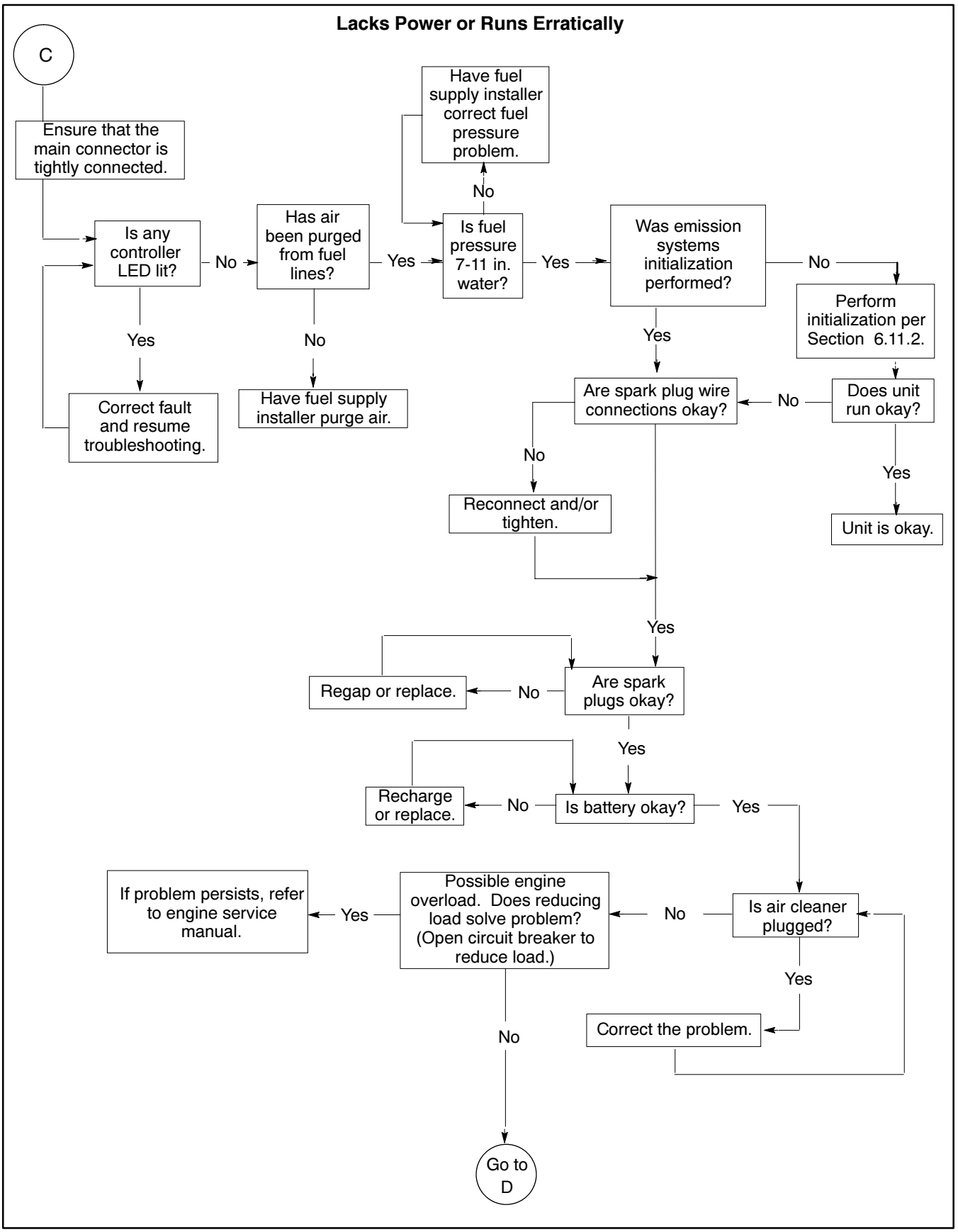
5.4 Fuel Regulation System and Emission Control Unit



Fuel Regulation System and Emission Control Unit (Cont'd)

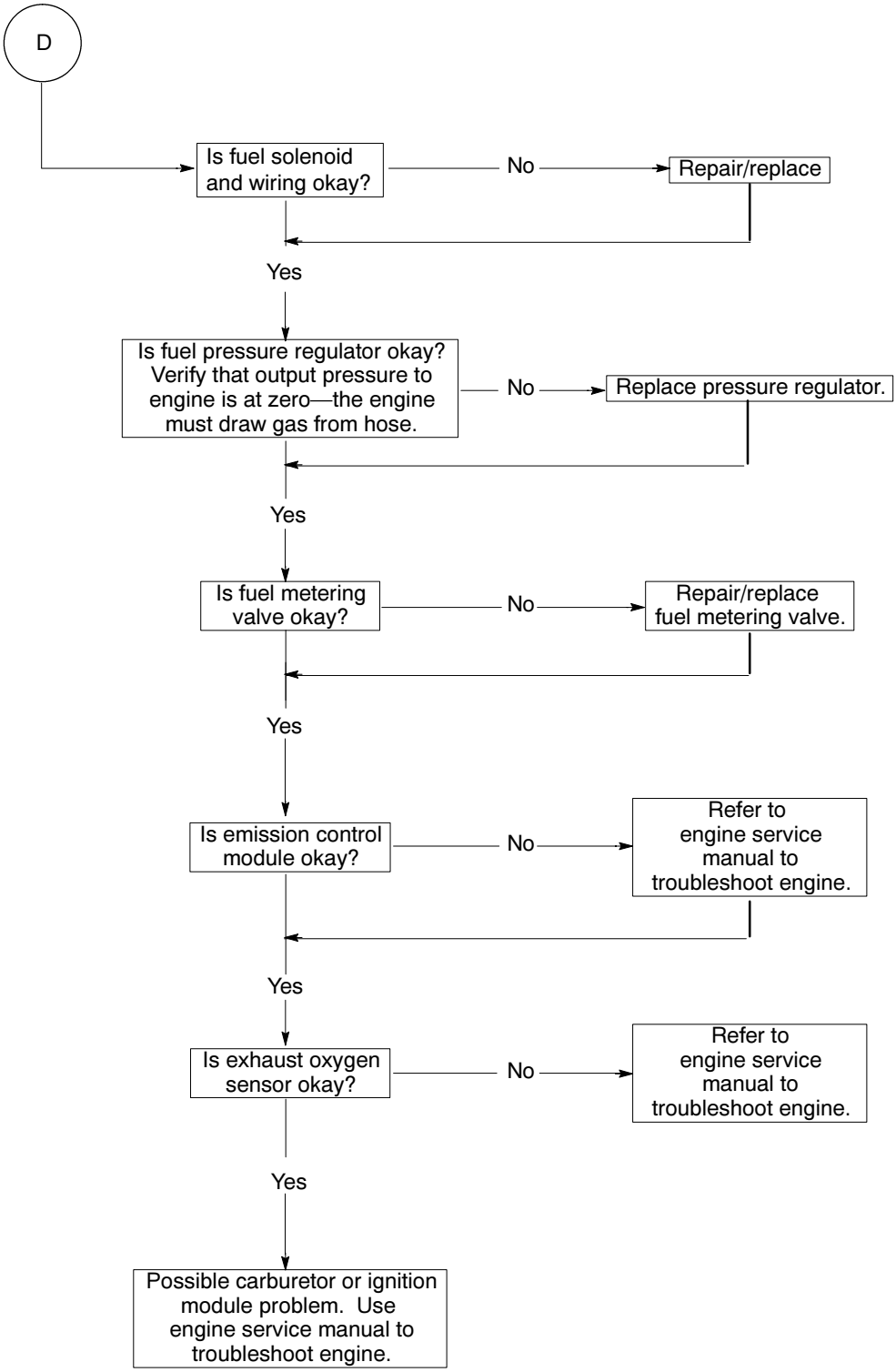


Fuel Regulation System and Emission Control Unit (Cont'd)

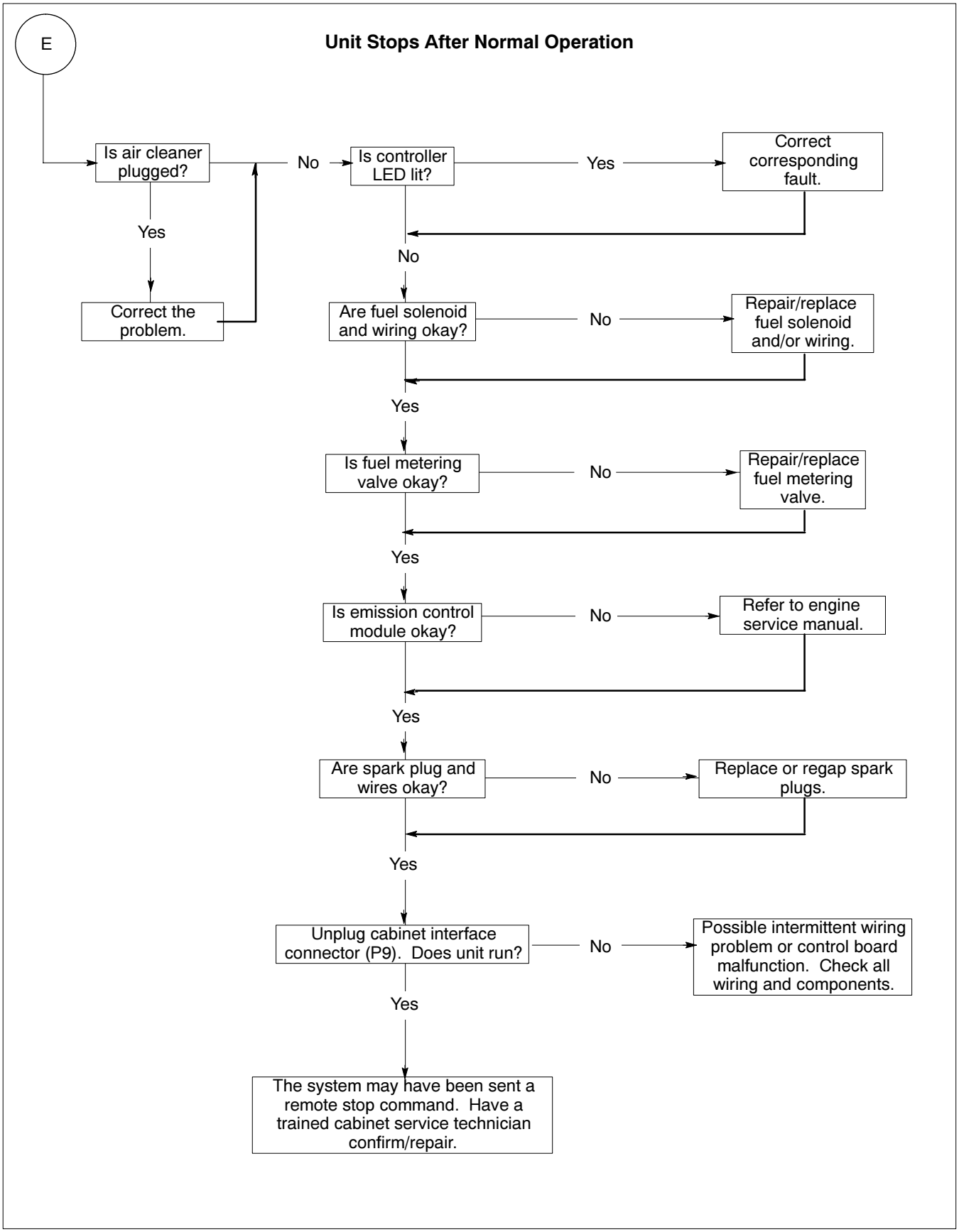


Fuel Regulation System and Emission Control Unit (Cont'd)

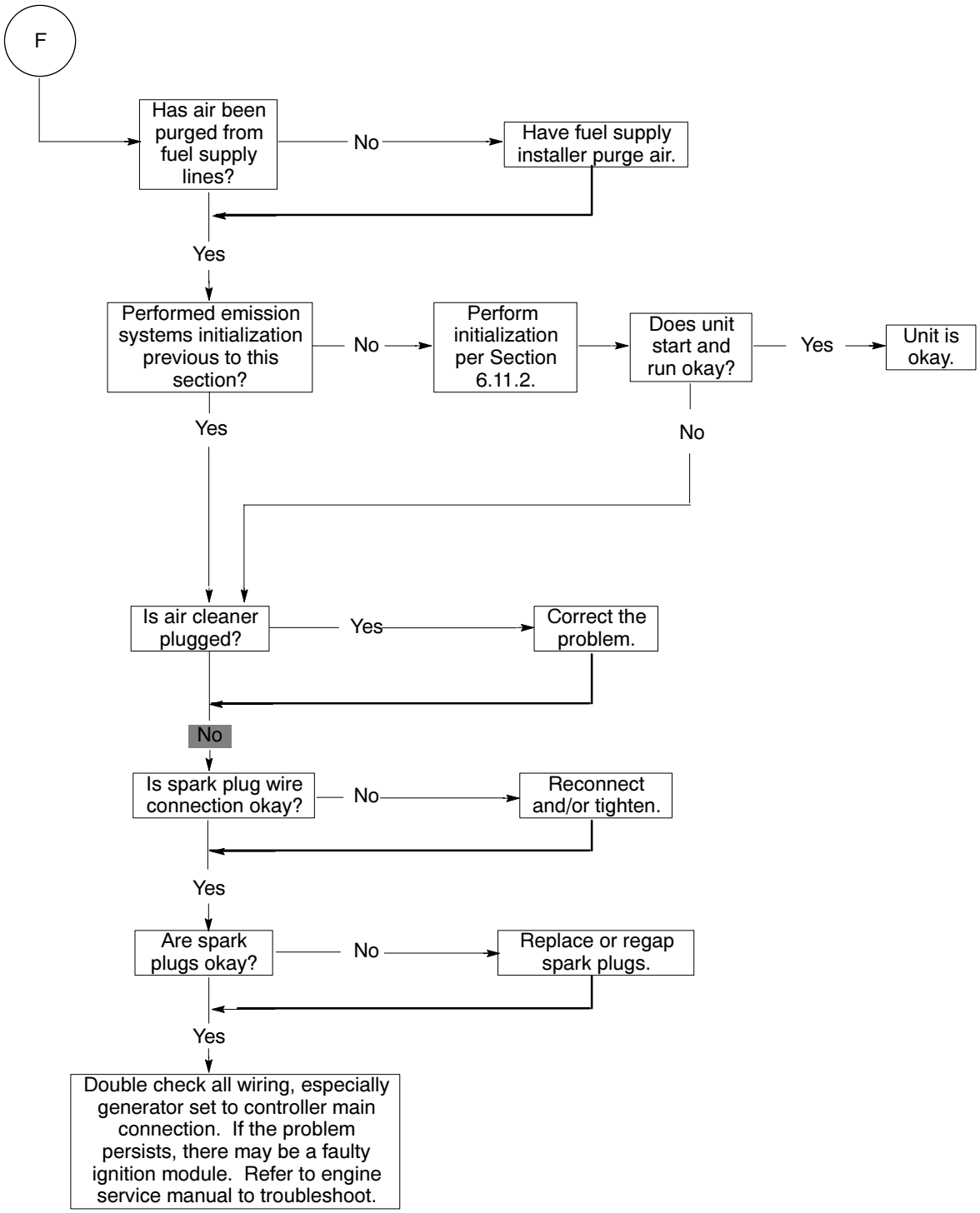
Lacks Power or Runs Erratically (Cont'd)

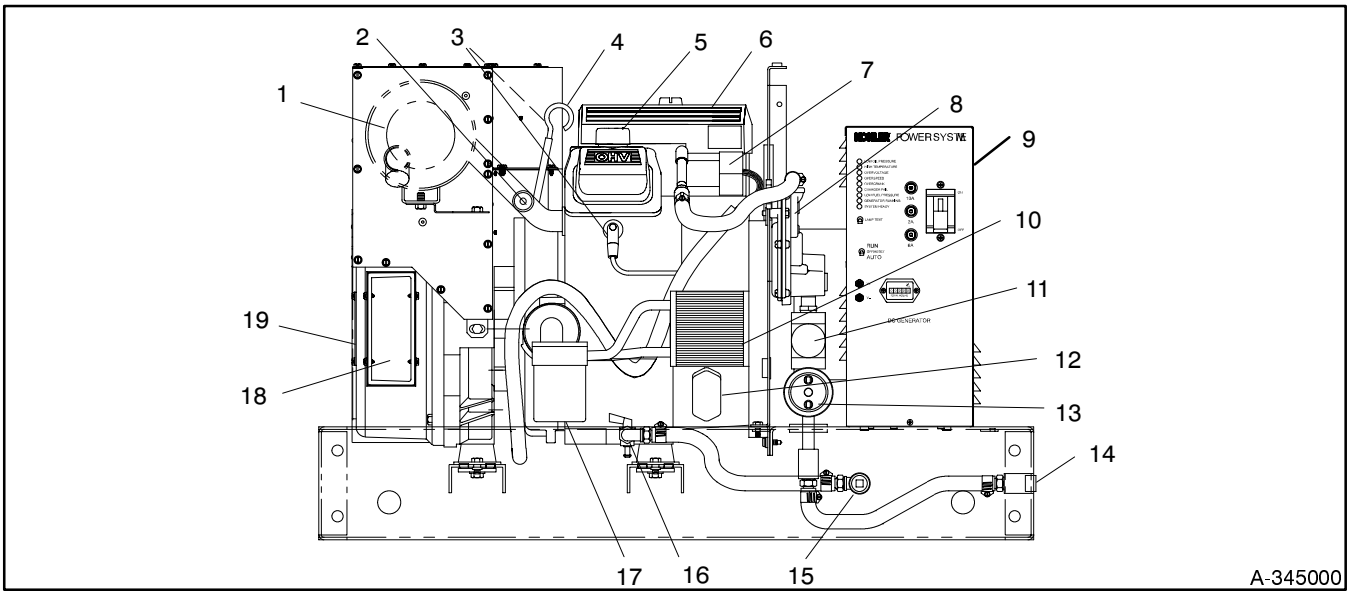


Fuel Regulation System and Emission Control Unit (Cont'd)



Engine Has Spark, Cranks, Does Not Start





1. Exhaust muffler
2. Oxygen sensor
3. Spark plug (quantity 2)
4. Engine oil dipstick
5. Engine oil fill
6. Air cleaner
7. Fuel control valve (Emissions module far side)
8. Fuel pressure regulator
9. Control system
10. Engine oil cooler
11. Fuel shutoff solenoid
12. Engine battery charger regulator
13. Low fuel pressure switch
14. Fuel supply connection (1/2 NPT)
15. Oil drain connection (1/2 NPT)
16. Oil drain valve
17. Engine oil filter
18. Generator cooling air inlet
19. Generator

Figure 6-1. COM-6 Generator Set with Controller

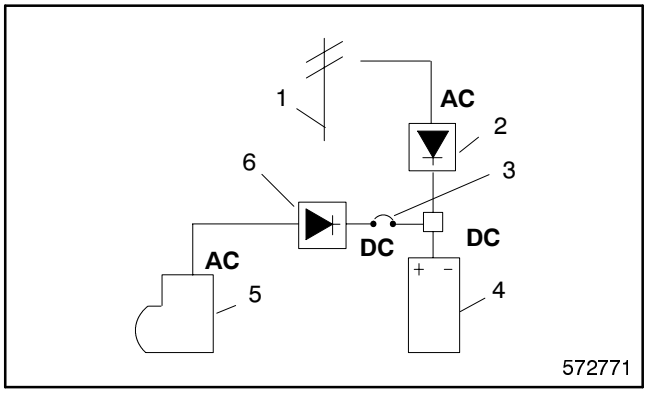
6.1 Generator Troubleshooting

Use Section 6 as a guide to check generator components for improper operation and to perform component adjustment. Use Section 3—General Troubleshooting as a guide to identify potentially defective components. During all test procedures, observe the safety precautions in this manual.

6.2 Theory of Operation

The COM-6 generator functions coordinate with the Telco cabinet control systems and rectifiers to provide power to communications equipment during a utility power failure. When utility power fails, the Telco control system signals the generator to start via the AC Fail Start command circuit. The unit starts after a time delay and provides DC power for continued system operation. COM-6 generator output voltage, 2.12 volts per cell, does not harm batteries even under high battery temperature conditions.

The Kohler CH20 engine drives a direct-connected variable-speed, 3-phase, special-voltage generator to produce high-frequency AC power. A 3-phase, full-wave rectifier in the control system rectifies the output to produce low-ripple DC power. The controller routes the low-ripple DC output through a filter system of capacitors and an inductor to smooth the wave form to nearly pure DC. The output line circuit breaker protects downstream devices from overcurrent and also disconnects the generator from the load for servicing and testing. Refer to Figure 6-2.



1. Utility power
2. Telco power system rectifiers
3. COM-6 line breaker
4. System batteries
5. COM-6
6. COM-6 rectifier and filter

Figure 6-2. COM-6 Operation

6.3 Permanent-Magnet Generator

The COM-6 uses a permanent-magnet generator. Increased generator RPM increases output voltage. Conversely, increased system load at any RPM decreases generator voltage. The control system increases generator set RPM to maintain generator output voltage. Consequently, the generator set operates at fixed voltage and low speeds under light loads and at higher speeds as load increases.

During normal operation, the controller filter capacitors charge to operating voltage. With the control system breaker open and the generator set not running, the capacitors discharge over a period of several minutes through bleeder resistors directly connected across the capacitor terminals. The filter capacitors hold charge voltage. When the breaker is open, the bleeder resistors connected across the capacitors are the only load on the generator set. Precise voltage control is difficult when operating with the resistors as the only load. The unit starts successfully at low capacitor voltage. In situations where the generator set is idle for several minutes with the system batteries connected and the control system breaker open, minimize surge current flowing to the filter capacitors by starting and running the generator set before closing the system breaker.

6.4 Voltage Regulator Test—Microprocessor

The microprocessor controller monitors the filtered DC output voltage. To verify accurate voltage control, increase and decrease loads while measuring DC output voltage at the DC voltage test jacks on the front of the controller. Voltage should remain approximately 26 or 52 vdc as RPM increases or decreases in response to load changes.

If voltage falls below 26 or 52 vdc as load increases or decreases, check for the following problems:

- Inadequate fuel supply
- Fuel solenoid malfunction (See Fuel Solenoid Check Procedure below)
- Fuel metering valve malfunction (See Section 6.11.3 Metering Valve Adjustment)

If none of the problems exists and voltage falls below 26 or 52 vdc, have the unit serviced by an authorized distributor.

6.4.1 Testing Voltage

Starting the unit with the circuit breaker open may cause an immediate overvoltage shutdown. The overvoltage shutdown occurs because the voltage rise at start-up combines with the charged filter capacitor voltage. An overvoltage shutdown is not unusual when the circuit breaker is open and the unit is operating without a load. Normal generator set operation with a closed circuit breaker and connected system batteries does not cause overvoltage.

6.4.2 Restarting the COM-6

If overvoltage shutdown occurs, close the circuit breaker and apply load or wait for the capacitors to discharge to 1/2 of rated voltage before restarting the unit. Verify voltage at test jacks with a voltmeter.

6.5 Fuel Solenoid (Gas Valve) Check Procedure

Momentarily apply 12 volts DC to the fuel valve terminals. A functional fuel valve solenoid actuates and clicks audibly. Remove power from solenoid immediately after test to avoid fuel flow.

6.6 Fault Test Procedures

Perform the following fault tests with the generator set running. Verify operation of the generator set high engine temperature, low oil pressure, overcrank, and overspeed shutdowns by grounding the corresponding wire per the following sections. If the tests indicate a controller shutdown malfunction, check wiring harnesses as described in Section 4—Controller Troubleshooting.

Many fault shutdown tests use the controller's generator master switch, labeled RUN-OFF-AUTO. Position the generator master switch to RUN to start the generator. Position the switch to OFF to stop the generator. The master switch in the OFF position disables the unit and resets the control system. The master switch in the AUTO position allows the generator set to start in response to a remote start signal from the cabinet power system.

6.6.1 High Engine Temperature

Ground the high engine temperature (HET) sensor, wire number 34, to shut down the COM-6 5 seconds after sensing the ground connection (fault condition). The controller ignores the high engine temperature shutdown fault for 30 seconds after engine start-up.

6.6.2 Low Fuel Pressure

Turn off the fuel supply to the running generator set so there is no fuel pressure at the fuel system inlet. The controller's low fuel LED illuminates. Restore the fuel supply quickly to prevent shutting down the unit by fuel starvation.

6.6.3 Low Oil Pressure

Ground the low oil pressure (LOP) switch at its terminal. Low oil pressure shutdown occurs 5 seconds after shorting the switch. The controller disables the low oil pressure shutdown for the first 30 seconds after initial unit start-up.

6.6.4 Overcrank

To test the overcrank shutdown, disconnect wires from the fuel solenoid to prevent starting. Position the generator set master control switch to RUN. The COM-6 should crank for 20 seconds, rest for 5 seconds, crank for 20 seconds, etc., until a 70-second sequence completes. The generator set then shuts down and the overcrank fault LED on the controller front panel illuminate.

6.6.5 Overspeed

NOTE

Do not test the Overspeed Fault Shutdown.

There is no overspeed fault shutdown test procedure. Do not attempt to raise engine speed above 3650 RPM. Voltage rises as RPM increases and may damage connected equipment, batteries, and generator set.

6.7 Electronic Governor System

The governor system regulates engine speed to achieve specified system DC output voltage. The governor system consists of an electronic governor control and stepper motor actuator. This is a closed-loop system which provides voltage and speed regulation. If system DC output voltage falls or rises, the voltage regulation system signals the governor to increase or decrease engine speed. This voltage regulation system maintains voltage within specifications.

6.7.1 Governor Checks

NOTE

Do not touch or move the linkage between the stepper motor and carburetor while the engine is running; overvoltage, erratic operation and other undesirable voltage changes can occur.

The factory-set electronic governor does not require adjustment. If the unit operates erratically, check the following items:

- Check electrical connections such as the stepper motor, DC-sensing leads at circuit breaker, and controller for clean and tight connections.
- Check fuses.
- Check the speed-sensing connections at the bridge/rectifier. Poor connections may cause an erratic signal which may or may not cause the unit to shut down.
- Check electrical ground connections. The power conditioner requires a good DC ground.
- Check for stepper motor/throttle shaft linkage binding or wear. The linkage arm and lever arms must not bind or rub against other components while moving.

6.7.2 Governor Adjustment Procedure

Use the following procedure to adjust a removed or tampered-with governor:

1. Check that the linkage rod connects to the throttle lever and the stepper motor arm. Also check that the linkage does not bind or rub as it moves. Readjust linkage if it binds.
2. Verify that the governor stepper motor operates with steady and smooth movement. If movement of stepper motor is erratic or large changes in movement occur, check for the following: shaft misalignment, linkage binding, and broken or loose wiring including plug connections.

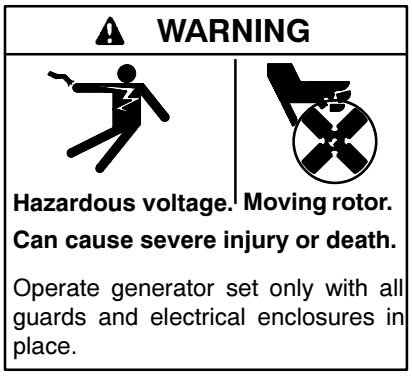
3. Test stepper motor operation as follows.
   a. Remove fuse F1 to remove governor control power.
   b. Manually move the governor linkage fully counterclockwise (open throttle).
   c. Reconnect fuse F1 or positive battery lead. Stepper motor should move clockwise (closed throttle) with a noticeable clicking sound. The stepper motor should remain in the closed throttle position. If stepper motor does not remain in the closed throttle position, replace the stepper motor. Before replacing the stepper motor, verify the proper operation of the power conditioner.

NOTE

Chattering at the end of stepper motor travel is not a problem as long as the stepper motor rotates smoothly through its clockwise travel. The throttle plate resetting against the closed throttle stop creates the chattering.

6.8 Stator

The stator produces electrical output (AC) as the permanent magnet rotor rotates within the stator windings. Perform the following procedures sequentially to test stator condition:



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

Check stator leads.

1. Disconnect generator starting battery (negative lead first).
2. Check the generator output leads for connections per wiring diagrams in Section 8.
3. Check condition of AC generator leads AC1, AC2, and AC3 at stator. Replace leads with evidence of breaks, cracks, or discoloration from overheating.
4. Check AC generator leads AC1, AC2, and AC3 at AC input to power conditioner at the stator and rectifier module to ensure there are no loose connections. Tighten loose connections.

Check stator windings.

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.

5. Disconnect all stator leads from the power conditioner to isolate the windings.
6. To check stator continuity, set ohmmeter on R x 1 scale.
7. Connect the red and black ohmmeter leads together: adjust ohmmeter to zero ohms.
8. Check continuity by connecting meter leads to stator leads. Perform continuity checks on all stator windings according to the following chart:

NOTE

The 24-volt stator is a 6 lead dual-wye stator. One wye consists of leads 1, 2 and 3. The other wye consists of leads 7, 8 and 9.

Between Leads	Continuity
1 and 2	yes
2 and 3	yes
1 and 3	yes
7 and 8	yes
8 and 9	yes
7 and 9	yes
Any stator lead and ground	no

Figure 6-3. 24-volt Stator Continuity

Between Leads	Continuity
1 and 2	yes
2 and 3	yes
1 and 3	yes
Any stator lead and ground	no

Figure 6-4. 48-volt Stator Continuity

Check stator winding resistance.

9. Connect ohmmeter leads and readjust ohmmeter to zero ohms.

10. Check cold resistance of stator windings by connecting meter to stator leads. Refer to Figure 6-5 for typical stator winding resistances.
11. If the stator resistance test proves inconclusive, perform a megohmmeter test on stator as described in the next step.

Stator	Resistance (Ohms) ±10%
24 vdc 3-phase dual wye	0.0056 within wye
48 vdc 3 lead	0.045

Figure 6-5. Line-to-Line Stator Winding Resistance

NOTE

Most ohmmeters do not accurately measure less than one ohm. Consider the stator functional if resistance reading is low (continuity) and there is no evidence of shorted windings (heat discoloration) or continuity to ground.

Perform megohmmeter test on stator.

12. Verify that the stator is grounded. Use a megohmmeter to apply 500 volts DC to any stator lead and the stator frame. (Follow the megohmmeter manufacturer's instructions when performing this test.)
13. Repeat test on the remaining leads. A reading of 500K ohms (1/2 megohm) and higher verifies stator functionality. A reading of less than 500K ohms indicates deterioration of winding insulation and possible current flow to ground. Repair or replace the stator.

6.9 Speed Sensing

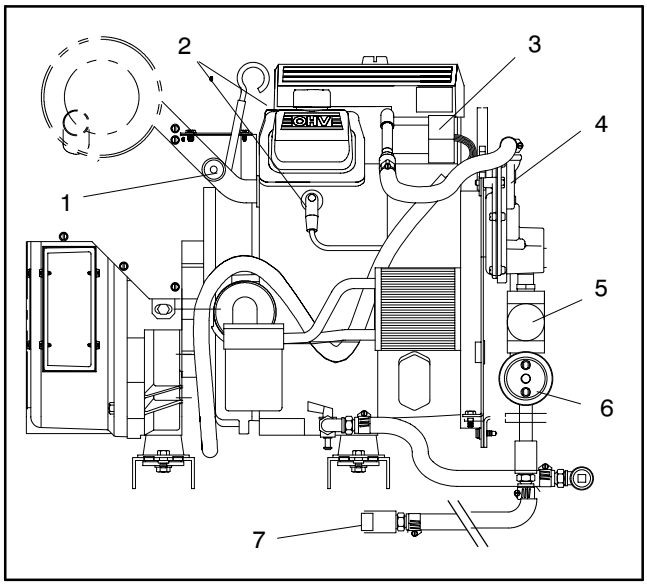
The microprocessor senses the frequency of AC output and interprets the frequency as engine speed. The generator set shuts down when frequency exceeds 730 Hz (3650 RPM).

Refer to Voltage Regulator Test—Microprocessor for speed sensing testing.

6.10 Fuel Regulation System

Use the following procedures and the flowcharts in Section 5—Generator/Controller Troubleshooting to troubleshoot fuel regulation system and emission control system problems.

The gas fuel system is factory-adjusted for natural gas. The fuel system can also be used with LP fuel. The fuel system uses a fuel solenoid valve to control fuel flow to the fuel pressure regulator. The regulator reduces fuel pressure to nil as fuel passes to the fuel-control valve. The fuel-control valve, under the control of an emission control module, manages fuel metering under varying load and speed conditions. The emission control module adjusts the fuel metering valve to maintain minimum emissions as sensed by an oxygen sensor in the exhaust. The carburetor or mixer receives gaseous fuel and mixes it with intake air for consumption by the engine.



1. Oxygen sensor
2. Spark plug (quantity 2)
3. Fuel control valve
4. Fuel pressure regulator
5. Fuel shutoff solenoid
6. Fuel pressure switch
7. Connection to fuel source (1/2 NPT)

Figure 6-6. COM-6 Service View, Fuel Regulation System

6.11 Exhaust Emissions System

The COM-6 emissions system controls engine exhaust emission levels and keeps them within emissions requirements. The emissions system does not require maintenance.

6.11.1 Principle of Operation

An oxygen sensor in the exhaust manifold, an electronic control unit and a stepper motor which drives a fuel metering valve control air/fuel ratio. The oxygen sensor measures oxygen in the exhaust stream. Too much oxygen indicates too little fuel, a lean operating condition. Too little oxygen indicates too much fuel, a rich operating condition. The sensor sends an electrical signal to the electronic control unit. After analyzing the signal, the electronic control unit sends a signal to the stepper motor to adjust the fuel metering valve, controlling the amount of fuel entering the engine. The emissions system maintains the air/fuel ratio within a set band under all operating conditions, minimizing exhaust emissions.

6.11.2 Emissions System Initialization

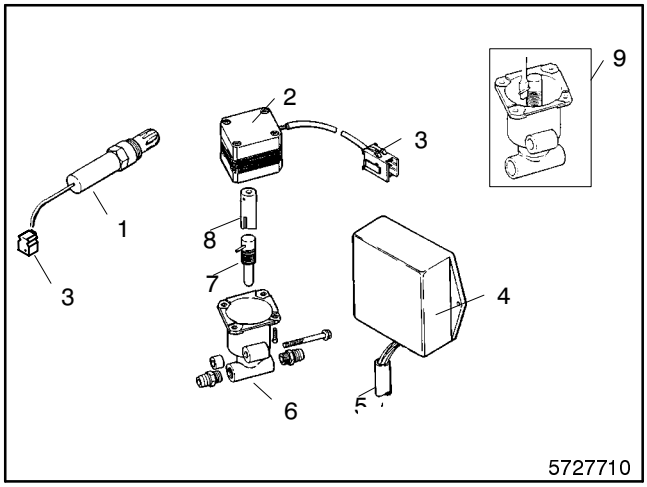
If the unit does not start or starts and runs poorly and all air has been purged from the fuel lines, the fuel mixture may be too rich. Starter cranking and false start attempts can cause the emission system to adjust fuel mixture to an excessively rich condition. If the unit runs roughly upon start-up, use one of the following procedures to reduce the fuel-to-air mixture of the operating generator set. Restrict the fuel flow for about 30 seconds or until the unit runs smoothly.

- Reduce fuel pressure by pinching the fuel hose between the fuel regulator and the engine. Do not use pliers or other similar tools as they can damage the hose.
- Reduce fuel pressure by turning the fuel supply valve off. The unit starts and runs until fuel runs out. Then turn fuel on and off intermittently until unit achieves stable operation. If the unit shuts down because of low fuel, turn fuel supply on and restart the generator set.

Automatic readjustment begins the first 20-30 seconds of engine operation. Once the emissions system stabilizes, the fuel mixture meets specifications.

6.11.3 Metering Valve Adjustment

Remove the stepper motor/fuel metering valve assembly from the engine. Remove the four small socket head screws and separate the fuel metering valve from the stepper motor. Try to turn the valve adjusting screw in the valve with a pencil or the blade of a small screwdriver. See Figure 6-7. The screw should turn easily. If the screw is stuck or binding, remove it from the valve body, clean the threads with solvent, and reinstall. Check it again for binding. Do not use any type of lubricant on the threads of the load-adjusting screw.



1. Oxygen sensor
2. DC stepper motor
3. To unit wiring harness
4. Electronic control unit
5. To unit wiring harness (12 volt source)
6. Fuel metering valve body
7. Fuel metering screw
8. Coupling
9. Valve adjusting screw

Figure 6-7. Emission Control System

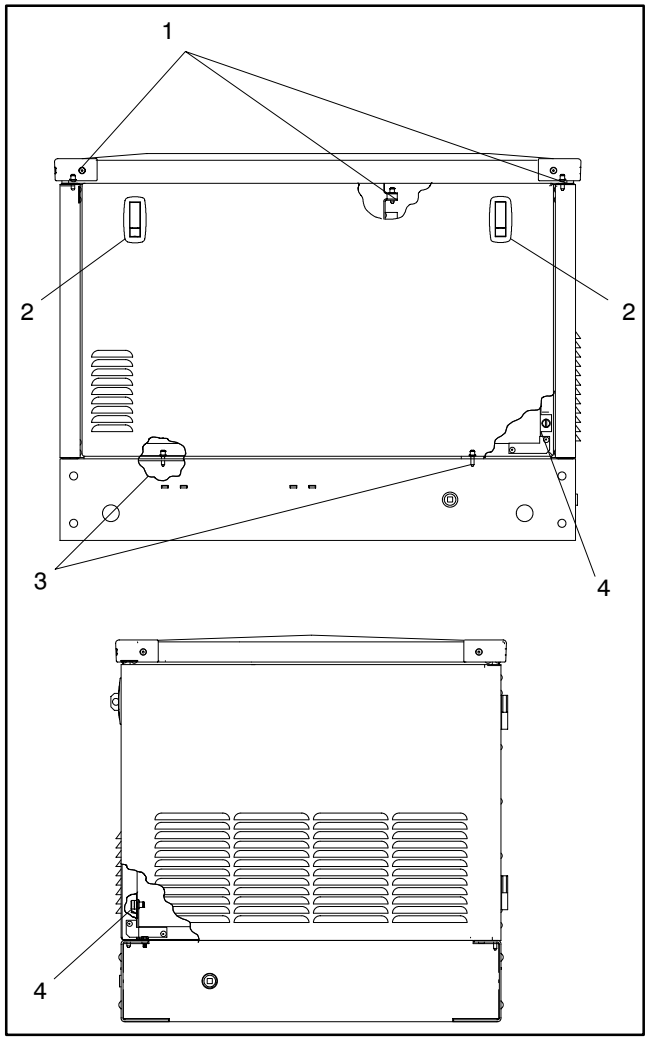
7.1 COM-6 Disassembly

The following steps describe unit disassembly and reassembly and component removal and replacement.

7.1.1 Sound Housing Removal

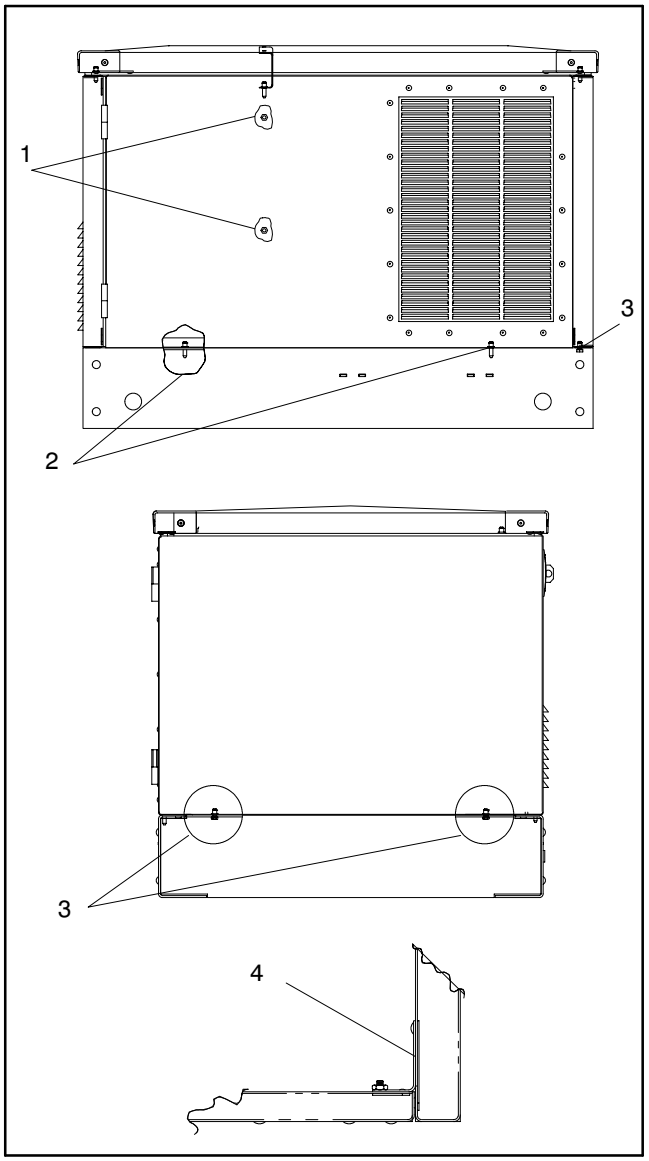
Partial removal

Perform the following steps to partially remove the sound housing for generator set maintenance. See Figure 7-1 and Figure 7-2.



1. Roof panel retaining pins
2. Service panel latches
3. Service panel retaining pins
4. Right side panel screw-type latch

Figure 7-1. Sound Housing Views (Service side, right side)



1. Inner panel/back panel mounting bolts
2. Bottom retaining pins
3. Left side panel mounting bolts
4. Bracket (Full access, step 1)

Figure 7-2. Sound Housing Views (Back side, Left side)

1. Open the latches on the service side of the sound housing.
2. Lift the service side panel to disengage the retaining pins. Remove the service side panel.

3. Lift the service side of the roof panel to disengage the retaining pins from the housing sides and the inner panel.
4. Slide the roof panel forward to disengage the retaining pins from the sound housing back panel. Remove the roof panel.
5. Unscrew the latch securing the right side panel. The right side panel is hinged to swing out for easy access to the controller and remains attached to the back panel for ease of removal and installation. Remove the right-side panel by swinging the panel out and lifting it off the hinge pins.

Full access

The left side and back panels are bolted to the skid. For greater accessibility, perform the following steps to complete sound housing removal.

1. Remove the bracket that attaches the left side and back panels of the sound housing.
2. The back panel is held to the inner panel by two bolts. Remove the bolts and lift the back panel to disengage the retaining pins. Remove the back panel.
3. Remove the two bolts holding the left side panel to the skid. Remove the side panel.

7.1.2 Generator Set Disconnection

Perform the following steps to disconnect the generator set for any maintenance.

1. Disconnect battery, negative lead first.
2. Disconnect AC power cord from battery charger AC input on rear of controller.
3. Disconnect generator power leads from the rectifier inside the controller.
4. Disconnect the DC leads from the negative stud and the line circuit breaker. To prevent short circuits, immediately insulate both leads with electrical tape after removal.
5. Disconnect the engine harness connector at the rear of the controller.
6. Disconnect the fuel system hose from the fitting on the fuel control valve at the front of the engine.
7. Remove ducting from around the generator set assembly as described in Section 7.1.3.

7.1.3 Muffler Removal

Perform the following steps to remove the ducting and muffler. Refer to Figure 7-3.

Muffler Removal

1. To expose the muffler, remove the hex-head screws that hold the top and front of the muffler duct.
2. Disconnect the electrical lead to the oxygen sensor and then remove the oxygen sensor.
3. Remove the bolt holding the exhaust mounting bracket to the bottom of the air box assembly and alternator housing.
4. Remove the four flange nuts holding the muffler flanges to the engine exhaust ports.
5. Remove the tail pipe/spark arrestor assembly.

Muffler Installation

1. Install new exhaust flange gaskets.
2. Reinstall the tail pipe/spark arrestor assembly.
3. Position the muffler flanges over the engine exhaust flange studs and attach the muffler using the four flange nuts removed in step 4 of Muffler Removal. Use a calibrated torque wrench to torque the flange nuts to 88 in. lbs.
4. Reinstall the bolt that holds the exhaust mounting bracket to the bottom of the air box assembly and alternator housing.

NOTE

Apply high temperature anti-seize compound (Loctite® No. 767) to the oxygen sensor's threads before reinstalling in the exhaust manifold. Replacement sensors have dry antiseize compound preapplied to the threads; do not use additional compound.

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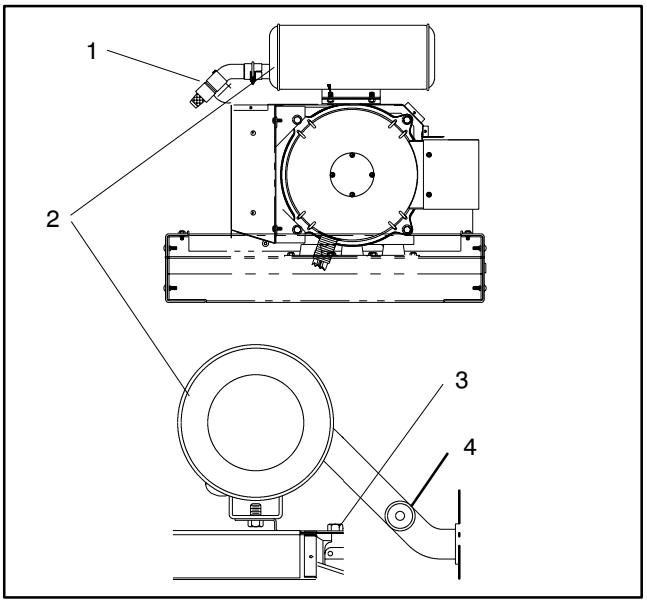
5. Reinstall the oxygen sensor and reconnect the electrical lead.
6. Reassemble the muffler ductwork.



1. Tail pipe/spark arrestor
2. Muffler
3. Exhaust mounting bracket bolt
4. Oxygen sensor

Figure 7-3. Muffler Assembly

7.1.4 Controller Board Replacement

Perform the following steps to replace the controller board. To gain access to the inside of the controller, remove the screws that hold the top and side of the controller housing. Replace the housing after completing controller maintenance.

Controller Board Removal

1. Disconnect the three interface connectors to the controller board.
2. Gently pry the controller board loose from the standoffs.
3. Remove the controller board by sliding it to the rear so that the LEDs and switches clear the front of the controller.

Controller Board Installation

1. Slide the controller board into place so that the LEDs and switches protrude through the face of the controller.
2. Gently press the controller board onto the standoffs until it snaps into place.
3. Reconnect the three interface connectors to the controller board.

7.1.5 Rectifier Replacement

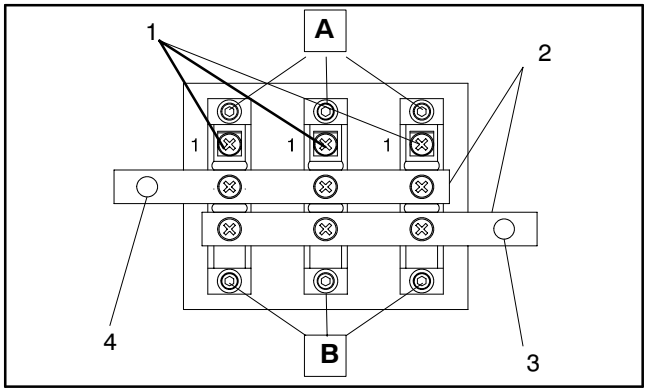
Perform the following steps to replace the rectifier module. To gain access to the rectifier, remove the controller housing as described in Section 7.1.4.

24 volt Rectifier Removal

1. Disconnect the generator power leads from the rectifier diodes. See Figure 7-4.
2. Disconnect sensing leads from the diodes and the bus bar.
3. Remove the lead connecting the bus bar to ground.
4. Remove the lead connecting the bus bar to the inductor.
5. Remove the six socket head screws labelled A and B in Figure 7-4.
6. Remove the rectifier.

24 volt Rectifier Installation

1. Place the new rectifier over the power module insulators.
2. Reinstall the six socket head screws and finger tighten.
3. Torque the screws labelled A to 15 in. lbs.
4. Torque the screws labelled B to 15 in. lbs.
5. Retorque the B screws to 35±5 in. lbs.
6. Retorque the A screws to 35±5 in. lbs.
7. Reattach the lead connecting the bottom bus bar to the inductor.
8. Reattach the lead connecting the top bus bar to ground.
9. Reattach all additional leads per the wiring diagram in Figure 8-2. Torque diode terminal screws to 35±1.75 in. lbs.



1. Rectifier diodes
2. Bus bar
3. Ground connection
4. Inductor connection

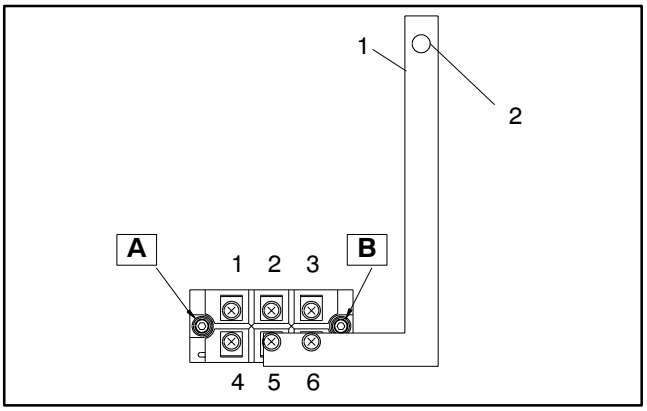
Figure 7-4. 24 Volt Rectifier Module

48 volt Rectifier Removal

1. Disconnect the generator power leads from the rectifier diodes labelled 1, 2 and 3.
2. Disconnect sensing leads from the diodes.
3. Disconnect the bus bar from the ground connection.
4. Remove the two socket head screws labelled A and B.
5. Remove the rectifier.

48 volt Rectifier Installation

1. Place the new rectifier over the power module insulators.
2. Reinstall the two socket head screws and finger tighten.
3. Torque the screw labelled A to 15 in. lbs.
4. Torque the screw labelled B to 15 in. lbs.
5. Retorque the B screw to 53±8 in. lbs.
6. Retorque the A screw to 53±8 in. lbs.
7. Reattach the bus bar to the ground connection.
8. Reattach all additional leads per the wiring diagram in Figure 8-6.



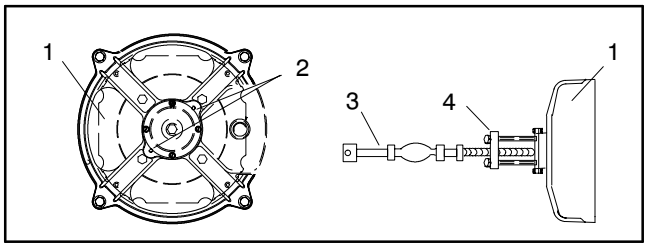
1. Bus bar
2. Ground connection

Figure 7-5. 48 Volt Rectifier Module

7.1.6 Alternator Disassembly

Perform the following steps to disassemble the alternator for maintenance.

1. Remove the top of the airbox assembly and muffler as described in Muffler Removal in Section 7.1.3.
2. Remove the four bolts holding the bottom half of the airbox assembly to the alternator housing.
3. Remove four screws from bearing cover.
4. Remove end bracket bolts.
5. Loosen the small set screw holding the ball bearing in place.
6. Use a puller or slide hammer to remove the end bracket. The end bracket has two 1/4 in. threaded holes, four inches apart, for use with an adapter bar. Refer to Figure 7-6.



1. End bracket
2. Two 1/4-20 in. holes, four inches apart, for use with slide hammer or puller
3. Slide hammer
4. adapter with long bolts attached to end bracket 1/4 in. holes

Figure 7-6. Remove End Bracket

7. Remove socket head screws which retain stator. Refer to Figure 7-7.

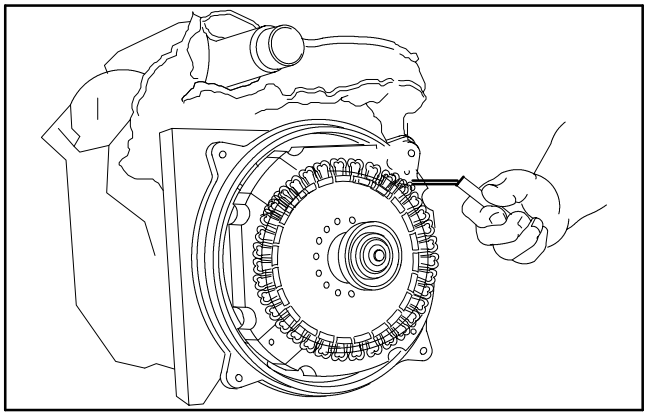


Figure 7-7. Remove Socket Head Screws

8. Grasp stator firmly and pull straight out to prevent damage to stator laminations. Refer to Figure 7-8.

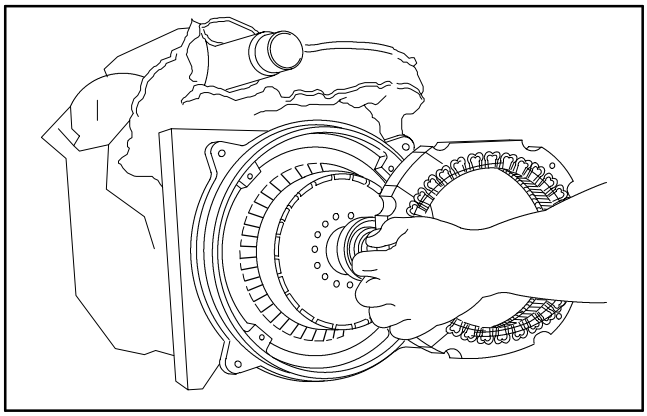


Figure 7-8. Remove Stator

9. Loosen the thrubolt. Refer to Figure 7-9.

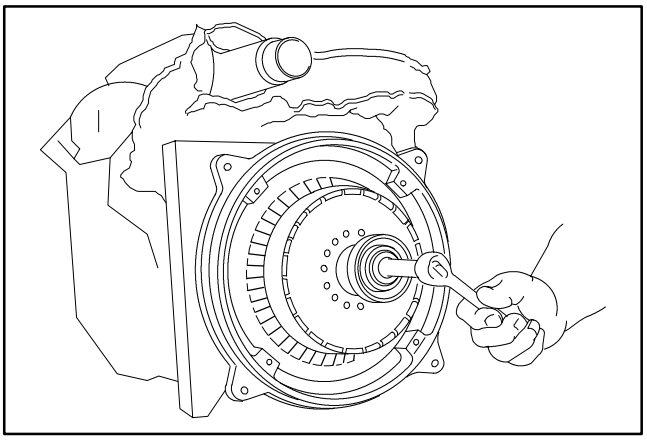


Figure 7-9. Loosen Thrubolt

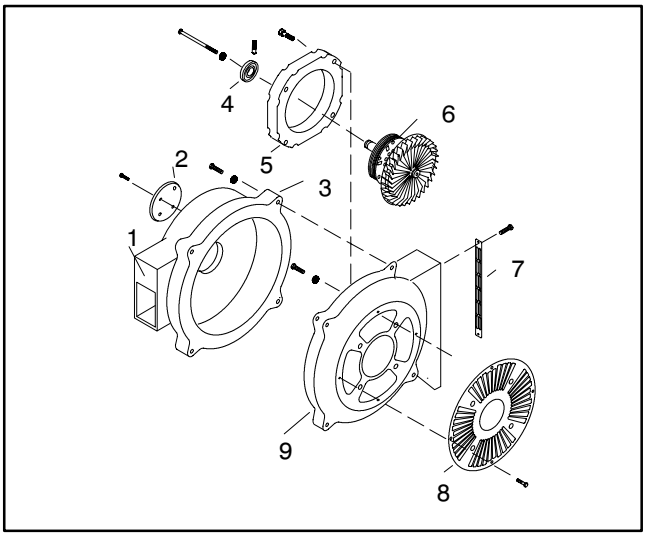
10. Loosen the rotor by lightly tapping on alternate sides with a rubber mallet. Use only a rubber mallet to prevent damage to the bolt.
11. Remove thrubolt and rotor.

7.2 COM-6 Reassembly

The following sections describe COM-6 component reinstallation and unit reassembly.

7.2.1 Alternator Reassembly

Follow the step-by-step procedures listed on the following pages. Refer to Figure 7-10 for a diagram on complete alternator reassembly.



1. Intake duct (insulation inside)
2. Bearing cover
3. End bracket casting
4. Ball bearing
5. Stator
6. Rotor and fan assembly
7. Air outlet guard
8. Air inlet guard
9. Alternator adapter casting

Figure 7-10. Alternator (exploded view)

Reassemble the Alternator

1. Apply antiseize thread compound to taper of engine crank shaft to ease future removals. Refer to Figure 7-11.

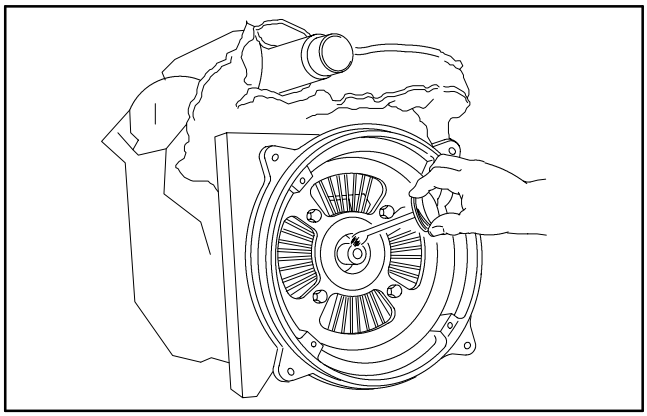


Figure 7-11. Apply Antiseize Compound

2. Clean and reinstall the rotor and thrubolt. Remove any magnetically held debris.
3. With a strap wrench around the rotor, torque the thrubolt to 28 ft. lbs. (38.0 Nm). See Figure 7-12.

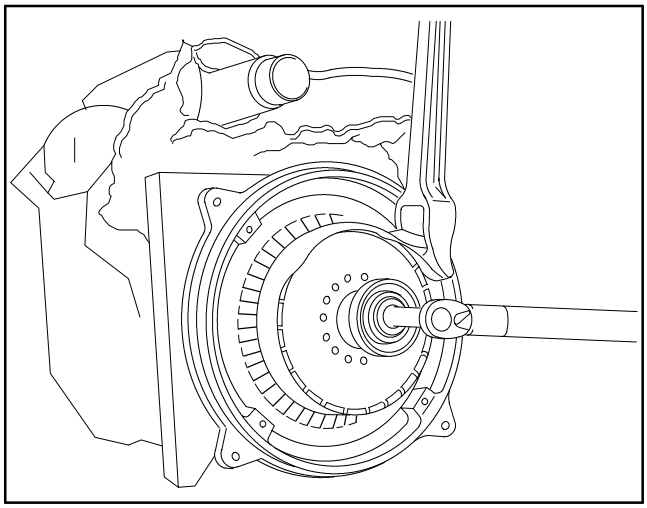


Figure 7-12. Torque Thrubolt

4. Reinstall the stator. Be careful not to pinch fingers between the stator and adapter. Magnets are very strong and cause the stator to quickly snap over the magnetized rotor. Place a guide pin or headless bolt in the stator mounting screw holes as a guide for reinstalling the stator. Stator damage can occur if it is not installed correctly.
5. Install stator with leads in lower left position by sliding over guides until fully installed on casting bosses.
6. Remove guides. Clean, install, and torque the socket head screws to 8 ft. lbs. (10.8 Nm). Refer to Figure 7-13.

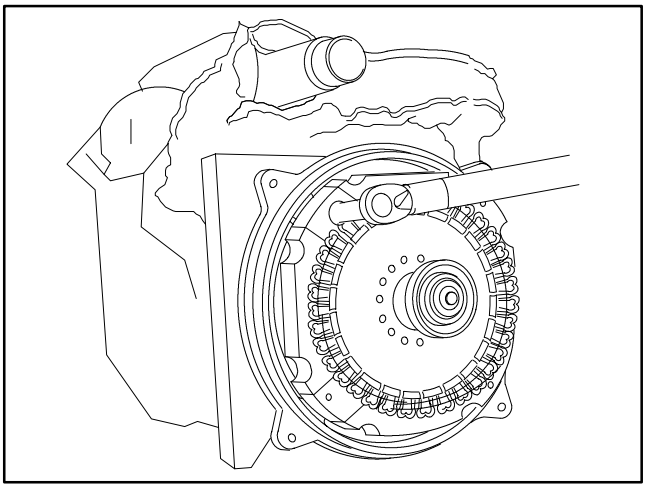


Figure 7-13. Torque Socket Head Screws

7. Route stator leads through port in end bracket. Align end bracket on stator assembly and rotor bearing. Inspect leads for signs of wear. Repair or replace as needed.
8. Clean, install and torque end bracket bolts to 28 ft. lbs. (38.0 Nm). Install the end bracket using the A, B, C, D tightening sequence shown in Figure 7-14.

NOTE

Do not install end bracket on rotor by tightening bolts. End bracket, engine, and/or generator adapter damage can result. Fully install and seat the end bracket casting against mating casting before installing bolts.

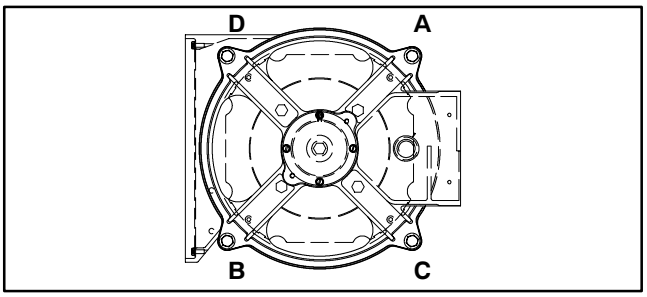


Figure 7-14. End Bracket: A, B, C, D Tightening Sequence

9. Replace the bearing cover and install screws.
10. Replace the set screw, but do not torque until after running the generator set to allow the bearing to center. After running the generator set torque the set screw to 18 ft. lbs. (24.4 Nm).
11. Reinstall the bottom half of the air box.
12. Reinstall the muffler and the top half of the air box as described in Section 7.1.3.

7.2.2 Sound Housing Reinstallation

Perform the following steps to reinstall the sound housing. See Figure 7-1 and Figure 7-2.

1. Reinstall the two bolts holding the left side panel to the skid.
2. Slide the back panel retaining pins into their inserts in the skid. Reinstall the two bolts holding the back panel to the inner panel.
3. Reinstall the bracket that attaches the left side and back panels of the sound housing.
4. Swing the right-side panel into its closed position and engage the latch.
5. Position the roof panel over the side and back panels and slide backward to engage the retaining pins in the back panel.
6. Lower the roof panel to engage the retaining pins in the service side of the roof panel into the slots in the right side, left side and inner panel.
7. Insert the service panel retaining pins into the slots in the skid.
8. Tilt the service panel into position and press in gently to latch.

Section 8. Wiring Diagrams

This manual applies to the model and specification numbers following. This manual may be used for similar unlisted specs or new specs created prior to the updated reprint or in cases where the manual is deemed an acceptable substitute for a manual under development.

Use the Wiring Diagram list to determine the information for a given model and spec number. Find that version number in the Controller Wiring Diagram Reference below and turn to the page listed.

Wiring Diagrams Reference

Controller Description	Drawing No.	Pg.
COM-6 Microprocessor Controller		
Generator Point-to-Point (24 vdc)	345243	37
Controller Point-to-Point (24 vdc)	A-345233, sheet 2	38
Controller Schematic Diagram (24 vdc)	ADV-6306	39
Generator Point-to-Point (48 vdc)	345334	40
Controller Schematic Diagram (48 vdc)	ADV-6325	41
Controller Interconnection Diagram (48 vdc)	A-345315, sheet 2	42

Notes

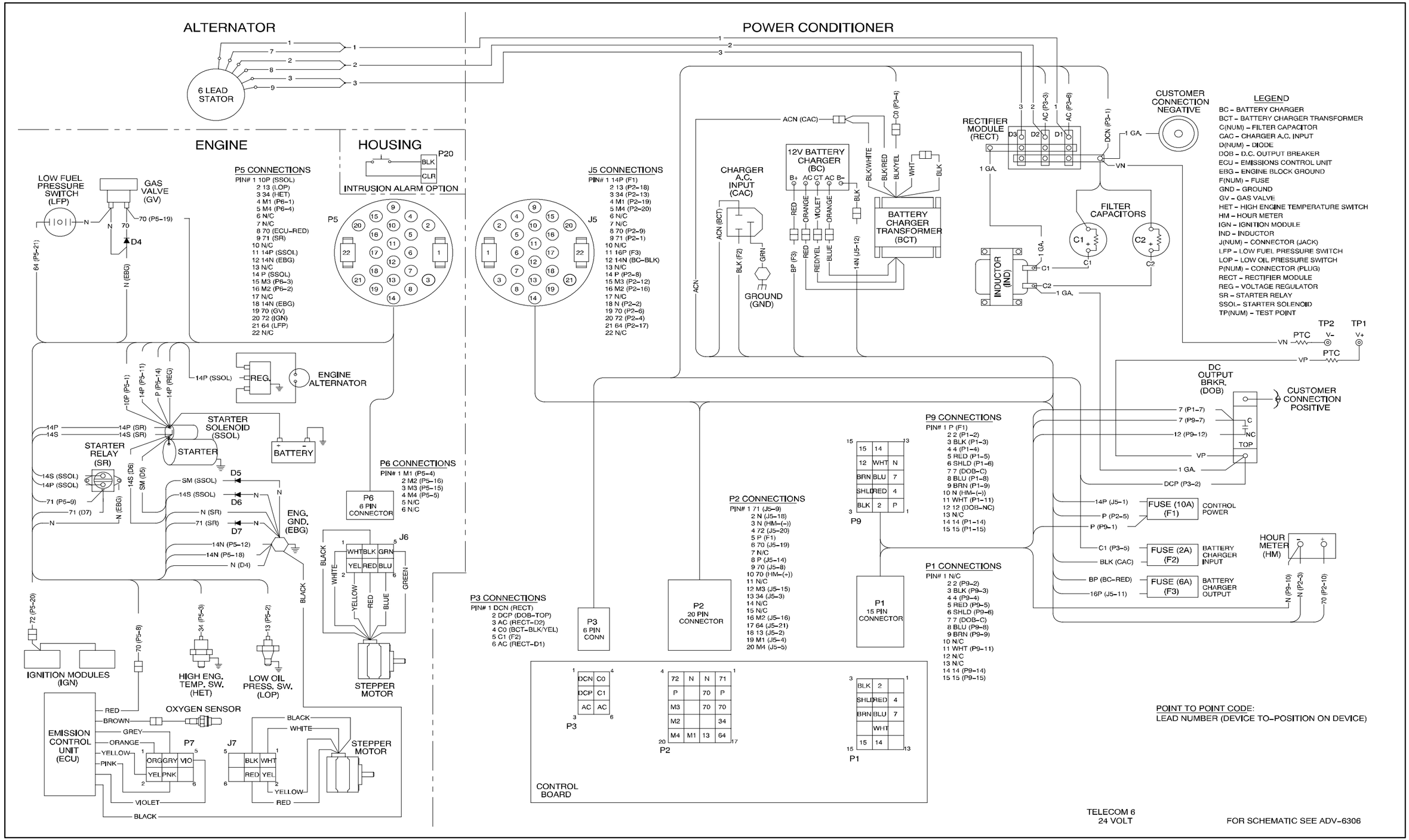


Figure 8-1. Generator Point to Point Diagram, (24 vdc 345243)

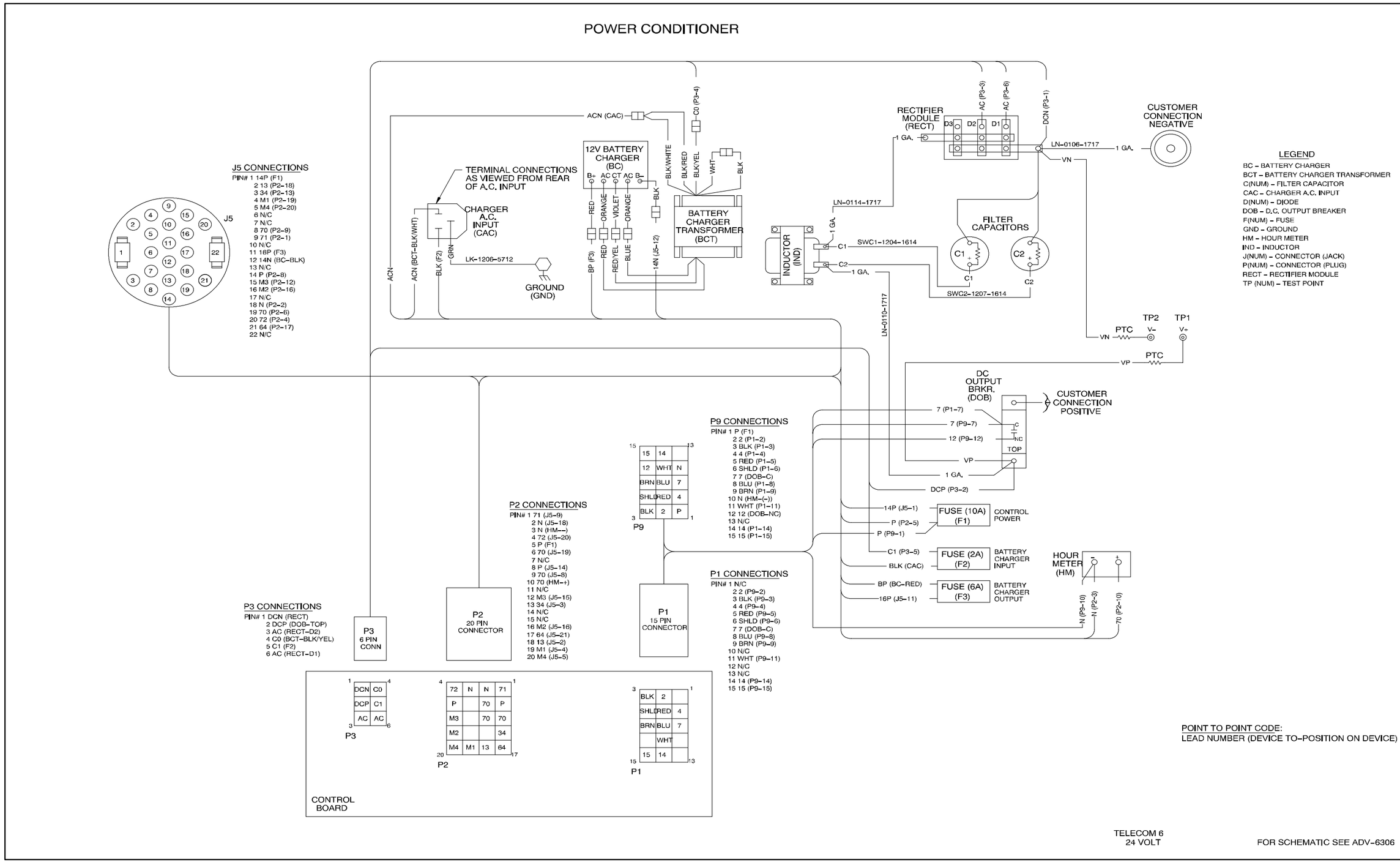


Figure 8-2. Microprocessor Controller, Point-to-Point Wiring Diagram, A–345233

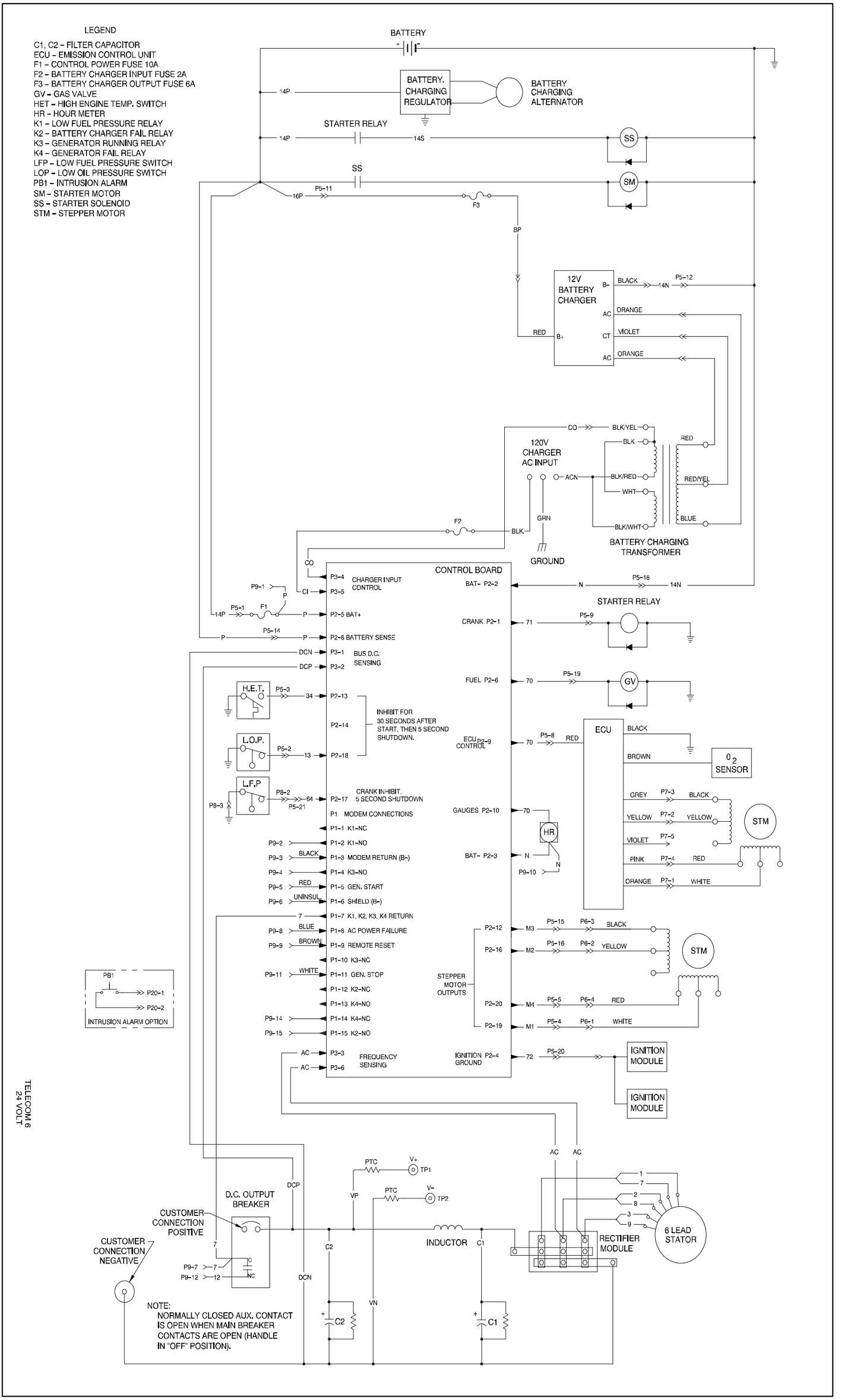


Figure 8-3. Microprocessor Controller, Schematic Diagram, ADV-6306

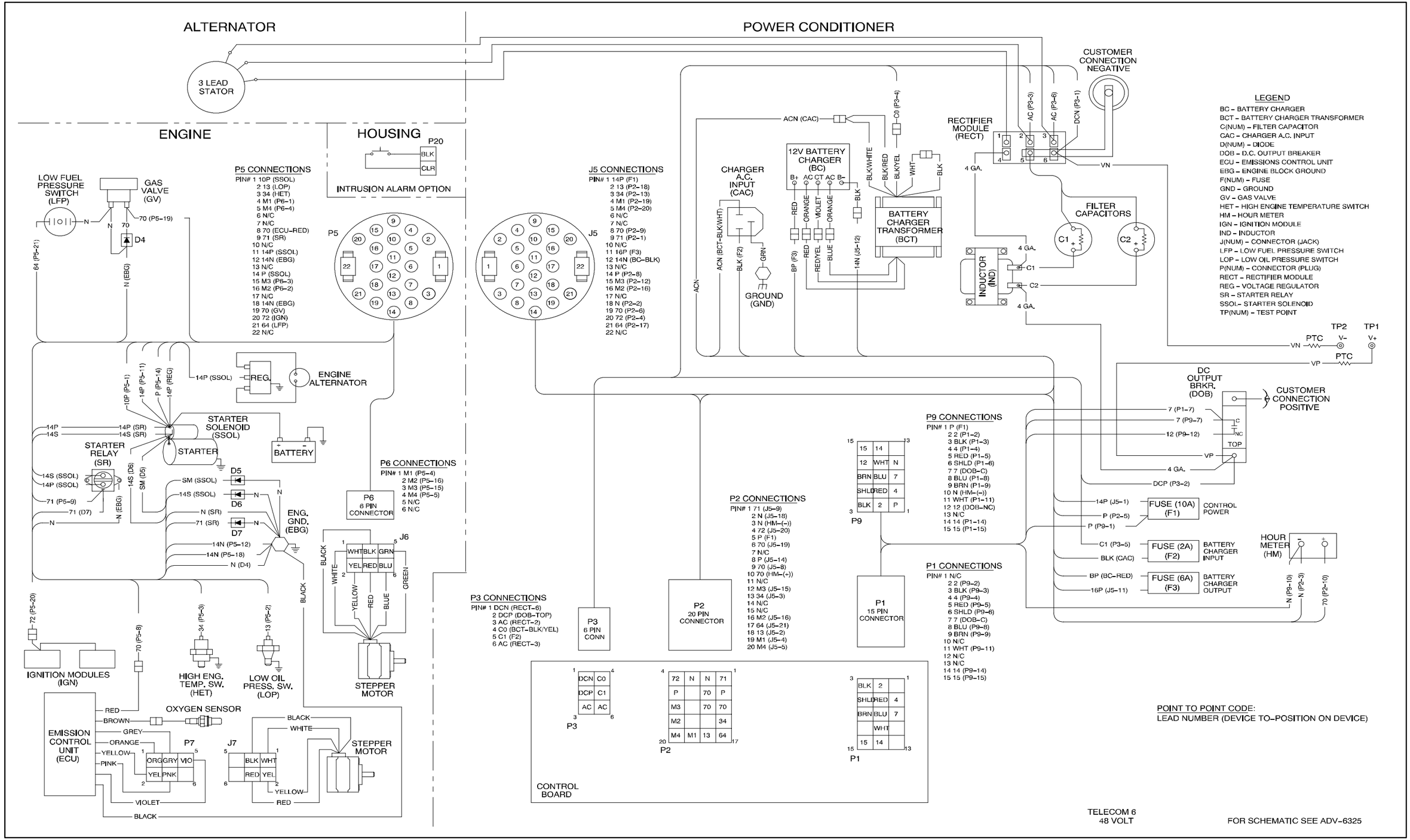


Figure 8-4. Microprocessor Controller, Point-to-Point Wiring Diagram, (48 vdc) 345334

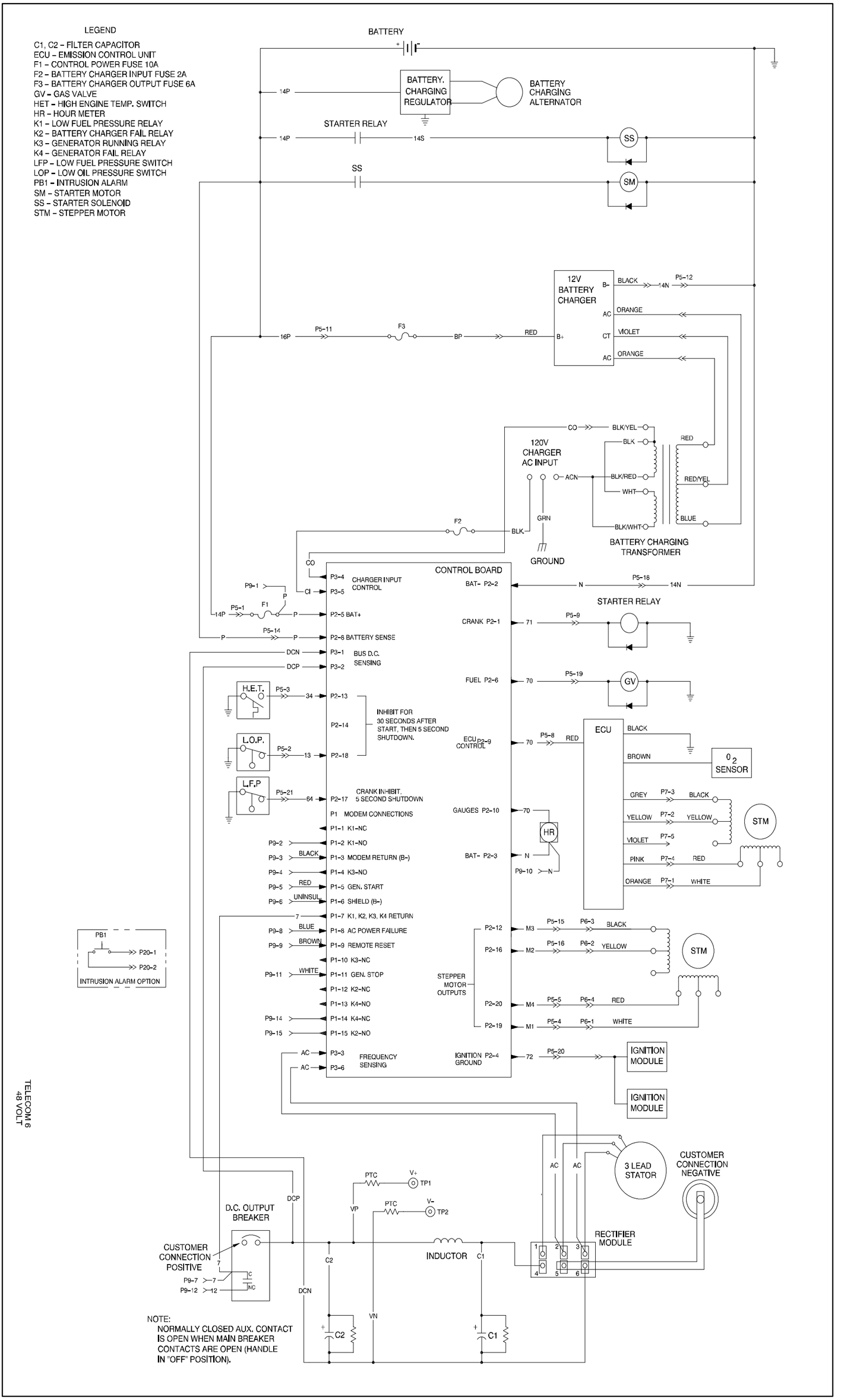


Figure 8-5. Microprocessor Controller, Schematic Diagram, (48 vdc ADV-6325)

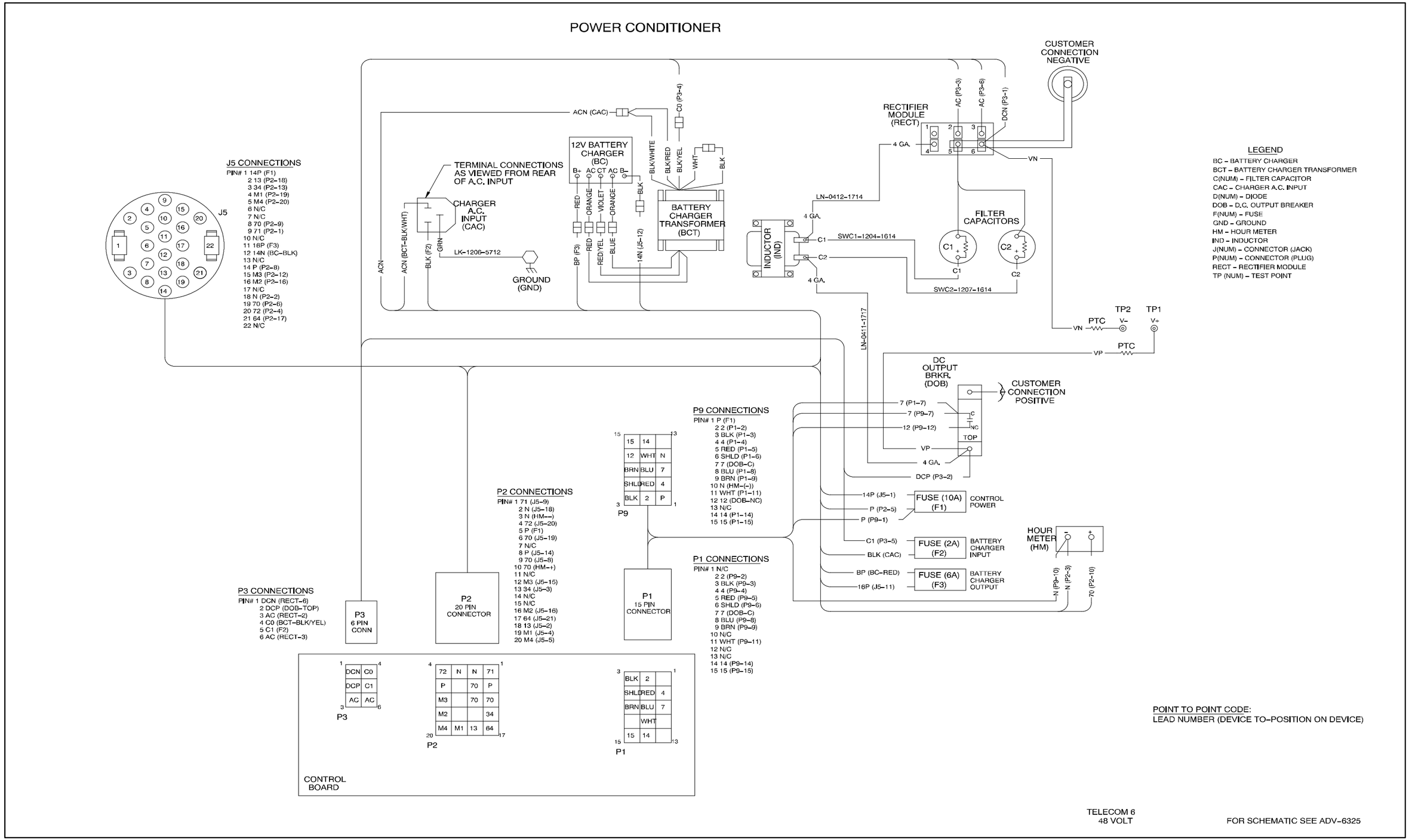


Figure 8-6. Microprocessor Controller, Interconnection Diagram, (48 vdc A–345315)

Appendix A. Glossary of Abbreviations

Abbreviations are used throughout this manual. Normally in the text they will appear in complete form with the abbreviation following in parenthesis the first time they are used. After that they will appear in the abbreviated form. The commonly used abbreviations are shown below.

AC	alternating current
AISI	American Iron and Steel Institute
Amp	ampere
Amps	amperes
ANSI	American National Standard Institute
API	American Petroleum Institute
approx.	approximate, approximately
A/R	as required, as requested
A/S	as supplied, as stated, as suggested
ASA	American Standards Association
ASME	American Society of Mechanical Engineers
assy.	assembly
ASTM	American Society for Testing Materials
ATDC	after top dead center
aux.	auxiliary
AWG	American Wire Gauge
AWM	appliance wiring material
BBDC	before bottom dead center
BDC	before dead center
BHP	brake horsepower
bmep	brake mean effective pressure
Btu	British thermal unit
°C	Celsius degree
cc	cubic centimeter
CCA	cold cranking Amps.
CEC	Canadian Electrical Code
cfh	cubic feet per hour
cfm	cubic feet per minute
CID	cubic inch displacement
cm	centimeter, centimeters
cmm	cubic meters per minute
co.	company
cont'd.	continued
CSA	Canadian Standards Association
CT	current transformer
cu. in.	cubic inch, cubic inches
cyl.	cylinder
dB	decibel
dBA	decibels (A weighted)
DC	direct current
DCR	direct current resistance
deg.	degree
dept.	department
dia.	diameter
e.g.	example given
EIA	Electronic Industries Association
EMI	electromagnetic interference
EPA	Environmental Protection Agency
etc.	et cetera (and so forth)
ext.	external
°F	Fahrenheit degree
fl. oz.	fluid ounce, fluid ounces
FM	frequency modulation
ft.	foot, feet
ft. lbs.	foot pound, foot pounds
ga.	gauge (meters, wire size)
gal./ gals.	gallon, gallons
gph	gallons per hour
gpm	gallons per minute
gr.	grade
grd.	ground
HCHT	high cylinder head temperature
HET	high exhaust (or engine) temperature
Hg	mercury (element)
H_2O	water
HP	horsepower
hr, hrs	hour
Hz	hertz (cycles per second)
ID	inside diameter
IEEE	Institute of Electrical and Electronic Engineers
in.	inch(es)
inc.	incorporated
in. lbs.	inch pounds
int.	internal
int.-ext.	internal-external
ISO	International Standards Organization
J	joule, joules
JIS	Japanese Industry Standard
kg	kilogram, kilograms
kg/cm^2	kilograms per square centimeter
kgm	kilogram meter(s)
kJ	kilojoules (btu cal)
km	kilometer, kilometers
kPa	kiloPascal, kiloPascals
kph	kilometers per hour
kV	kilovolt
kVA	kilovolt amperes
kW	kilowatt, kilowatts
kWH	kilowatt hour
L	liter, liters
LxWxH	length x width x height
LED(s)	light emitting diode
lb., lbs.	pound, pounds
L/hr.	liter per hour, liters per hour
L/min.	liter(s) per minutes
LOP	low oil pressure
LP	liquefied petroleum
m	meter, meters
m^3	cubic meter, cubic meters
max.	maximum
MCM	one thousand circular mils.
meggar	megohmmeter
MHz	megahertz
mi.	mile, miles
mil	one one-thousandth of an inch
min.	minimum
mJ	millijoule, millijoules
MJ	mega joule, mega joules
mm	millimeter, millimeters
m^3/min	cubic meters per minute
MPa	megaPascal
mW	milliwatt, milliwatts
MW	megawatt, megawatts
N/A	not available or not applicable
NBS	National Bureau of Standards
N.C.	normally closed
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
Nm	Newton meter, Newton meters
no., nos	number, numbers
NPT	National Standard taper pipe thread per general use
N/R	not required
OC	overcrank
OD	outside diameter
OEM	original equipment manufacturer
OS	overspeed, oversize
O/S	oversize
OSHA	Occupational Safety and Health Act
OV	overvoltage
oz.	ounce, ounces
PF	power factor
PMG	permanent magnet generator
pot.	potentiometer
ppm	parts per million
psi	pounds per square inch
pt., pts.	pint, pints
PVC	polyvinyl chloride
qt., qts.	quart, quarts
qty.	quantity
ref.	reference
RFI	radio frequency interference
r.h.m.	round-head machine (screw)
rms	root mean square
RPM	revolutions per inch
RTV	room temperature vulcanization
SAE	Society of Automotive Engineers
SCR	silicon-controlled rectifier
sec.	second, seconds
spec.	specs, specification
sq.	square
sq. cm	square centimeters
sq. in.	square inch, square inches
tach	tachometer
TDC	top dead center
tech. pub.	technical publications
temp.	temperature
TIF	telephone influence factor
TP, TPs	technical publications
turbo	turbocharger
UHF	ultrahigh frequency
UNC	Unified coarse thread (was NC)
UNF	Unified fine thread (was NF)
UL	Underwriter's Laboratories, Inc.
U/S	undersize
U.S.A.	United States of America
V	volt, volts
vac	volts alternating current
vdc	volts direct current
VHF	very high frequency
W	watt, watts

Notes

Appendix B. Common Hardware Application Guidelines

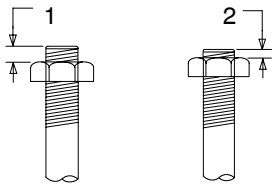
Use the information below and on the following pages to identify proper fastening techniques when no specific reference for reassembly is made.

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

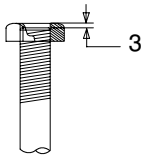
Washers and Nuts: Use split lock washers as a bolt locking device where specified. Use SAE flat washers with whiz nuts, spiralock nuts, or standard nuts and preloading (torque) of the bolt in all other applications.

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

Preferred Nut/Bolt Clearance



Unacceptable Nut/Bolt Clearance



1. 1/2 of Bolt Diameter
2. Min. 1 Full Thread Beyond Top of Nut
3. Below Top of Nut

Figure 1. Acceptable Bolt Lengths

Steps for common hardware application:

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

   For round and slotted exit holes, determine if hardware is greater than 1/2 inch in diameter, or 1/2 inch in diameter or less. Hardware that is *greater than 1/2 inch* in diameter takes a standard nut and SAE washer. Hardware *1/2 inch or less* in diameter can take a properly torqued whiz nut or spiralock nut. See the diagram below.

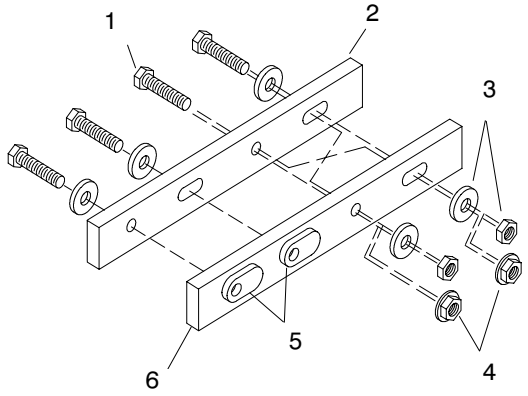
3. Follow these SAE washer rules after determining exit hole type:

   a. Always use a washer between hardware and a slot.

   b. Always use a washer under a nut (see 2 above for exception).

   c. Use a washer under a bolt when the female thread is fixed (weld nut).

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



1. Cap screw
2. Entry hole types
3. Standard nut and SAE washer
4. Whiz nut or spiralock: up to 1/2” dia. hardware
5. Weld nuts: above 1/2” dia. hardware
6. Exit hole types

Figure 2. Acceptable Hardware Combinations

Notes

Appendix C. General Torque Specifications

American Standard Fasteners

Use the following specifications for American Standard fasteners when no torque values are given elsewhere in this or the service manual for a specified bolt.

The values given are based on new plated threads. Increase values by 20% if nonplated threads are used.

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

Metric Fasteners

Use the following specifications for metric fasteners when no torque values are given elsewhere in this manual for a specified bolt. These values are based on new plated threads.

Increase values by 20% if nonplated threads are used. Screws threaded into aluminum must have two diameters of threads engaged and may require 30% or more reduction in the torque.

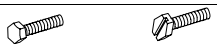
	Torque ft-lb (Nm)		
Size (mm)	5.8	6.8	10.9	Fasteners Assembled Into Aluminum
6 x 1.00	5 (7)	6 (9)	9 (12)	5 (7)
8 x 1.25	14 (19)	14 (20)	20 (37)	14 (19)
8 x 1.00	16 (21)	17 (24)	23 (31)	16 (21)
10 x 1.50	25 (35)	27 (37)	38 (51)	25 (35)
10 x 1.25	29 (39)	34 (46)	45 (61)	29 (39)
12 x 1.75	42 (57)	45 (61)	65 (89)	
12 x 1.50	48 (65)	55 (75)	78 (106)	
14 x 2.00	64 (86)	69 (94)	101 (137)	
14 x 1.50	74 (100)	81 (110)	116 (157)	
16 x 2.00	98 (133)	104 (141)	150 (204)	
16 x 1.50	104 (141)	116 (157)	168 (228)	
18 x 2.50	133 (181)	145 (196)	208 (283)	
18 x 1.50	145 (196)	156 (212)	226 (306)	

Notes

Appendix D. Common Hardware Identification

Screws/Bolts/Studs

Head Styles

Hex. Head or Machine Head	
Hex. Head or Machine Head with Washer	
Flat Head (f.h.m.)	
Round Head (r.h.m.)	
Pan Head	
Socket Head Cap or Allen Head Cap	
Socket Head or Allen Head Shoulder Bolt	
Sheet Metal Screw	
Stud	

Drive Styles

Hex.	
Hex. and Slotted	
Phillips	
Slotted	
Hex. Socket	

Hardness Grade

American Standard

Grade 2	
Grade 5	
Grade 8	
Grade 8/9	

Metric

Number stamped on hardware; 5.8 shown	

Nuts

Nut Styles

Hex. Head	
Lock Nut or Nylock Nut	
Square Nut	
Cap Nut or Acorn Nut	
Wing Nut	

Nut Hardness Grades

American Standard

Grade 2	
Grade 5	

Metric

Number stamped on hardware	

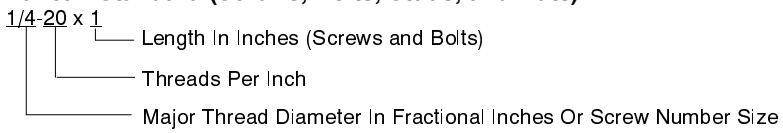
Washers

Washer Styles

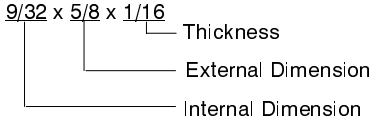
Plain	
Split Lock or Spring	
Spring or Wave	
External Tooth Lock	
Internal Tooth Lock	
Internal-External Tooth Lock	

Sample Dimensions

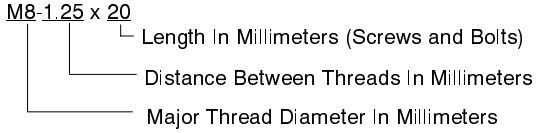
American Standard (Screws, Bolts, Studs, and Nuts)



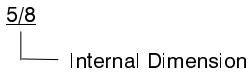
Plain Washers



Metric (Screws, Bolts, Studs, and Nuts)



Lock Washers



Notes

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