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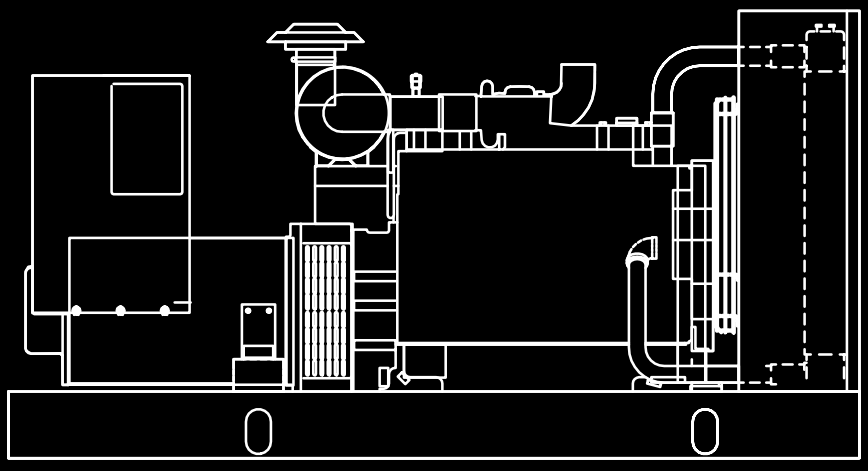
Power Generation

Power Generation

Service Manual

Detector™ Control Generator Sets



Models

DGBA, DGBB, DGBC, DGCA, DGCB, DGDA, DGDB
DGEA, DGFA, DGFB
QSGBA, QSGCA, QSGCB, QSDA, QSDB, QSEA, QSFA
4B3.9, 4BT3.9, 6BT5.9, 6CT8.3, 6CTA8.3

Printed in U.S.A.

960-0505 4-2001

Table of Contents

IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS – This manual contains important instructions that should be followed during installation and maintenance of the generator and batteries.

Before operating the generator set (genset), read the Operator's Manual and become familiar with it and the equipment. **Safe and efficient operation can be achieved only if the equipment is properly operated and maintained.** Many accidents are caused by failure to follow fundamental rules and precautions.

The following symbols, found throughout this manual, alert you to potentially dangerous conditions to the operator, service personnel, or the equipment.

⚠ DANGER ***This symbol warns of immediate hazards which will result in severe personal injury or death.***

⚠ WARNING ***This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.***

⚠ CAUTION ***This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.***

FUEL AND FUMES ARE FLAMMABLE

Fire, explosion, and personal injury or death can result from improper practices.

- DO NOT fill fuel tanks while engine is running, unless tanks are outside the engine compartment. Fuel contact with hot engine or exhaust is a potential fire hazard.
- DO NOT permit any flame, cigarette, pilot light, spark, arcing equipment, or other ignition source near the generator set or fuel tank.
- Fuel lines must be adequately secured and free of leaks. Fuel connection at the engine should be made with an approved flexible line. Do not use zinc coated or copper fuel lines with diesel fuel.
- Be sure all fuel supplies have a positive shutoff valve.
- Be sure battery area has been well-ventilated prior to servicing near it. Lead-acid batteries emit a highly explosive hydrogen gas that can be ignited by arcing, sparking, smoking, etc.

EXHAUST GASES ARE DEADLY

- Provide an adequate exhaust system to properly expel discharged gases away from enclosed or sheltered areas and areas where individuals are likely to congregate. Visually and audibly inspect the exhaust daily for leaks per the maintenance schedule. Make sure that exhaust manifolds are secured and not warped. Do not use exhaust gases to heat a compartment.
- Be sure the unit is well ventilated.
- Engine exhaust and some of its constituents are known to the state of California to cause cancer, birth defects, and other reproductive harm.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Keep your hands, clothing, and jewelry away from moving parts.
- Before starting work on the generator set, disconnect battery charger from its AC source, then disconnect starting batteries, negative (–) cable first. This will prevent accidental starting.
- Make sure that fasteners on the generator set are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.
- Do not wear loose clothing or jewelry in the vicinity of moving parts, or while working on electrical equipment. Loose clothing and jewelry can become caught in moving parts.
- If adjustment must be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

DO NOT OPERATE IN FLAMMABLE AND EXPLOSIVE ENVIRONMENTS

Flammable vapor can cause an engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death. Do not operate a genset where a flammable vapor environment can be created by fuel spill, leak, etc., unless the genset is equipped with an automatic safety device to block the air intake and stop the engine. The owners and operators of the genset are solely responsible for operating the genset safely. Contact your authorized Onan/Cummins dealer or distributor for more information.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Remove electric power before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surface to be damp when handling electrical equipment. Do not wear jewelry. Jewelry can short out electrical contacts and cause shock or burning.
- Use extreme caution when working on electrical components. High voltages can cause injury or death. DO NOT tamper with interlocks.
- Follow all applicable state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag and lock open switches to avoid accidental closure.
- DO NOT CONNECT GENERATOR SET DIRECTLY TO ANY BUILDING ELECTRICAL SYSTEM. Hazardous voltages can flow from the generator set into the utility line. This creates a potential for electrocution or property damage. Connect only through an approved isolation switch or an approved paralleling device.

MEDIUM VOLTAGE GENERATOR SETS

(601V to 15kV)

- Medium voltage acts differently than low voltage. Special equipment and training is required to work on or around medium voltage equipment. Operation and maintenance must be done only by persons trained and qualified to work on such devices. Improper use or procedures will result in severe personal injury or death.
- Do not work on energized equipment. Unauthorized personnel must not be permitted near energized equipment. Due to the nature of medium voltage electrical equipment, induced voltage remains even after the equipment is disconnected from the power source. Plan the time for maintenance with authorized personnel so that the equipment can be de-energized and safely grounded.

GENERAL SAFETY PRECAUTIONS

- Coolants under pressure have a higher boiling point than water. DO NOT open a radiator or heat exchanger pressure cap while the engine is running. Allow the generator set to cool and bleed the system pressure first.
- Used engine oils have been identified by some state or federal agencies as causing cancer or reproductive toxicity. When checking or changing engine oil, take care not to ingest, breathe the fumes, or contact used oil.
- Keep multi-class ABC fire extinguishers handy. Class A fires involve ordinary combustible materials such as wood and cloth; Class B fires, combustible and flammable liquid fuels and gaseous fuels; Class C fires, live electrical equipment. (ref. NFPA No. 10).
- Make sure that rags are not left on or near the engine.
- Make sure generator set is mounted in a manner to prevent combustible materials from accumulating under the unit.
- Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and engine damage which present a potential fire hazard.
- Keep the generator set and the surrounding area clean and free from obstructions. Remove any debris from the set and keep the floor clean and dry.
- Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment unsafe.
- Substances in exhaust gases have been identified by some state or federal agencies as causing cancer or reproductive toxicity. Take care not to breath or ingest or come into contact with exhaust gases.
- Do not store any flammable liquids, such as fuel, cleaners, oil, etc., near the generator set. A fire or explosion could result.
- Wear hearing protection when going near an operating generator set.
- To prevent serious burns, avoid contact with hot metal parts such as radiator, turbo charger and exhaust system.

KEEP THIS MANUAL NEAR THE GENSET FOR EASY REFERENCE

1. Introduction

GENERAL

This manual covers models produced under the Cummins®/Onan® and Cummins Power Generation brand names.

Each operator should read this manual before operating the set for the first time. A generator set (genset) must be operated and maintained properly if you are to expect safe, reliable and quiet operation. The manual includes a troubleshooting guide and a maintenance schedule.

The engine manual is included with the set. Where there is conflicting information, this manual takes precedence over the engine manual.

⚠WARNING ***Improper operation and maintenance can lead to severe personal injury or loss of life and property by fire, electrocution, mechanical breakdown or exhaust gas asphyxiation. Read and follow the safety precautions on page iii and carefully observe all instructions and precautions in this manual.***

HOW TO OBTAIN SERVICE

When the generator set requires servicing, contact your nearest Cummins Power Generation distributor. Factory-trained Parts and Service representatives are ready to handle all your service needs.

To contact your local Cummins Power Generation distributor in the United States or Canada, call 1-800-888-6626 (this automated service utilizes touch-tone phones only). By selecting Option 1 (press 1), you will be automatically connected to the distributor nearest you.

If you are unable to contact a distributor using the automated service, consult the Yellow Pages. Typically, our distributors are listed under:

GENERATORS-ELECTRIC or
ELECTRICAL PRODUCTS

For outside North America, call Cummins Power Generation, 1-763-574-5000, 7:30 AM to 4:00 PM, Central Standard Time, Monday through Friday. Or, send a fax to Cummins Power Generation using the fax number 1-763-574-8087.

When contacting your distributor, always supply the complete Model, Specification, and Serial Number as shown on the generator set nameplate.

⚠ WARNING

INCORRECT SERVICE OR PARTS REPLACEMENT CAN RESULT IN SEVERE PERSONAL INJURY, DEATH, AND/OR EQUIPMENT DAMAGE. SERVICE PERSONNEL MUST BE TRAINED AND EXPERIENCED TO PERFORM ELECTRICAL AND/OR MECHANICAL SERVICE.

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2. AC Control

GENERAL

The control box is mounted on top of the generator, facing the rear. Figure 2-1 points out the components on the AC control panel. Pages 9-3 through 9-6 show the wiring connections.

STANDARD CONTROL PANEL COMPONENTS

Field Circuit Breaker (CB21) The field circuit breaker protects the generator from over-excitation.

OPTIONAL CONTROL PANEL COMPONENTS

AC Voltmeter (M21) The voltmeter indicates output voltage for the phase selected.

AC Ammeter (M22) The ammeter indicates output amperage for the phase selected. Input to the ammeter is from current transformers CT21, CT22 and CT23.

Phase Selector Switch (S21) The selector switch is used to select the phase for voltage and amperage readings.

Scale Indicator Lamps (DS21 and DS22) The scale indicator lamps indicate whether to read the upper or lower scales of the voltmeter and ammeter.

Frequency Meter (M23) The frequency meter indicates output frequency in Hertz (Hz) and engine speed in RPM.

Wattmeter (M24) The wattmeter indicates output power in kilowatts (kW).

Powerfactor Meter (M25) The powerfactor meter indicates output powerfactor as a percentage of unity powerfactor.

Output Voltage Trimmer (R21) The output voltage trimmer can be used to adjust output voltage plus or minus five percent of nominal voltage.

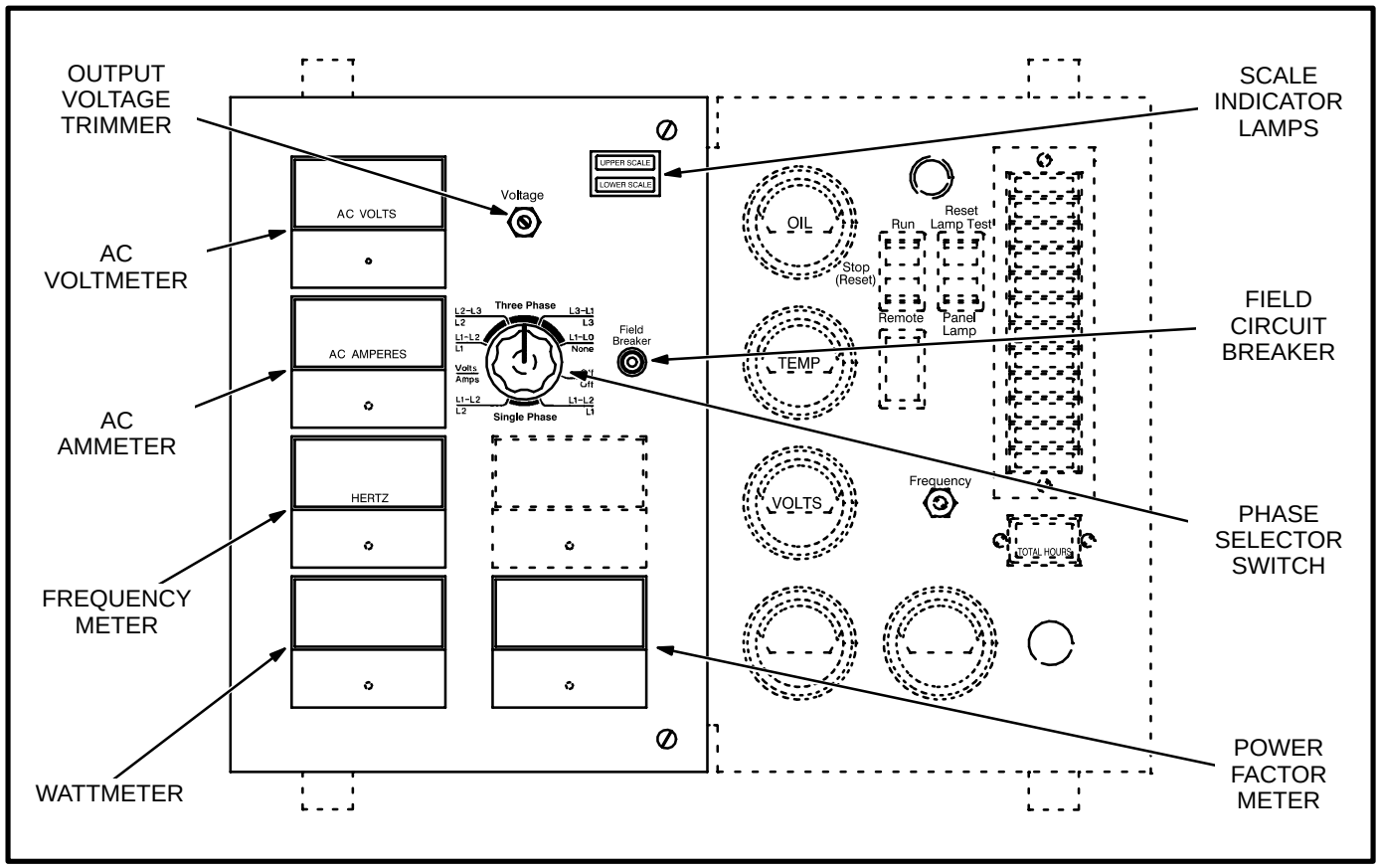


FIGURE 2-1. AC CONTROL PANEL

AUTOMATIC VOLTAGE REGULATOR (AVR) ADJUSTMENTS

The automatic voltage regulator is mounted on the back wall of the control cabinet. It can be adjusted by means of the potentiometers (pots) shown in Figure 2-2 or 2-3. Figures 2-4 and 2-5 show typical voltage regulating circuits.

These measurements and adjustments are done while the set is running and require access to uninsulated high voltage parts in the control and power output boxes.

⚠ DANGER ***HIGH VOLTAGE. Touching uninsulated high voltage parts inside the control and power output boxes can result in severe personal injury or death. Measurements and adjustments must be done with care to avoid touching high voltage parts.***

For your protection, stand on a dry wooden platform or rubber insulating mat, make sure your clothing and shoes are dry, remove jewelry from your hands and wear elbow length insulating gloves.

Jumper Reconnections

Jumpers provide for reconnections to adapt the voltage regulator to the application. See Figure 2-2. Reconnect the response jumper, if necessary, so that terminal **A** connects to terminal **C** if generator output is 90 kW or less, **B** to **C** if generator output is greater than 90 kW but less than 550 kW and **A** to **B** if output is greater than 550kW. Reconnect the frequency jumper, if necessary, to correspond to the application frequency.

Voltage and Voltage Stability Adjustments

Use the control panel mounted voltage trimmer, if provided, for small voltage adjustments. Measure generator output voltage while the set is running without load at the nominal frequency. If the trimmer does not provide enough adjustment, lock it at its midpoint. Then turn the **VOLTS** pot fully counterclockwise and the **STABILITY** pot to its midpoint. If the red LED (light emitting diode) on the board lights, refer to Jumper Reconnections and to UFRO Adjustments. Then turn the **VOLTS** pot clockwise until rated voltage is obtained. If voltage becomes unstable when a large load is connected, turn the **STABILITY** pot clockwise until voltage is stable. Check and readjust the **VOLTS** pot**,** if necessary, each time the **STABILITY** pot is readjusted.

UFRO Adjustments

The voltage regulator has an under-frequency protection circuit having a threshold frequency that can be preset (typically at 59 Hz for 60 Hz applications and 49 Hz for 50 Hz applications). The red LED on the board lights when frequency dips below the threshold. The threshold frequency is preset by turning the **UFRO** (under frequency roll off) pot clockwise to raise it and counterclockwise to lower it. Determine threshold frequency by lowering generator frequency until the LED lights. Note that Dip and Dwell adjustments, below, are related.

Dip Adjustments

The **DIP** pot adjusts the voltage vs. frequency slope of the generator for frequencies below the threshold preset by the **UFRO** pot. Turning the **DIP** pot clockwise increases the slope (for greater voltage roll off as frequency drops), making it easier for the engine to pick up a large load, but also increasing the voltage dip. The generator voltage vs. frequency slope is the same above and below the threshold frequency when the pot is turned fully counterclockwise.

Dwell Adjustments

The **DWELL** pot times voltage recovery when frequency dips below the preset threshold. Clockwise adjustment increases dwell time. Full counterclockwise adjustment eliminates dwell, in which case, voltage recovery follows engine speed recovery.

Droop Adjustments

The **DROOP** pot is for adjusting the input signal from the droop compensating CT in paralleling applications. **DROOP** is preset at the factory for five percent droop at full load and zero power factor.

V / Trim Adjustments

The **V / Trim** pot is for adjusting the input signal from a VAR / PF controller in utility paralleling applications. Full clockwise adjustment is normal, resulting in maximum sensitivity. The auxiliary controller has no effect when the pot is turned fully counterclockwise.

EXC, OVER V, I / LIMIT, STAB/1and RMS

These pots are factory preset and do not require adjustment.

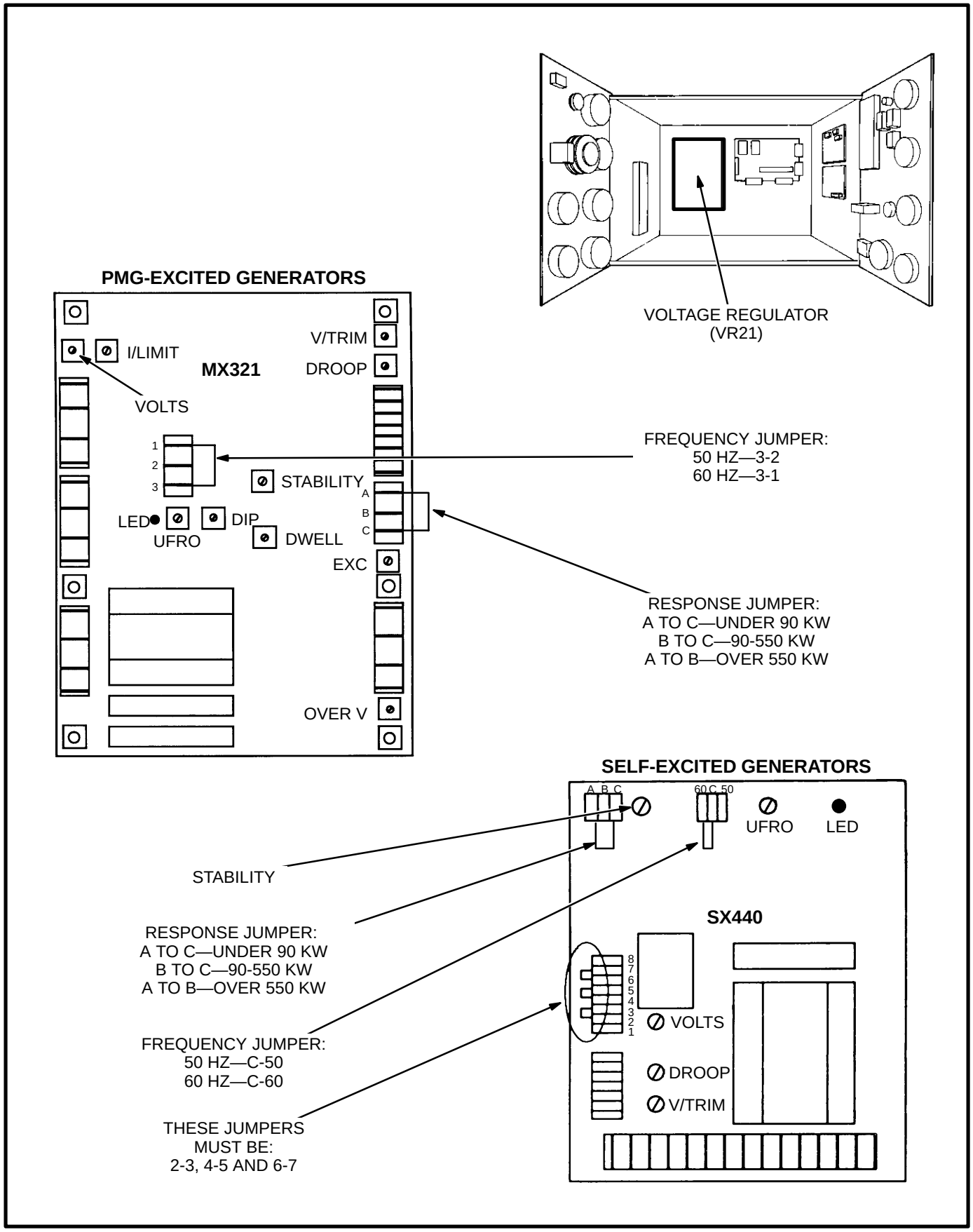
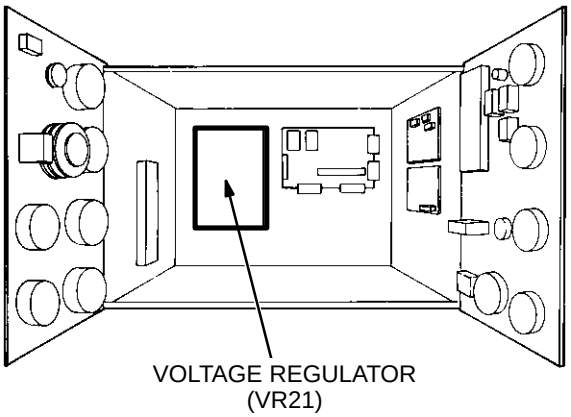
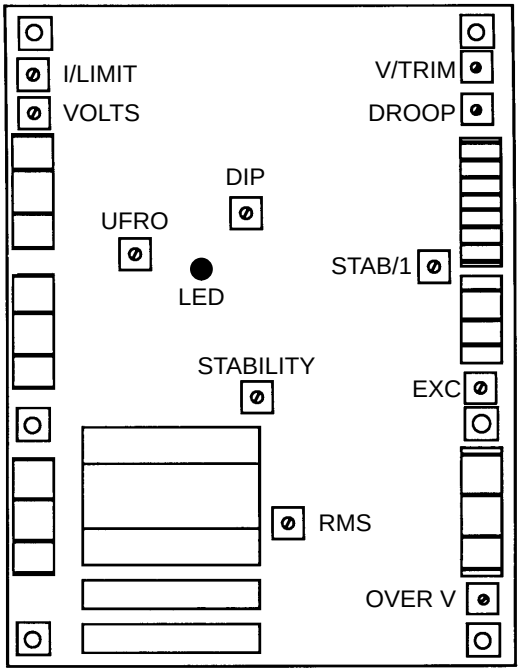


FIGURE 2-2. VOLTAGE REGULATOR ADJUSTMENT POTS AND SELECTION JUMPERS (BEGINNING JANUARY 1990)



PMG-EXCITED GENERATORS



SELF-EXCITED GENERATORS

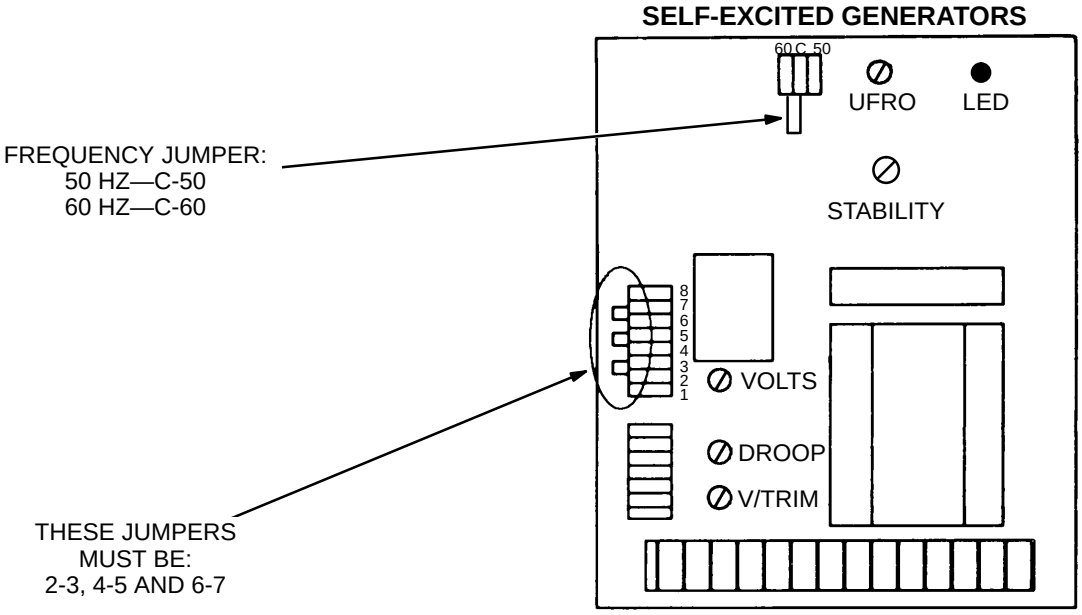
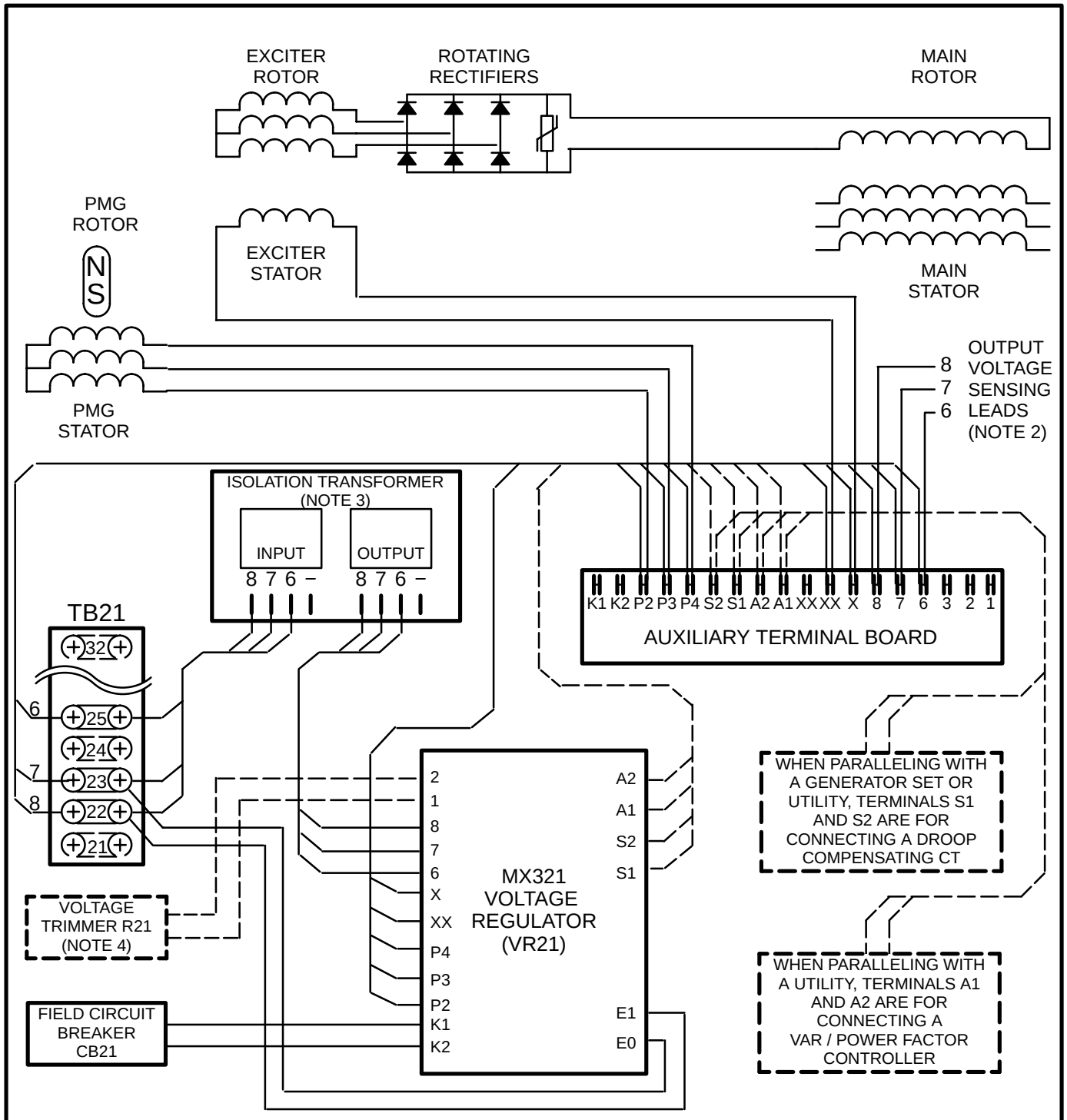


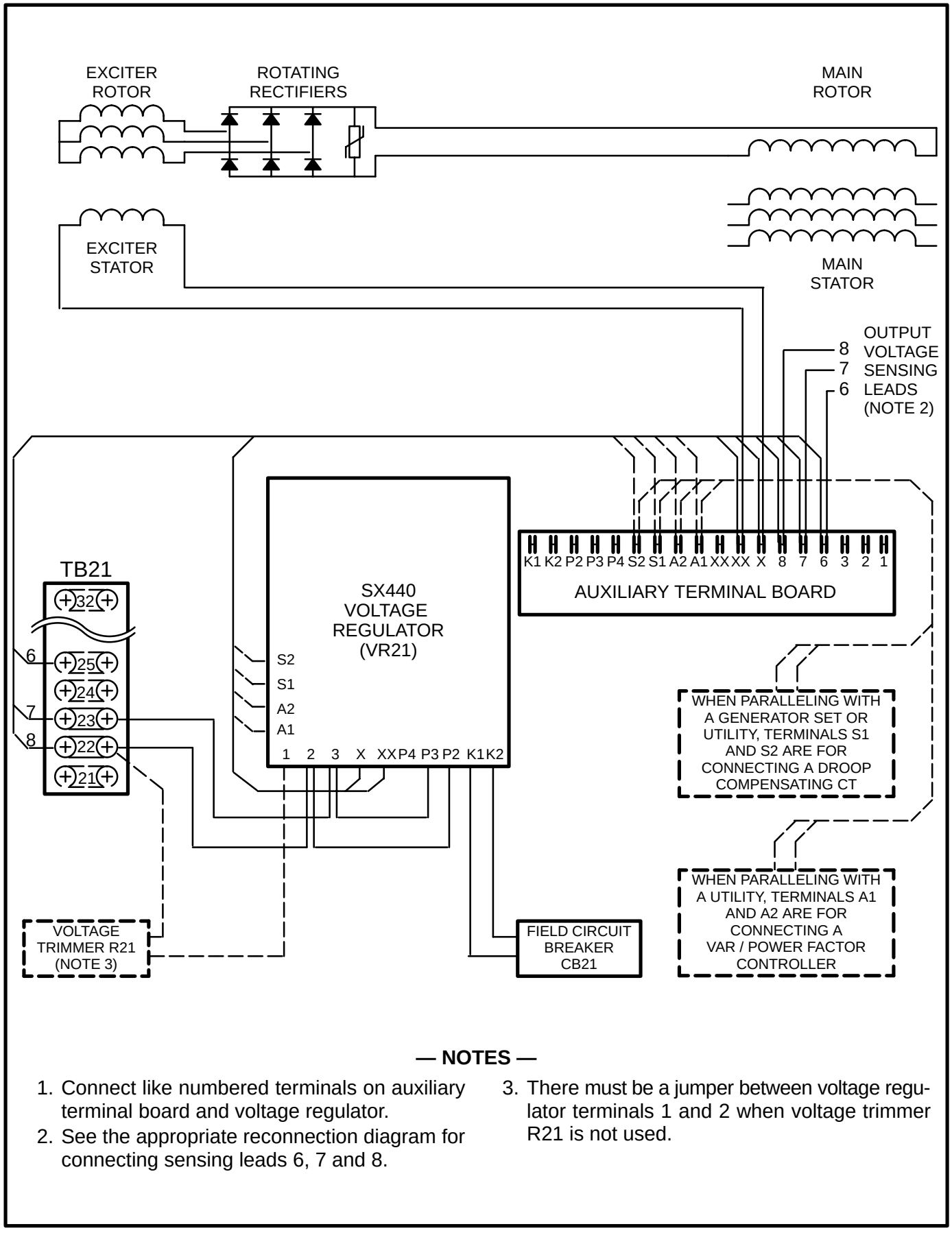
FIGURE 2-3. VOLTAGE REGULATOR ADJUSTMENT POTS AND SELECTION JUMPERS (PRIOR TO JANUARY 1990)



— NOTES —

1. Connect like numbered terminals on auxiliary terminal board and voltage regulator.
2. See the appropriate reconnection diagram for connecting sensing leads 6, 7 and 8.
3. When the generator is connected for single-phase output, voltage regulator terminal 6 is not connected to the isolation transformer but is jumpered to voltage regulator terminal 8.
4. There must be a jumper between voltage regulator terminals 1 and 2 when voltage trimmer R21 is not used.

FIGURE 2-4. TYPICAL VOLTAGE REGULATING CIRCUITS FOR PMG-EXCITED GENERATORS



— NOTES —

1. Connect like numbered terminals on auxiliary terminal board and voltage regulator.
2. See the appropriate reconnection diagram for connecting sensing leads 6, 7 and 8.
3. There must be a jumper between voltage regulator terminals 1 and 2 when voltage trimmer R21 is not used.

FIGURE 2-5. TYPICAL VOLTAGE REGULATING CIRCUITS FOR SELF-EXCITED GENERATORS

PRINCIPLE OF GENERATOR OPERATION

1. The generator field (main rotor) is rotated by the engine to induce output current (AC) in the main stator windings.
2. Generator output current is proportional to field strength, which is varied to match the load. Output voltage and frequency are held constant by the voltage regulator and engine governor, respectively.
3. Generator field strength is proportional to field current, which is supplied by the exciter.
4. The exciter field (stator) induces current in the exciter rotor windings. A full wave rectifier bridge (rotating rectifiers) mounted on the exciter rotor converts exciter output (3-phase AC) to DC. The exciter rotor is mounted on the main rotor shaft.
5. Exciter output current is proportional to exciter field current.
6. The automatic voltage regulator (AVR) regulates exciter field current by comparing generator output voltage and frequency with reference values.
7. **PMG-Excited Generators.** Exciter field current is supplied by a PMG (permanent magnet) exciter through the voltage regulator. The PMG consists of a stator and a permanent magnet rotor mounted on the end of the main rotor shaft.
8. **Self-Excited Generators.** Exciter field current is supplied by the generator stator through the voltage regulator. Residual field magnetism initiates “self-excitation” during startups.

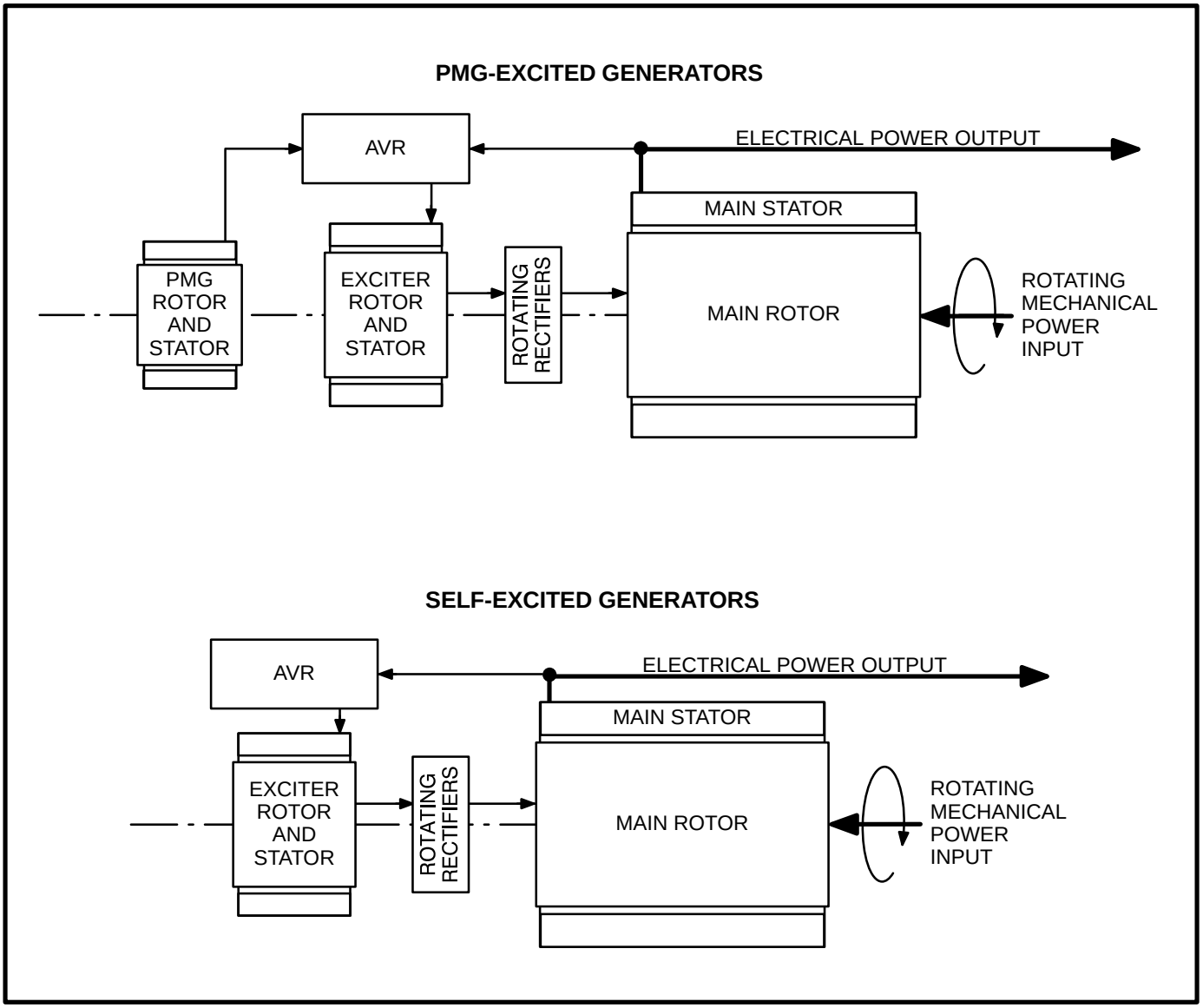


FIGURE 2-6. SCHEMATIC OF GENERATOR OPERATION

3. Engine Control

CONTROL PANEL

The control box is mounted on top of the generator, facing the rear. Figure 3-1 shows the components on the engine control panel.

STANDARD CONTROL PANEL COMPONENTS

Run / Stop / Remote Switch (S12) The switch is pushed to the **Run** position to start and run the generator set and the **Stop** position to stop the set. The **Remote** position allows a remote controller to automatically run the set. The switch must be in the **Stop** position when the reset switch (described next) is used to restore generator set operation following a fault shutdown.

Reset / Lamp Test / Panel Lamp Switch (S11) The switch is pushed to the **Reset** position (momentary contact) to reset the engine control to restore operation following a fault shutdown. The **Run / Stop / Remote** switch must be in the **Stop** position for reset to occur. The **Lamp Test** position (momentary contact) lights all the fault indicator lamps. Replace lamps that do not light. The **Panel Lamp** position lights the panel illumination lamp.

Oil Pressure Gauge (M11) The oil pressure gauge indicates engine oil pressure.

Coolant Temperature Gauge (M12) The coolant temperature gauge indicates engine coolant temperature.

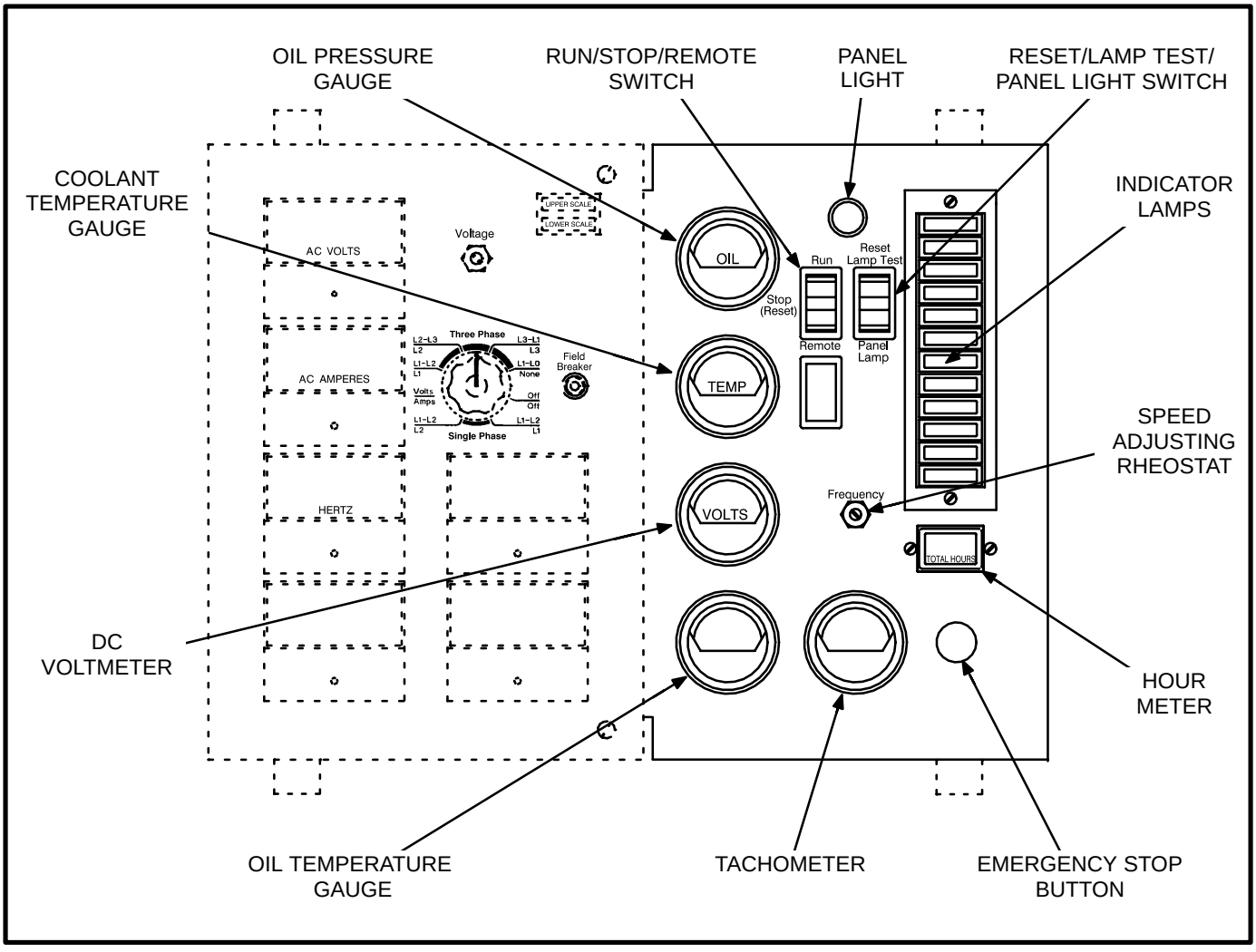


FIGURE 3-1. ENGINE CONTROL PANEL

DC Voltmeter (M13) The DC voltmeter indicates voltage across the battery terminals during operation.

Hour Meter (M14) The hour meter indicates the accumulated number of hours the set has run. It cannot be reset.

Panel Lamp (DS11) The panel lamp illuminates the control panel.

Detector-7 Fault and Status Indicator Lamps (A12)

- **Run (Green)** This lamp indicates that the generator set is running and that the starter has been disconnected.
- **Pre Low Oil Pressure (Yellow)** This lamp indicates that engine oil pressure is abnormally low (less than 20 psi).
- **Low Oil Pressure (Red)** This lamp indicates that the engine shut down because of excessively low engine oil pressure (less than 14 psi).
- **Pre High Engine Temperature (Yellow)** This lamp indicates that engine coolant temperature is abnormally high (greater than 220° F).
- **High Engine Temperature (Red)** This lamp indicates that the engine shut down because of excessively high engine coolant temperature (greater than 230° F).
- **Overcrank (Red)** This lamp indicates that the engine shut down because it did not start during the timed cranking period (approximately 75 seconds, including two rest periods).
- **Overspeed (Red)** This lamp indicates that the engine shut down because of overspeed.

OPTIONAL CONTROL PANEL COMPONENTS

Oil Temperature Gauge (M15) The oil temperature gauge indicates engine oil temperature.

Tachometer (M16) The tachometer indicates engine speed in RPM.

Speed Adjusting Rheostat The speed adjusting rheostat is used to adjust engine speed from the control panel (an option with the optional electric governor).

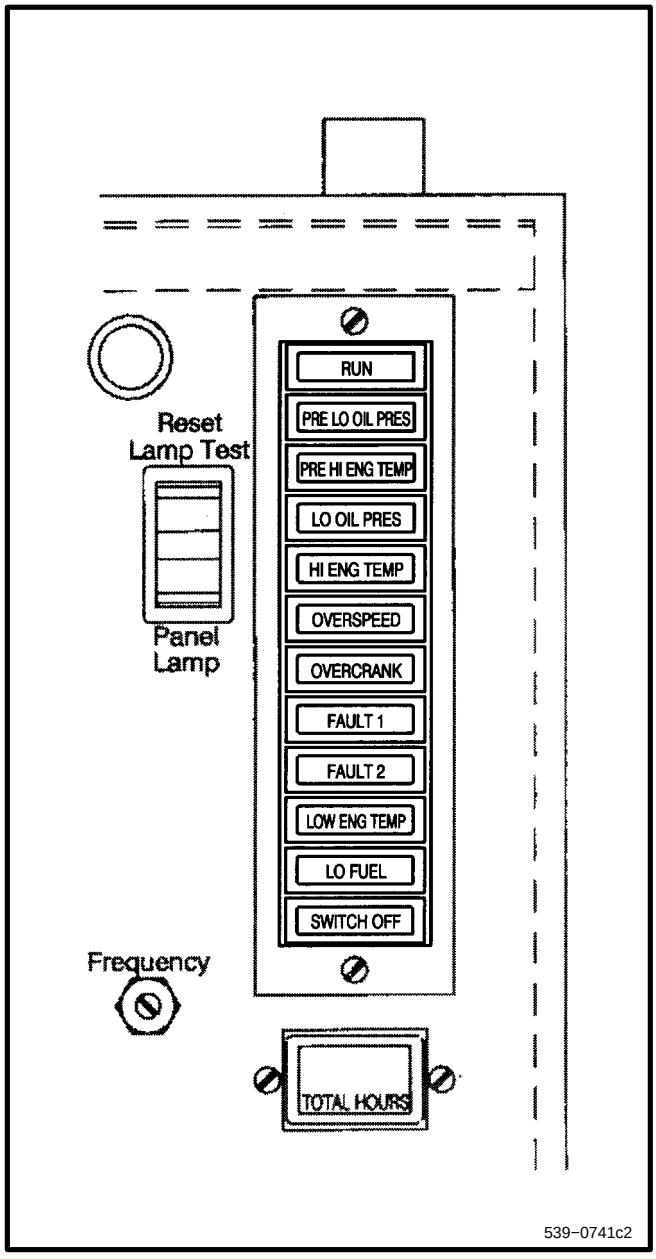


FIGURE 3-2. DETECTOR-12 INDICATOR LAMPS

Emergency Stop Button (S14) The emergency stop button is a red, push-in switch used to stop the engine. The button lights up when it is pushed in. The button has to be pulled out and the engine control reset to restore operation.

Low Coolant Level Cutout Switch (S7) When coolant level in the radiator top tank falls below the switch sensor, the switch closes the circuit to ground. This switch may be connected in parallel with the high engine temperature cutout switch to shut down the engine and light the **High Engine Temperature** lamp or in parallel with the pre-high engine temperature switch to light the **Pre High Engine Temperature** light only.

Detector-12 Fault and Status Indicator Lamps (A12) The Detector-12 control panel has the five following indicator lamps in addition to the standard seven.

- **Low Engine Temperature (Yellow)** This lamp indicates that engine temperature is less than 70° F, and the possibility that the engine might not start.
- **Low Fuel (Yellow)** This lamp indicates that the fuel level in the supply tank has dropped to less than the reserve necessary to run the set at full load for the prescribed number of hours. The customer has to make connections to use this lamp.
- **Fault 1 (Red)** This lamp indicates that the engine shut down because of a system fault. The customer has to make connections to use this lamp. The lamp is a part of a 10 second time delay shutdown circuit. The customer can make reconnections for non-timed shutdown. See Engine Control Monitor (ECM).
- **Fault 2 (Red)** This lamp indicates that the engine shut down because of a system fault. The customer has to make connections to use this lamp. The lamp is part of a non-time delay shutdown circuit. The customer can make reconnections for 10 second time delay shutdown. See Engine Control Monitor (ECM).
- **Switch-off (Flashing Red)** This lamp indicates that the **Run / Stop / Remote** switch is in the **Stop** position, which prevents remote, automatic operation.

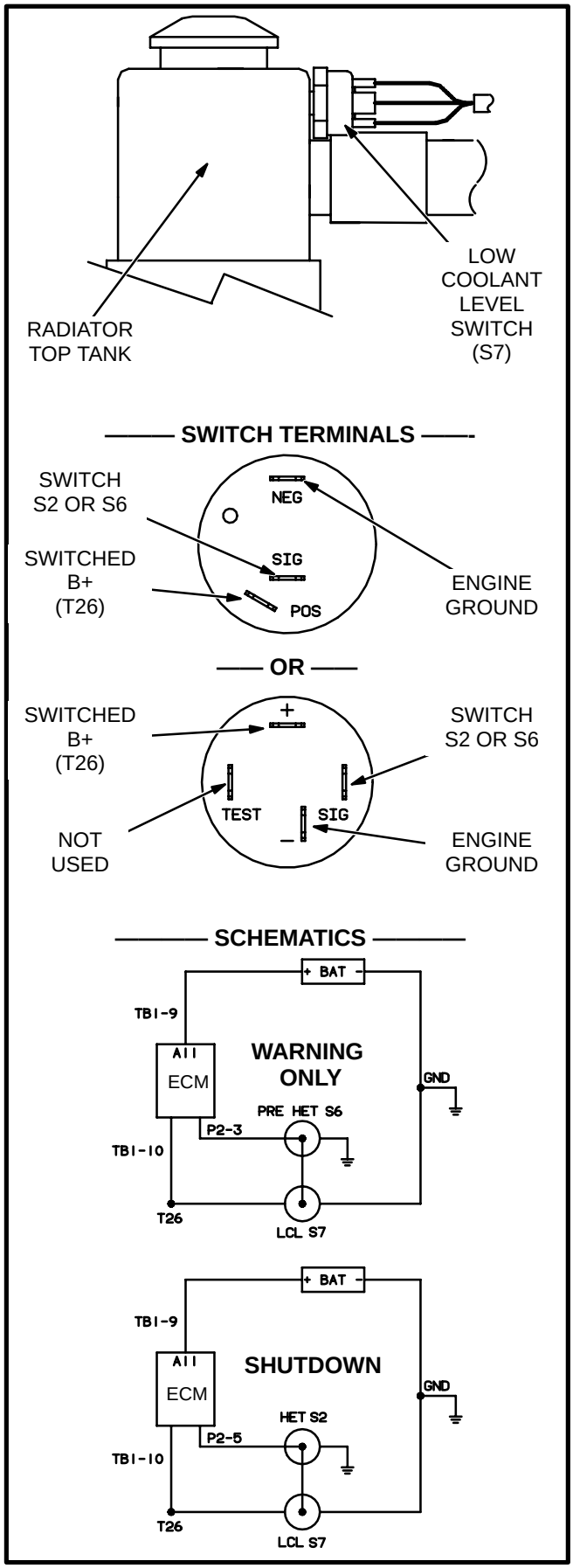


FIGURE 3-3. LOW COOLANT LEVEL SWITCH

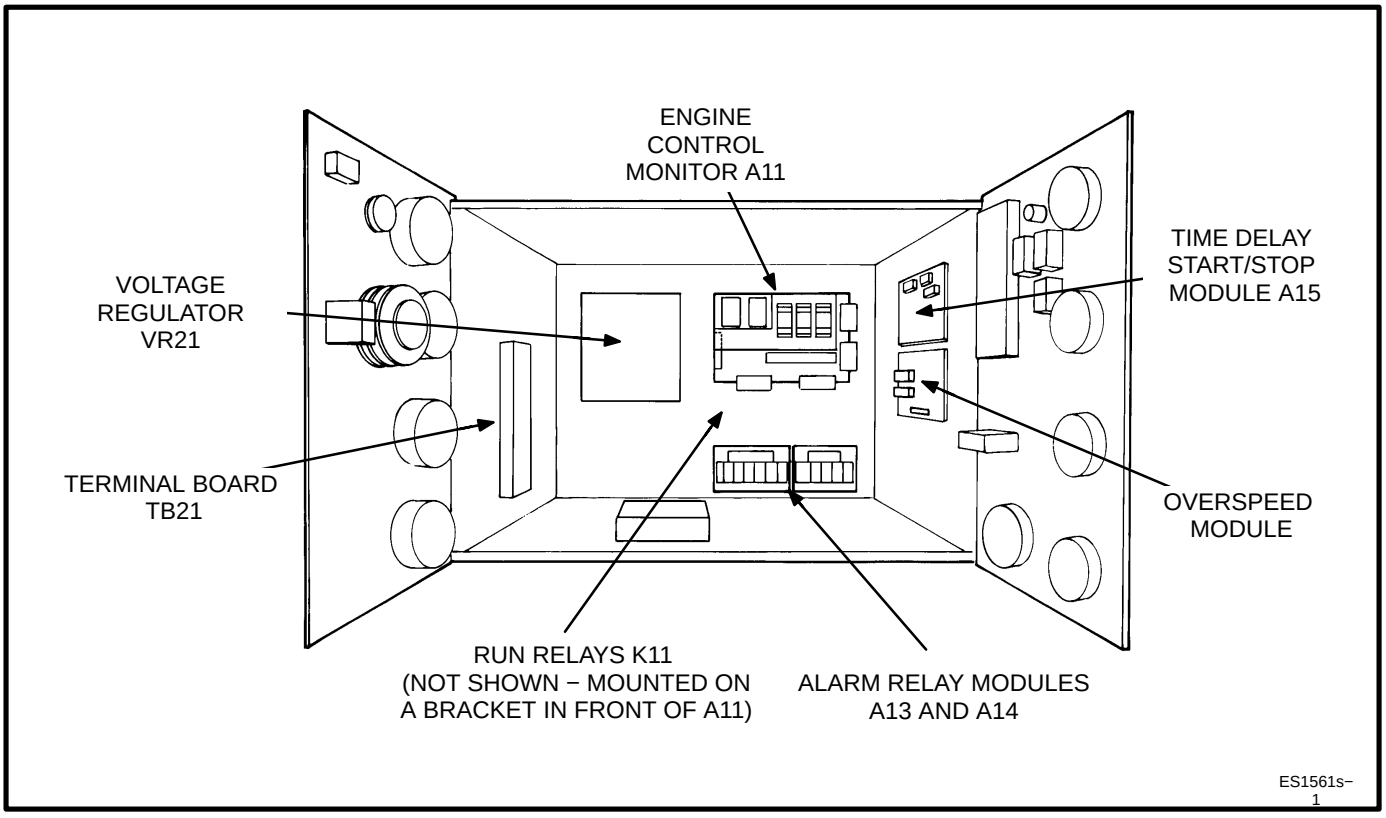


FIGURE 3-4. ARRANGEMENT OF COMPONENTS INSIDE THE CONTROL BOX

CONTROL BOX INTERIOR

Figure 3-4 shows the arrangement of components inside the control box, including the engine control monitor and some of the auxiliary components under following headings.

ENGINE CONTROL MONITOR (A11)

The heart of the engine control system is the engine control monitor (ECM). It is a printed circuit board assembly mounted on the back wall of the control box. It starts and stops the engine in response to the control panel switches, engine sensors and remote control signals. Figure 3-5 shows the newer ECM board used in current production and as a direct replacement for older boards. The boards are distinquishable from each other in that the newer boards have automotive-type fuses and the older boards have cartridge-type fuses.

Terminals and Connectors

See Pages 9-7 through 9-10 for the appropriate connection and schematic drawings for the DC control system. See Page 9-16 for typical customer connections at terminal boards **TB1** and **TB2** on the ECM and page 9-17 if the set is also equipped with the auxiliary relay board.

Fuses

The ECM has five replaceable fuses to protect it from overloads and groundfaults. They are:

- **F1** Starter solenoid circuit, 20 amps
- **F2** Fuel solenoid (switched B+) circuits, 20 amps
- **F3** Continuous B+ out to remote circuits, 15 amps
- **F4** ECM circuits, 5 amps
- **F5** Engine gauge circuits, 5 amps.

Function Selection Jumpers

Newer ECM boards have six selection jumpers that can be repositioned to provide the following timed or non-timed warnings or timed or non-timed shutdowns with warnings:

W1 Jumper Position (jumper **W8** must be in the **B** position):

- **A** Non-timed warning under **FLT 2** conditions.
- **B** Non-timed shutdown and warning under **FLT 2** conditions.
- **C** Timed warning under **FLT 2** conditions.
- **D** Timed shutdown and warning under **FLT 2** conditions.

W2 Jumper Position (jumper **W9** must be in the **B** position):

- **A** Non-timed warning under **FLT 1** conditions.
- **B** Non-timed shutdown and warning under **FLT 1** conditions.
- **C** Timed warning under **FLT 1** conditions.
- **D** Timed shutdown and warning under **FLT 1** conditions.

W6 Jumper Position:

- **A** Warning under **Pre-High Engine Temperature** conditions.
- **B** Shutdown and warning under **Pre-High Engine Temperature** conditions.

W7 Jumper Position:

- **A** Warning under **Pre-Low Oil Pressure** conditions.
- **B** Shutdown and warning under **Pre-Low Oil Pressure** conditions.

W8 Jumper Position:

- **A** Warning while running or during standby under **FLT 2** conditions.
- **B** Allows selection of functions with **W1** jumper.

W9 Jumper Position:

- **A** Warning while running or during standby under **FLT 1** conditions.
- **B** Allows selection of functions with **W2** jumper.

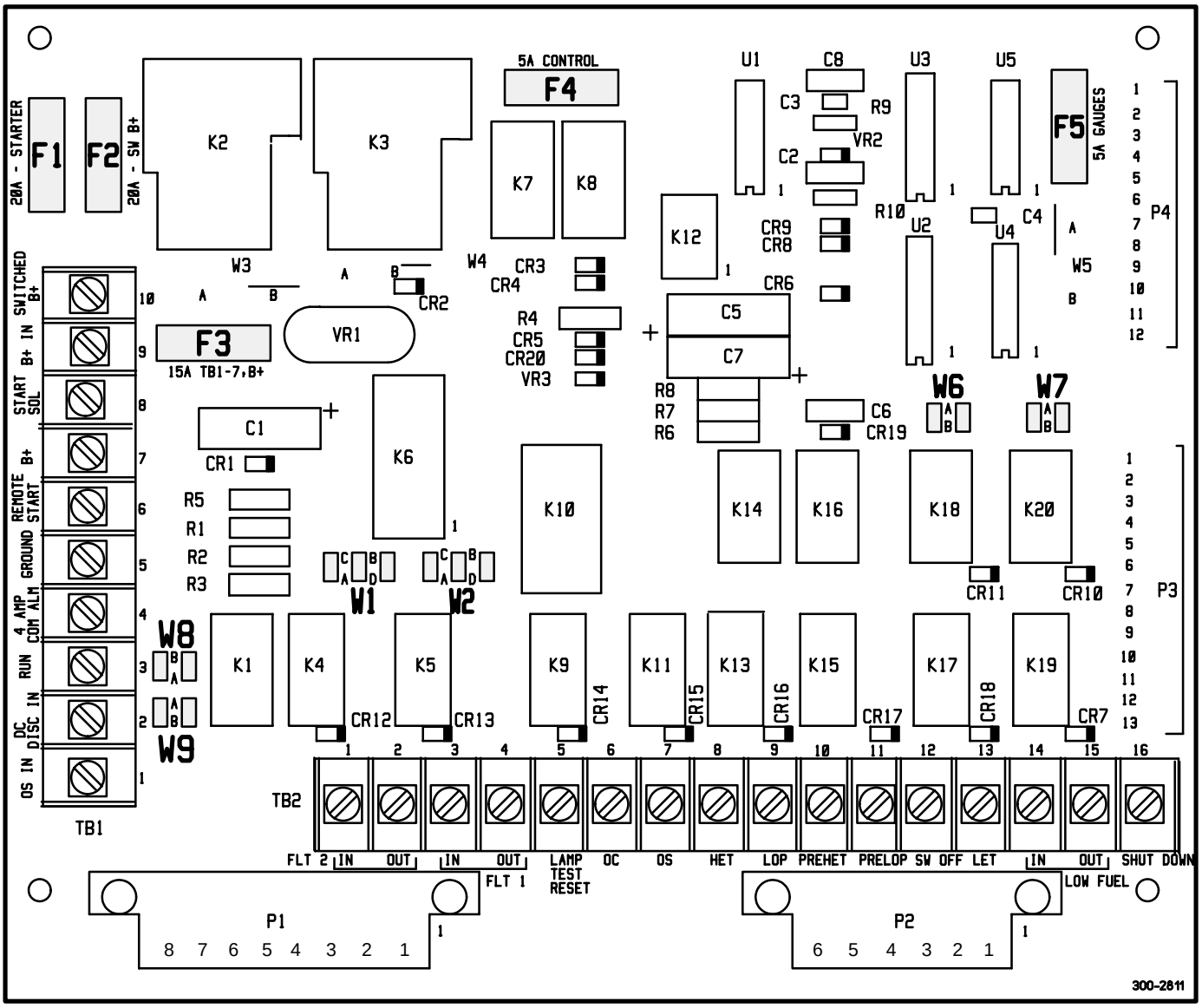


FIGURE 3-5. ENGINE CONTROL MONITOR FUSES AND FUNCTION SELECTION JUMPERS

ENGINE SENSORS

Figures 3-6, 3-7, 3-8 and 3-9 show the locations of the gauge senders and the coolant temperature and oil pressure sensing switches to which the ECM responds. The switches function by closing the fault or warning circuit to the engine chassis ground (battery negative [-]).

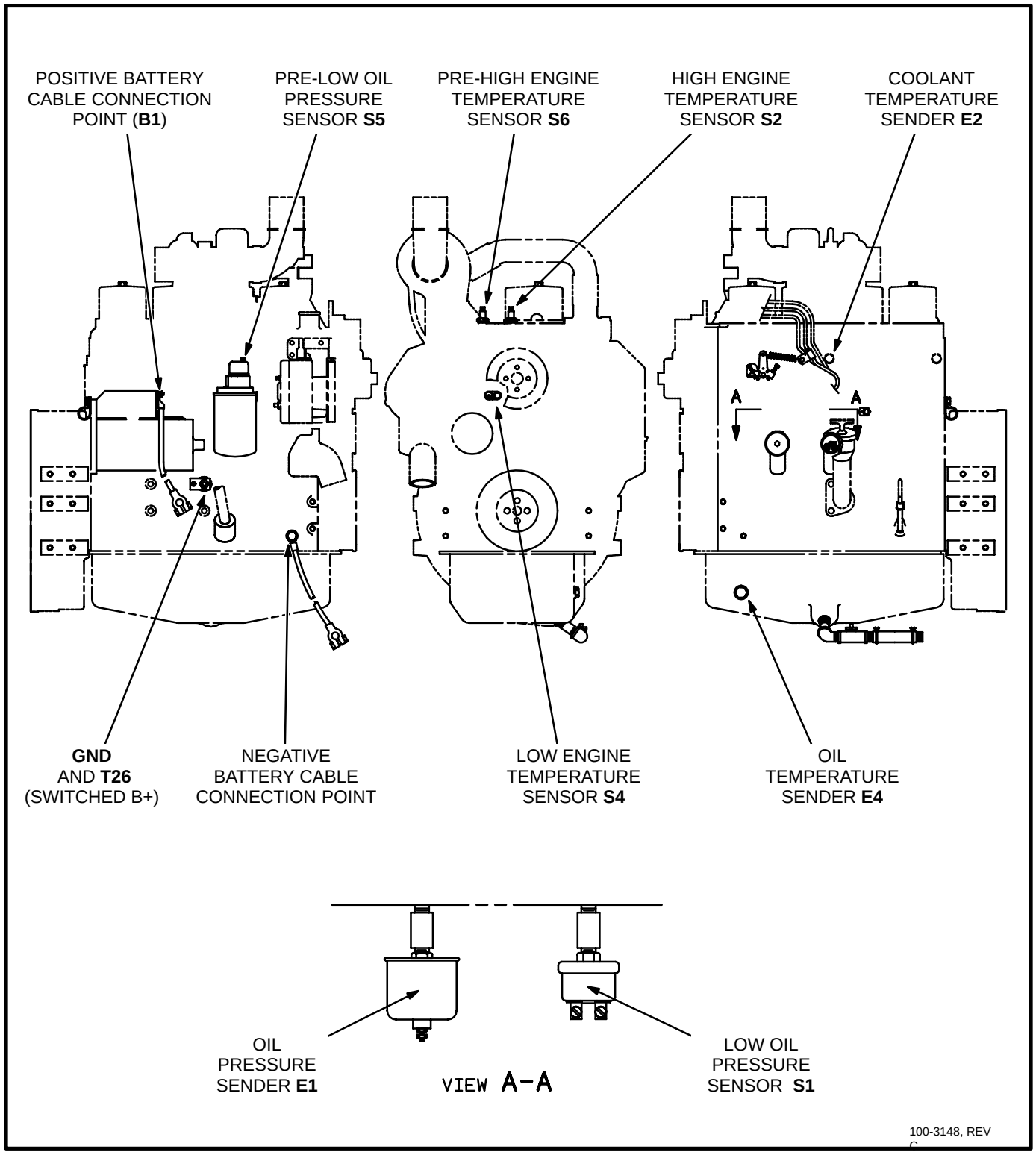


FIGURE 3-6. ENGINE SENSOR LOCATIONS (FOUR CYLINDER B-SERIES ENGINES)—BEGINNING SPEC H

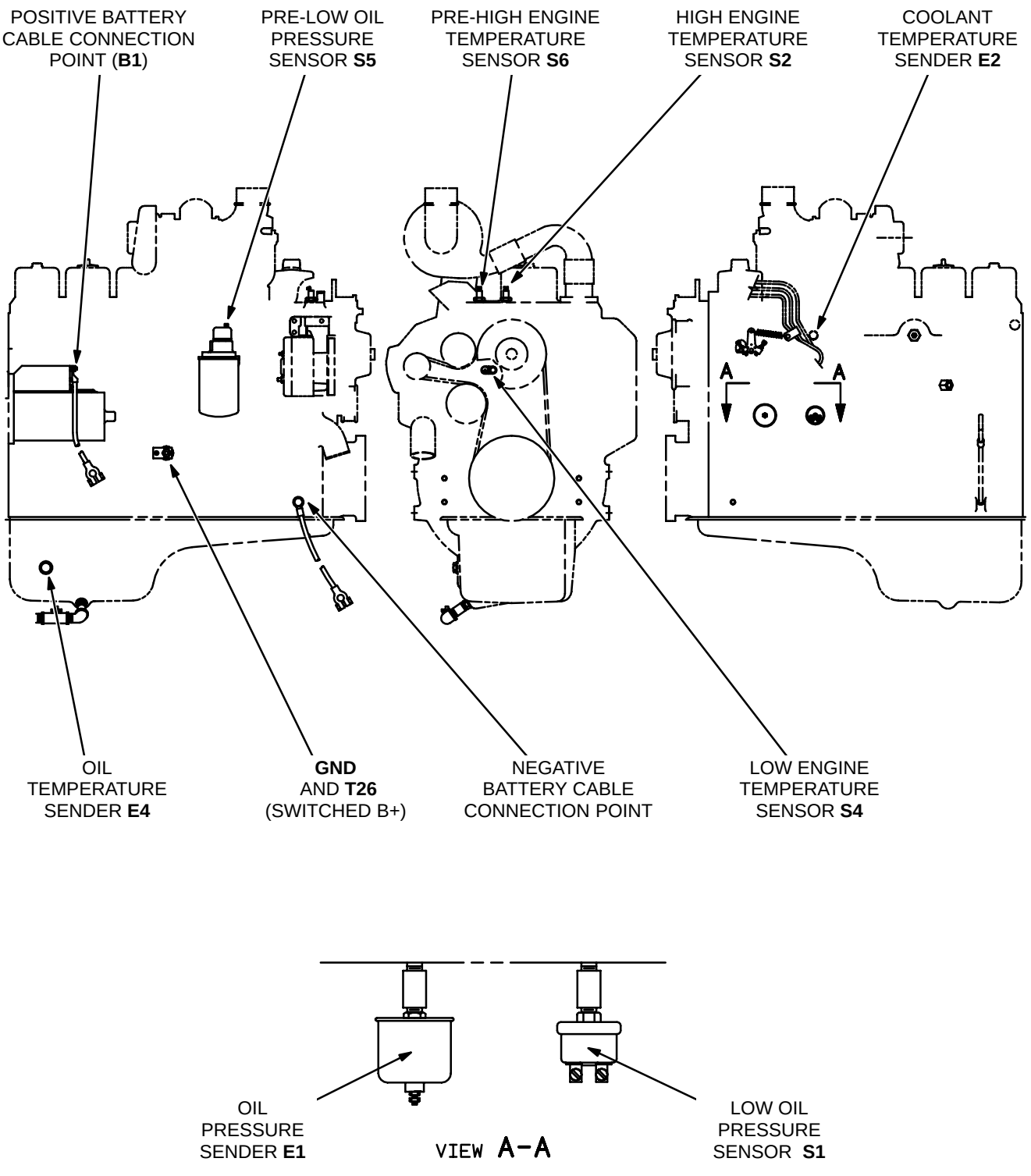


FIGURE 3-7. ENGINE SENSOR LOCATIONS (SIX CYLINDER B-SERIES ENGINES)—BEGINNING SPEC H

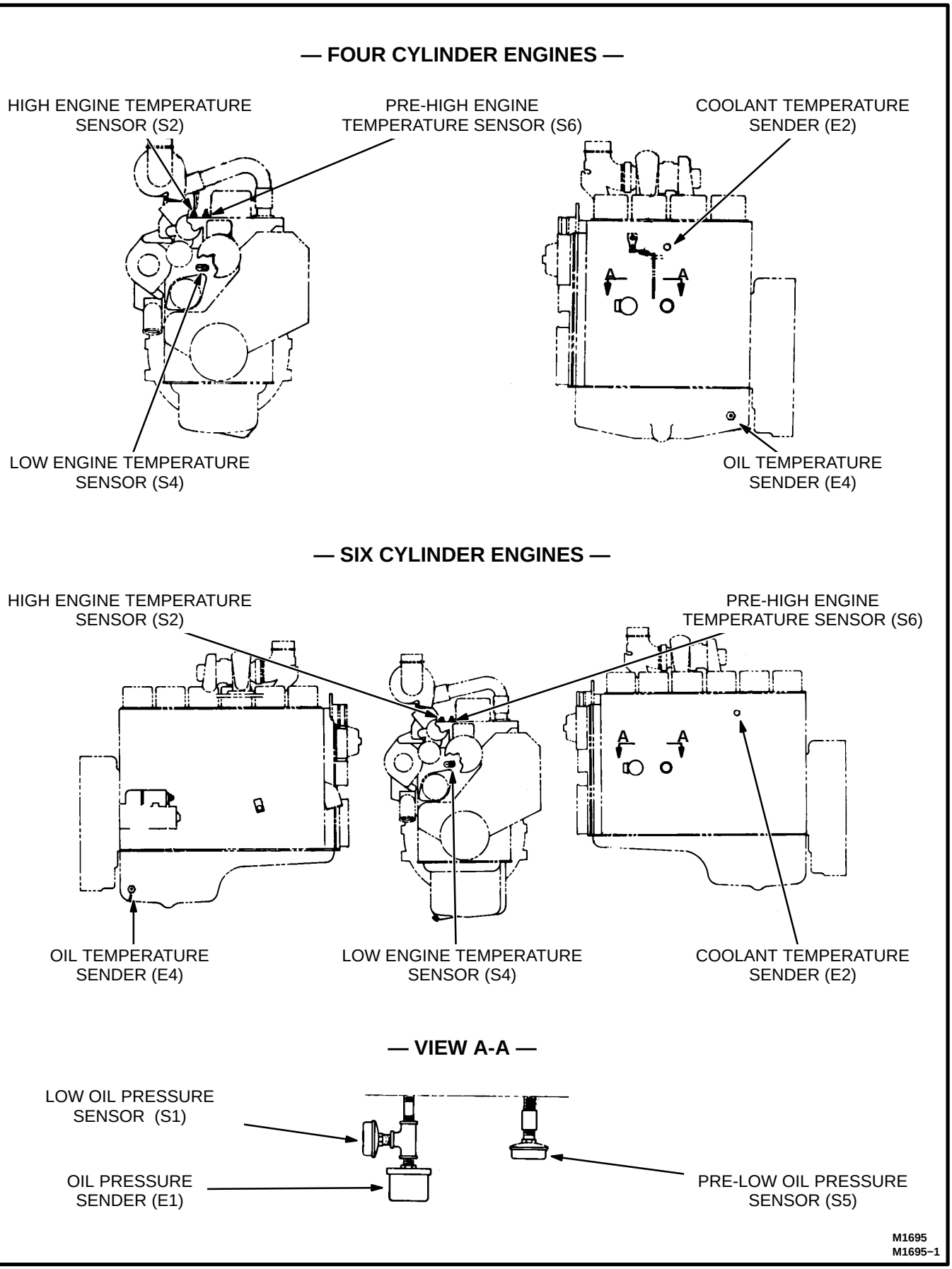


FIGURE 3-8. ENGINE SENSOR LOCATIONS (B-SERIES ENGINES)—PRIOR TO SPEC H

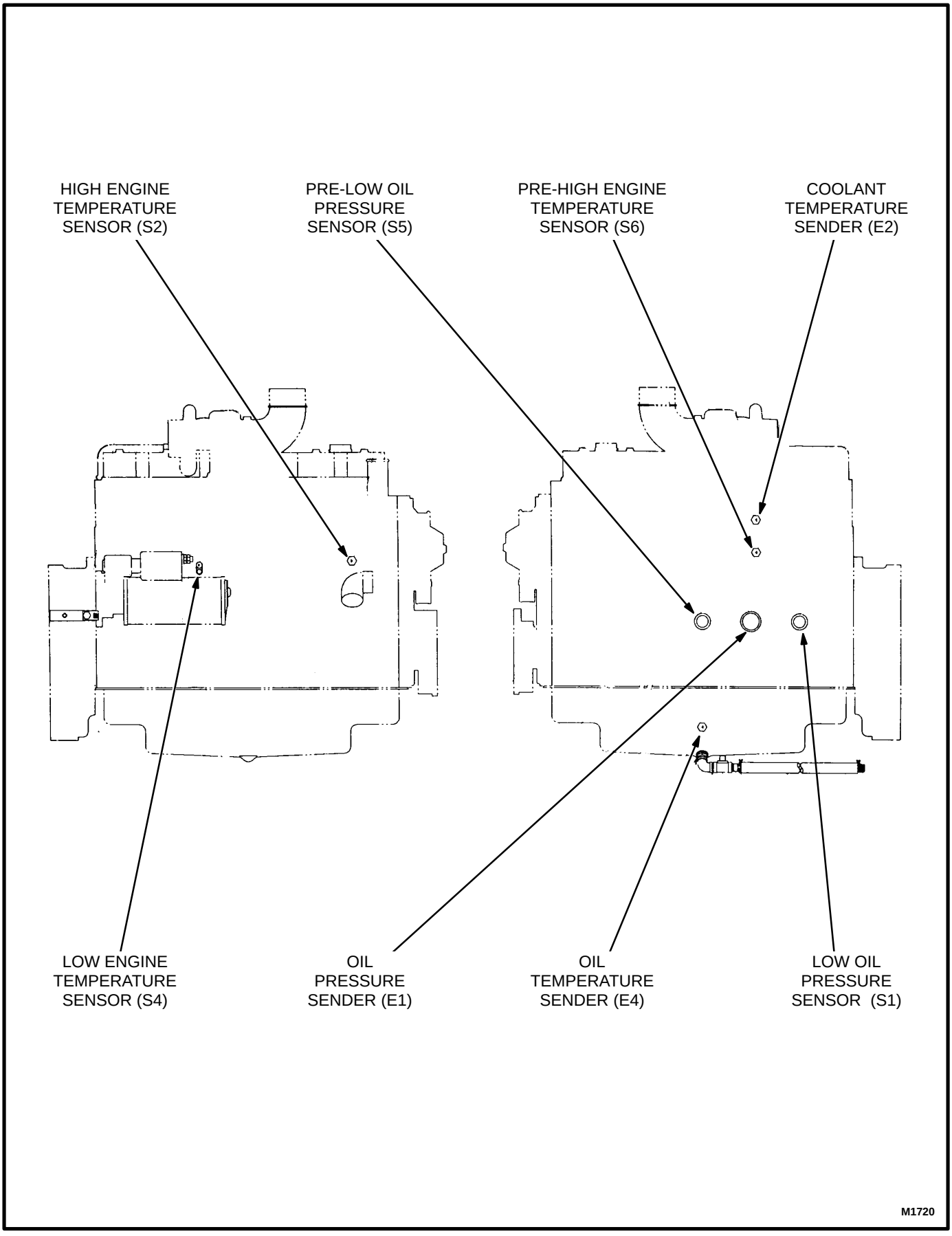


FIGURE 3-9. ENGINE SENSOR LOCATIONS (C-SERIES ENGINES)

AUXILIARY CONTROL COMPONENTS

The set might be equipped with one or more of the following components.

Mechanical Overspeed Switch (Standard)

The mechanical overspeed switch is bolted to the end of the generator rotor shaft.

1. Check overspeed cutout RPM and turn the adjustment screw, if necessary, so that shutdown occurs within the following RPM ranges:
   60 Hz Sets . . . . . 2000 to 2200 RPM
   50 Hz Sets . . . . . 1800 to 2100 RPM
2. Replace the switch if the cutout speed adjustment results in an air gap between the magnet and the fly arm of less than 0.005 inches (0.13 mm).
3. Torque the center rotor bolt to 40 ft-lbs (54 Nm) when replacing the switch.

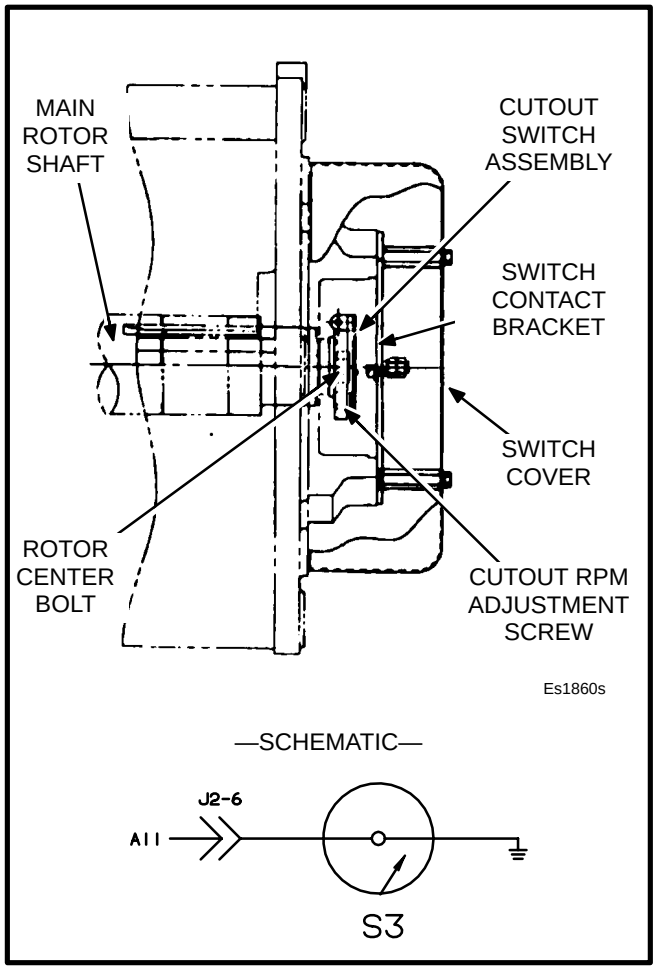


FIGURE 3-10. MECHANICAL OVERSPEED SWITCH

Electronic Overspeed Module (Optional)

PMG-excited generators are equipped with an electronic overspeed module in the control box. The module senses PMG output frequency to determine generator speed (frequency). Adjust the overspeed pot to cut out at 1800 to 1900 RPM for 50 Hz sets and 2100 to 2200 RPM for 60 Hz sets. Do not adjust the cranking pot.

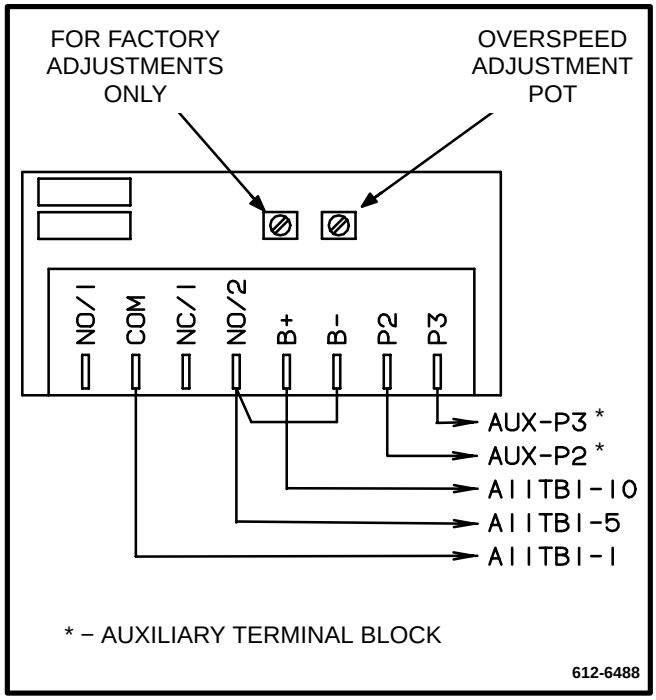


FIGURE 3-11. ELECTRONIC OVERSPEED MODULE

Run Relays (K11)

The set can be equipped with one to three 3-pole, double-throw relays to control auxiliary equipment such as fans, pumps, and motorized air dampers. The relays are mounted on a standoff bracket in front of the ECM.

The contacts are rated:

- 10 amps at 28 VDC or 120 VAC, 80% PF
- 6 amps at 240 VAC, 80% PF
- 3 amps at 480 VAC, 80% PF

The set might instead be equipped with an auxiliary relay board. If so, see Auxiliary Relay Board (ARB).

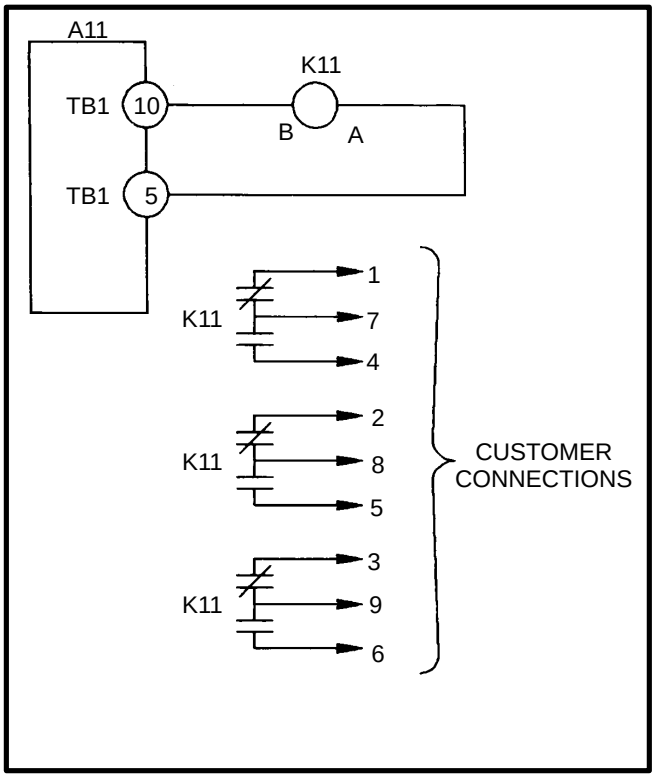


FIGURE 3-12. RUN RELAYS

Alarm Relay Modules (A13 and A14)

The set can be equipped with relay modules to interface with a remote annunciator that is powered independently of the control circuit of the set. Sets with Detector-7 need module A13 and sets with Detector-12, modules A13 and A14.

These are all normally open contacts and they are rated:

- 15 amps at 250 VAC
- 15 amps at 30 VDC

The set might instead be equipped with an auxiliary relay board. If so, see Auxiliary Relay Board (ARB).

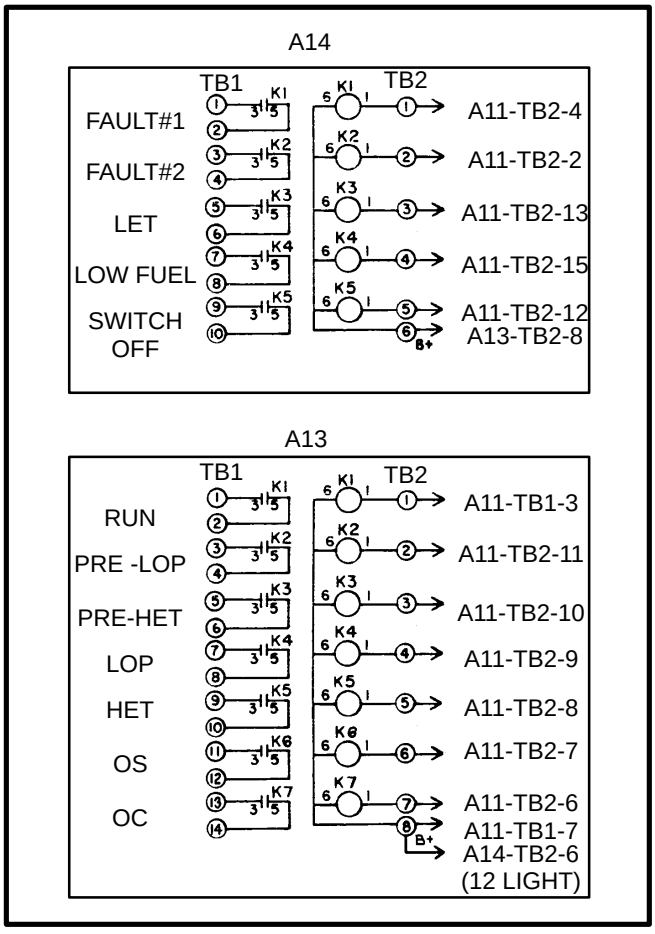


FIGURE 3-13. ALARM RELAY MODULES

Auxiliary Relay Board (ARB)

The following describes the design/functional criteria for the auxiliary relay board (ARB) with a Detector-7 or -12 Genset control. The board is mounted directly on top of the ECM using standoffs and has access holes for the fuses located on the ECM. There are two versions of the ARB; with and without the set of 12 Fault relays (Figure 3-14). Page 9-17 is a detailed connection diagram for the ARB.

The set might instead be equipped with separate run and alarm relay modules. If so, see Run Relay (K11) and Alarm Relay Modules (A13 and A14).

Terminal Blocks:

- **TB1** − ARB TB1 and ECM TB1 are identically numbered and provide the same remote control connection points. Note that additional terminals are provided for terminals 5, 7, and 10 of ARB TB1.
- **TB2 through TB5** − Connection points for relays K1 through K3. TB2 provides the N/O and N/C connections (three form 'C' contacts for each relay). TB3 through TB5 provide the common connection points (TB3 for K1, TB4 for K2 and TB5 for K3).
- **TB6 and TB7** − Connection points for fault relays K4 through K15. Three terminals are provided for each relay, which are labeled COM, N/C, N/O.

Plug-In Relays (K1, K2, K3): The ARB can be equipped with one to three 3-pole, double-throw relays. These relays (K1, K2, K3) are field changeable plug-in relays for easy field addition and replacement.

Each relay can be operated as a RUN, COMMON ALARM, or ISOLATED COIL with the changing of a jumper.

The relay contact ratings are:

- 10 amps at 28 VDC or 120 VAC, 80% PF
- 6 amps at 240 VAC, 80% PF
- 3 amps at 480 VAC, 80% PF

Jumper Positions for Plug-In Relays: Jumpers W1, W2 and W3 perform the same functions for their respective relays, W1 for relay K1, W2 for relay K2, and W3 for relay K3. They can be located in any of 3 positions (A, B, C) independently of each other.

- **Jumper Position A (Run)** − The relay operates as a Run relay, energizing when SW B+ is applied from the ECM.
- **Jumper Position B (Common Alarm)** − The relay operates as a Common Alarm relay. The relay energizes any time there is an engine shutdown. This signal is provided from the ECM.
- **Jumper Position C (Isolated)** − The relay operates as an Isolated relay. The relay coil is energized by a customer applied B+ signal through the terminal block; TB3-1 for relay K1, TB4-1 for relay K2, and TB5-1 for relay K3.

Jumpers W11, W12, and W13 perform the same functions for their respective relays; W11 for relay K1, W12 for relay K2, and W13 for relay K3. They can be located in two different positions (A, B) independently of one another.

- **Jumper Position A** − The relay operates isolated from the board. The customer provides the circuit completion through terminal block; TB3 for relay K1, TB4-5 for relay K2, and TB5-5 for relay K3. The customer can operate the relay with switched ground logic or use this relay in the middle of more complex logic circuits if needed.
- **Jumper Position B** − The relays operate with the coils connected to ground through the board connections. The coil will require a B+ signal to energize with the jumper in this position.

Fault Relays (K4 through K15): These optional relay modules are used to operate a remote alarm annunciator that has an independent power source. This allows the use of either AC or DC for alarm drives. The relays are energized through the latching relays on the ECM and provided N/O and N/C contacts for each external alarm connection.

The 12 relays with form 'C' contacts are rated:

- 10 Amp, 120 VAC
- 10 Amp. 30 VDC

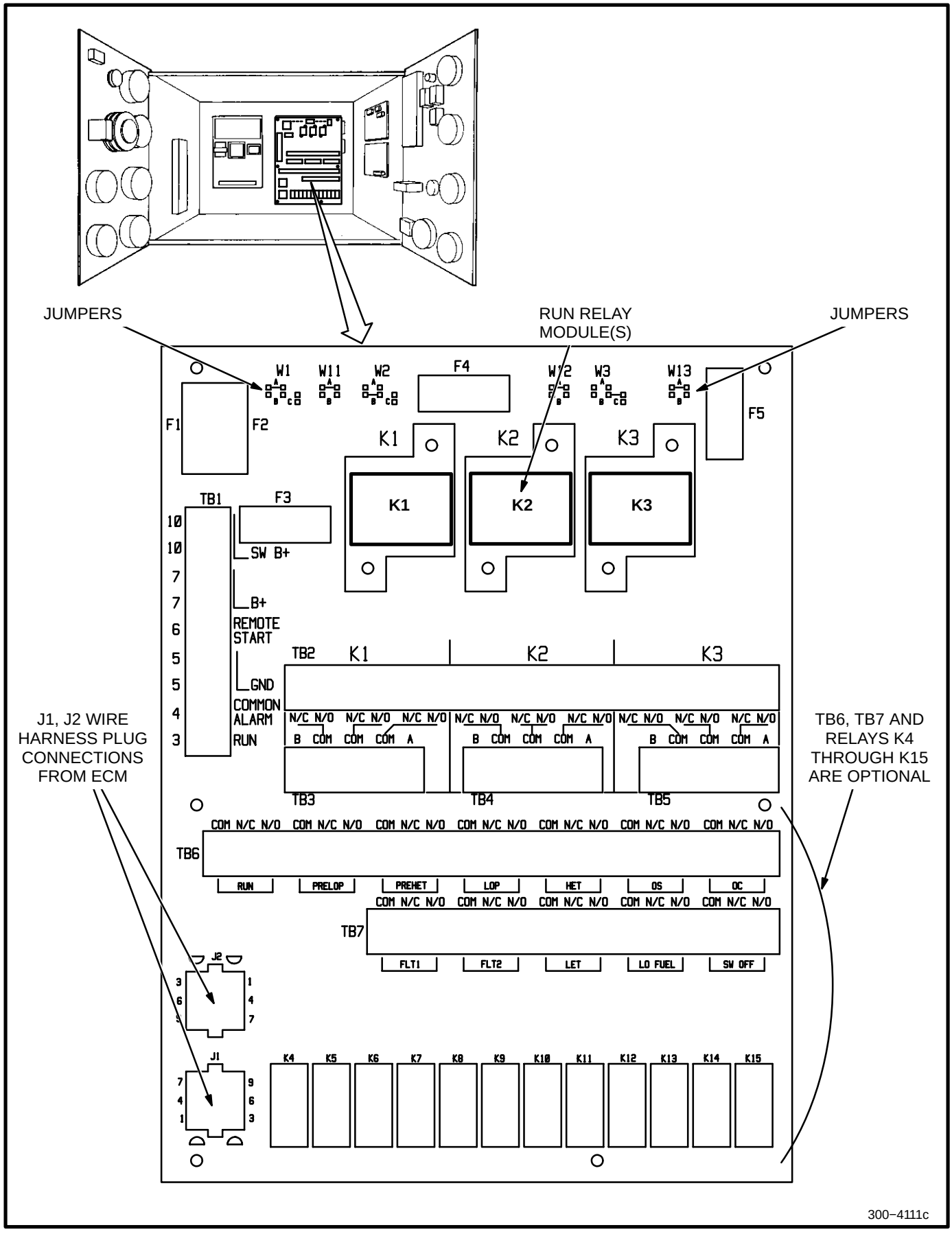


FIGURE 3-14. AUXILIARY RELAY BOARD (ARB)

Over / Under Voltage Module (A17)

The set can be equipped with an adjustable voltage-sensitive relay usually connected into the **Fault 1** circuit (Detector-12 controls only) to shut down the set when the output voltage is over or under nominal voltage by the preselected percentage (typically 10 percent over and under).

With the module is an adjustable time delay relay (**K17**) to prevent nuisance tripping. An adjustment of 25 percent is equivalent to about 2.5 seconds delay.

Recalibrate the module as follows before installing it on 139/240 VAC or 277/480 VAC sets.

1. Remove the two screws that secure the top to the case of the module and withdraw the top assembly.
2. Adjust the **SET** pot for the **UNDER** setpoint on the face of the top assembly to 75 percent.
3. Apply single-phase, 60 Hertz, 104.25 VAC across terminals **L** and **N**.
4. Adjust pot **R25** on the PC board until the relay trips (de-energizes).
5. Adjust the **SET** pot for the **OVER** setpoint on the face of the top assembly to 125 percent.
6. Apply single-phase, 60 Hertz, 173.75 VAC across terminals **L** and **N**.
7. Adjust pot **R26** on the PC board until the relay trips (energizes).
8. Repeat the above steps until no adjustments are necessary.
9. Reassemble the module.
10. On the module nameplate mark out the factory calibration value for monitored voltage (120 V) and write in **139 V**.

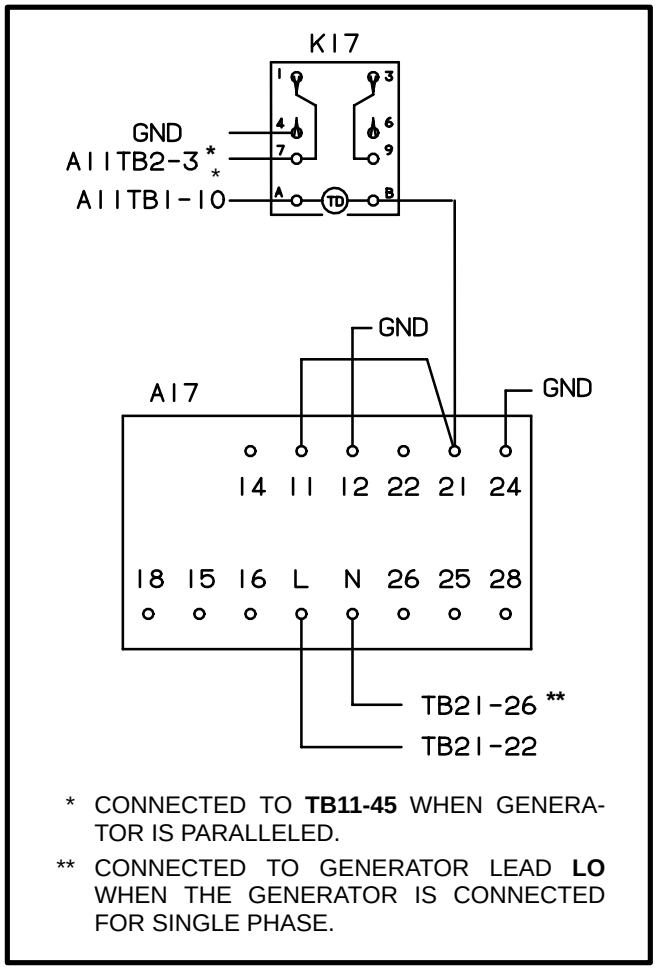


FIGURE 3-15. OVER / UNDER VOLTAGE MODULE

Over / Under Frequency Module (A19)

The set can be equipped with an adjustable frequency-sensitive relay to shut down the set when the output frequency (Hz) is over or under nominal frequency by the preselected amount. It is usually connected into the **Fault 2** circuit (Detector-12 controls only) if the over / under voltage module is also provided. Set points are typically 5 Hertz over and under nominal frequency (50 or 60 Hertz) and reset points 3 Hertz over and under.

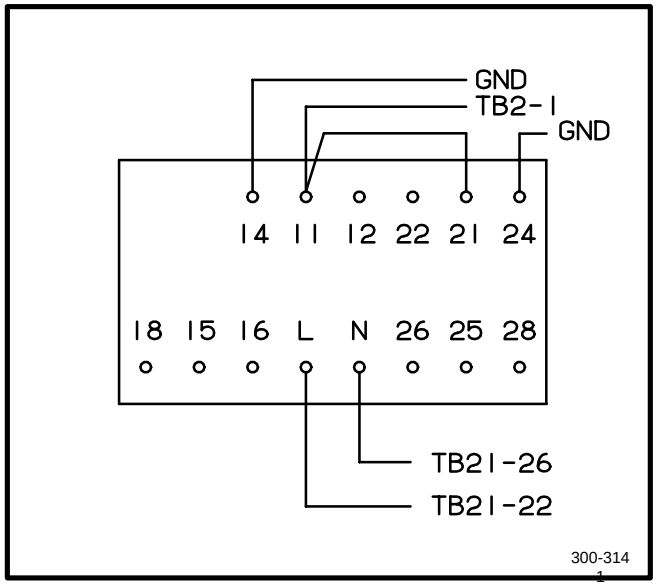


FIGURE 3-16. OVER / UNDER FREQUENCY MODULE

Time Delay Start / Stop Module (A15)

The set can be equipped with a module to delay starting and stopping when the start and stop signals are received from the remote controller. It is adjustable to delay starts from 1 to 15 seconds to prevent nuisance starts in installations where momentary power interruptions are frequent. It is adjustable to delay stops 1 to 30 minutes to allow the prime source of power time to stabilize.

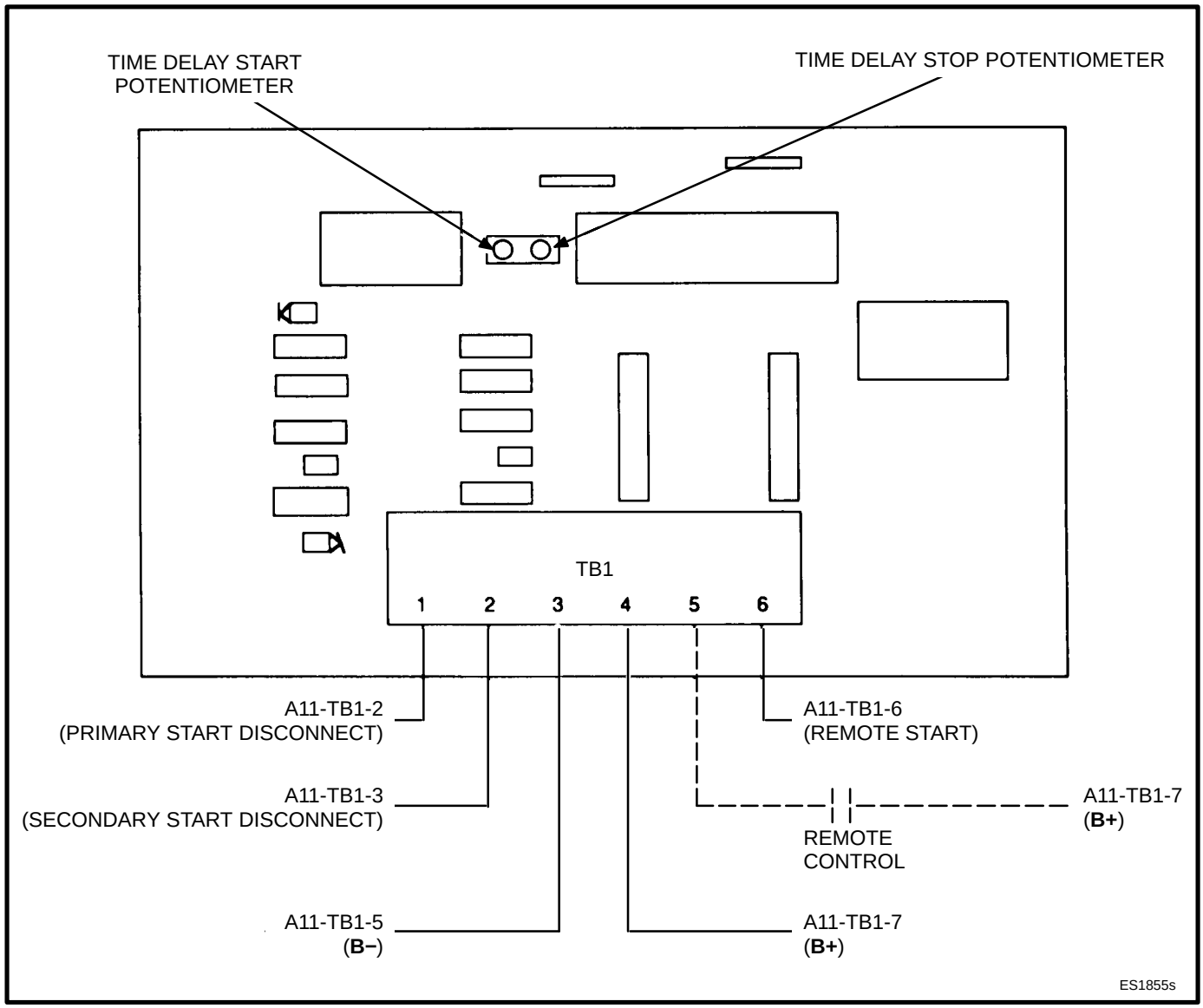


FIGURE 3-17. TIME DELAY START / STOP MODULE

SEQUENCE OF OPERATION

The sequence of operation is as follows. Refer to the schematic on Page 9-8 or 9-10, as appropriate.

1. The ECM is powered by cranking battery voltage (24 VDC). Terminal **TB1-9** is connected to battery positive (+) and connector **P1-6** to battery negative (-).
2. The starting cycle begins when relay **K7** is powered, either manually by pushing the panel **Run** switch, or automatically by a remote controller connected at terminal **TB1-6**. (The panel switch must be in the **Remote** position for remote, automatic operation.)
3. Relay **K7** powers relays **K2** and **K3**.
4. Relay **K2** powers the engine gauges and terminal **TB1-10**, to which the fuel solenoid and ignition module are connected.
5. Relay **K3** powers terminal **TB1-8** to which starter relay **K4** is connected. Engine cranking begins.
6. The engine starts and runs up to governed speed in a matter of seconds.
7. The starter is disconnected when engine speed gets to about 600 RPM. This is done by relay **K10** or **K14**, whichever acts first to open the circuit powering relay **K3**.
8. Relay **K10** is powered by the generator output voltage (120 VAC) through plug-in connectors **P1-1** and **P1-2**. The remote **Run** indicator lamp should light (connected through terminal **TB1-3)**.
9. Relay **K14** is powered by the engine-driven battery charging alternator (24 VDC) through plug-in connector **P1-3**. The panel **Run** indicator lamp should light. Relays K10 and K14 are redundant.*
10. Relays **K2** and **K3** are deenergized (by latching relay **K6**) causing shutdown to occur if the engine does not start within 75 seconds. The **Overcrank** indicator lamp lights and common alarm terminal **TB1-4** is powered.

    The ECM has a cycle crank feature whereby the engine is cranked for three 15 second periods alternated with two 15 second rest periods.

11. Relay **K3** is deenergized (by latching relay **K6**) causing shutdown to occur during operation when a low oil pressure, high engine temperature or engine overspeed condition is sensed or the optional emergency stop button is pressed. The appropriate fault indicator lamp lights and common alarm terminal **TB1-4** is powered. (There is no fault lamp for emergency stop.)

    The low oil pressure and high engine temperature shutdowns have 10 second time delays to allow oil pressure and engine temperature to stabilize during startup.

12. To restore operation after a shutdown fault has been serviced, reset latching relay **K6** by pushing the panel **Stop** switch and then the **Reset** switch. The set should run or be ready to run when the panel switch is pushed to **Run** or to **Remote**.

    If the emergency stop switch has been used, the control will have to be reset to restore operation. First pull the emergency stop switch button and then push the panel Stop and Reset switches.

13. The set is stopped manually by pressing the panel **Stop** switch or automatically by a remote controller. (The panel switch must be in the **Remote** position for remote, automatic operation.)

* On older ECM boards (those having cartridge-type fuses):
- If the starter disconnects normally but the panel Run indicator lamp does not light, the DC (K14) starter disconnect circuit is not working.
- If the starter disconnects normally but neither the panel nor the remote Run indicator lamps light, the AC (K10) starter disconnect circuit is not working.

* On newer ECM boards (those having automotive-type fuses):
- If the starter disconnects normally but neither the panel nor the remote Run indicator lamps light, the AC (K10) starter disconnect circuit is not working.
- Both the remote and the panel Run indicator lamps will light even if the DC (K14) starter disconnect circuit is not working. Check the DC voltmeter to determine whether or not the battery charging alternator is working.

4. Troubleshooting

These troubleshooting charts are designed to help you think through generator set problems. To save time troubleshooting, read the entire manual ahead of time to understand the generator set. Try to think through problems. Go over what was done during the last service call. The problem could be as simple as an empty fuel tank, closed fuel shutoff valve, loose wire, blown fuse or tripped circuit breaker.

⚠WARNING ***There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about fuel, electrical and machinery hazards. Read the safety precautions page and carefully observe all instructions and precautions in this manual.***

THE ENGINE DOES NOT CRANK

The **Run-Stop-Remote** switch is at **Stop. (**The **Switch-Off** light will be flashing, if provided.)	Push the **Run-Stop-Remote** switch to **Run** or **Remote.**
The **Emergency Stop** switch has been used. (No fault lamp is on.)	Pull the **Emergency Switch** button. To reset the engine control, push the **Run-Stop-Remote** switch to **Stop** and the **Reset** switch to **Reset**. Then push the **Run-Stop-Remote** switch to **Run** or **Remote.**
The remote control circuit is faulty.	Push the **Run-Stop-Remote** switch to **Run**. If the engine cranks, find and repair the fault in the remote control circuit.
A **Fault Shutdown** is being indicated by one of the red lights on the control panel.	Service the set as necessary. To reset the engine control, push the **Run-Stop-Remote** switch to **Stop** and the **Reset** switch to **Reset**. Then push the **Run-Stop-Remote** switch to **Run** or **Remote.**
A **Lo Shutdown** is being indicated on the day tank pump control panel (if provided).	Determine the cause and service as necessary. See Section 7, *Day Tank Fuel Pump and Control*. To reset the engine control, push the **Run-Stop-Remote** switch to **Stop** and the **Reset** switch to **Reset**. Then push the **Run-Stop-Remote** switch to **Run** or **Remote.** Note that the engine control will shut down unless the day tank control has been reset first.

Continued on next page.

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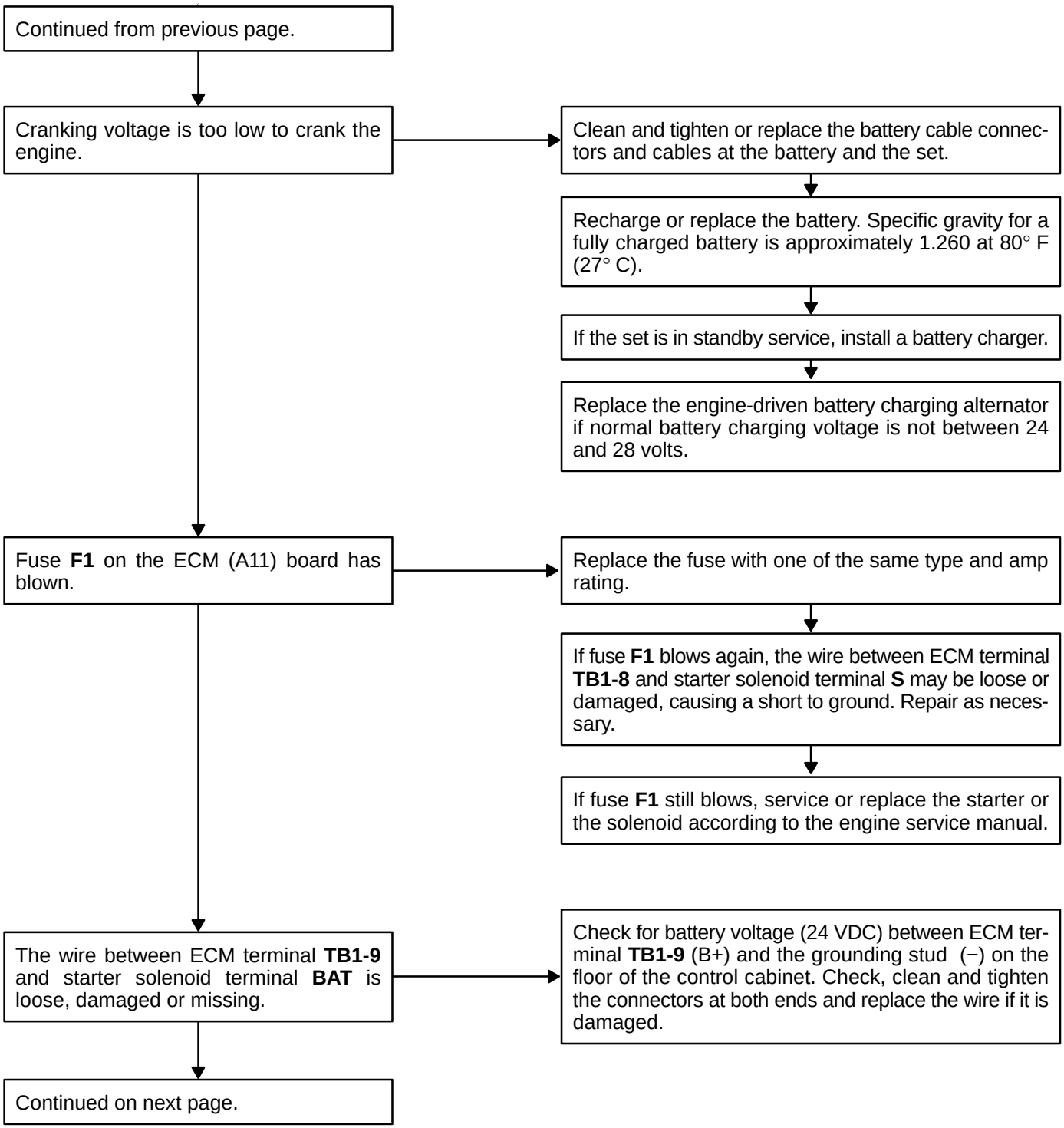
THE ENGINE DOES NOT CRANK (CONT.)



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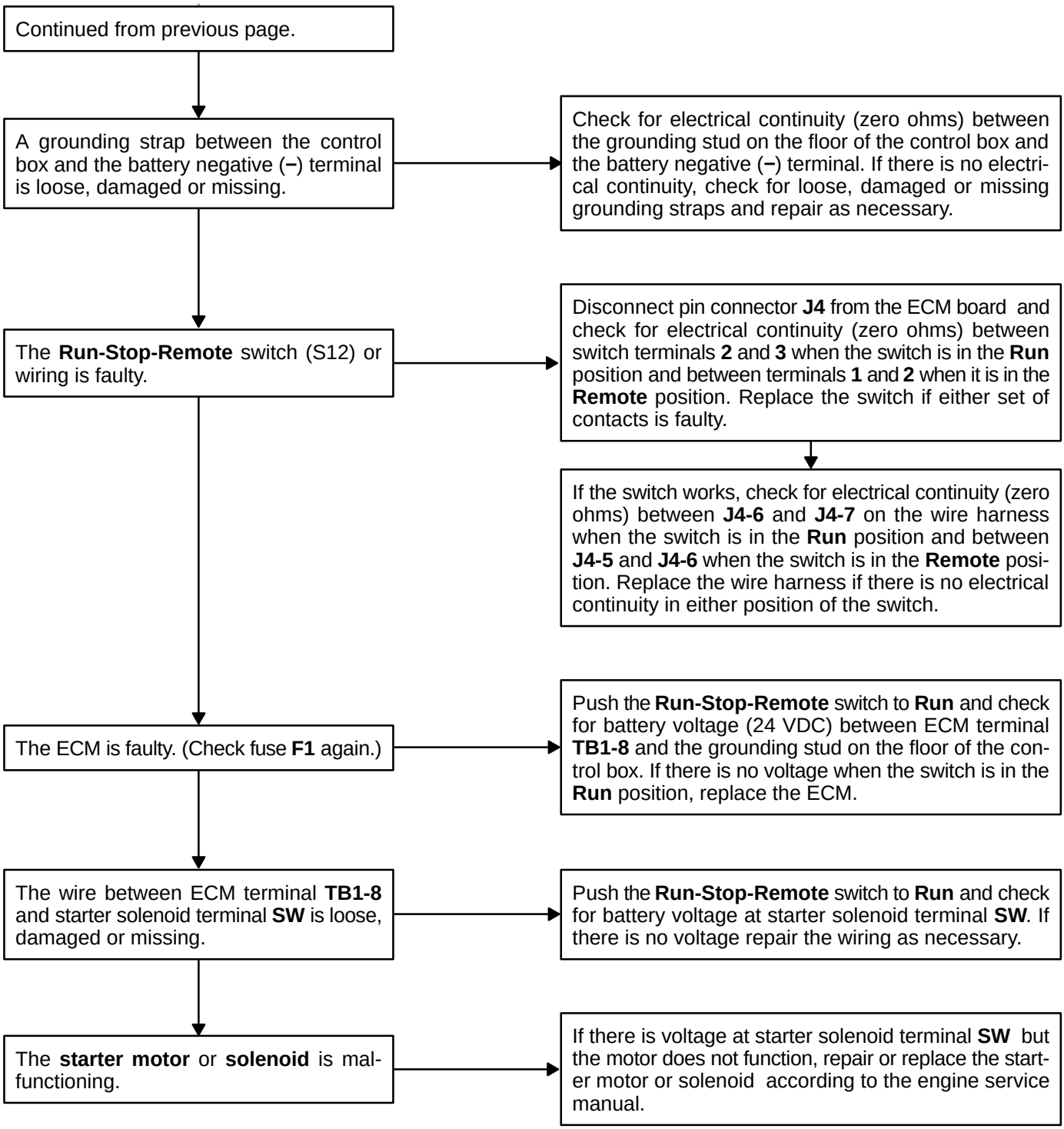
THE ENGINE DOES NOT CRANK (CONT.)



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THE ENGINE CRANKS BUT DOES NOT START

When the **Run-Stop-Remote** switch is in the **Run** position**,** the control will attempt to crank the engine for approximately 75 seconds (including two rest periods) and then the red **OVERCRANK** lamp will light if the engine does not start. If the **OVERCRANK** lamp comes on, reset the control by pushing the **Run-Stop-Remote** switch to **Stop** and the **Reset** switch to **Reset**. Then push the **Run-Stop-Remote** switch to **Run** or **Remote.**

The engine is not getting fuel.

- Open any closed shutoff valve in the fuel line supplying the engine.
- Fill the main fuel supply tank.
- Restore fuel pump prime according to the applicable Operator's Manual.

Fuse **F2** on the ECM board (A11) has blown.

- Replace the fuse with one of the same type and amp rating.
- If fuse **F2** blows again, the wire between ECM terminal **TB1-10** and engine block terminal **T26** may be loose or damaged, causing a short to ground. Repair as necessary.
- If fuse **F2** still blows, the wire between fuel solenoid **K1** and terminal **T26** may be loose or damaged, causing a short to ground. Repair as necessary.

Fuel solenoid **K1** is faulty (does not open).

- Connect the terminal on fuel solenoid **K1** to the **BAT** terminal on the starter solenoid with a jumper wire**.** Replace the fuel solenoid if it does not "click" each time power is connected.

Continued on next page.

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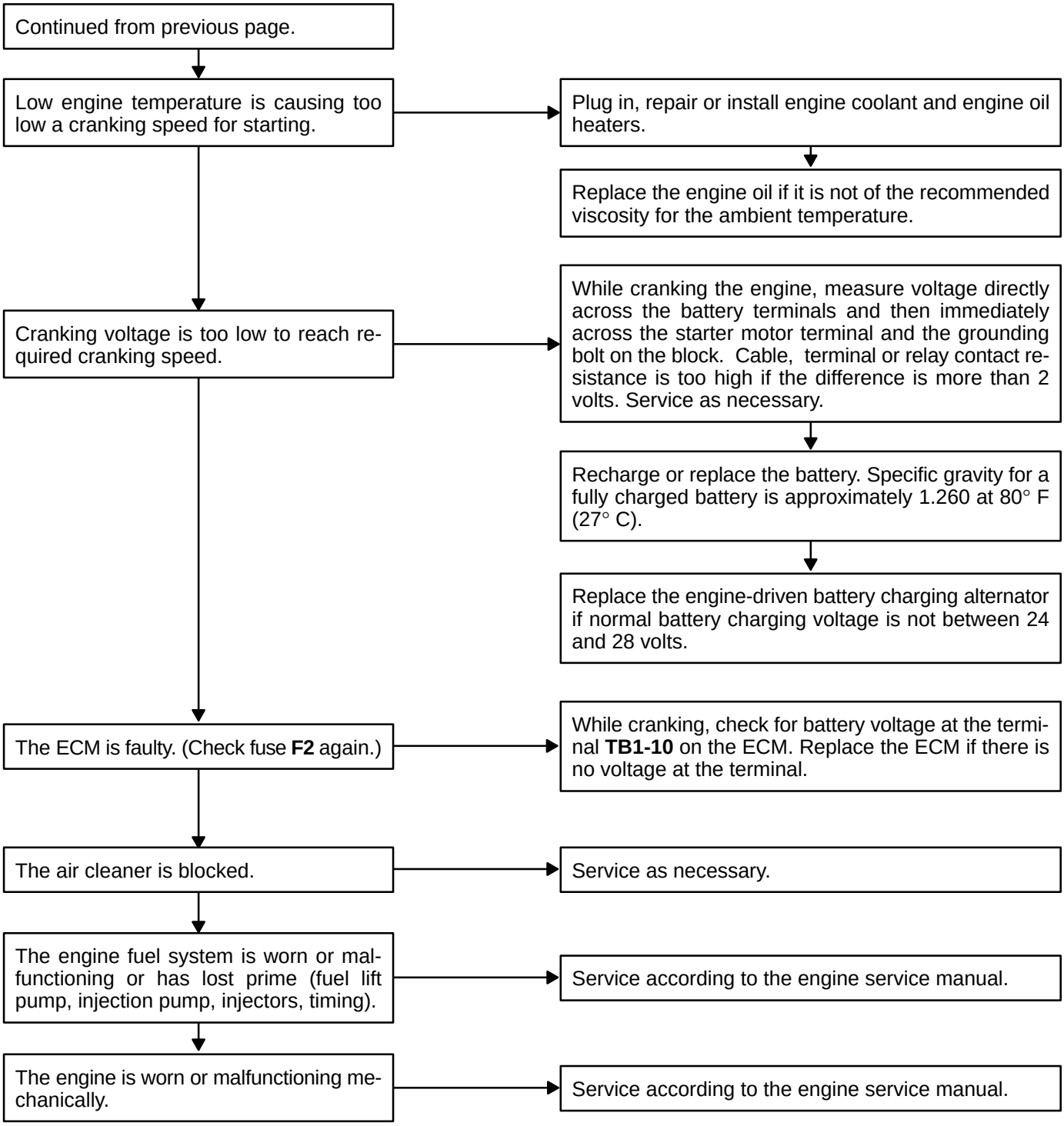
THE ENGINE CRANKS BUT DOES NOT START (CONT.)



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THE ENGINE RUNS UNTIL FAULT SHUTDOWN (RED SHUTDOWN LAMP ON)

The **OVERSPEED** lamp comes on when the engine shuts down.

Reset the ECM by pushing the **Run-Stop-Remote** switch to **Stop** and the **Reset** switch to **Reset** and restart the set, monitoring engine speed. Readjust the cutout speed if it is lower than specified. Replace the overspeed module (PMG equipped sets) or the overspeed switch if it cannot be readjusted. See Section 3, *Engine Control*.

Adjust the governor according to Section 6, *Governors.*

Mechanical Governor: Service or replace the injection pump unit if the set still shuts down due to overspeed.

Electronic Governor: If the governor cannot be adjusted to prevent shutdown due to overspeed, check for binding in the linkage. Repair and adjust the linkage as necessary. (A spring inside the actuator will resist movement, which is normal.)

If the set still shuts down due to overspeed, re-install the magnetic speed pick-up unit to make sure the clearance with the flywheel gear teeth is correct. Replace the speed-pickup unit if output voltage at cranking speed is less than 2.5 VDC as measured at terminals 10 (−) and 11 (+) on the governor controller.

Disconnect the actuator leads at governor controller terminals **4** and **5**. Jumper the lead for terminal **4** to the **BAT** terminal on the starter solenoid and touch the lead for terminal **5** to a good ground on the block**.** Replace the actuator unit if it does not drive the linkage through its full travel when power is connected or return it when power is disconnected.

Replace the governor controller if the set still shuts down due to overspeed.

Continued on next page.

⚠WARNING ***There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about fuel, electrical and machinery hazards. Read the safety precautions page and carefully observe all instructions and precautions in this manual.***

THE ENGINE RUNS UNTIL FAULT SHUTDOWN (CONT)

Continued from previous page.

The **LOW OIL PRESSURE** lamp comes on when the engine shuts down.

Reset the ECM by pushing the **Run-Stop-Remote** switch to **Stop** and the **Reset** switch to **Reset** and fill up with as much engine oil as necessary and repair all oil leaks.

If the set still shuts down due to low oil pressure, disconnect the wire to fuel solenoid **K1** (to keep the engine from starting) and observe oil pressure while cranking the engine. Service the lubricating oil system according to the engine service manual if oil pressure is less than 10 psi. Replace the low oil pressure cutout switch if oil pressure is greater than 10 psi. See Figure 3-5, 3-6, 3-7 or 3-8 in Section 3, *Engine Control* to locate the switch.

The **HIGH ENGINE TEMPERATURE** lamp comes on when the engine shuts down.

Reset the ECM by pushing the **Run-Stop-Remote** switch to **Stop** and the **Reset** switch to **Reset** and fill up with as much engine coolant as necessary and repair all leaks.

If the set still shuts down due to high engine temperature, start the engine and observe coolant temperature as the system heats up. If shutdown occurs before the coolant reaches 200° F (93° C), replace the high engine temperature cutout switch. If coolant temperature exceeds 200° F (93° C), clean and service the entire cooling system as required to restore full cooling capacity. See Figure 3-5, 3-6, 3-7 or 3-8 in Section 3, *Engine Control,* to locate the switch.

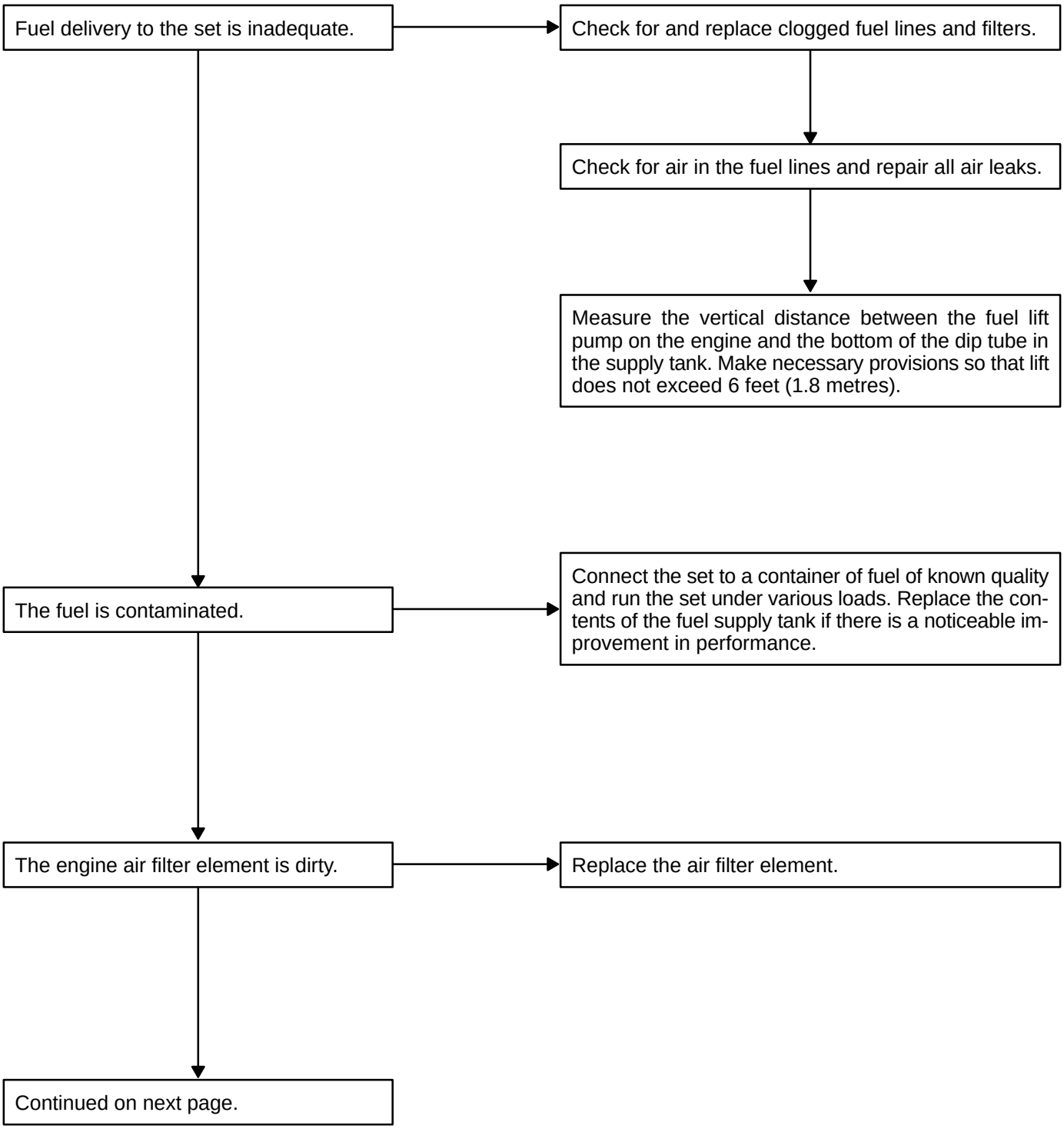
The **FAULT 1** or **FAULT 2** lamp comes on when the engine shuts down.

Service as required. (The customer has supplied the system fault indicating switches. By means of selection jumpers, either fault may be chosen to display the warning only. See Section 3, *Engine Control*.)

If the set is equipped with the optional low frequency shutdown feature and the red **FAULT 1** or **FAULT 2** lamp is on, the set probably ran out of fuel. Service as required.

⚠WARNING ***There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about fuel, electrical and machinery hazards. Read the safety precautions page and carefully observe all instructions and precautions in this manual.***

THE ENGINE LACKS POWER OR STABLE SPEED



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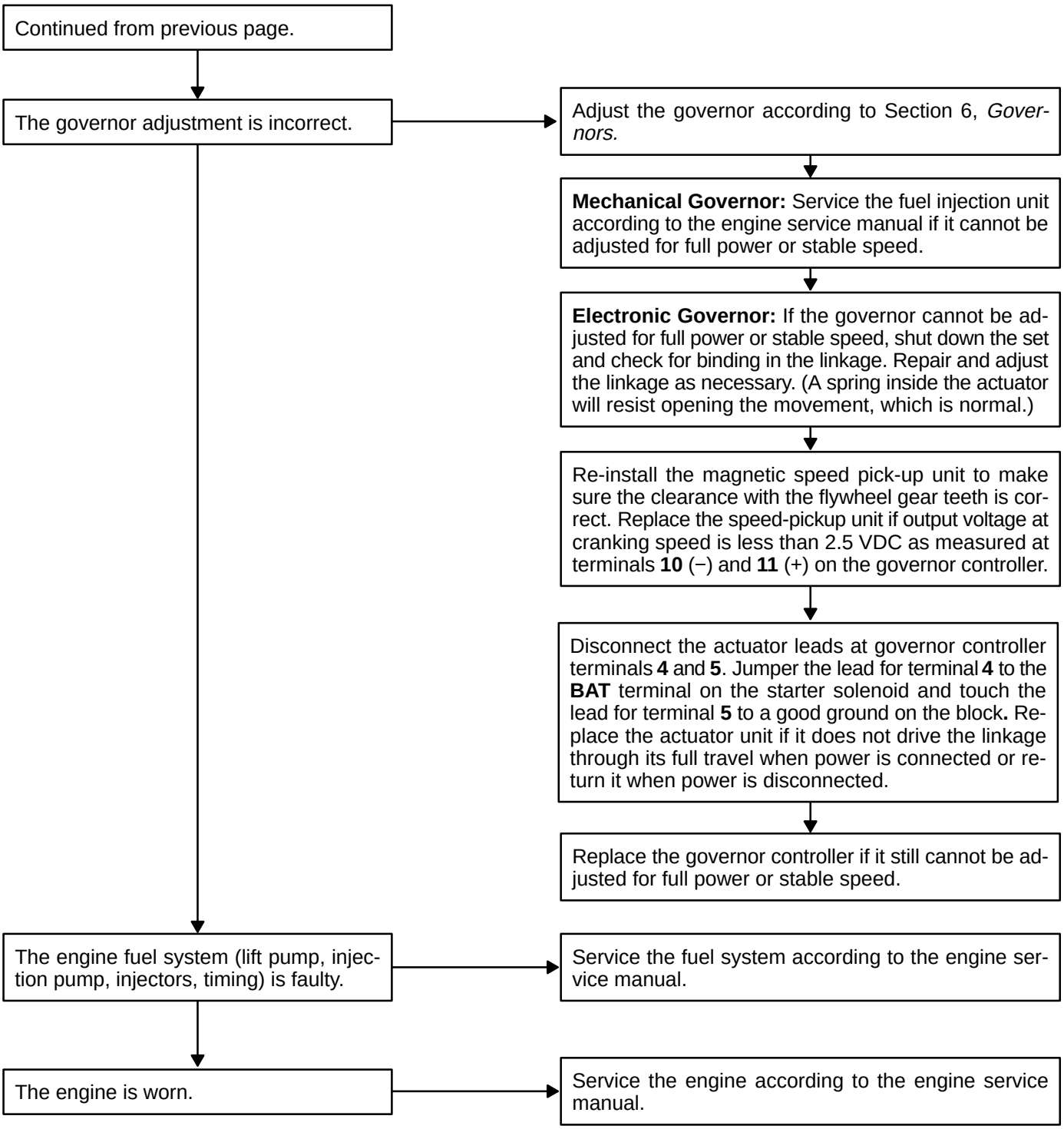
THE ENGINE LACKS POWER OR STABLE SPEED (CONT.)



⚠WARNING ***There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about fuel, electrical and machinery hazards. Read the safety precautions page and carefully observe all instructions and precautions in this manual.***

AMBER WARNING LAMP ON

The **PRE-LOW OIL PRESSURE** lamp comes on while the engine is running.	Shut down the set if possible or disconnect non-critical loads.(Oil pressure will be less than 20 psi but greater than 14 psi.) Service the engine lubricating system according to the engine service manual.
The **PRE-HIGH ENGINE TEMPERATURE** lamp comes on while the engine is running.	Shut down the set if possible or disconnect non-critical loads. (Engine temperature will be greater than 220° F but less than 230° F.) Service the engine cooling system to restore full cooling capacity.
The **LOW ENGINE TEMPERATURE** lamp comes on while the set is in standby.	Plug in, repair or install engine coolant and engine oil heaters.
The **LOW FUEL** lamp comes on.	Fill the main fuel supply tank with the appropriate grade of fuel. (The customer has supplied the fuel level switch to make use of this warning.)
FAULT 1 or **FAULT 2 (RED)**	Service as required. (The customer has supplied the system fault indicating switches. By means of selection jumpers, either fault may be chosen to shut down the engine. See See Section 3, *Engine Control*.

⚠WARNING ***There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about fuel, electrical and machinery hazards. Read the safety precautions page and carefully observe all instructions and precautions in this manual.***

THE GREEN RUN LAMPS STAY OFF BUT THE SET RUNS NORMALLY

The set mounted **RUN** lamp does not light although the starter has disconnected normally and the engine is running

→ Press the panel **Lamp Test** switch and replace the run lamp bulb if it does not light.

↓ If the lamp is good and the set has an older ECM board (one with cartridge-type fuses) this indicates that the DC disconnect circuit (K14 relay circuit on the ECM) is not working. Check the DC voltmeter and if there is not at least 24 volts, check for loose or missing wiring between the battery charging alternator and terminal **TB1-2** and pin connector **P1-3** on the ECM. See Page **9-8** or **9-9** regarding the applicable alternator configuration. If the connections are good, replace the battery charging alternator.

↓ If the **RUN** lamp, wiring connections and battery charging alternator are all good and the **RUN** lamp does not light during normal operation, replace the ECM.

Neither the remote nor the set mounted **RUN** lamp light although the starter has disconnected normally and the engine is running.

→ Press the panel **Lamp Test** switch and replace the run lamp bulb if it does not light. Test the remote **RUN** lamp by suitable means and replace it if it does not light.

↓ If both lamps are good, this indicates that the AC disconnect circuit (K10 relay circuit on the ECM) is not working. Check the AC voltmeter to determine whether or not there is generator output voltage and service as necessary. See There Is No Output Voltage.

↓ If there is generator output voltage, check for 120 VAC across pin connectors **P1-1** and **P1-2** on the ECM. If there is no voltage, check for loose or missing leads between the connectors and **TB21-21** and **TB21-32** inside the control box and service as necessary.

↓ Replace the ECM if there is 120 VAC across pin connectors **P1-1** and **P1-2** but neither **RUN** lamp lights during normal operation.

⚠WARNING ***There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about fuel, electrical and machinery hazards. Read the safety precautions page and carefully observe all instructions and precautions in this manual.***

THERE IS NO OUTPUT VOLTAGE (ENGINE SPEED IS STABLE)

The line circuit breaker is **OFF**.	Find out why the circuit breaker was turned **OFF**, make sure it is safe to reconnect power, and then throw the circuit breaker **ON**.
The line circuit breaker has **TRIPPED**.	Shut down the set and service as necessary to clear the short circuit or ground fault that caused tripping, and then **RESET** the circuit breaker and start the set.
The line circuit breaker is faulty.	Shut down the set, make sure the power output lines from the set have been disconnected from all other sources of power, attempt to **RESET** the circuit breaker and throw it **ON** and check for electrical continuity across each line contact. Replace the circuit breaker if there is measurable resistance across any contact.
Field circuit breaker **CB21** has **TRIPPED**.	**RESET** the circuit breaker. If it keeps tripping, troubleshoot according to the chart, *Field Circuit Breaker Keeps Tripping*.
Field circuit breaker **CB21** is faulty.	Shut down the set, attempt to **RESET** the circuit breaker and disconnect either lead. Replace the circuit breaker if there is measurable resistance across the terminals.
Continued on next page.	

⚠WARNING ***There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about fuel, electrical and machinery hazards. Read the safety precautions page and carefully observe all instructions and precautions in this manual.***

THERE IS NO OUTPUT VOLTAGE (CONT.)

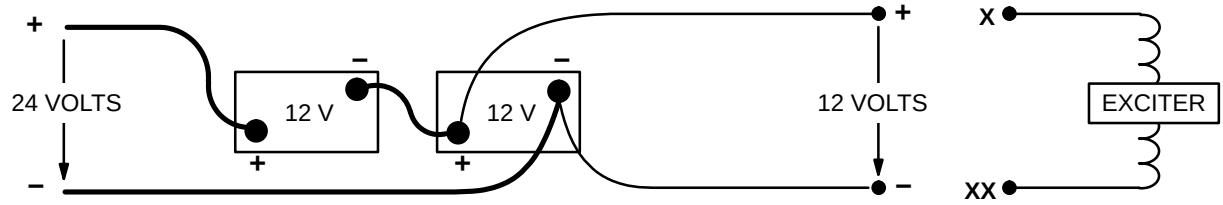
Continued from previous page.

Determine, as follows, whether the fault is in the **VOLTAGE REGULATING** or **GENERATOR** circuits:

1. Throw the line circuit breaker **OFF** and shut down the set.

   ⚠ CAUTION ***This test involves unregulated excitation of the generator. To prevent damage to the generator due to overcurrent, make sure that all loads have been disconnected and that all faults have been cleared from the power output terminals of the generator.***

2. Open the control panel and disconnect the **X** and the **XX** leads from the voltage regulator. See Figure 2-2 or 2-3, as appropriate.
3. Prepare to measure output voltage across the generator terminals while the set is running.
4. Bring two jumpers from a **12 volt battery** for connection to the **X** and **XX** leads inside the control box. Connect the jumper from the positive (**+**) post of the the battery to the **X** lead. Be prepared to connect the jumper from the negative (**–**) post of the battery to the **X X** lead. If one of the 12 volt cranking batteries is used, bring the jumpers from the battery connected on the grounded side of the system to avoid inadvertently imposing 24 volts on the system.



5. Check polarity again. Polarity must be correct or this test will be inconclusive because the induced and residual magnetic polarities in the exciter stator will be opposed. Also, it might be necessary to reflash a self-excited generator if polarity is reversed in this test.

   HIGH VOLTAGE. Touching uninsulated high voltage parts inside the control box can result in
   ⚠ DANGER ***onal injury or death. Measurements and adjustments must be done with care to avoid touching high voltage parts.***

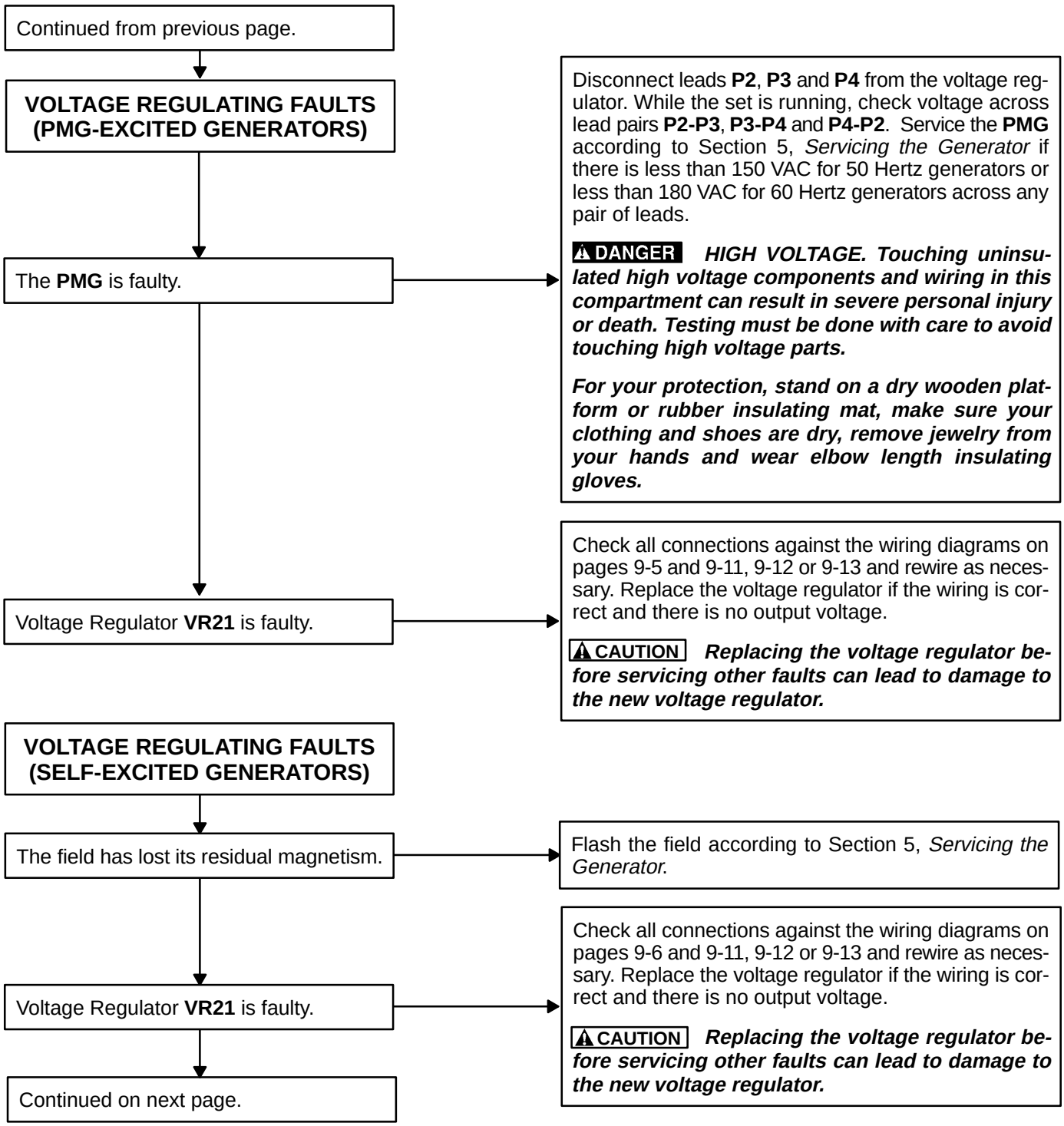
   For your protection, stand on a dry wooden platform or rubber insulating mat, make sure your clothing and shoes are dry, remove jewelry from your hands and wear elbow length insulating gloves.

6. Start the set and connect the jumper from the battery negative (**–**) terminal to the **X X** lead.
7. The generator is probably okay if rated output voltage or higher is obtained and the voltages for all phases are balanced when the exciter is powered by a 12 volt battery. Use the appropriate **VOLTAGE REGULATING FAULT** chart to troubleshoot. (Normal excitation voltage ranges from approximately 10 VDC at no-load to approximately 40 VDC at full-load.)
8. Use the **GENERATOR FAULT** chart to troubleshoot if the output voltages are not balanced or are less than ninety percent of rated output voltage when the exciter is powered by a 12 volt battery. If the voltages are unbalanced, troubleshoot the main stator first. If the voltages are uniformly low, troubleshoot the exciter and field circuits first.

Continued on next page.

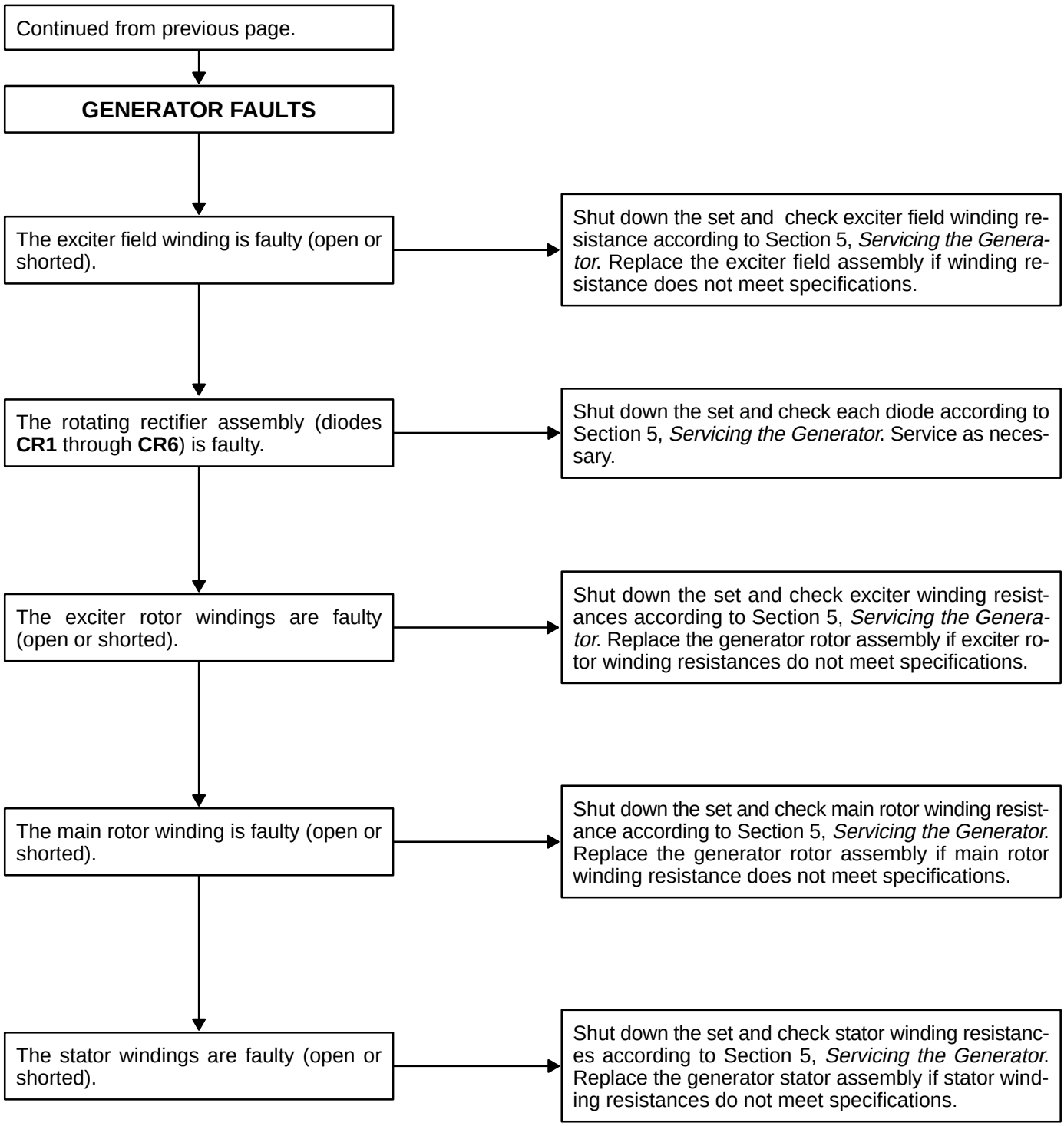
⚠WARNING ***There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about fuel, electrical and machinery hazards. Read the safety precautions page and carefully observe all instructions and precautions in this manual.***

THERE IS NO OUTPUT VOLTAGE (CONT.)



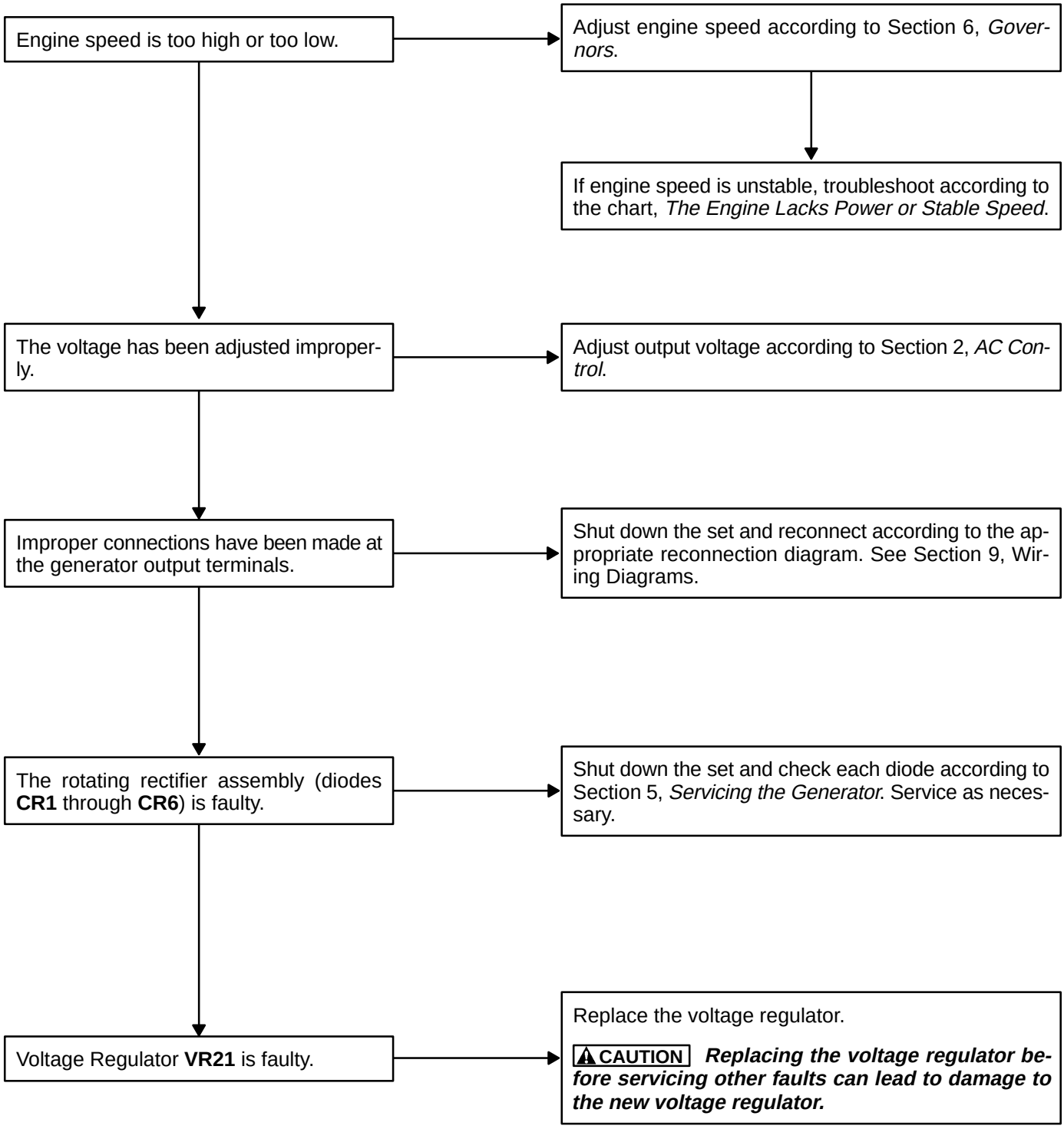
⚠WARNING ***There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about fuel, electrical and machinery hazards. Read the safety precautions page and carefully observe all instructions and precautions in this manual.***

THERE IS NO OUTPUT VOLTAGE (CONT.)



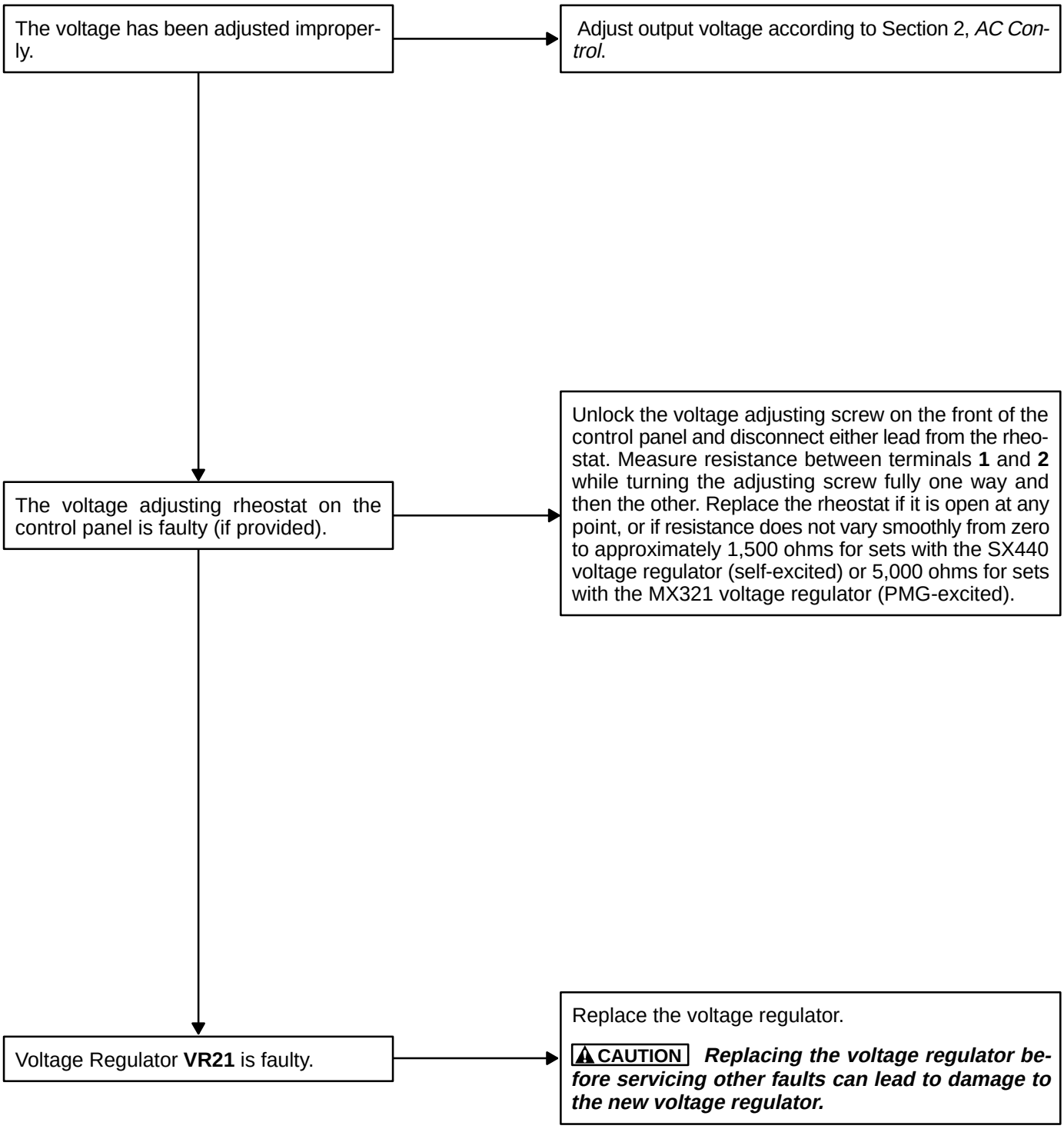
⚠WARNING ***There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about fuel, electrical and machinery hazards. Read the safety precautions page and carefully observe all instructions and precautions in this manual.***

OUTPUT VOLTAGE IS TOO HIGH OR TOO LOW



⚠WARNING ***There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about fuel, electrical and machinery hazards. Read the safety precautions page and carefully observe all instructions and precautions in this manual.***

OUTPUT VOLTAGE IS UNSTABLE



⚠WARNING ***There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about fuel, electrical and machinery hazards. Read the safety precautions page and carefully observe all instructions and precautions in this manual.***

THE FIELD CIRCUIT BREAKER KEEPS TRIPPING

The rotating rectifier assembly (diodes **CR1** through **CR6**) is faulty.	Shut down the set and check each diode according to Section 5, *Servicing the Generator*. Service as necessary.
The exciter field winding is shorted.	Shut down the set and check exciter field winding resistance according to Section 5, *Servicing the Generator*. Replace the exciter field assembly if winding resistance does not meet specifications.
The exciter rotor windings are shorted.	Shut down the set and check exciter winding resistances according to Section 5, *Servicing the Generator*. Replace the generator rotor assembly if exciter rotor winding resistances do not meet specifications.
The main rotor winding is shorted.	Shut down the set and check main rotor winding resistance according to Section 5, *Servicing the Generator*. Replace the generator rotor assembly if main rotor winding resistance does not meet specifications.
The stator windings are shorted.	Shut down the set and check stator winding resistances according to Section 5, *Servicing the Generator*. Replace the generator stator assembly if stator winding resistances do not meet specifications.
Voltage Regulator **VR21** is faulty.	Replace the voltage regulator. **⚠CAUTION** ***Replacing the voltage regulator before servicing other faults can lead to damage to the new voltage regulator.***

⚠WARNING ***There are hazards present in troubleshooting that can cause equipment damage, severe personal injury or death. Troubleshooting must be performed by qualified persons who know about fuel, electrical and machinery hazards. Read the safety precautions page and carefully observe all instructions and precautions in this manual.***

THE PHASE CURRENTS ARE UNBALANCED

The connected loads are distributed unevenly among the phases.	Shut down the set and redistribute the loads so that there is a difference of less than 10 percent between phases.
Improper connections have been made at the generator output terminals.	Shut down the set and reconnect according to the appropriate reconnection diagram. See Section 9, *Wiring Diagrams*.
The stator windings are faulty (open or shorted).	Shut down the set and check stator winding resistances according to Section 5, *Servicing the Generator*. Replace the generator stator assembly if stator winding resistances do not meet specifications.
A load has a ground fault or short circuit.	Service the faulty equipment as necessary.

5. Servicing the Generator

TESTING THE GENERATOR

These tests can be performed without removing the generator. Before starting tests, disconnect the starting battery cables (negative [-] first) to make sure the engine will not start while performing these tests.

⚠WARNING ***Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [−] first).***

Arcing can ignite the explosive hydrogen gas given off by batteries, causing severe personal injury. Arcing can occur if the negative (−) battery cable is connected and a tool being used to connect or disconnect the positive (+) battery cable accidentally touches the frame or other grounded metal part of the set. To prevent arcing, always remove the negative (−) cable first, and reconnect it last.

⚠CAUTION ***Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits of the set.***

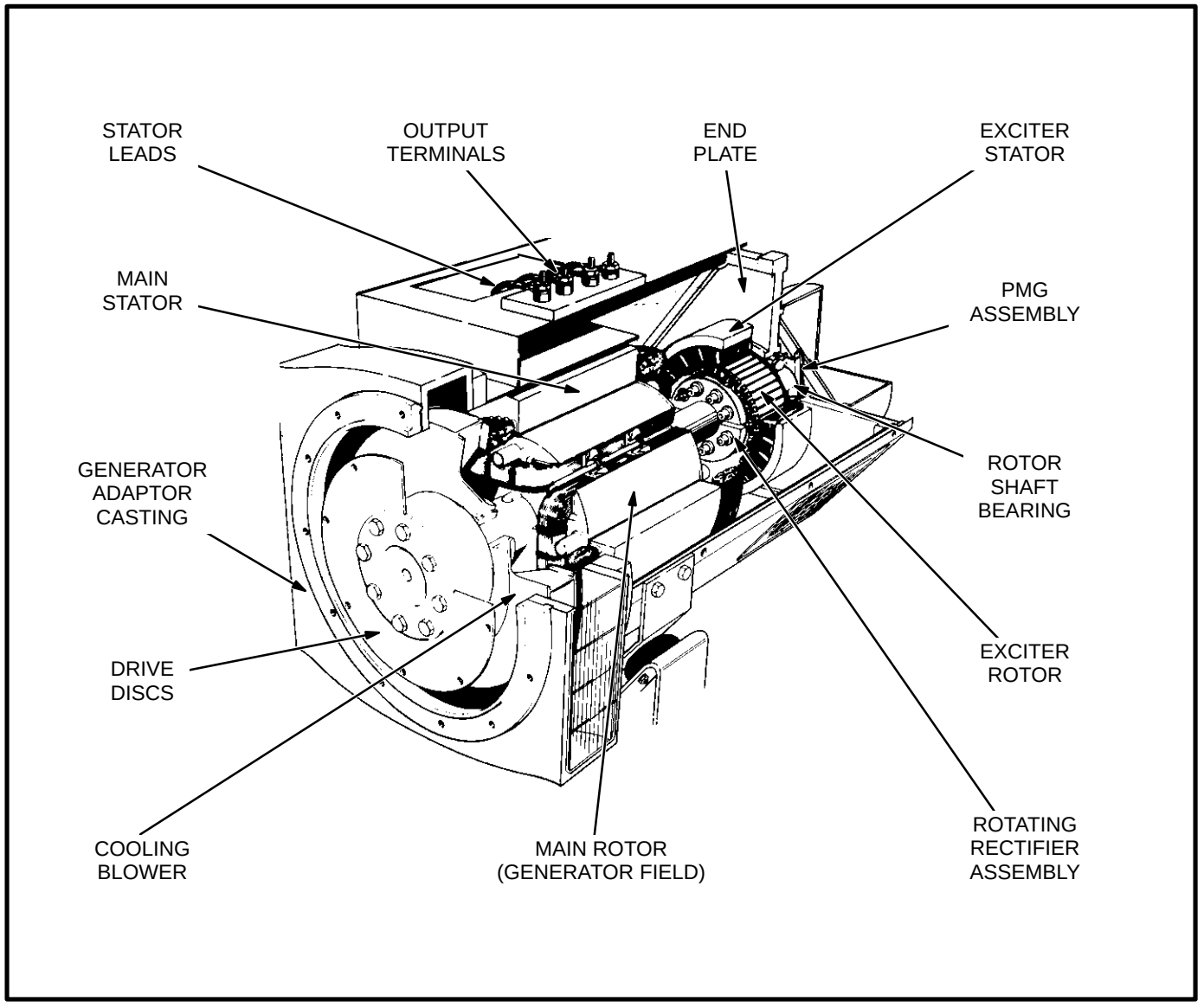


FIGURE 5-1. GENERATOR

Exciter Stator

Testing Winding Resistance: Measure winding resistance with a Wheatstone bridge or digital ohmmeter. Replace the stator if winding resistance is not as specified by Table 5-1.

Testing Winding Insulation Resistance: Disconnect the exciter stator leads from terminals **X** and **XX** on the auxiliary terminal board in the generator output box. Using an ohmmeter, measure resistance between either lead and the stator laminations. Replace the stator if insulation resistance is less than 1 megohm (1,000,000 ohms)

Flashing the Field (Self-Excited Generators Only): If necessary, flash the exciter field before or after installation. Apply 110 to 220 VAC for one to two seconds to the **X** and **XX** leads of the exciter stator. **The generator must be shut down, the AVR disconnected, a diode used to establish correct polarity and a 3 amp fuse to prevent over-excitation.** See the diagram.

Alternatively, while the set is running and disconnected from all loads, apply a 12 VDC battery for one to two seconds as shown in the diagram. **Polarity must be correct: + to X, − to XX**.

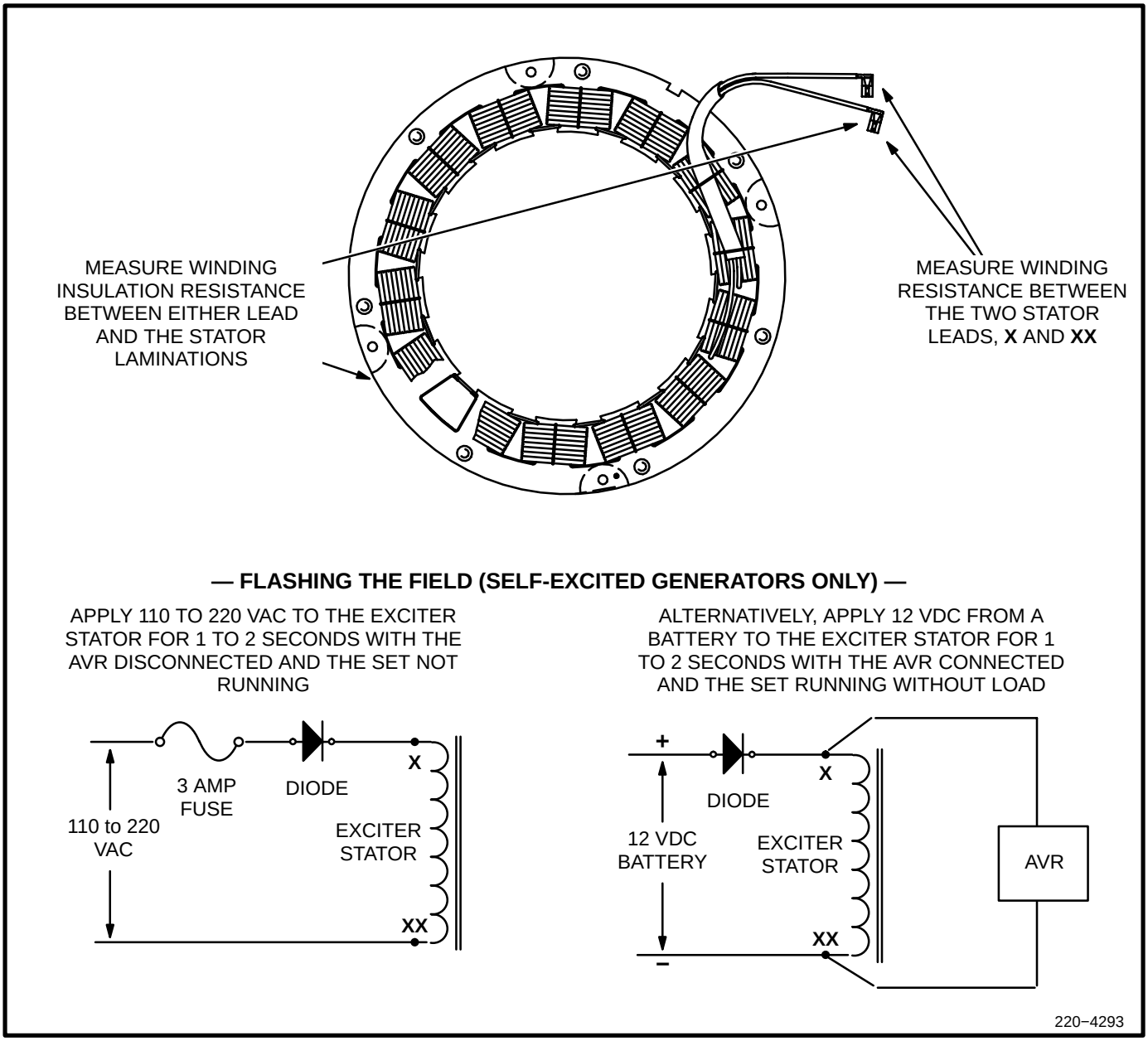


FIGURE 5-2. TESTING AND FLASHING THE EXCITER STATOR

Exciter Rectifier Bridge (Rotating Rectifier Assembly)

The exciter rectifier bridge is mounted on the exciter rotor, inboard, facing the main rotor. It consists of a positive plate and a negative plate, split diametrically. Each carries three diodes, three terminal posts for connecting exciter rotor leads to the diode pigtails and a terminal for the main rotor (generator field) lead. A surge suppresser is connected across the two plates to prevent transient voltages that could damage the diodes.

Testing Diodes: Disconnect the diode pigtails from the terminal posts. Using an ohmmeter, measure electrical resistance between each diode pigtail and the plate on which the diode is mounted. Reverse the meter test probes and repeat the tests. The electrical resistance across each diode should be high in one direction and low in the other. If the resistance is high or low in both directions, replace the diode.

Replacing Diodes: Make sure the replacement diode is of the correct polarity. Disconnect the pigtail from the terminal post and unscrew the old diode. Apply heat-sink compound under the head of the diode. Make sure the compound does not get on the threads. Torque the diodes to 36 to 42 in-lbs (4 to 4.8 Nm) and the pigtail terminals to 24 in-lbs (2.7 Nm) when reassembling.

Surge Suppresser Testing and Replacement: Remove the suppresser. Replace the suppresser if it appears to have overheated or if ohmmeter readings indicate less than infinite resistance (end of scale) in both directions. Torque the terminals to 24 in-lbs (2.7 Nm) when reassembling.

⚠ CAUTION ***Layers of dust can cause diodes to overheat and fail. Brush dust off regularly.***

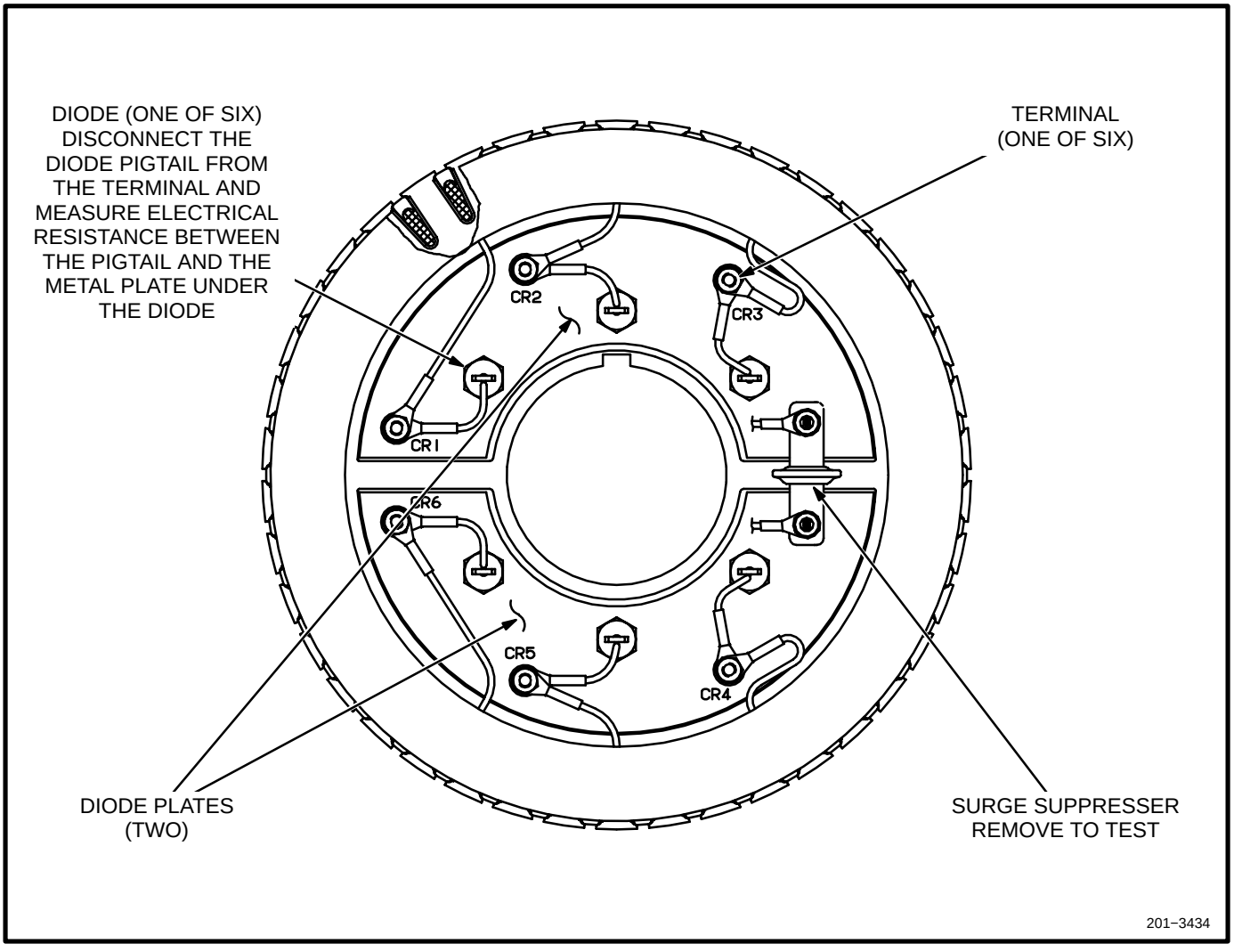


FIGURE 5-3. TESTING THE ROTATING RECTIFIER ASSEMBLY

Exciter Rotor

Testing Winding Resistance: Disconnect the six rotor winding leads from the terminal posts on the rectifier assembly. With a Wheatstone bridge, measure electrical resistance across each pair of rotor windings: **U** (CR1 or CR4) and **V** (CR2 or CR5), **V** (CR2 or CR5) and **W** (CR3 or CR6), **W** (CR3 or CR6) and **U** (CR1 or CR4). See the winding schematic. Replace the whole rotor shaft assembly if the resistance of any winding is not as specified in Table 5-1.

Testing Winding Insulation Resistance: Using an ohmmeter, measure the resistance between any rotor winding lead or the terminal to which it is connected and the rotor laminations. Replace the whole rotor shaft assembly if insulation resistance is less than 1 megohm.

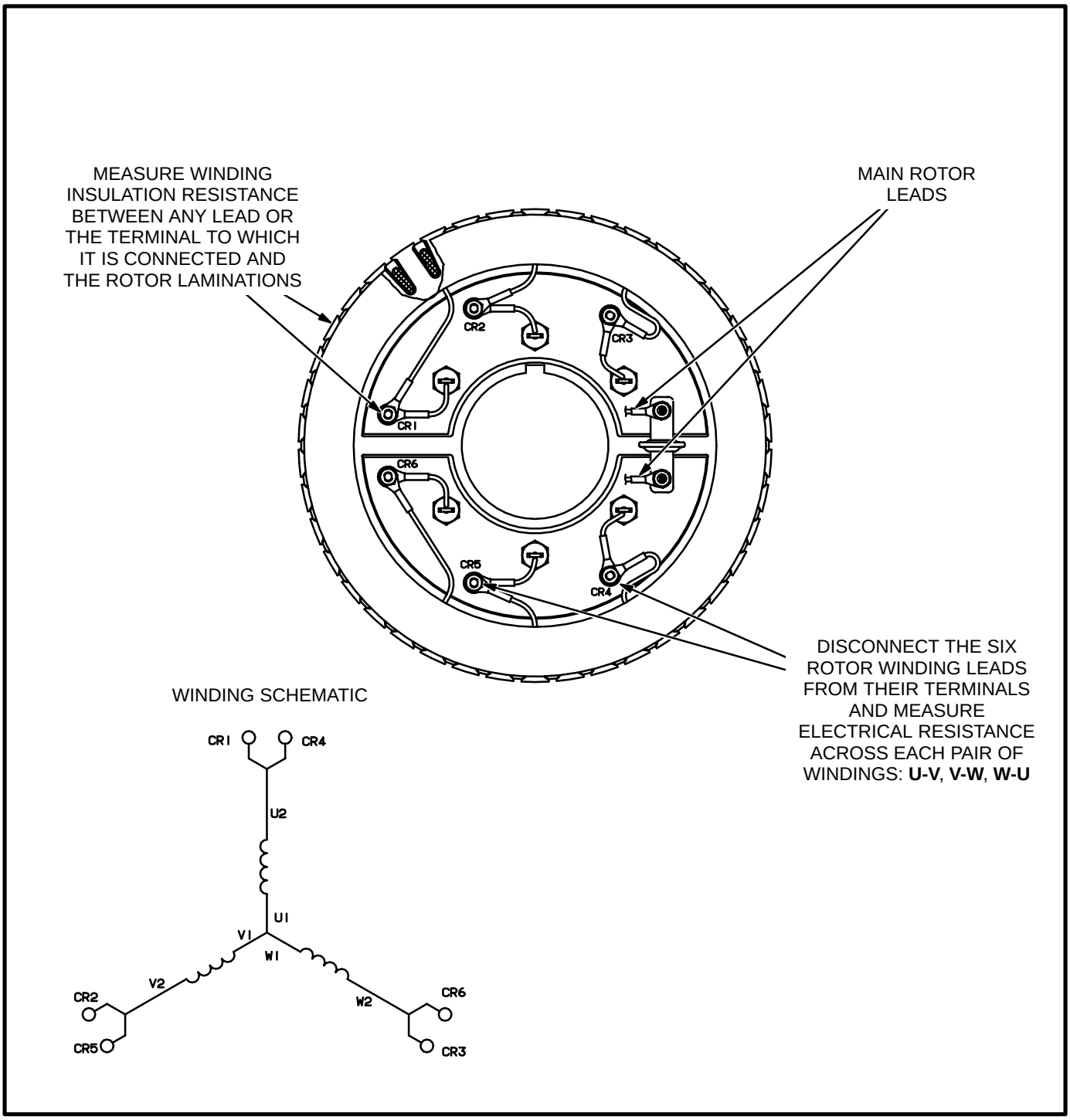


FIGURE 5-4. TESTING THE EXCITER ROTOR

Main Rotor (Generator Field)

Testing Winding Resistance: Disconnect the two leads of the main rotor from the terminals on the rotating rectifier assembly. See Figure 5-4. Measure electrical resistance between the two leads with a Wheatstone bridge or digital ohmmeter. Replace the rotor if the resistance is not as specified in Table 5-1. Connect the rotor leads and torque the terminals to 24 in-lbs (2.7 Nm) when reassembling.

Testing Winding Insulation Resistance: Using an ohmmeter, measure the resistance between either lead of the main rotor windings, or the terminal to which it is connected, and the main rotor laminations. Replace the rotor if insulation resistance is less than 1 megohm.

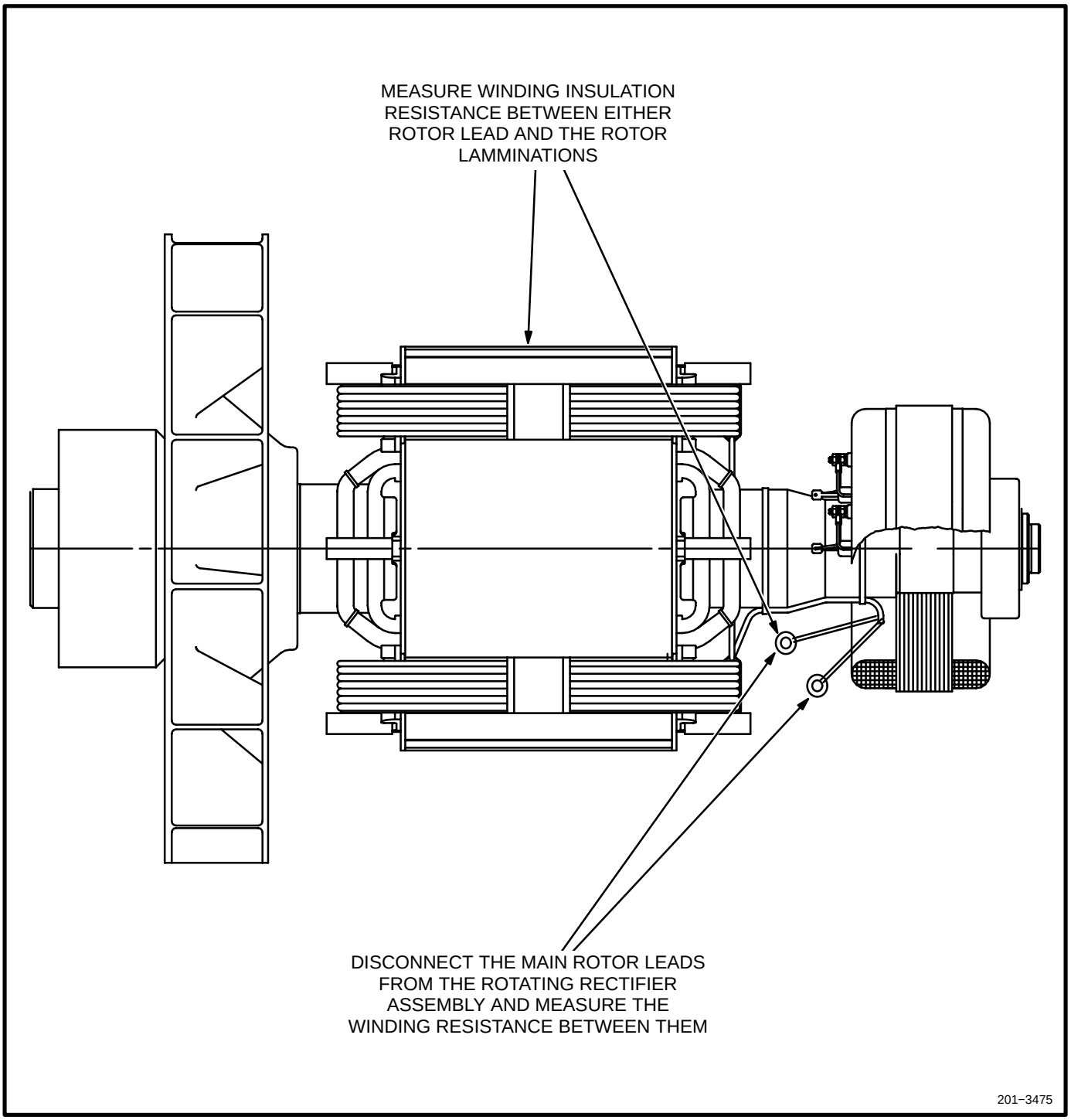


FIGURE 5-5. TESTING THE MAIN ROTOR

Main Stator

Testing Winding Resistance: Measure electrical resistance across each pair of stator leads (U1-U2, U5-U6, VI-V2, V5-V6, W1-W2 and W5-W6) with a Wheatstone bridge or ohmmeter having at least 0.001 ohm precision. Replace the stator if the resistance of any winding is not as specified in Table 5-1.

Testing Winding Insulation Resistance: Disconnect all stator leads and winding taps from their respective terminals and make sure the ends do not touch the generator frame. Using an ohmmeter, measure electrical resistance between any stator lead and the stator laminations. Replace the stator if insulation resistance is less than 1 megohm.

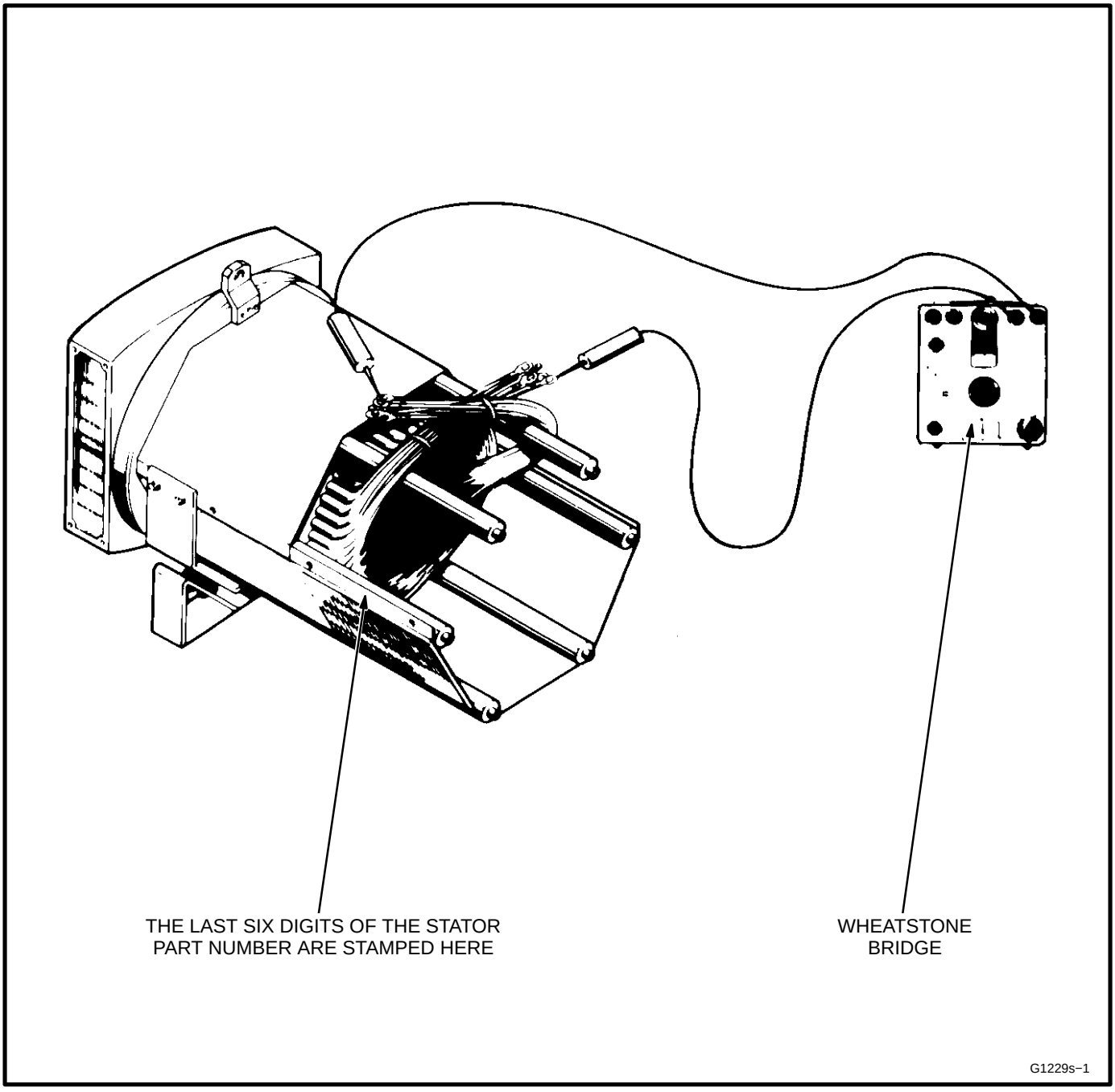


FIGURE 5-6. TESTING THE GENERATOR STATOR

TABLE 5-1. GENERATOR WINDING RESISTANCES*

MAIN STATOR PART NUMBER**	MAIN STATOR (OHMS)	MAIN ROTOR (OHMS)	EXCITER STATOR (OHMS)	EXCITER ROTOR (OHMS)
BROAD RANGE GENERATORS				
220-4289-31	0.170	0.57	20.3	0.167
220-4289-32	0.129	0.64	20.3	0.167
220-4289-33	0.110	0.67	19.5	0.180
220-4289-34	0.069	0.80	19.5	0.180
220-4289-35	0.055	0.93	19.5	0.180
220-4298-31	0.062	1.11	19.5	0.180
220-4298-32	0.047	1.20	19.5	0.180
220-4298-33	0.033	1.31	19.5	0.210
220-4298-34	0.025	1.50	19.5	0.210
220-4298-35	0.022	1.66	19.5	0.210
220-4298-36	0.016	1.80	19.5	0.210
380 VOLT GENERATORS (60 HERTZ)				
220-4289-36	0.118	0.57	20.3	0.167
220-4289-37	0.088	0.64	20.3	0.167
220-4289-38	0.070	0.67	19.5	0.180
220-4289-39	0.048	0.80	19.5	0.180
220-4289-40	0.036	0.93	19.5	0.180
220-4298-37	0.045	1.11	19.5	0.180
220-4298-38	0.034	1.20	19.5	0.180
220-4298-39	0.023	1.31	19.5	0.210
220-4298-40	0.020	1.50	19.5	0.210
220-4298-41	0.017	1.66	19.5	0.210
220-4298-42	0.015	1.80	19.5	0.210
600 VOLT GENERATORS				
220-4289-41	0.285	0.57	20.3	0.167
220-4289-42	0.200	0.64	20.3	0.167
220-4289-43	0.150	0.67	19.5	0.180
220-4289-44	0.099	0.80	19.5	0.180
220-4289-45	0.082	0.93	19.5	0.180
220-4298-43	0.090	1.11	19.5	0.180
220-4298-44	0.066	1.20	19.5	0.180
220-4298-45	0.052	1.31	19.5	0.210
220-4298-46	0.040	1.50	19.5	0.210
220-4298-47	0.027	1.66	19.5	0.210
220-4298-48	0.029	1.80	19.5	0.210

* - These values are approximate, plus or minus 10 percent at 68° F (20° C).
** - See Figure 5-6 for the location of the stator part number.

REMOVING AND DISASSEMBLING THE GENERATOR

The generator is heavy. You will need an assistant and a hoist of sufficient capacity to remove and service the generator.

⚠WARNING ***Accidentally dropping the generator can damage it and cause severe personal injury and death. The hoist, straps and chains must have sufficient capacity and be attached properly so that the load cannot shift.***

Before starting, disconnect the starting battery cables (negative (-) first) to make sure the set will not start while working on it.

⚠WARNING ***Accidental starting of the generator set while working on it can cause severe injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative (-) first).***

Always remove the negative (-) cable first, and reconnect it last, to prevent arcing if a tool accidentally touches the frame or other grounded metal part while removing the positive (+) battery cable. Arcing can ignite the explosive hydrogen gas given off by the batteries, causing severe injury.

Removing The Generator Output Box

1. Disconnect the line cables and conduit. For reconnections later, make sure each cable is clearly marked to indicate the correct terminal.
2. Disconnect the remote control wiring and conduit. For reconnections later, make sure each wire is clearly marked to indicate the correct terminal.
3. Disconnect all engine wiring harness connections in the generator control and output boxes. For reconnections later, make sure each wire is clearly marked to indicate the correct terminal.
4. Disconnect all generator control leads (winding taps) from connections in the output box. For reconnections later, make sure each wire is clearly marked to indicate the correct terminal.
5. If the set has a mounted line circuit breaker, disconnect the cables to the circuit breaker. For reconnections later, make sure each cable is clearly marked to indicate the correct terminal.
6. Attach a hoist to the generator output box, loosen the mounting bolts on the sides of the generator and remove the box.

Withdrawing The Generator From The Set

1. The rotor will be carried inside the stator when the generator is withdrawn from the engine. Bar the engine until one of the four poles of the rotor points straight down so that the rotor will rest on the face of the pole when the generator is withdrawn.

   ⚠CAUTION ***The rotor can be damaged if it rests on the edges of the winding slot between two poles.***

2. Attach lifting eyes and a hoist of sufficient capacity (Figure 5-7).
3. Take up hoist slack and remove the two through bolts securing the generator to the rubber isolation mounts.
4. Raise the generator end approximately one inch (12 mm) and securely block the engine under the flywheel housing. Lower the generator slightly so that the blocks carry most of the weight.
5. Remove the bolts securing the generator drive discs to the flywheel.
6. Loosen all the bolts securing the generator adapter casting to the flywheel housing. Adjust the hoist to carry the full weight of the generator, remove the bolts and pull the generator away.

   ⚠CAUTION ***Never withdraw the generator leaving the rotor to hang by the drive discs. The weight of the rotor will damage the drive discs.***

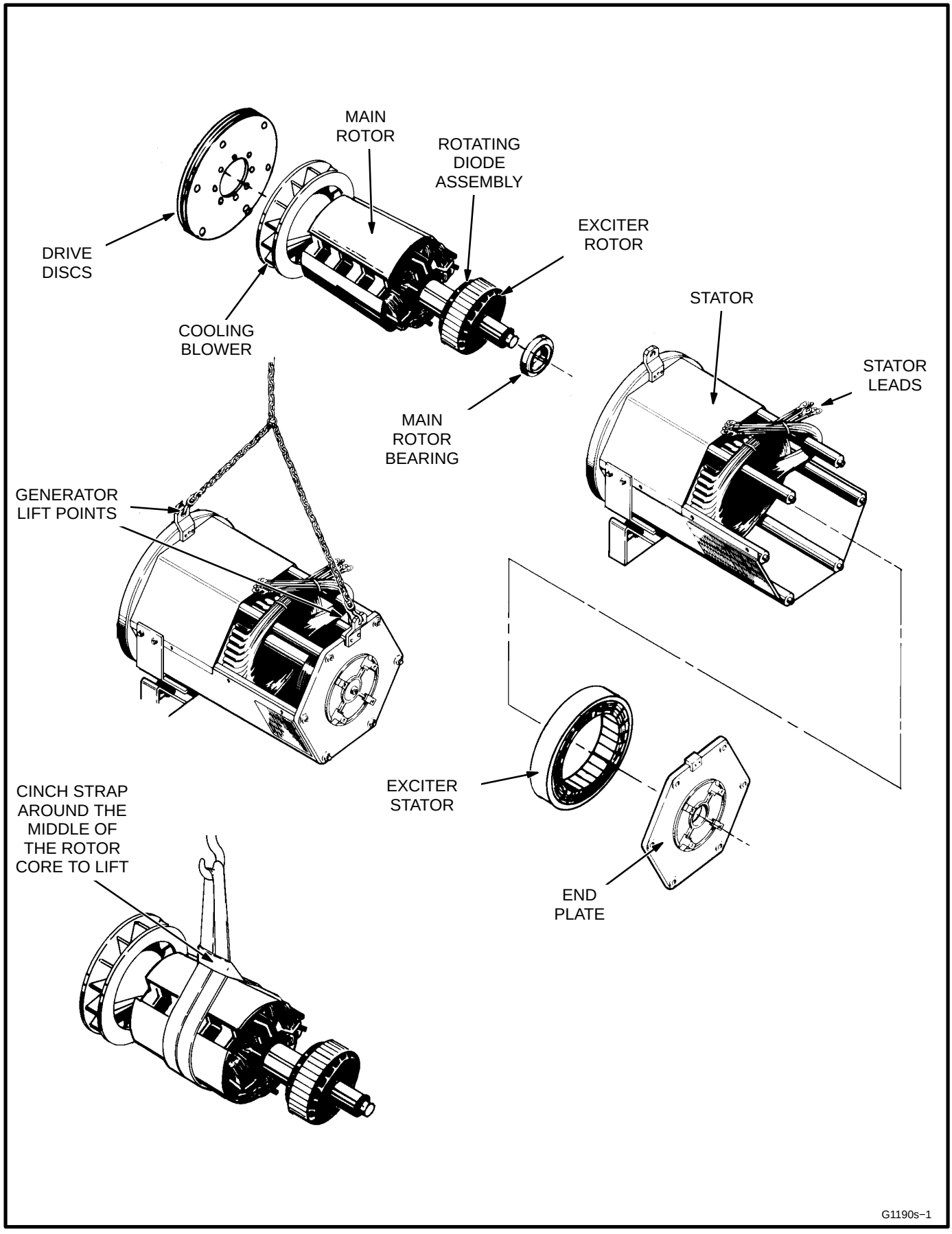


FIGURE 5-7. GENERATOR ASSEMBLY

Withdrawing the Rotor From the Generator

1. Remove the generator adaptor casting on the drive disc end and the end plate on the bearing end.
2. Using a hoist of sufficient capacity, cinch a lifting strap on the drive end of the rotor. Lift the bearing end of the rotor by hand and push it towards the drive end of the generator until half the width of the rotor core protrudes from the stator. Release the weight of the rotor and recinch the lifting strap around the middle of the rotor core. Withdraw the rotor until it is free of the stator, guiding it by hand on both ends to prevent contact with the stator windings
3. Rest the rotor in a cradle, solidly supporting it on two pole faces—not on the drive discs, blower or exciter.
4. Remove the retaining clip if the rotor shaft bearing is to be removed.

REASSEMBLING THE GENERATOR

Reassembling is the reverse of disassembling. Note the following.

1. Apply force to the inner race of the rotor bearing when pressing it onto the shaft, otherwise, it will be damaged. Be sure to secure the retaining clip.
2. The drive disc-to-rotor bolts should be torqued to 190 ft-lbs (257 Nm).
3. The drive disc-to-flywheel bolts should be torqued to 50 ft-lbs (67 Nm).
4. The exciter stator mounting screws should be torqued to 7 ft-lbs (10 Nm).
5. The generator end plate mounting bolts should be torqued to 25 ft-lbs (34 Nm).
6. Make sure the rubber O-ring is in place in the bearing bore in the generator endplate.
7. The generator mounting bracket bolts should be torqued to 65 ft-lbs (88 Nm) if M12 or 35 ft-lbs (47 Nm) if M10.
8. The generator-to-adaptor bolts should be torqued to 40 ft-lbs (55 Nm).
9. The adaptor-to-engine bolts should be torqued to 35 ft-lbs (48 Nm).
10. Reconnect the generator as required. See Page 9-11, 9-12 or 9-13.

SERVICING THE PMG

The following is applicable if the generator is equipped with a PMG (permanent magnet) exciter.

Testing

1. Disconnect leads **P2**, **P3** and **P4** from the voltage regulator.
2. Start the engine at the set and let the speed stabilize.

   ⚠ DANGER ***HIGH VOLTAGE. Touching uninsulated high voltage parts inside the control and power output boxes can result in severe personal injury or death. Measurements and adjustments must be done with care to avoid touching high voltage parts.***

   For your protection, stand on a dry wooden platform or rubber insulating mat, make sure your clothing and shoes are dry, remove jewelry from your hands and wear elbow length insulating gloves.

3. Measure voltage across lead pairs **P2-P3**, **P3-P4** and **P4-P2**. Voltage should be at least 150 VAC for 50 Hz sets and at least 180 VAC for 60 Hz sets, and should be approximately the same for each set of leads. If the voltages are low or uneven, check all the leads and connections between the voltage regulator and the PMG and repair as necessary before disassembling the PMG. Note the connections at the auxiliary terminal board in the power output box. See Figure 2-3.
4. Stop the set and measure electrical resistance across lead pairs **P2-P3**, **P3-P4** and **P4-P2** with a Wheatstone bridge or digital ohmmeter. Each winding should have a resistance of approximately 4.4 ohms.

Disassembling the PMG

1. Disconnect the starting battery cables (negative (-) first) to make sure the set will not start while working on it.

   ⚠WARNING ***Accidental starting of the generator set while working on it can cause severe injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative (-) first).***

   Always remove the negative (-) cable first, and reconnect it last, to prevent arcing if a tool accidentally touches the frame or other grounded metal part while removing the positive (+) battery cable. Arcing can ignite the explosive hydrogen gas given off by the batteries, causing severe injury.

   ⚠CAUTION ***Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits of the set.***

2. Remove the PMG cover and disconnect the leads at the connector.
3. Remove the bolts and clamps that secure the PMG stator to the generator frame and carefully pull away the stator.

   The rotor is magnetic and will attract the stator. Hold the stator firmly so that the windings are not damaged by striking the stator support lugs.

4. Remove the rotor center bolt and pull away the rotor. The rotor is magnetic and will attract iron filings. Put it in a clean plastic bag until it is remounted. Do not take it apart or it will lose its magnetism. Also, if the dowel pin in the end of the shaft is loose, stow it in a safe place until it is time to reassemble the PMG.

Reassembling the PMG

Reassembling is the reverse of disassembling. Torque the rotor center bolt to 40 ft-lbs (54 Nm). The stator leads must be at 12 o'clock.

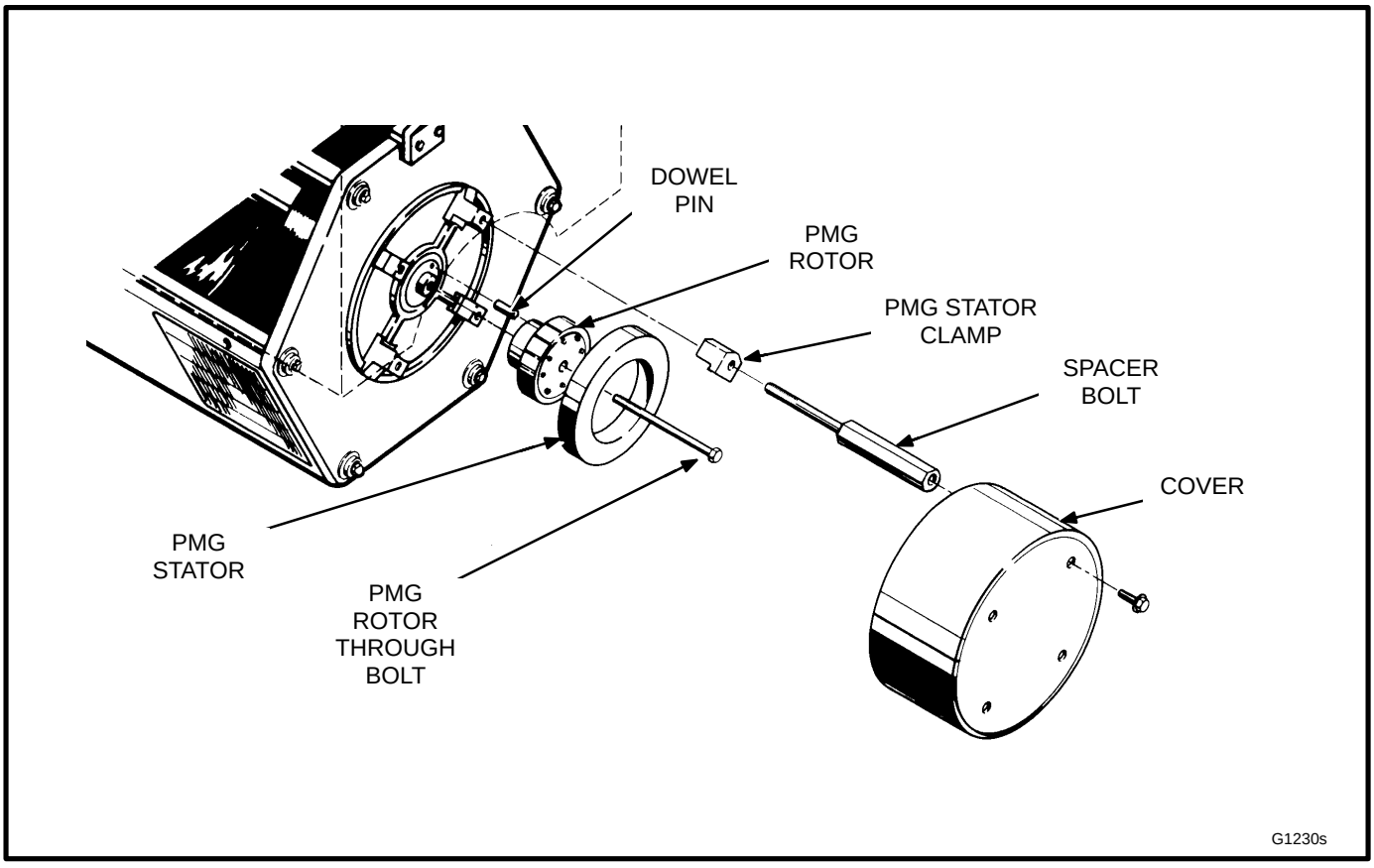


FIGURE 5-8. PMG ASSEMBLY

6. Governors

MECHANICAL GOVERNOR

Governor Adjustments: B-Series Engines (Beginning Spec H on DG Sets and Spec B on QS Sets)

Output frequency (50 Hz or 60Hz) can be adjusted by turning the governor speed adjusting screw while the engine is running at its normal operating temperature under full load. Adjust droop to within five percent of nominal frequency (3 Hertz for 60 Hertz sets and 2.5 Hertz for 50 Hertz sets). Check operation under various loads and increase droop if the governor hunts. Readjust full-load frequency if droop is adjusted.

Do not adjust the idle adjusting screw: it is factory set and sealed.

⚠ CAUTION ***Do not adjust the idle speed screw or break its wire seal. Doing so can void the generator set warranty.***

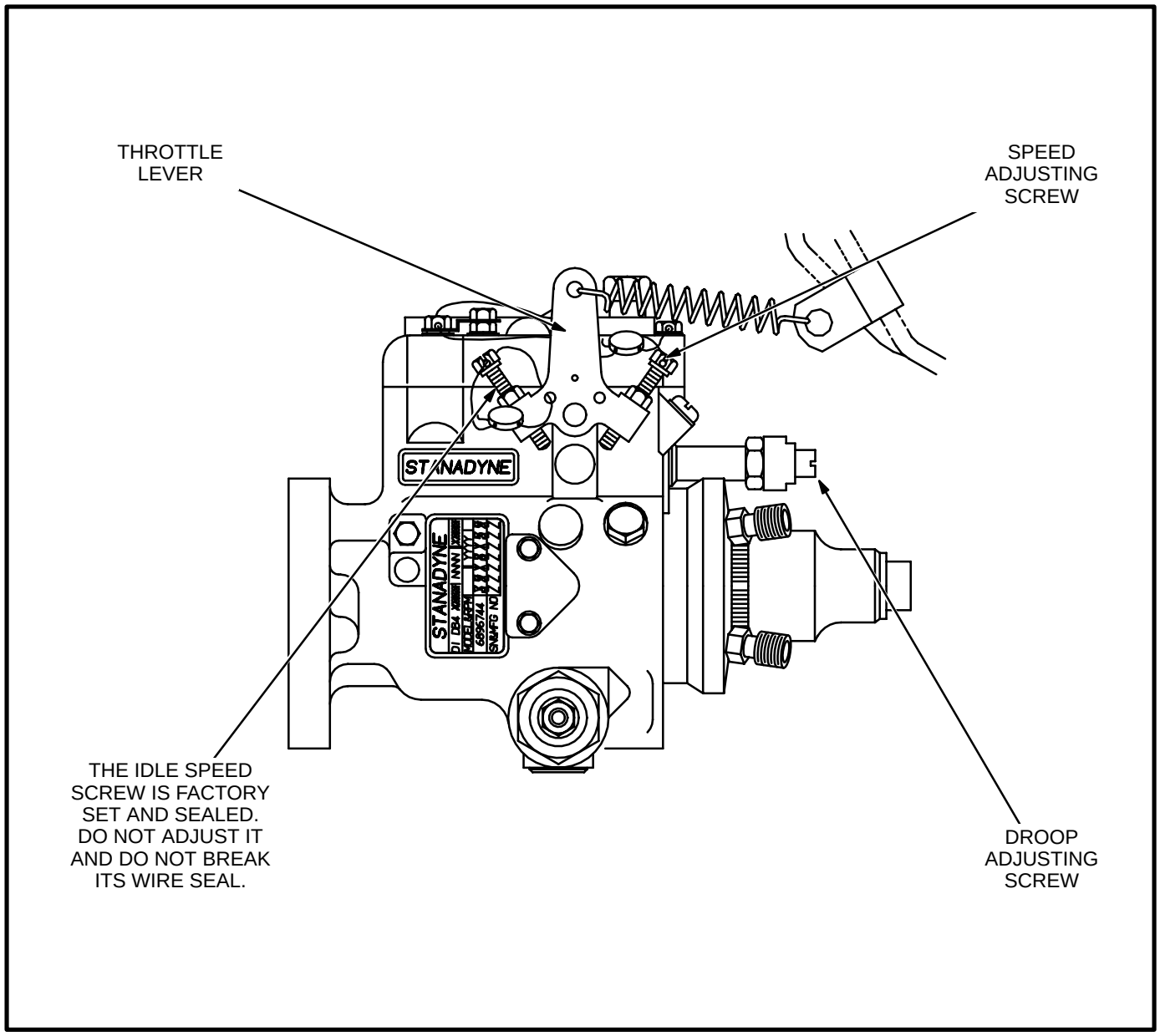


FIGURE 6-1. B-SERIES ENGINE GOVERNOR

Governor Adjustments: B-Series Engines (Prior to Spec H on DG Sets and Spec B on QS Sets)

Output frequency (50 Hz or 60Hz) can be adjusted by turning the governor speed adjusting screw while the engine is running at its normal operating temperature under full load.

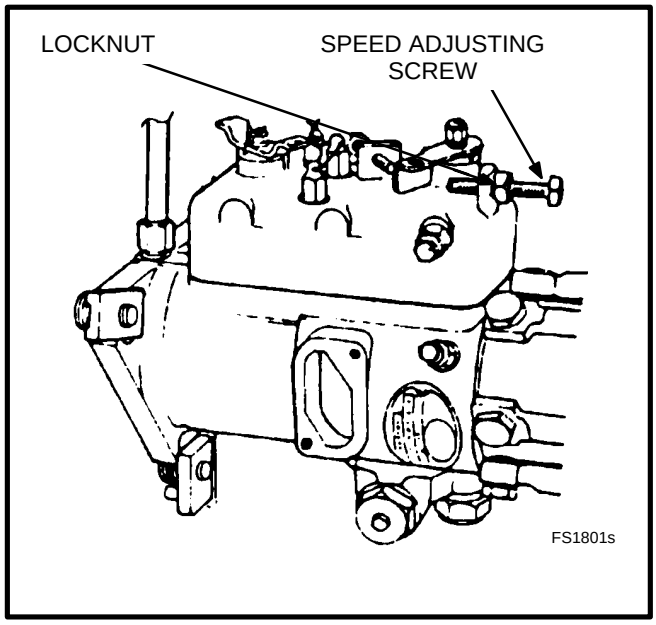


FIGURE 6-2. B-SERIES ENGINE GOVERNOR

Governor Adjustments: C-Series Engines

Output frequency (50 Hz or 60Hz) can be adjusted by turning the governor speed adjusting screw while the engine is running at its normal operating temperature under full load. Back off the set screw first before turning the adjusting screw.

If the governor hunts, or if droop is excessive (more than 3 Hz for 60 Hz sets or 2.5 Hz for 50 Hz sets), make the following adjustments:

1. f droop is excessive, loosen the bumper spring screw locknut and turn the screw counterclockwise in quarter-turn increments until droop is within specifications. Note the number of turns the screw has been turned out. Check for hunting under a range of loads from no-load to full-load. Tighten the locknut if the governor does not hunt. If the governor hunts, turn the screw clockwise in quarter-turn increments until hunting stops. Go to Step 2 if the bumper spring screw does not afford enough adjustment for droop or hunting.

2. Adjust the governor spring lever arm screw inside the governor housing as follows if the procedure in Step 1 does not afford enough adjustment:

   A. Remove the access plug at the top of the housing.

   B. Back off the throttle set screw and the idle adjustment screw so that the throttle lever can be rotated clockwise far enough to line up the lever arm screw (inside pump housing) with the opening.

   C. It will take a flat bladed screwdriver or a 3/16 inch ball point driver to turn the screw.

   D. The screw “clicks” every quarter-turn. Turn the screw clockwise and count the number of “clicks” until it bottoms. Write down the number. Turn the screw out (counterclockwise) the same number of “clicks” to return the adjustment to the original position.

   E. Turn the screw clockwise one “click” if there is too much droop, and then readjust the output frequency under full-load. Repeat the procedure until droop is within specifications. If the governor hunts, turn the screw counterclockwise one “click” at a time until hunting stops.

   F. If hunting occurs only under light load, adjust the bumper spring screw clockwise in quarter-turn increments until hunting stops. Then check droop again.

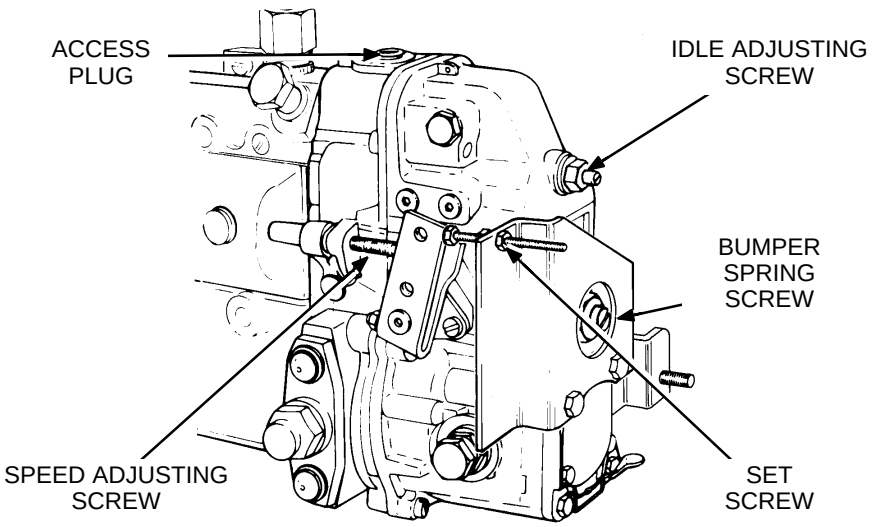


FIGURE 6-3. C-SERIES ENGINE GOVERNOR

ELECTRIC GOVERNOR

Governor Adjustments: B-Series Engines (Beginning Spec H on DG Sets and Spec B on QS Sets)

If necessary, adjust the linkage according to Figure 6-6, wire the controller according to Figure 6-9 and install the magnetic speed pickup unit according to Figure 6-10. Then adjust the governor controller as follows:

1. Push both selector switches (**S1**, **S2**) on the controller to their **OFF** positions.
2. Note that the pots (potentiometers) on the controller are adjustable from zero to 100 percent and are marked off in divisions of ten percent. The speed pot has a 20-turn adjustment range. Set the pots initially as follows:

   Gain 20%

   I 20%

   D 30%

   Droop 0%

3. If a remote speed pot is used, set it at its midpoint.
4. Start the set and adjust the **Speed** pot to obtain the required output frequency: 60 Hertz (1800 RPM) or 50 Hertz (1500 RPM). Warm up the set under load until it is up to normal operating temperature.
5. Disconnect the load and turn the **GAIN** pot to 100 percent or until operation becomes unstable. Then turn the pot counterclockwise until operation again becomes stable.
6. Adjust **D** as in Step 5.
7. Adjust **I** as in Step 5.
8. Readjust **Speed** if necessary.
9. Manually push the throttle to the minimum speed position and hold it there until the engine reaches minimum speed. Release the throttle and observe speed overshoot. Two to five Hertz overshoot may be acceptable. If overshoot is unacceptable, turn the **I** pot clockwise (slightly) to reduce overshoot. If the set hunts during steady state operation, turn the **I** pot counterclockwise (slightly) until the set is stable.

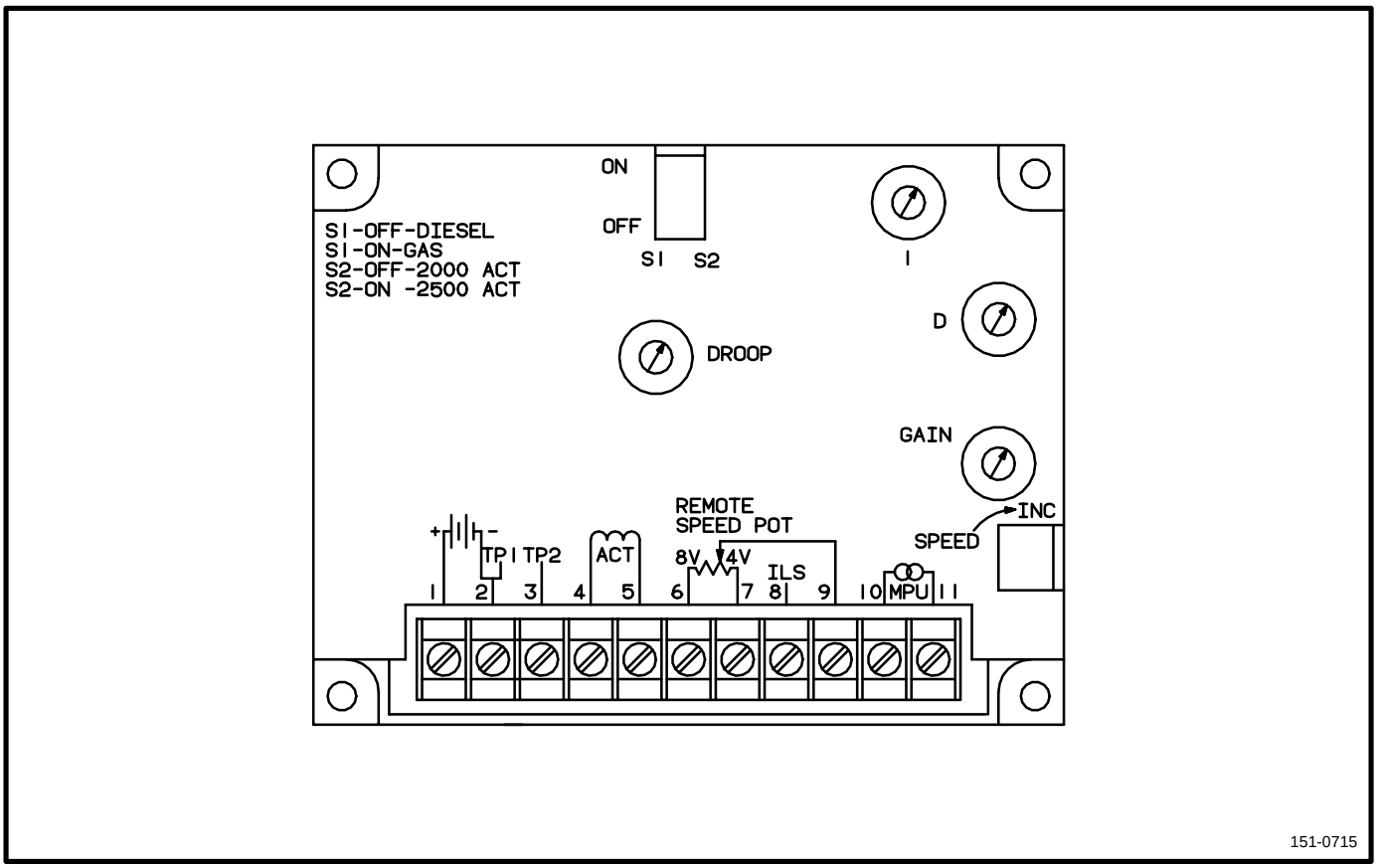


FIGURE 6-4. GOVERNOR CONTROLLER TERMINALS, SWITCHES AND ADJUSTING POTENTIOMETERS

Governor Adjustments: C-Series Engines and B-Series Engines (Prior to Spec H on DG Sets and Spec B on QS Sets)

If necessary, adjust the linkage according to Figure 6-7 or 6-8, wire the controller according to Figure 6-9 and install the magnetic speed pickup unit according to Figure 6-10. Then adjust the governor controller as follows:

1. Warm up the set under at least 1/4 load until the engine is up to its normal operating temperature.
2. Disconnect the load and turn the **Droop** potentiometer to zero.
3. Turn the **Speed** potentiometer to obtain the specified output frequency (50 Hz or 60 Hz).
4. Turn the **Gain** potentiometer clockwise until the governor begins to hunt. Turn it back until there is no audible hunting.
5. Adjust the **D** potentiometer (if provided) the same way as the **Gain** potentiometer (Step 4).
6. Manually push the throttle to the minimum speed position and hold it there until the engine reaches minimum speed. Release the throttle and observe the overshoot on a frequency meter. Adjust the **I** potentiometer counterclockwise slightly to decrease overshoot. Some overshoot is acceptable.
7. Connect 1/4 load and readjust the **Gain** potentiometer (Step 4).
8. Connect rated-load in one step while the set is running. Shut down the set if it cannot pick up the load. Lengthen the governor rod by half turns and repeat the test until the set is able to pick up rated-load in one step. For B-Series engines, shorten the governor rod by half turns and repeat the test until the set is able to pick up rated-load in one step. Back off the governor full speed stop screw if necessary.
9. Check for stability (no audible hunting) under a range of loads from no-load to full-load.
10. Stop the set and wait for 30 seconds for the turbo to coast down. Restart the set and check for speed overshoot. If overspeed shutdown occurs, check for linkage binding and repair as necessary.
11. Set the governor rod locknuts, if necessary, and check again for binding in the linkage.

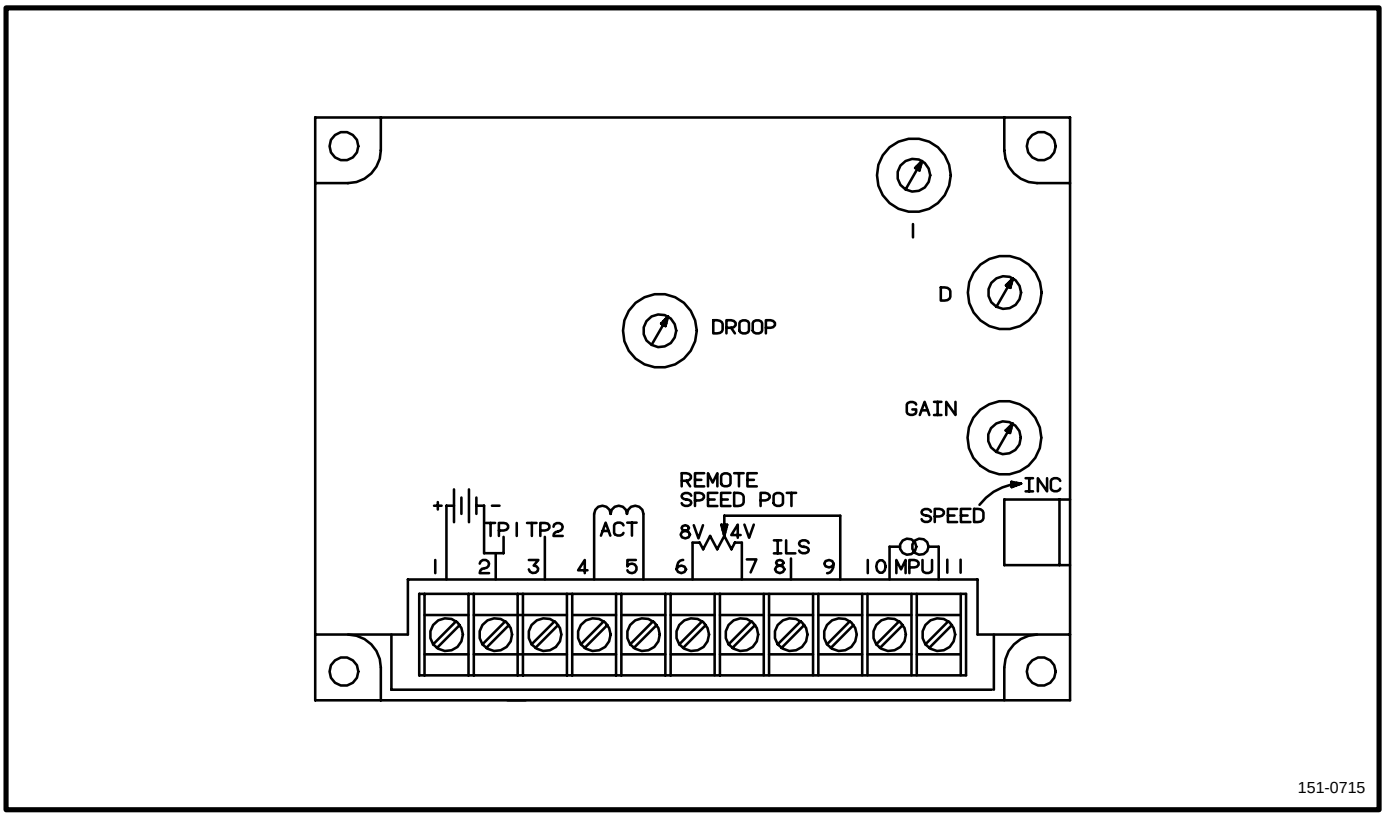


FIGURE 6-5. GOVERNOR CONTROLLER TERMINALS AND ADJUSTING POTENTIOMETERS

Linkage Adjustments: B-Series Engines (Beginning Spec H on DG Sets and Spec B on QS Sets)

Figure 6-6 illustrates the arrangement of electric governor components on B-Series engines.

If the injection pump has been replaced, it will be necessary to adjust the position of the throttle lever before connecting the actuator linkage. The throttle lever is on the side of the pump away from the engine. See Figure 6-1.

1. Operate the set and disconnect all loads after the engine has warmed up to normal operating temperature.
2. Loosen the locknut on the throttle lever speed adjusting screw and turn the screw counterclockwise to increase engine speed to 1980 RPM (66 Hertz) for 60 Hertz sets or to 1650 RPM (55 Hertz) for 50 Hertz sets.
3. Set the locknut. Leave the spring in place to maintain the position of the throttle lever.

Assemble the linkage as follows.

1. Thread the locknut onto the male swivel-end link. Then thread the female link five turns onto the male link and set the lock nut.
2. Secure the male end of the link to the injection pump lever on the engine side of the pump. Make sure to tighten two nuts on the screw before connecting the swivel end of the link to the injection pump lever.
3. Loosely thread the locknut and clevis onto the actuator shaft.
4. Rotate the injection pump lever towards the front of the engine. Turn the clevis on the actuator shaft until the hole in the link swivel registers with the holes in the clevis and connect the clevis and link with the screw, nut and lock washer as shown.
5. Tighten the clevis locknut on the actuator shaft.

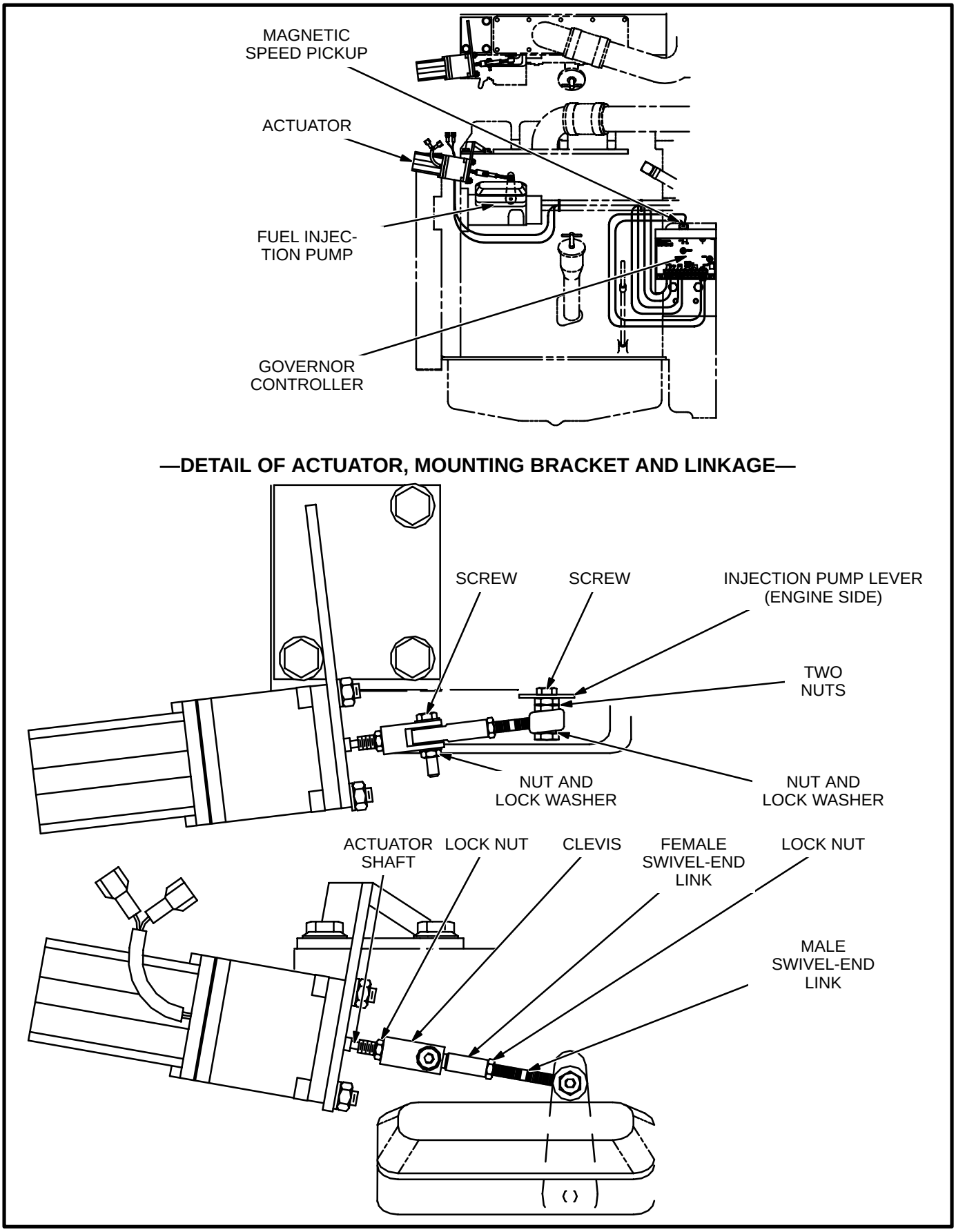


FIGURE 6-6. B-SERIES ENGINE ELECTRIC GOVERNOR LINKAGE (BEGINNING SPEC H OR SPEC B)

Linkage Adjustments: B-Series Engines (Prior to Spec H on DG Sets and Spec B on QS Sets)

Figure 6-7 illustrates the arrangement of electric governor components on B-Series engines. The following should be noted:

1. After the actuator has been mounted, loosen the four screws around the head of the actuator and rotate the head, if necessary, until the shaft inclines approximately 30 degrees (View A-A).

2. Secure the actuator lever on the shaft so that it points towards the engine and approximately 30 degrees forward, to the front of the engine (View A-A).

3. Adjust the governor rod to the approximate length indicated by Detail A and connect it to the actuator lever. Assemble with all the washers shown, in the order shown.

4. Rotate the throttle lever to the full speed stop and the actuator lever towards the generator end. Adjust the length of the governor rod, if necessary, so that the holes in the injection pump lever and rod swivel line up. Assemble with all the washers shown, in the order shown (Detail A).

5. The pump and actuator levers should be approximately parallel when the assembly is pushed up against the full speed stop. The governor rod should not bind on either lever or on the fuel line at any point in its travel. Rotate the head of the actuator, if necessary, and then tighten the head screws.

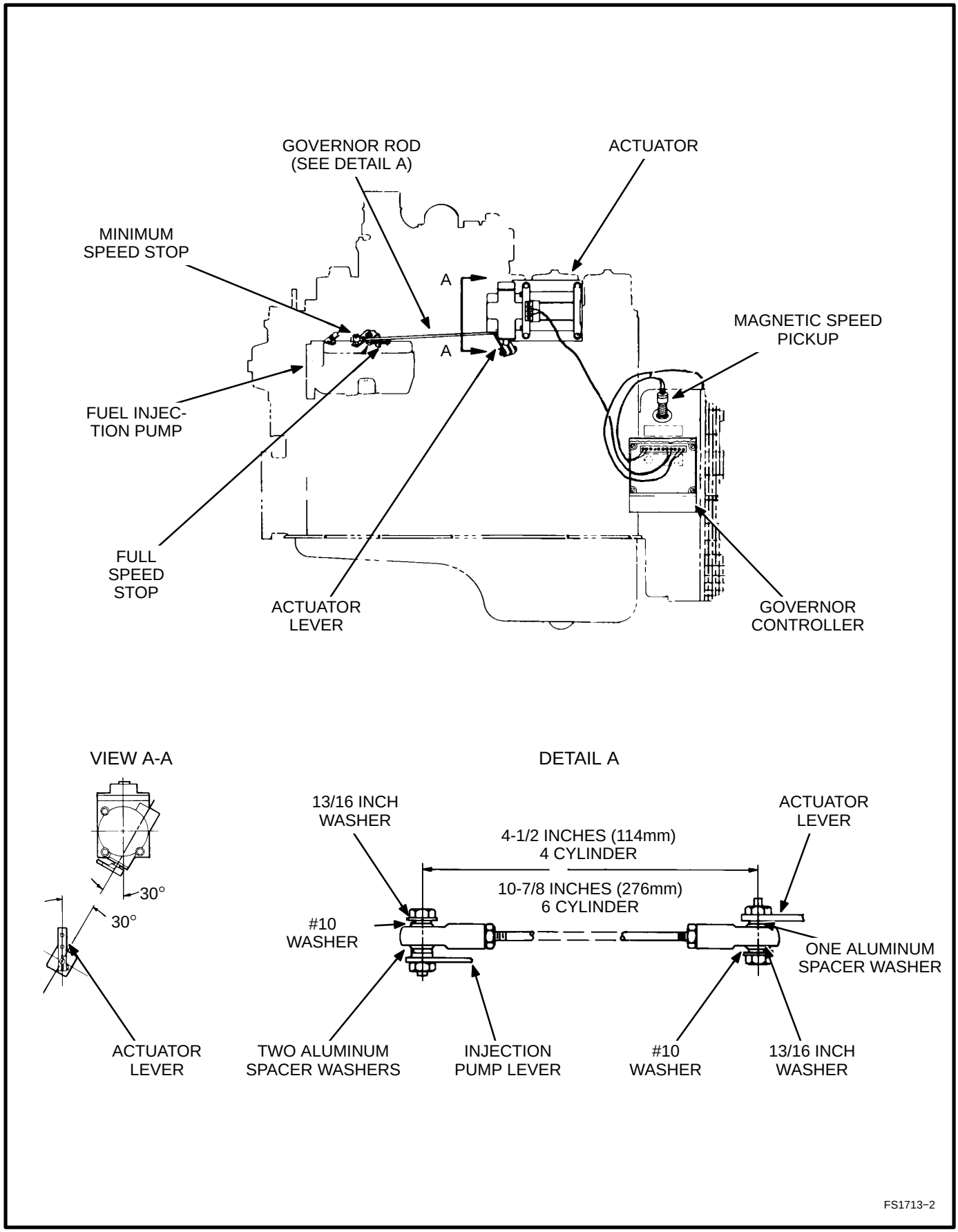


FIGURE 6-7. B-SERIES ENGINE ELECTRIC GOVERNOR LINKAGE (PRIOR TO SPEC H OR SPEC B)

Linkage Adjustments: C-Series Engines

Figure 6-8 illustrates the arrangement of electric governor components on C-Series engines. The following should be noted:

1. After the actuator has been mounted, loosen the four screws around the head of the actuator, if necessary, to line up the shaft as shown by View A-A.

2. Secure the actuator lever on the shaft so that it points down and towards the front of the engine approximately 45 degrees (View A-A).

3. Adjust the governor rod to the approximate length indicated by Detail A and connect it to the outer hole in the actuator lever. Assemble with all the washers shown, in the order shown.

4. Before connecting the governor rod to the injector pump lever, start the engine and turn the idle speed adjusting screw until output frequency is 10 Hertz above normal frequency, and set the lock nut.

⚠CAUTION ***During this procedure, the injector pump lever has to be turned up by hand to start the engine and turned down by hand to stop the engine.***

5. Shut down the engine by pushing the control panel switch to **OFF** and turning the injector pump lever down.

6. Rotate the pump lever up until you feel a slight catch in the movement. This is the maximum fuel position.

7. Readjust the length of the governor rod, if necessary, so that when the actuator lever reaches the end of its travel the pump lever will reach the maximum fuel position, and connect the governor rod. Assemble with all the washers shown, in the order shown (Detail A).

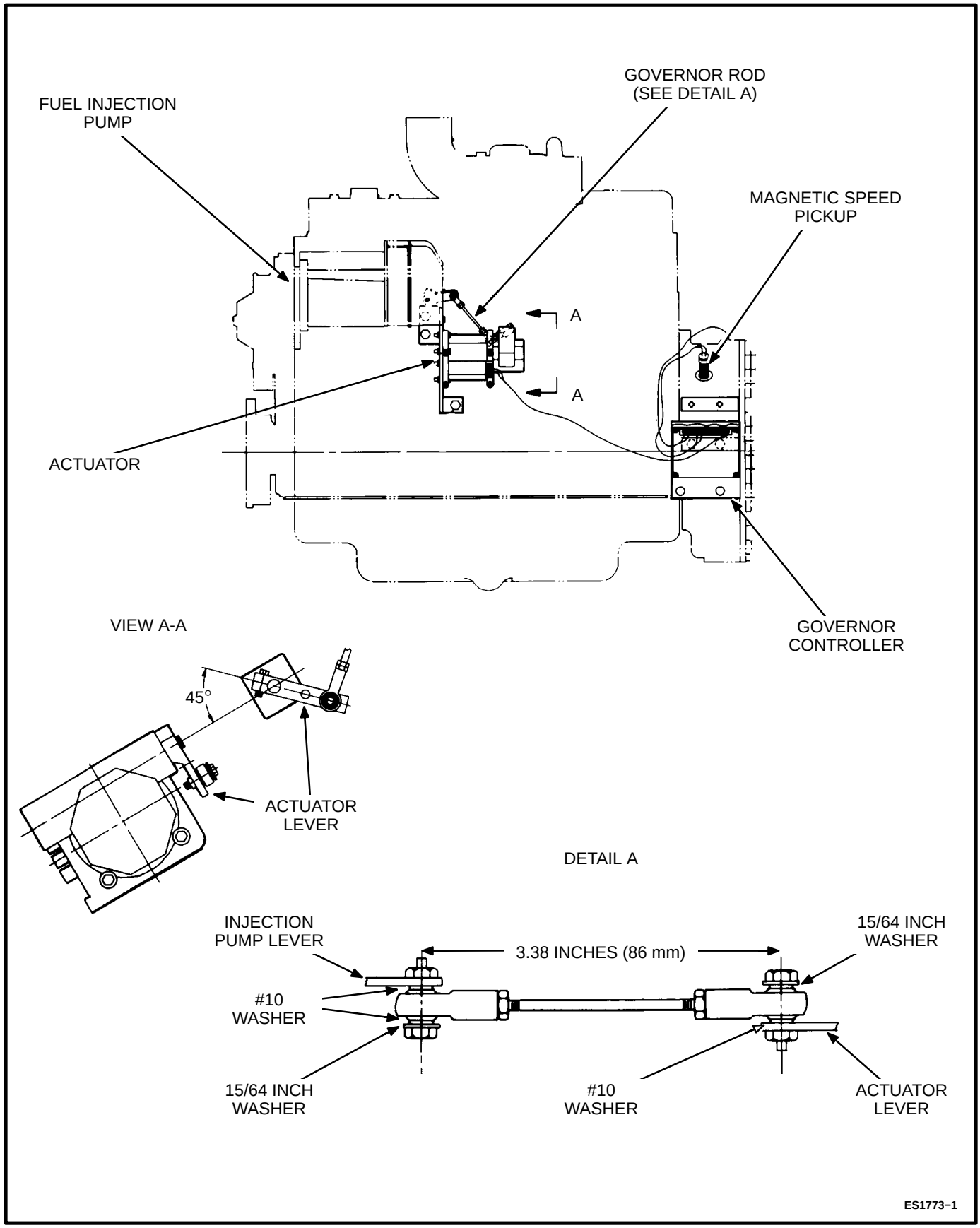


FIGURE 6-8. C-SERIES ENGINE ELECTRIC GOVERNOR LINKAGE

Electric Governor Wiring

Wire the governor according to Figure 6-9.

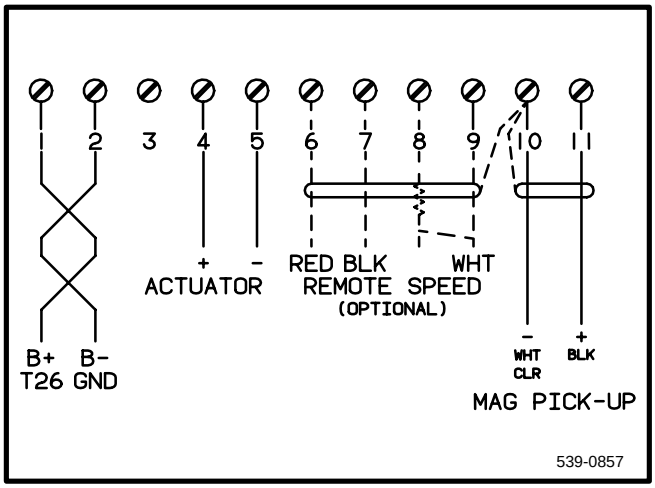


FIGURE 6-9. WIRING THE GOVERNOR

Magnetic Speed Pickup Unit Installation

To install the magnetic speed sensor, bar the engine until a gear tooth on the flywheel lines up in the center of the mounting hole. Thread the sensor in gently by hand until it just touches the gear tooth. Back it out one quarter turn and set the locknut.

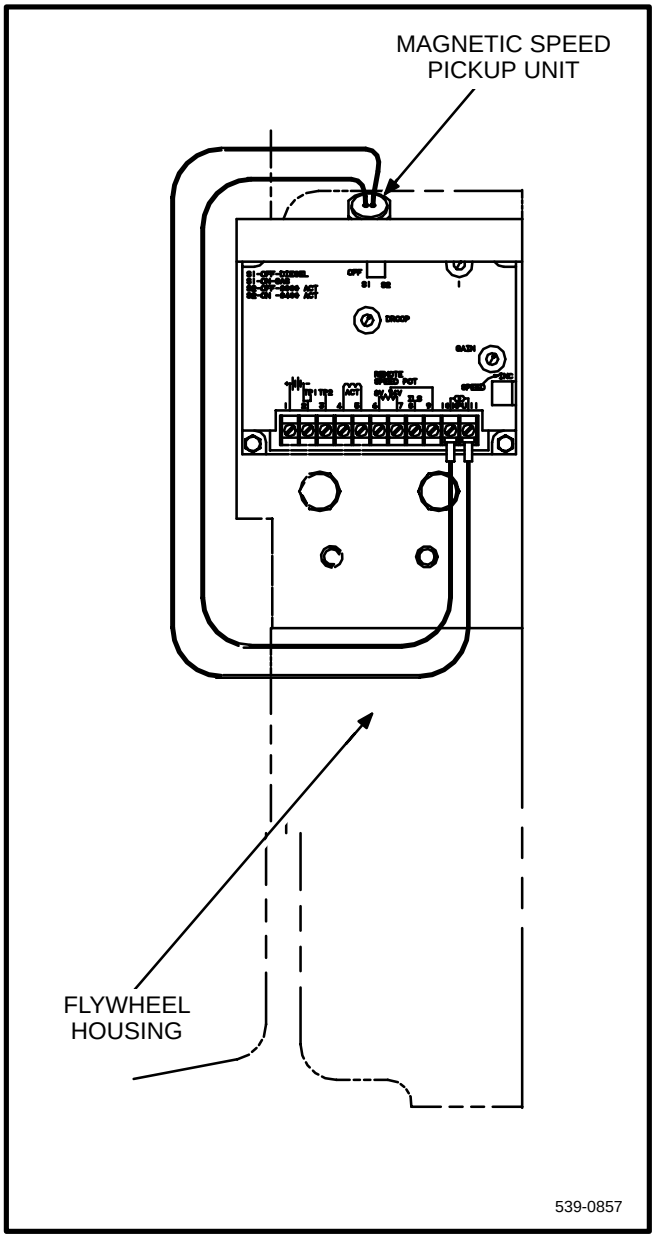


FIGURE 6-10. MAGNETIC SPEED PICKUP UNIT

7. Day Tank Fuel Transfer Pump and Control

A fuel transfer pump and control are available when a sub-base or in-skid day tank are provided. the automatic control operates the fuel pump to maintain a reservoir of fuel in the day tank.

⚠WARNING ***Diesel fuel is highly combustible. Improper installation of this kit can lead to spillage of large quantities of fuel and loss of life and property if the fuel is accidentally ignited. Installation and service must be performed by qualified persons in accordance with the applicable codes.***

Do not smoke near fuel and keep flames, sparks and other sources of ignition well away.

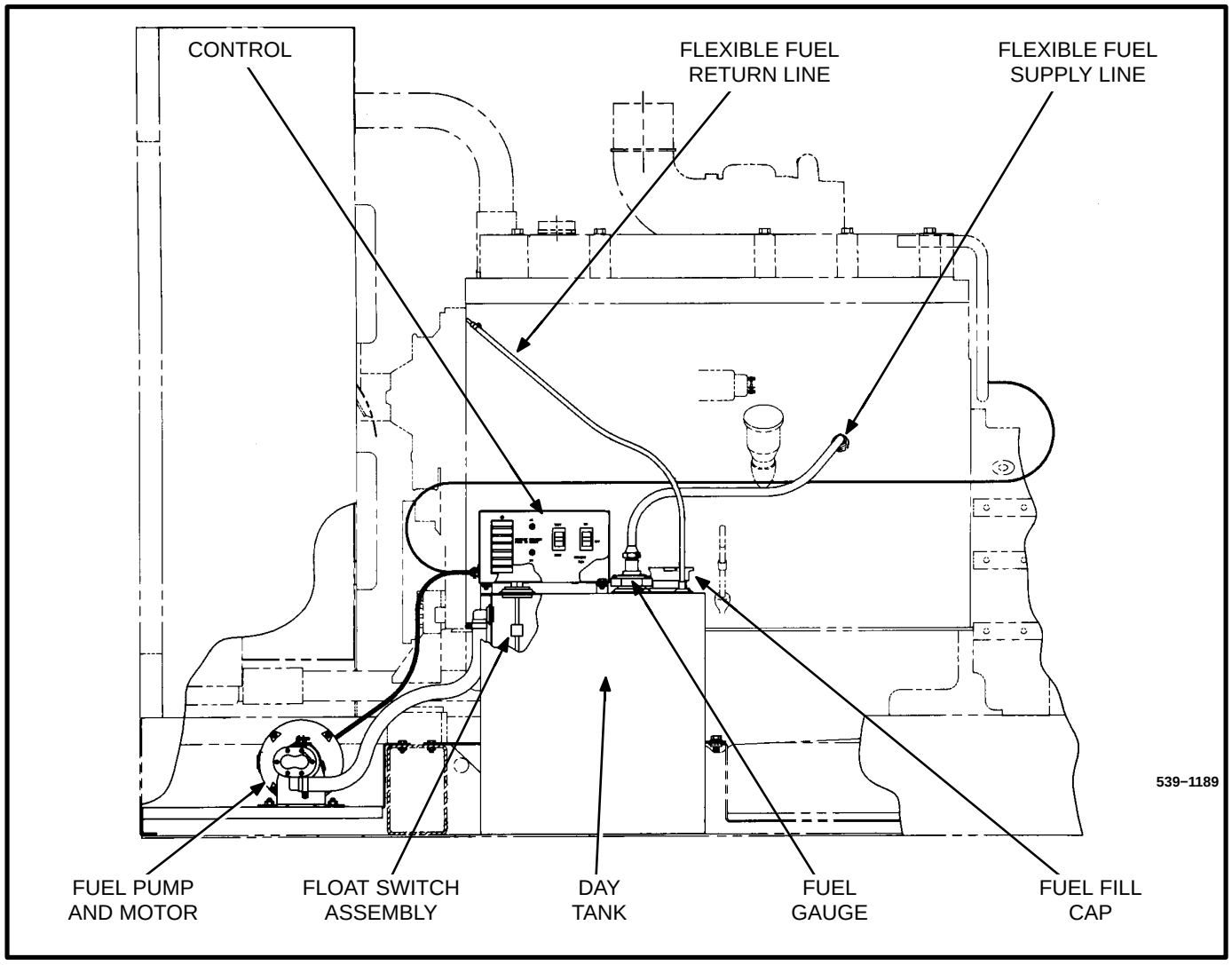


FIGURE 7-1. TYPICAL IN-SKID DAY TANK INSTALLATION

OPERATION

1. Push the control switch to the **ON** position for automatic operation. The green **SYSTEM READY** light will come on and the pump will fill the tank if AC power is available for pumping and DC power is available for the internal logic circuits. The level of fuel in the tank will be automatically kept between a set of pump-on and pump-off float switches.

   When filling an empty tank, the red LO SHUTDOWN and LO FUEL lights will come on when the control switch is pushed to the ON position. This is normal. Push the panel RESET switch to turn off the red lights after the tank has been filled.

   If the SYSTEM READY light does not come on, check for correct AC and DC power connections. See Wiring Connections and Fuel Pump Motor Connections below.

2. The green **PUMP ON** light indicates when the pump is running. It will come on and go off as fuel is pumped to maintain the proper level in the tank.

3. Push the control switch to the **EMERGENCY RUN** position (momentary contact) to pump fuel into the tank if the control fails to operate the pump automatically.

   The green PUMP ON light does not come on when the switch is in the EMERGENCY RUN position.

4. The red lights indicate fault conditions and the need for service. The control panel includes the following lights:

   A. ***HI FUEL:*** The fuel in the tank has reached an abnormally high level, indicating possible failure of the pump-off float switch. The high-fuel float switch takes over as the automatic pump-off switch. The **HI FUEL** light stays on. The light can be **RESET** with the panel switch when the fuel level drops to normal, but will come back on again during the next pumping cycle if the fault remains.

   ⚠WARNING ***Continued operation with a HI FUEL fault present can lead to spillage of large quantities of fuel if the high-fuel float switch fails. Spilled fuel can cause loss of life and property if it is accidentally ignited.***

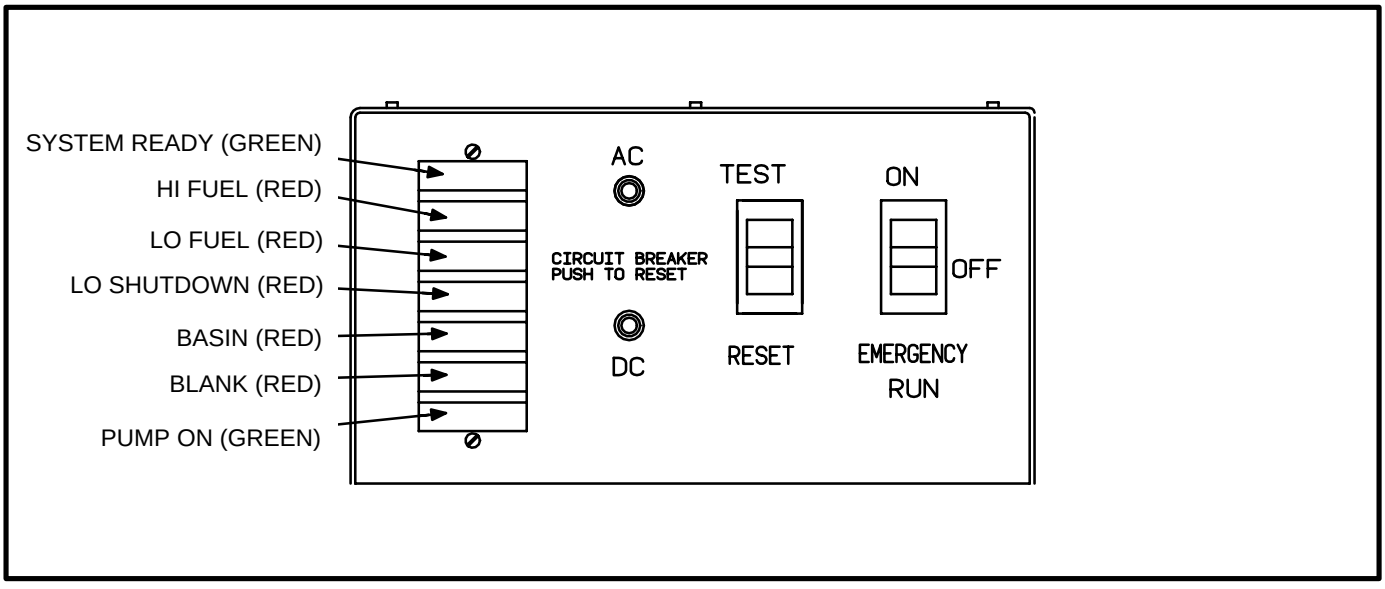


FIGURE 7-2. FUEL PUMP CONTROL PANEL

B. ***LO FUEL:*** The fuel in the tank has dropped to an abnormally low level, indicating possible failure of the pump-on float switch. The lo-fuel float switch takes over as the automatic pump-on switch. The **LO FUEL** light stays on. The light can be **RESET** with the panel switch when the fuel level rises to normal, but will come back on again during the next pumping cycle if the fault remains.

⚠ CAUTION ***Continued operation with a LO FUEL fault present can lead to low-fuel shutdown if the low-fuel float switch fails.***

C. ***LO SHUTDOWN:*** The fuel has dropped to a level near the bottom of the tank, indicating an empty main fuel tank, pump failure or possible failure of both the pump-on and low-fuel level float switches. Further operation will allow air to enter the engine fuel unit, causing shutdown and the necessity to bleed the fuel unit to start up the engine again. Connections should have been made to Terminals **TB1-14** and **TB1-15** to shut down the engine automatically (to ground terminal **TB2-16** on the engine control monitor board [ECM]). If the light comes on, check the fuel level in the main fuel tank and fill it if necessary. As the day tank is refilling, **RESET** the light with the panel switch.

To restore engine operation following this fault, both the pump control and the engine control have to be RESET.

D. ***BASIN:*** Fuel has overflowed into the rupture basin (if provided), indicating possible failure of both the pump-off and hi-fuel level float switches, or a leak in the day tank. **RESET** the control after the fuel in the basin has been safely disposed of and the cause of the overflow corrected.

E. ***BLANK:*** For customer use.

The control fault circuits will trip and latch, requiring RESET, even if AC power is lost.

5. Press the **TEST** switch to test the indicator lights and pump operating circuits. Replace any light that does not come on. The pump will stop automatically after it has filled the tank to the normal pump-off fuel level.

6. Press the reset button of the **AC** or **DC** circuit breaker if either has tripped.

WIRING CONNECTIONS

See page 9-15 when making connections at the control box terminal board. The following should be noted.

1. The control can be powered by 120 VAC or 240 VAC. The control is set up at the factory for connection to 240 VAC. Make sure selector switch **S103** on the control PCB is in the down position for 240 V. Make the following reconnections when connecting the control box to a 120 VAC power source:

   A. Remove the two jumpers between terminals **TB1-6** and **TB1-7** in the control box and connect one between terminals **TB1-5** and **TB1-6** and the other between terminals **TB1-7** and **TB1-8**.

   B. Move selector switch **S103** on the control PCB to the up position for 120V.

   C. If the control is equipped with a transformer, remove the two jumpers between terminals **H2** and **H3** and connect one between **H1** and **H3** and the other between **H2** and **H4**.

2. Attach a tag to the control box indicating the supply voltage.

3. If a two lead wiring harness is provided, the control does not include a power transformer. To provide 24 VDC for the control circuit, connect terminal **TB1-19** to the positive (+) terminal of the 24 V starter motor solenoid and terminal **TB-20** to the negative (-) terminal.

4. To immediately shut down the engine when the **LO SHUTDOWN** light comes on, connect terminal **TB1-14** to a good grounding point on the engine block and terminal **TB1-15** to terminal **TB2-16** on the engine control monitor board (ECM).

5. Terminals **TB1-10** through **TB1-17** and **TB2-23** through **TB2-27** are available for connections to remote annunciators.

6. Terminal **TB2-22** is available for connection of a grounding signal to activate the blank red light.

7. Terminals **TB1-8** and **TB1-5** are available for connection of a 120 or 240 VAC electric fuel shutoff valve rated not more than 0.5 amps. The voltage rating of the valve must correspond with the voltage utilized for the pump. See Item 2 above.

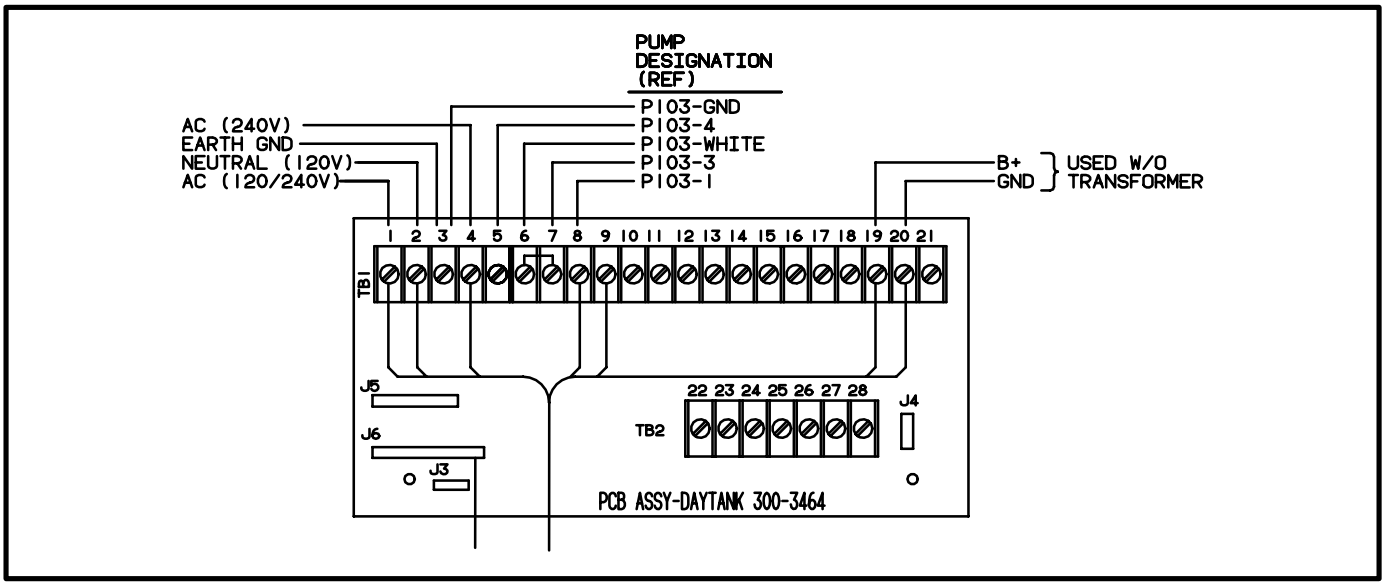


FIGURE 7-3. FUEL PUMP CONTROL TERMINAL BOARD

FUEL TRANSFER PUMP MOTOR CONNECTIONS

Connect a replacement fuel transfer pump motor as follows.

1. Remove the end bell cover for access to the motor wiring terminals.
2. Disconnect the brown lead from motor terminal **P103-3** and connect it to terminal **P103-6**. (Terminal **P103-6** is an insulated receptacle for securing the end of the lead so that it cannot move and touch the motor frame or a live terminal and cause a short circuit.)
3. Disconnect the red lead from motor terminal **P103-2**. It will be connected to the piggy-back terminal on the lead connected at motor terminal **P103-3**.
4. Cut the white lead from its ring connector at motor terminal **P103-4**. Strip 1/2 inch (12 mm) of insulation from the end of the white motor lead for splicing to the wire harness lead marked **P103-WHITE**.
5. Connect each lead of the five-lead wiring harness to the motor terminal or lead marked on it.
6. Connect the red motor lead to the piggy-back terminal at motor terminal **P103-3**.
7. Secure the end bell cover.

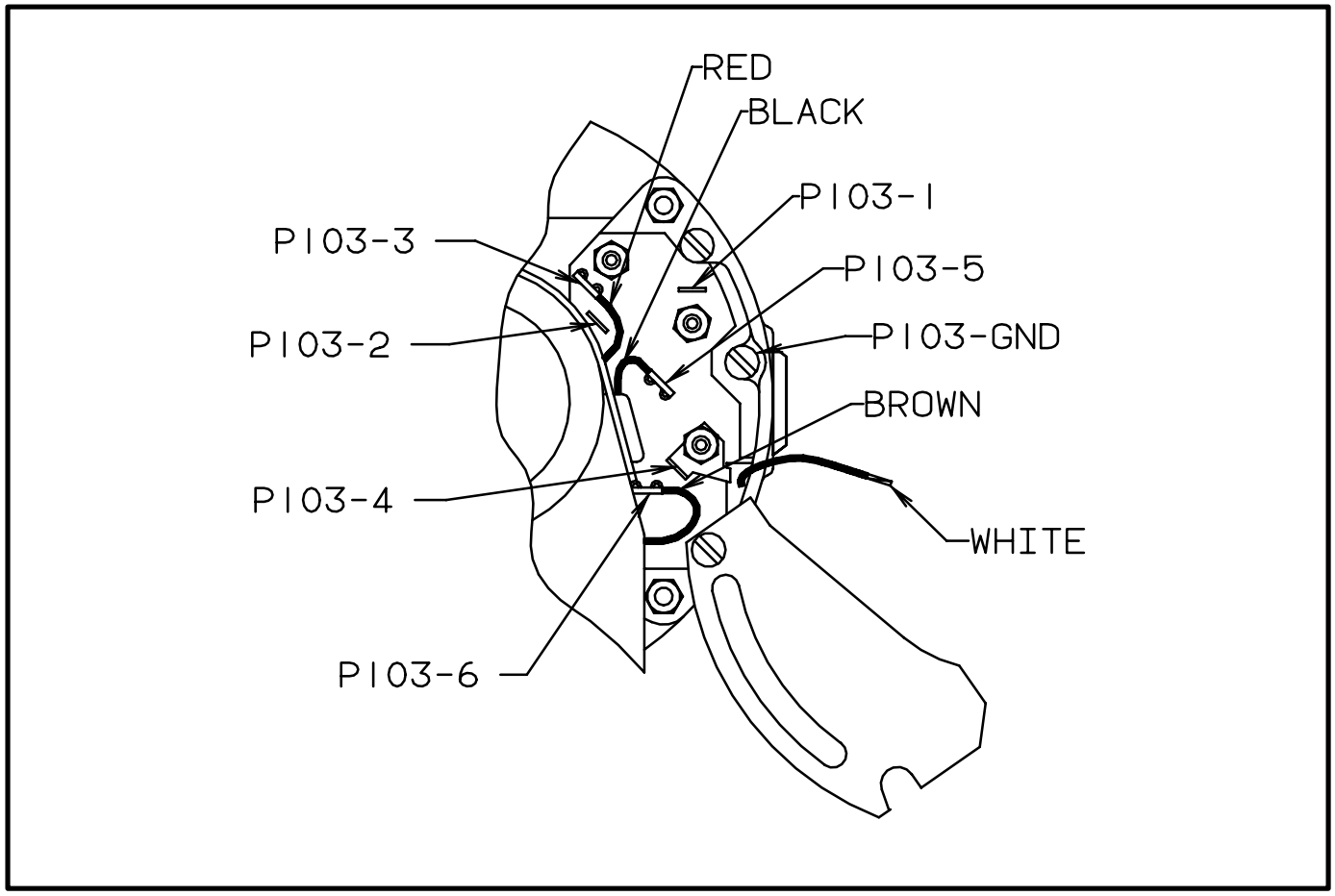


FIGURE 7-4. FUEL TRANSFER PUMP MOTOR CONNECTIONS

TESTING THE FLOAT SWITCH ASSEMBLY

The float switch assembly consists of 5 switches. Each switch has a pair of color coded leads connected to a common jack.

To test the float switches, remove the fuel pump control cover, disconnect the wiring jack and unscrew the assembly from the top of the day tank. Test as follows:

1. With an ohmmeter, test for electrical continuity (switch closed) between each pair of colored leads, while holding the assembly vertical. Replace the assembly if any switch is open (all the readings should be zero).

2. Lift each float, in turn, to 1/8 inch (3 mm) below the C-clip stop above it (use a feeler gauge) and test for electrical continuity. Replace the assembly if any switch does not open (all the readings should be infinity).

3. Use pipe thread sealant when replacing the assembly.

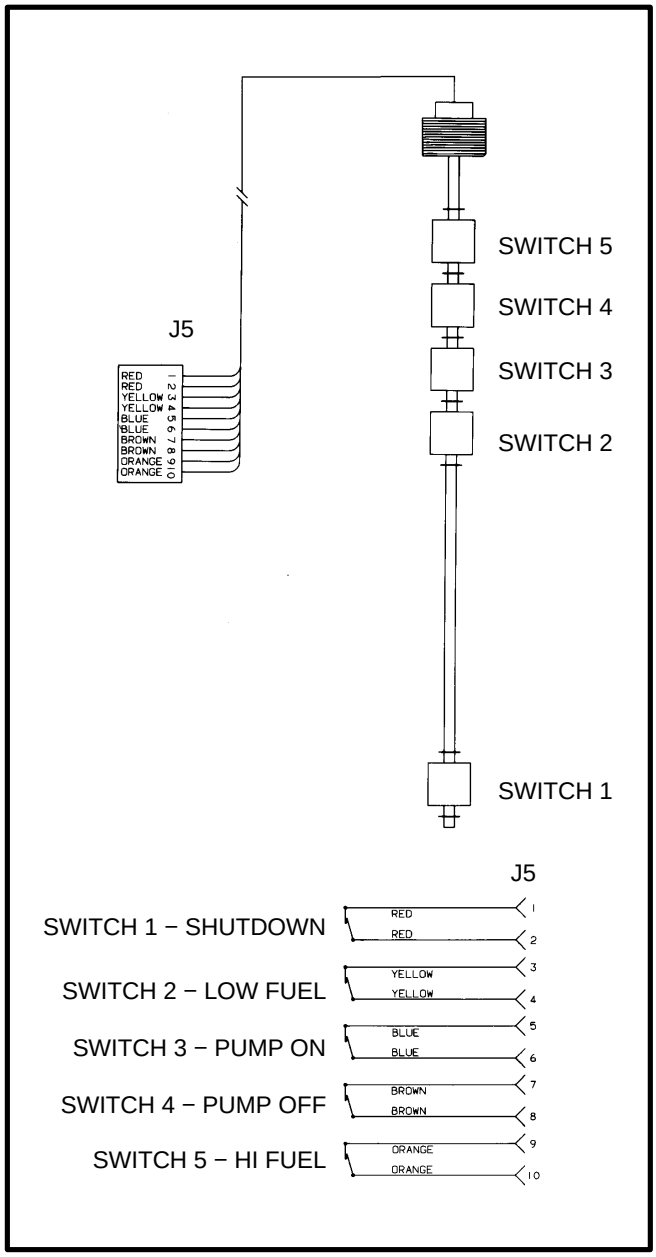


FIGURE 7-5. FLOAT SWITCH ASSEMBLY

8. QS- and QSG-Series Generator Sets

OPTIONAL POWER DISTRIBUTION PANEL FOR QSG-SERIES

The wiring diagrams for QSG-Series generator sets with the optional power distribution panel are on pages 9-13 and 9-14. The panel includes:

1. A rotary switch under a lockable cover to select 120/240 VAC single phase, 120/208 VAC three phase or 277/480 VAC three phase output
2. A six-pole line circuit breaker
3. Main output terminals
4. A set of convenience receptacles with individual circuit breakers: one 120 VAC, 20 Amp duplex; one 120 VAC, 20 Amp twist lock; one 240 VAC, 30 Amp twist lock and one 240 VAC, 50 Amp twist lock.

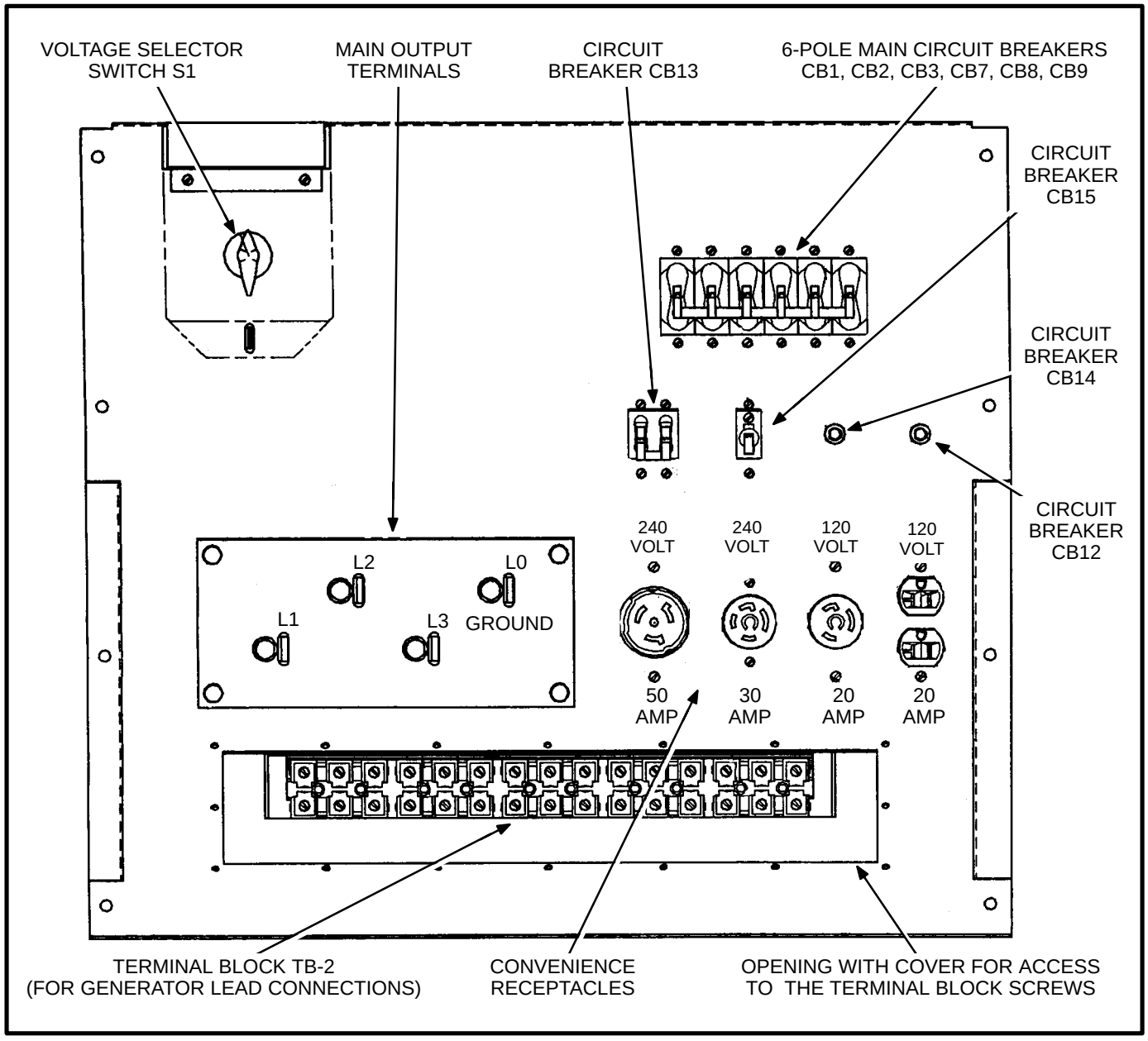


FIGURE 8-1. OPTIONAL POWER DISTRIBUTION PANEL FOR QSG-SERIES GENERATOR SETS

Removing The Power Distribution Panel

For access to the back of the generator and PMG or overspeed switch, it is necessary to remove the power distribution panel. Do so as follows.

1. Shut down the set and disconnect the batteries (negative [−] cable first) to prevent accidental starting.

   ⚠WARNING ***Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [−] first).***

   Arcing can ignite the explosive hydrogen gas given off by batteries, causing severe personal injury. Arcing can occur if the negative (−) battery cable is connected and a tool being used to connect or disconnect the positive (+) battery cable accidentally touches the frame or other grounded metal part of the set. To prevent arcing, always remove the negative (−) cable first, and reconnect it last.

   ⚠CAUTION ***Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits of the set.***

2. Remove the screws securing the outer door hinge and lay the door aside.

3. Remove the access cover over terminal block **TB2** and disconnect all the generator leads. For reconnections later, make sure each cable is clearly marked to indicate the correct terminal.

4. Disconnect the cable connected (inside) to the grounding lug below the panel.

5. Open the control box above the panel and disconnect the wires connected to terminals **VR21-2** and **VR21-4** on the voltage regulator and to terminal **23** on terminal block **TB21**. For reconnections later, make sure each wire is clearly marked to indicate the correct terminal and then push it through the opening in the back of the box.

6. Remove the panel mounting screws and pull the panel away.

7. Assembly is the reverse of disassembly.

OPTIONAL TRAILER PACKAGE FOR QS- AND QSG-SERIES

The trailer package for QS-Series generator sets incorporates hydraulic surge brakes. When the brakes are applied in the tow vehicle, trailer momentum forces the hitch / actuator assembly to telescope into the case assembly, applying force to the master cylinder piston, thus providing hydraulic pressure for braking. A break-away mechanism applies brake pressure in the event of coupling failure.

Brake Maintenance

1. Keep the master cylinder reservoir at least half full with DOT-3 hydraulic brake fluid.
2. Use a pressure-type brake bleeder if it is necessary to refill and bleed the brake system.
3. There are no adjustments in the brake actuator for stroke length. Readjust the brake shoes to reduce actuator stroke length if it exceeds 1 inch (25 mm). (The length of the roller path on top of the actuator when it is fully extended is the same as stroke length). Brake shoe adjustments are accessible through slots in the back of each drum assembly. Turn the brake drum forward while making shoe adjustments. Back off each shoe 10 clicks from the point where you cannot turn the drum by hand.

⚠WARNING ***Braking power can diminish, leading to a serious road accident, when actuator stroke length exceeds 1 inch (25mm). Check actuator stroke length regularly and service the brakes if necessary.***

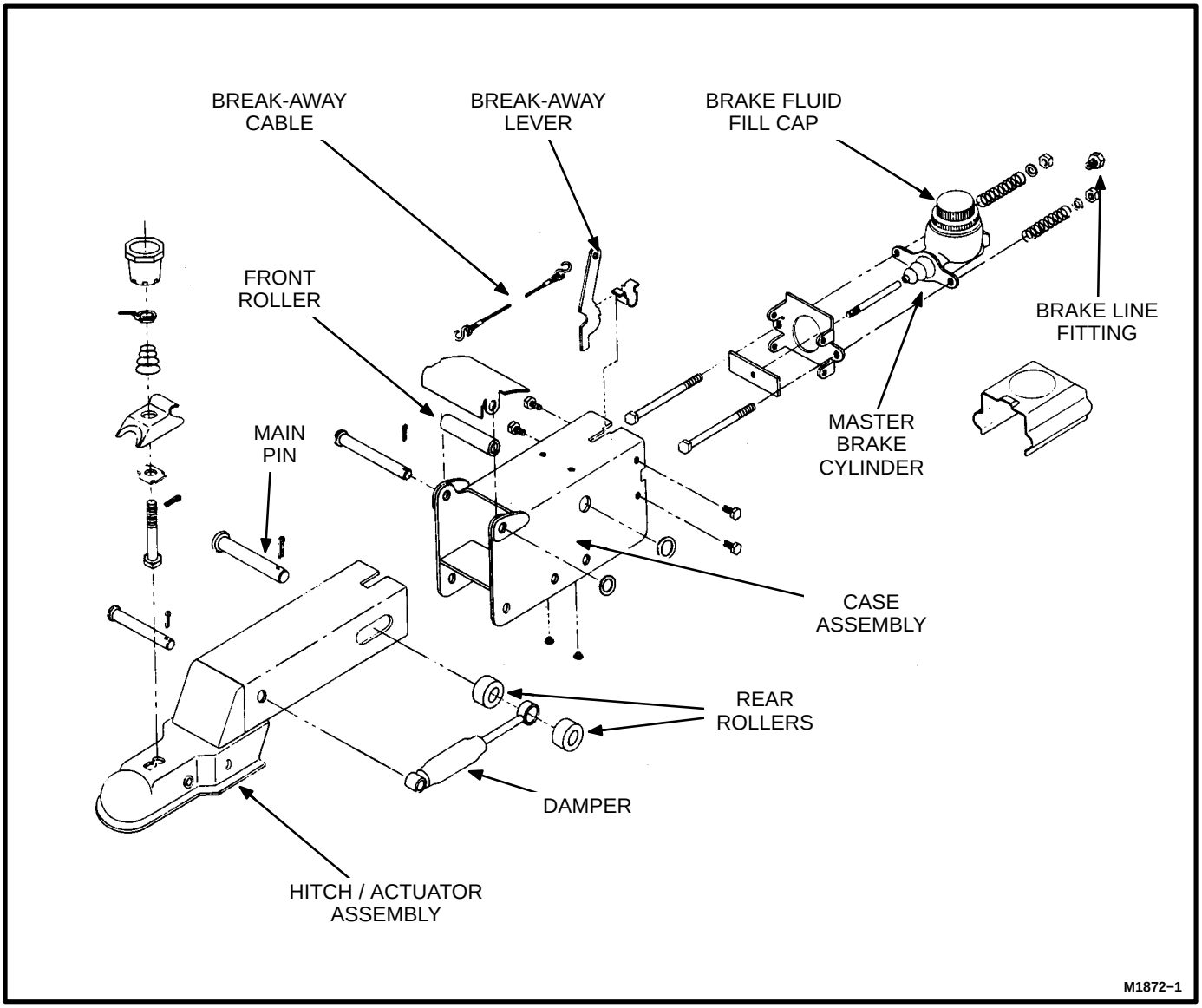


FIGURE 8-2. TRAILER HITCH AND SURGE BRAKE SYSTEM

Trailer Lights and Wiring

1. Trailer wiring is color coded as follows:

   White - Ground
   Brown - Side and rear running lights
   Yellow - Left turn signal and brake
   Green - Right turn signal and brake.

2. The running lights should come on with the tow vehicle head lights, the left and right signal lights should flash at the same time as the tow vehicle signal lights and the brake lights should come on each time the tow vehicle brake pedal is pressed.

3. It may be necessary to install a heavy duty flasher in the tow vehicle to make the signal lights work.

4. All points where wiring on the trailer is grounded to the frame should be checked for a good electrical bond.

5. Check for reversed trailer wiring or reversed trailer-to-vehicle connections if trailer and tow vehicle signal lights flash on opposite sides.

FAN BELT REPLACEMENT PROCEDURE FOR QSG-SERIES

The radiator cooling blower is secured by four bolts to a standoff spacer on the top engine belt pulley. The stand off spacer extends through a hole in the blower compartment bulkhead. To change the belt:

1. Shut down the set and disconnect the batteries (negative [−] cable first) to prevent accidental starting.

   ⚠WARNING ***Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [−] first).***

   Arcing can ignite the explosive hydrogen gas given off by batteries, causing severe personal injury. Arcing can occur if the negative (−) battery cable is connected and a tool being used to connect or disconnect the positive (+) battery cable accidentally touches the frame or other grounded metal part of the set. To prevent arcing, always remove the negative (−) cable first, and reconnect it last.

   ⚠CAUTION ***Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits of the set.***

2. Go to the front of the set and remove the air inlet screen and box.
3. Remove the air cone.
4. Loosen the four blower hub bolts and withdraw the blower and spacers.
5. Go to the engine compartment and slip the old belt off and the new belt on over the top pulley.
6. Reassemble the blower. Note that the blower wheel, hub cap, the two rubber isolators, and the back plate have eight bolt holes. Line up the four holes in each that match the bolt holes in the spacer. Tighten all four hub bolts by hand and then torque each to 8 ft-lbs (11 Nm).
7. Thread the fan belt through the pulleys in accordance with the engine service manual.
8. Reassemble the air cone, screen and box.

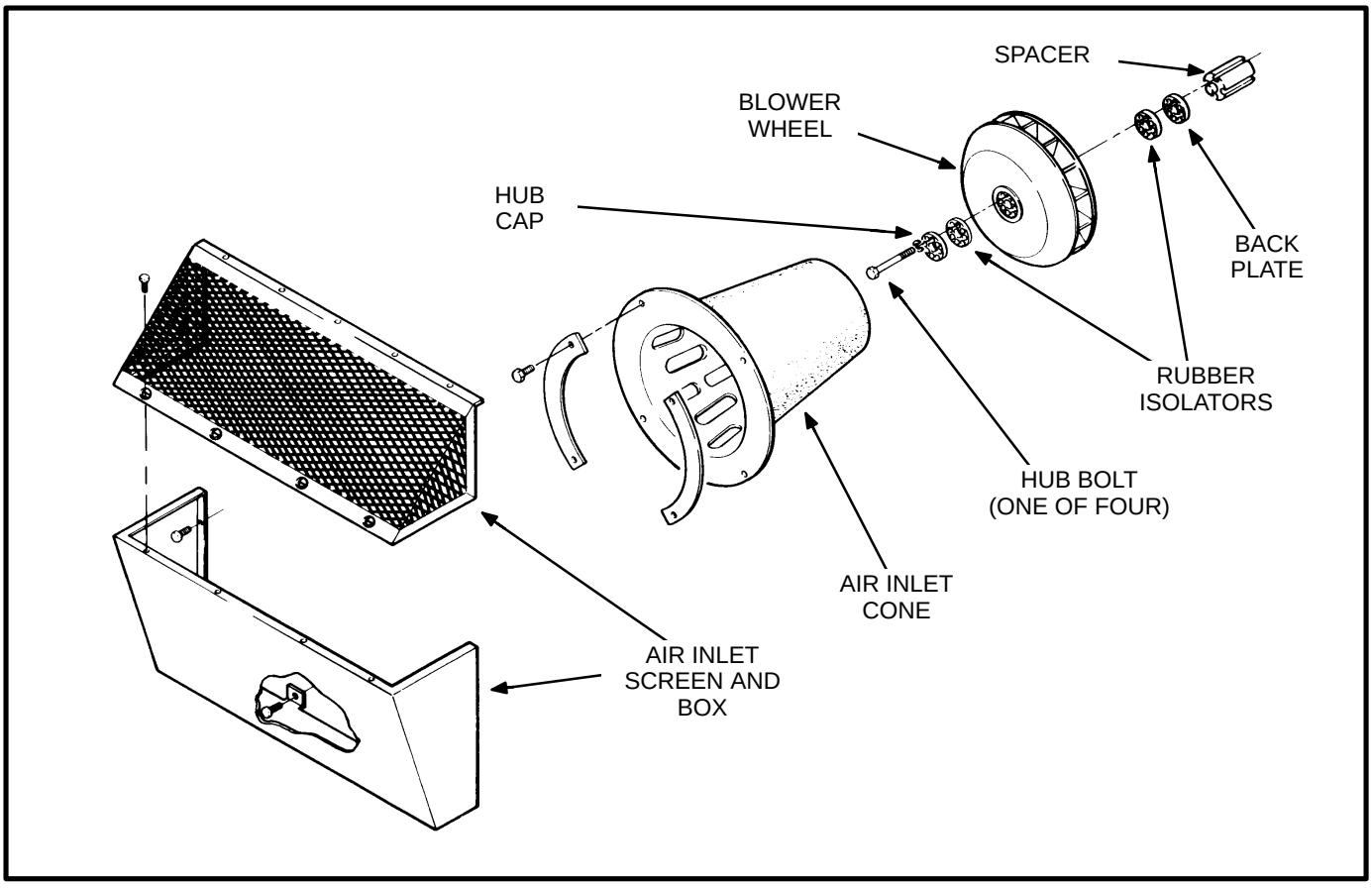


FIGURE 8-3. QSG-SERIES RADIATOR COOLING BLOWER

BLOWER REPLACEMENT PROCEDURE FOR QS-SERIES

QS-Series generator sets have twin blowers for radiator cooling. The blowers are mounted on separate pulley-driven shafts that extend through the front bulkhead of the engine compartment. See Figures 8-4 and 8-5.

To remove a blower, its shaft and its bearings:

1. Shut down the set and disconnect the batteries (negative [−] cable first) to prevent accidental starting.

   ⚠WARNING ***Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [−] first).***

   Arcing can ignite the explosive hydrogen gas given off by batteries, causing severe personal injury. Arcing can occur if the negative (−) battery cable is connected and a tool being used to connect or disconnect the positive (+) battery cable accidentally touches the frame or other grounded metal part of the set. To prevent arcing, always remove the negative (−) cable first, and reconnect it last.

   ⚠CAUTION ***Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits of the set.***

2. Remove the air inlet box.
3. Remove the air cone.
4. Remove the four blower hub bolts and withdraw the blower.
5. Back out the set screw in the bearing collar and with a light hammer and drift pin tap the collar in a counterclockwise direction until it is loose and then withdraw it.
6. Unscrew the nuts that secure the front bearing retainer. See Figure 8-5.
7. Go to the engine compartment and remove the fan belt and shaft pulley and remove the bearing collar as in Step 5, except that the collar must be tapped loose in the clockwise direction.
8. Withdraw the shaft into the blower compartment.
9. If necessary, unscrew the nuts that secure the bearing retainer (bearing on the pulley end of the shaft).

Reassembly is the reverse of disassembly. Note the following:

1. Make sure the shaft shoulder is snug against the rear bearing (Figure 8-5) and then position and snug the **rear bearing locking collar** against the bearing. Lock the collar in place by tapping it **counterclockwise** with a light hammer and drift pin and tightening the set screw.
2. Secure the front and rear bearing retainers before positioning the front bearing locking collar.
3. Position and snug the **front bearing locking collar** against the bearing and then lock it in place by tapping it **clockwise** with a light hammer and drift pin and tightening the set screw.
4. Torque the blower hub bolts to 8 ft-lbs (11 Nm).

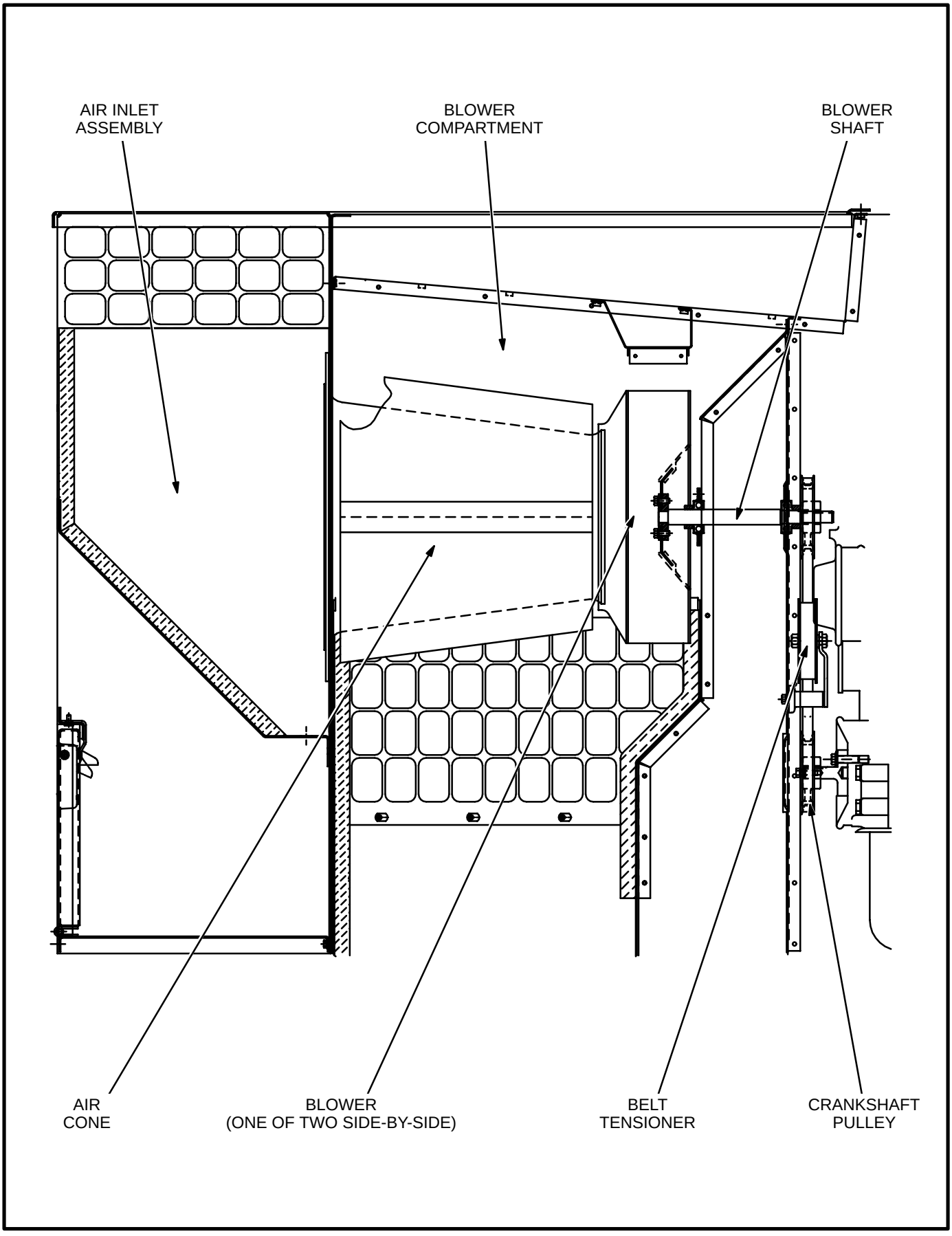


FIGURE 8-4. QS-SERIES RADIATOR COOLING BLOWER (ONE OF TWO)

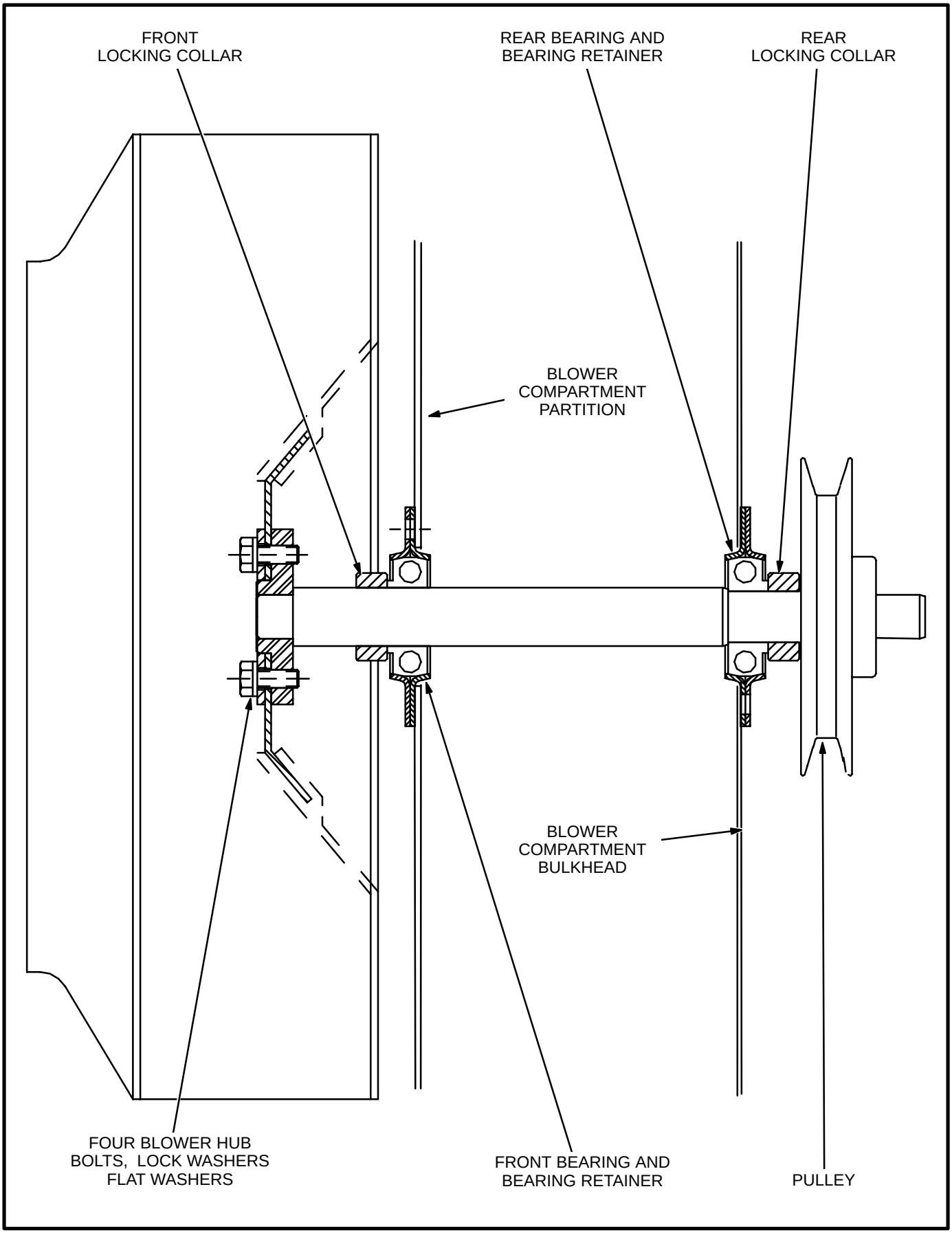
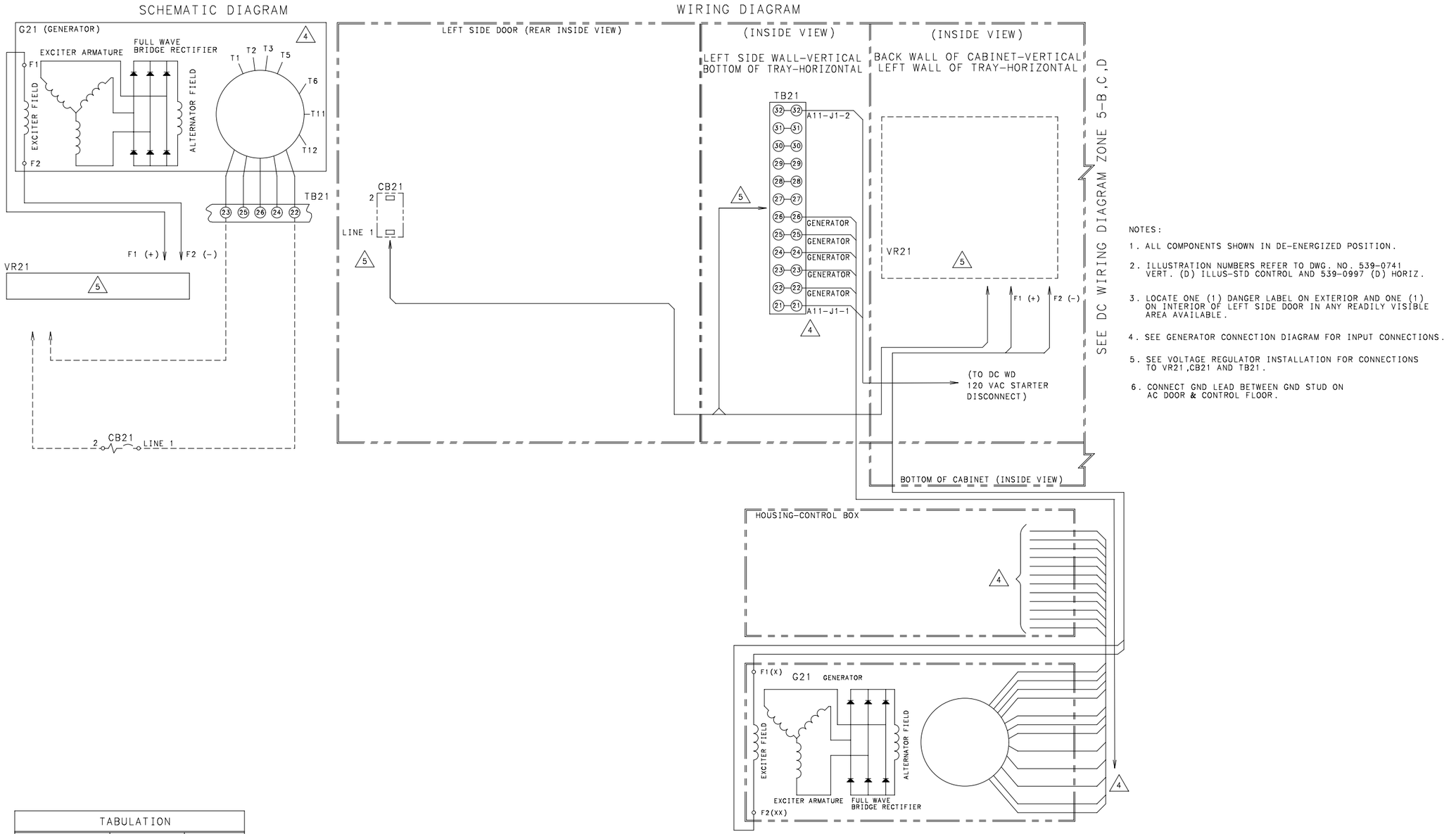


FIGURE 8-5. BLOWER, SHAFT AND BEARING ASSEMBLY

9. Wiring Diagrams

This section consists of the schematic and connection wiring diagrams referenced in the text. The following drawings are included:



NOTES:

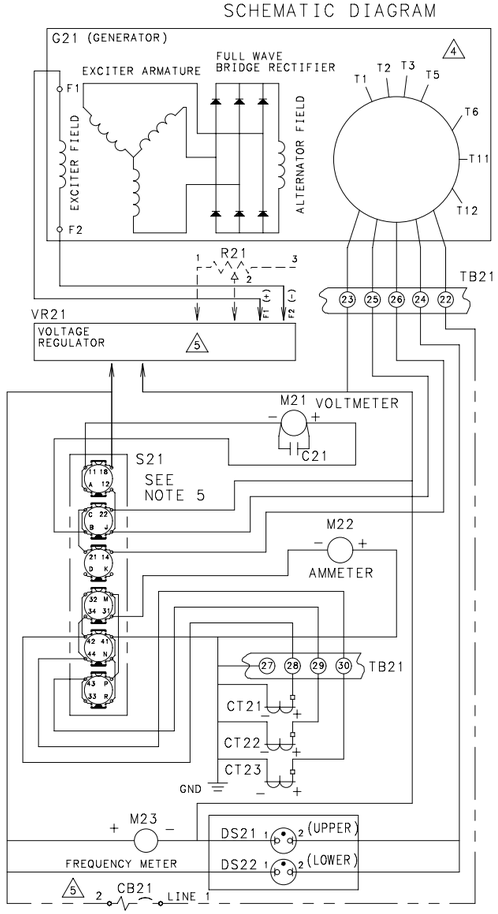
1. ALL COMPONENTS SHOWN IN DE-ENERGIZED POSITION.
2. ILLUSTRATION NUMBERS REFER TO DWG. NO. 539-0741 VERT. (D) ILLUS-STD CONTROL AND 539-0997 (D) HORIZ.
3. LOCATE ONE (1) DANGER LABEL ON EXTERIOR AND ONE (1) ON INTERIOR OF LEFT SIDE DOOR IN ANY READILY VISIBLE AREA AVAILABLE.
4. SEE GENERATOR CONNECTION DIAGRAM FOR INPUT CONNECTIONS.
5. SEE VOLTAGE REGULATOR INSTALLATION FOR CONNECTIONS TO VR21,CB21 AND TB21.
6. CONNECT GND LEAD BETWEEN GND STUD ON AC DOOR & CONTROL FLOOR.

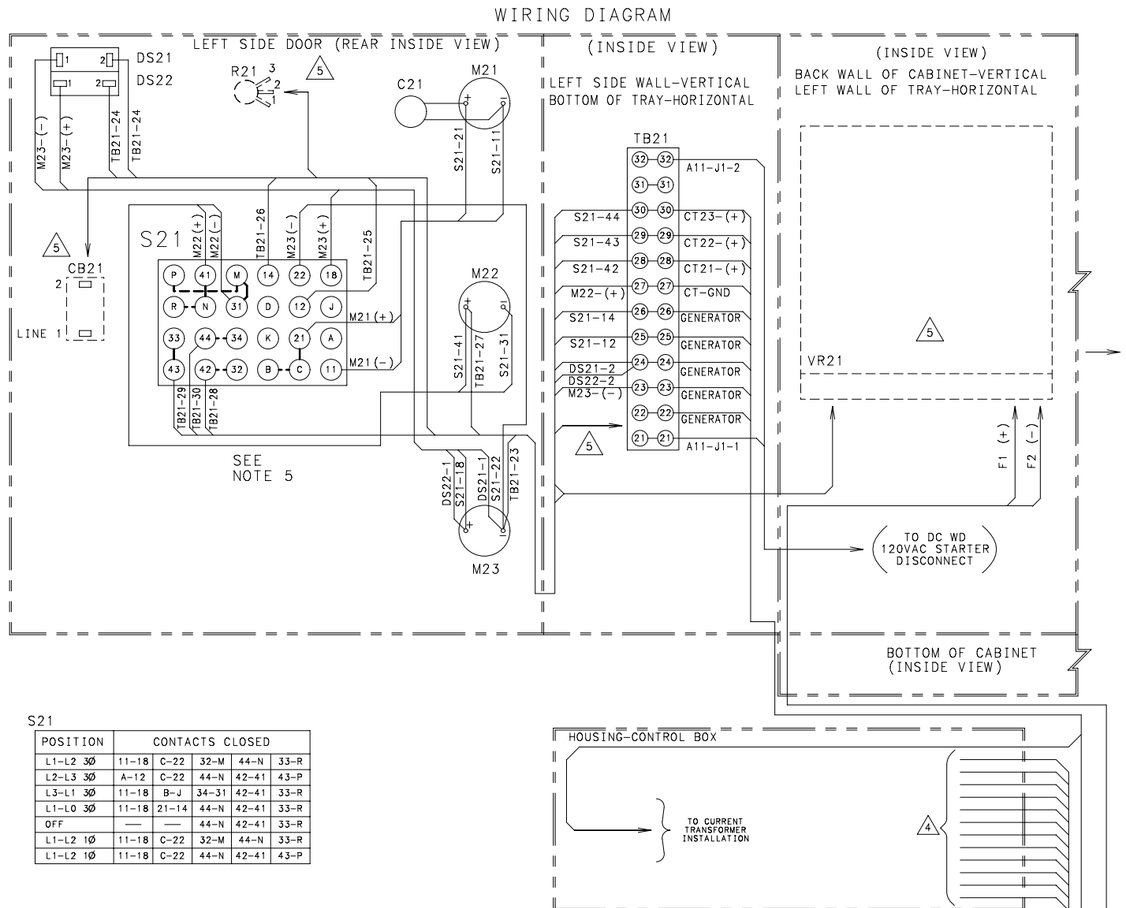
TABULATION		
PART NO.	ITEM 1 PART NO.	CURRENT ER NO.
0612-6489-01	0301-8065	FRD8629
0612-6489-02	0319-3030	FRD9455

WITHOUT METERS

No. 612-6489
Rev. S Sys: Revisio
Modified 6/2001

AC CONTROL WIRING DIAGRAM (WITHOUT METERS)





WITH METERS

S21

POSITION	CONTACTS CLOSED				
L1-L2 3Ø	11-18	C-22	32-M	44-N	33-R
L2-L3 3Ø	A-12	C-22	44-N	42-41	43-P
L3-L1 3Ø	11-18	B-J	34-31	42-41	33-R
L1-L0 3Ø	11-18	21-14	44-N	42-41	33-R
OFF	—	—	44-N	42-41	33-R
L1-L2 1Ø	11-18	C-22	32-M	44-N	33-R
L1-L2 1Ø	11-18	C-22	44-N	42-41	43-P

TABULATION "B"

<500V	VERTICAL	-01	-02	-03	-04	-05	-06	-07	-08	-09
600V	VERTICAL	-26	-27	-28	-29	-30	-31	-32	-33	-34
MV4160	VERTICAL	-81	-82	-83	-84	-85	-86	-87	-88	-89
<500V	HORIZONTAL	-51	-52	-53	-54	-55	-56	-57	-58	-59
600V	HORIZONTAL	-76	-77	-78	-79	-80				
ITEM 32 (M22)		302-1975	302-1473	302-1147	302-1683	302-1684	302-1685	302-1724	302-1725	302-1726
AMMETER SCALE (M22)		(0-25,0-50)	(0-50,0-100)	(0-75,0-150)	(0-100,0-200)	(0-150,0-300)	(0-200,0-400)	(0-250,0-500)	(0-375,0-750)	(0-400,0-800)
CURRENT TRANSFORMER SECONDARY CONNECTION		0-25 (1-2) 0-50 (1-3)	0-50 (1-2) 0-100 (1-3)	0-75 (1-2) 0-150 (1-3)	0-100 (1-2) 0-200 (1-3)	0-150 (1-2) 0-300 (1-3)	0-200 (1-2) 0-400 (1-3)	0-250 (1-2) 0-500 (1-3)	0-375 (1-2) 0-750 (1-3)	0-400 (1-2) 0-800 (1-3)

TABULATION "B"

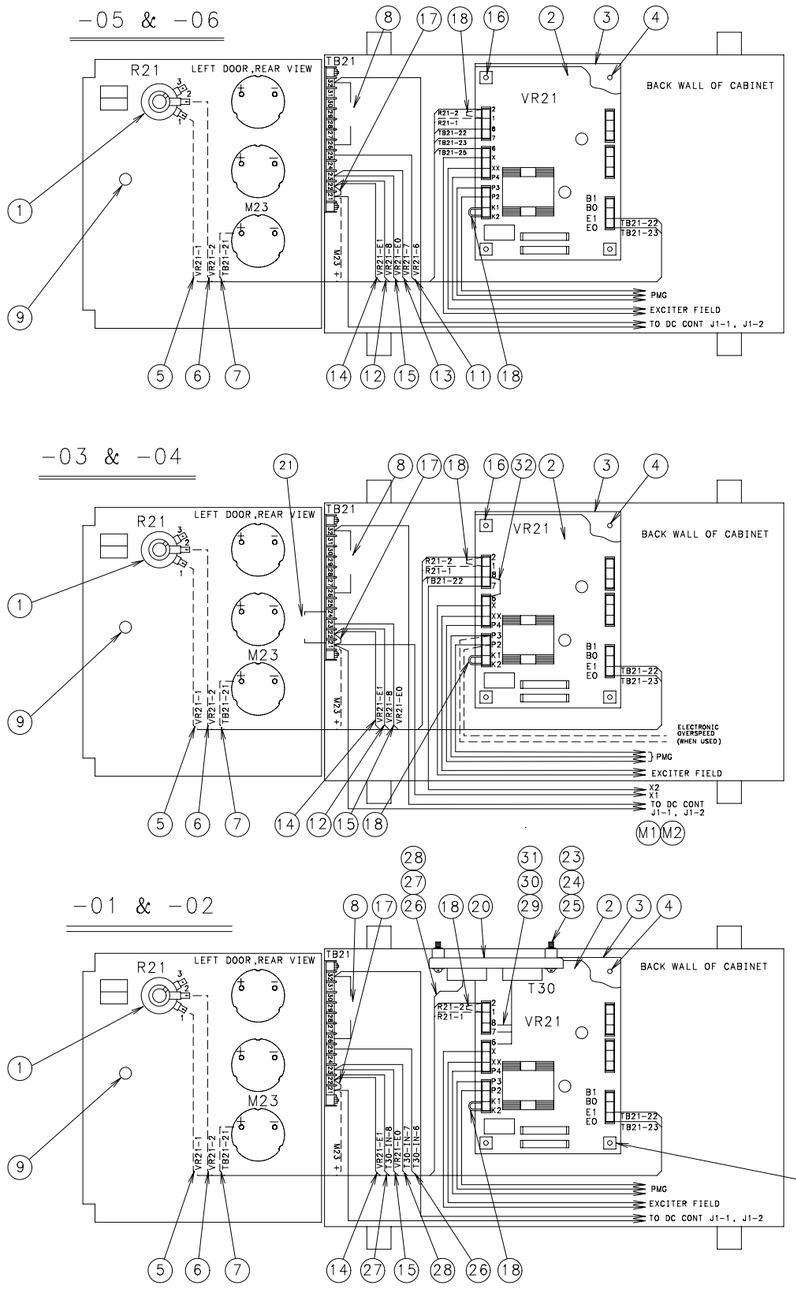
<500V	VERTICAL	-10	-11	-12	-13	-14	-15	-16	-17	-18/-99
600V	VERTICAL	-35	-36	-37	-38	-39	-40	-41	-42	-43
MV4160	VERTICAL	-90	-91	-92	-93	-94	-95	-96	-97	-98
<500V	HORIZONTAL	-60	-61	-62	-63	-64	-65	-66	-67	-68
600V	HORIZONTAL									
ITEM 32 (M22)		302-1727	302-1728	302-1729	302-1798	302-1799	302-1800	302-1908		NA
AMMETER SCALE (M22)		(0-500,0-1000)	(0-600,0-1200)	(0-750,0-1500)	(0-1000,0-2000)	(0-1500,0-3000)	(0-2000,0-4000)	(0-3000;0-6000)		NA
CURRENT TRANSFORMER SECONDARY CONNECTION		0-500 (1-2) 0-1000 (1-3)	0-600 (1-2) 0-1200 (1-3)	0-750 (1-2) 0-1500 (1-3)	0-1000 (1-2) 0-2000 (1-3)	0-1500 (1-2) 0-3000 (1-3)	0-2000 (1-2) 0-4000 (1-3)	0-3000 (1-2) 0-6000 (1-3)		NA

NOTES:

1. ALL COMPONENTS SHOWN IN DE-ENERGIZED POSITION.
2. ILLUSTRATION NUMBERS REFER TO DWG. NO. 539-0741 VERT. (D) ILLUS-STD CONTROL AND 539-0997 (D) HORIZ.
3. LOCATE ONE (1) DANGER LABEL ON EXTERIOR AND ONE (1) ON INTERIOR OF LEFT SIDE DOOR IN ANY READILY VISIBLE AREA AVAILABLE.
4. SEE GENERATOR CONNECTION DIAGRAM FOR INPUT CONNECTIONS.
5. SEE VOLTAGE REGULATOR INSTALLATION FOR CONNECTIONS TO VR21,CB21,R21 AND TB21.
6. TERMINAL 18 TO BE ON THE TOP AND TERMINAL 11 TO BE ON THE BOTTOM.

No. 612-6490
Rev. ZB Sys: Revisio
Modified 1/2002

AC CONTROL WIRING DIAGRAM (WITH METERS)



TABULATION	
PART NUMBER	CURRENT ER NUMBER
300-3606-01	FRD4457
300-3606-02	FRD4457
300-3606-03	FRD4457
300-3606-04	FRD4457
300-3606-05	FRD4457
300-3606-06	FRD4457

	TABULATION																								
	DASH NO.	WITH PNL VOLTAGE ADJUST	W/OUT PNL VOLTAGE ADJUST	QTY. ITEM 1	QTY. ITEM 5	QTY. ITEM 6	QTY. ITEM 7	QTY. ITEM 11	QTY. ITEM 12	QTY. ITEM 13	QTY. ITEM 18	QTY. ITEM 20	QTY. ITEM 21	QTY. ITEM 22	QTY. ITEM 23	QTY. ITEM 24	QTY. ITEM 25	QTY. ITEM 26	QTY. ITEM 27	QTY. ITEM 28	QTY. ITEM 29	QTY. ITEM 30	QTY. ITEM 31	QTY. ITEM 32
	-01	–	X	–	–	–	–	–	–	–	2	1	–	–	4	4	4	1	1	1	1	1	1	–
	-02	X	–	1	1	1	1	–	–	–	1	1	–	–	4	4	4	1	1	1	1	1	1	–
*	-03	–	X	–	–	–	–	–	1	–	2	–	1	1	–	–	–	–	–	–	–	–	–	1
*	-04	X	–	1	1	1	1	–	1	–	1	–	1	1	–	–	–	–	–	–	–	–	–	1
	-05	–	X	–	–	–	–	1	1	1	2	–	–	–	–	–	–	–	–	–	–	–	–	–
	-06	X	–	1	1	1	1	1	1	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–

*-03 & -04 ARE QUIET SITE I & II WITH RECONNECT PANEL. REGULATOR IS CONNECTED FOR 2 PHASE SENSING.

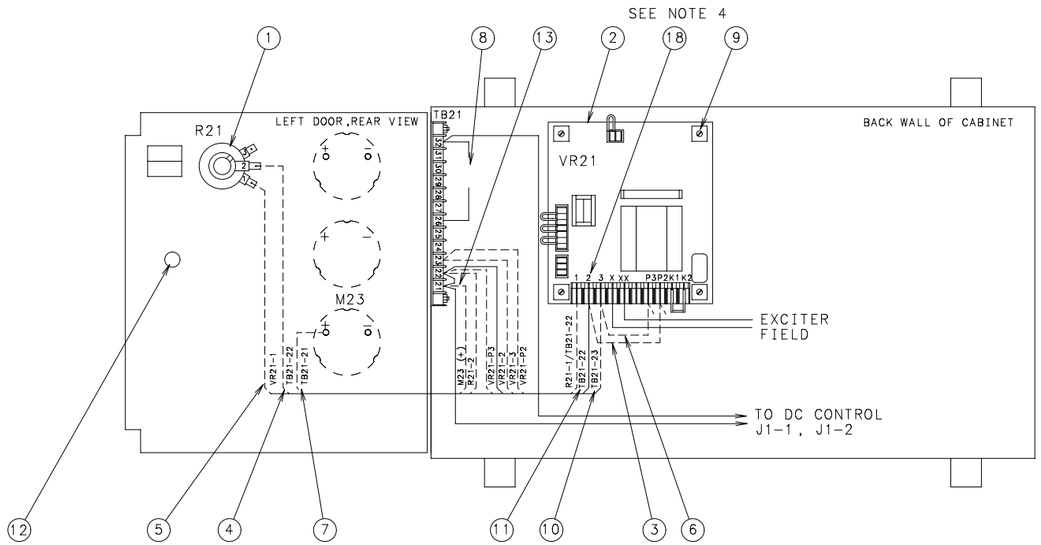
NOTES

1. DASHED LEADS INDICATE WHEN USED
2. REFER TO ILLUSTRATION DRAWING 539-0741
3. TIE EXTRA WIRE INTO HARNESS
4. FOR 2 PHASE (1Ø) GENERATOR OPERATION.
   A) FOR -03 THRU -06 DISCONNECT LEAD FROM TB21-25 TO VR21-6. CONNECT JUMPER LEAD (ITEM 32) FROM TERMINAL VR21-8 TO VR21-6.
   B) FOR -01 AND -02 DISCONNECT LEAD FROM TB21-25 TO T30-IN-6 AND T30-OUT-6 TO VR21-6. CONNECT JUMPER LEAD (ITEM 32) FROM TERMINAL VR21-8 TO VR21-6.

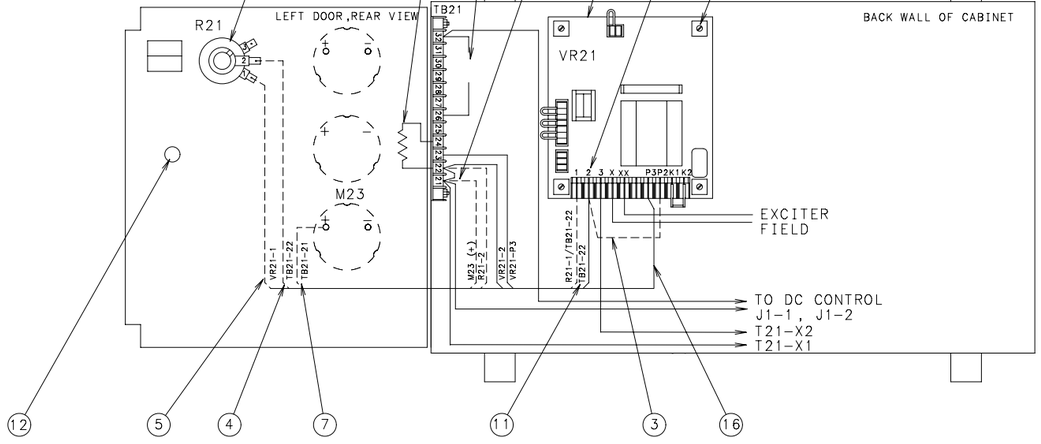
MX321

No. 300-3606
Rev. P Sys: Revisio
Modified 3/2000

-1 & -2



-3 & -4



TABULATION														
DASH NO.	WITH PANEL VOLTAGE ADJUST	WITHOUT PANEL VOLTAGE ADJUST	QTY. ITEM 1	QTY. ITEM 3	QTY. ITEM 4	QTY. ITEM 5	QTY. ITEM 6	QTY. ITEM 7	QTY. ITEM 10	QTY. ITEM 14	QTY. ITEM 15	QTY. ITEM 16	QTY. ITEM 17	QTY. ITEM 18
-01	–	X	–	1	–	–	1	–	1	1		–	–	–
-02	X	–	1	1	1	1	1	1	1	–		–	–	–
-03	–	X	–	1	–	–	–	–	–	1		1	1	1
-04	X	–	1	1	1	1	–	1	–	–		1	1	1

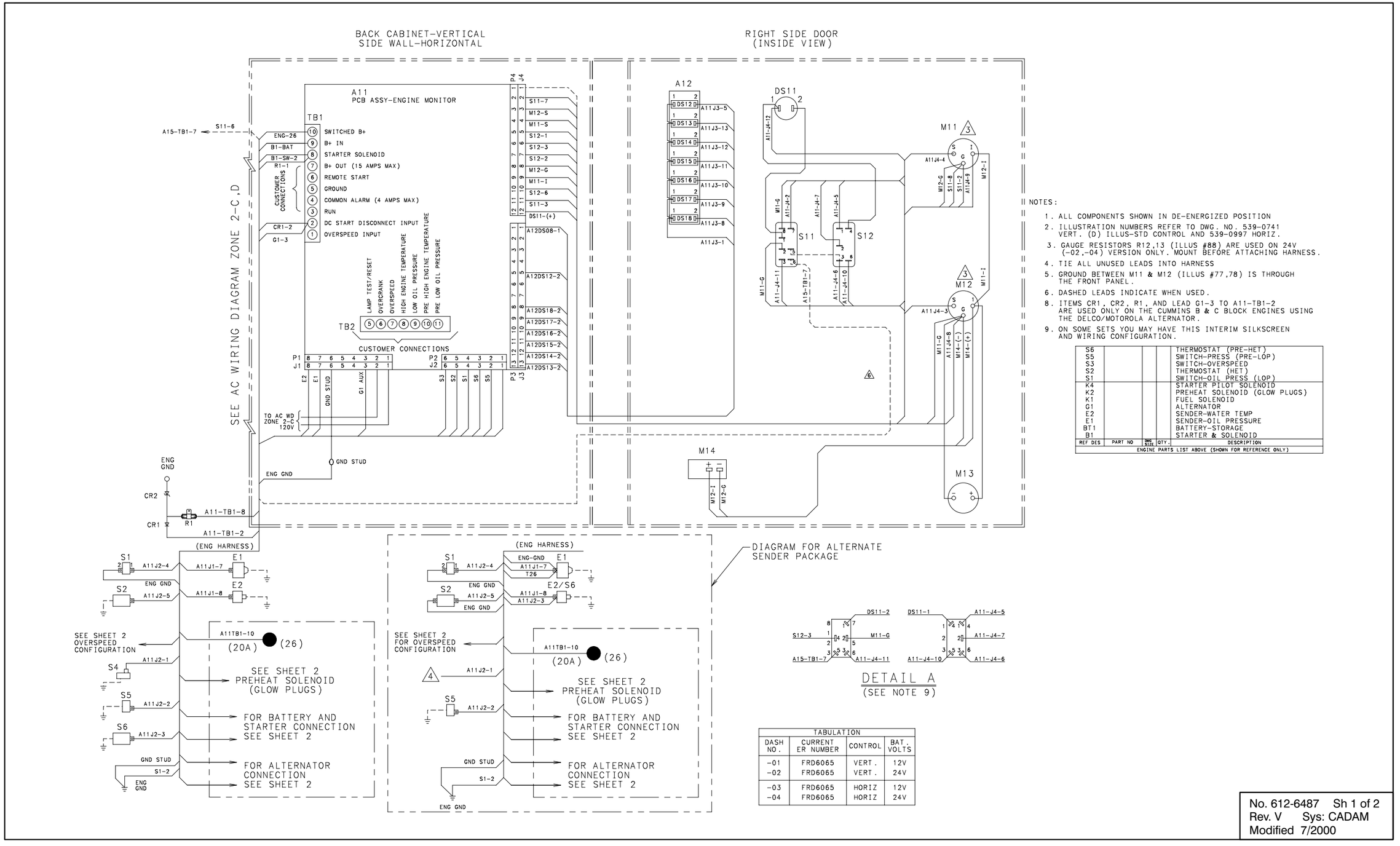
QUIET SITE I & II WITH RECONNECT PANEL. REGULATOR IS CONNECTED FOR 2 PHASE SENSING.

NOTES

1. DASHED LEADS INDICATE WHEN USED
2. REFER TO ILLUSTRATION DRAWING 539-0741
3. TIE EXTRA WIRE INTO HARNESS
4. ON -03,-04 USE ITEM 18 TO CONNECT LEAD TO VR21-2.

SX440

No. 300-3607
Rev. G Sys: Revisio
Modified 4/1993



NOTES:

1. ALL COMPONENTS SHOWN IN DE–ENERGIZED POSITION
2. ILLUSTRATION NUMBERS REFER TO DWG. NO. 539–0741 VERT. (D) ILLUS–STD CONTROL AND 539–0997 HORIZ.
3. GAUGE RESISTORS R12,13 (ILLUS #88) ARE USED ON 24V (–02,–04) VERSION ONLY. MOUNT BEFORE ATTACHING HARNESS.
4. TIE ALL UNUSED LEADS INTO HARNESS
5. GROUND BETWEEN M11 & M12 (ILLUS #77,78) IS THROUGH THE FRONT PANEL.
6. DASHED LEADS INDICATE WHEN USED.
8. ITEMS CR1, CR2, R1, AND LEAD G1–3 TO A11–TB1–2 ARE USED ONLY ON THE CUMMINS B & C BLOCK ENGINES USING THE DELCO/MOTOROLA ALTERNATOR.
9. ON SOME SETS YOU MAY HAVE THIS INTERIM SILKSCREEN AND WIRING CONFIGURATION.

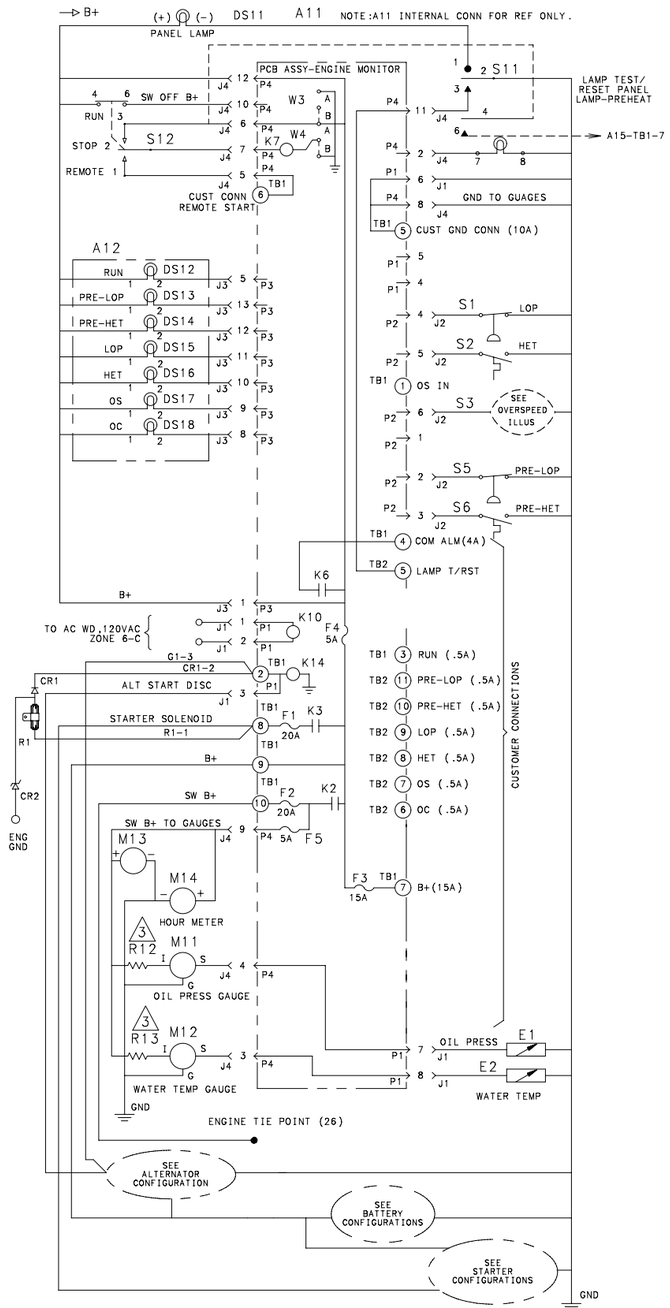
S6				THERMOSTAT (PRE–HET)
S5				SWITCH–PRESS (PRE–LOP)
S3				SWITCH–OVERSPEED
S2				THERMOSTAT (HET)
S1				SWITCH–OIL PRESS (LOP)
K4				STARTER PILOT SOLENOID
K2				PREHEAT SOLENOID (GLOW PLUGS)
K1				FUEL SOLENOID
G1				ALTERNATOR
E2				SENDER–WATER TEMP
E1				SENDER–OIL PRESSURE
BT1				BATTERY–STORAGE
B1				STARTER & SOLENOID
REF DES	PART NO	DWG SIZE	QTY.	DESCRIPTION
ENGINE PARTS LIST ABOVE (SHOWN FOR REFERENCE ONLY)				

TABULATION			
DASH NO.	CURRENT ER NUMBER	CONTROL	BAT. VOLTS
–01	FRD6065	VERT.	12V
–02	FRD6065	VERT.	24V
–03	FRD6065	HORIZ	12V
–04	FRD6065	HORIZ	24V

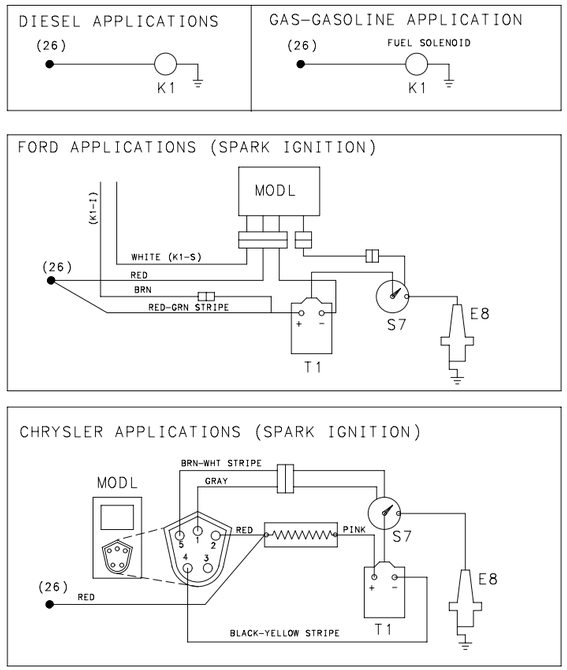
No. 612-6487 Sh 1 of 2
Rev. V Sys: CADAM
Modified 7/2000

7-LIGHT DC CONTROL WIRING DIAGRAM, SHEET 1

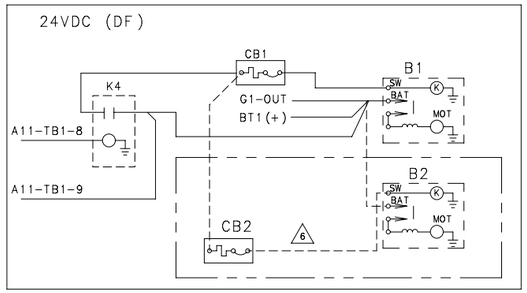
SCHEMATIC DIAGRAM

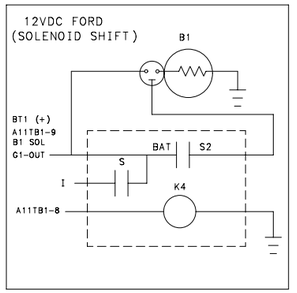


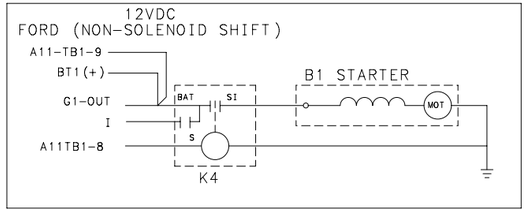
IGNITION SYSTEMS

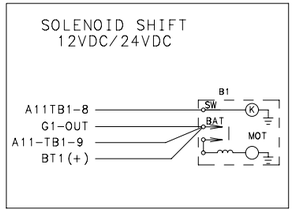


STARTER CONFIGURATIONS

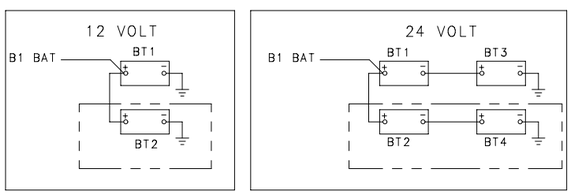


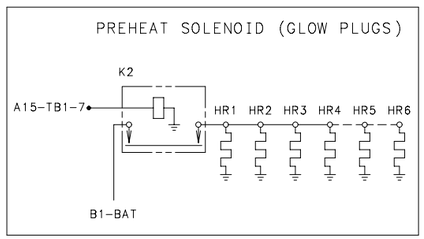


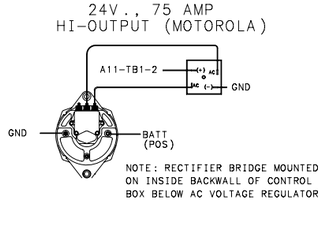


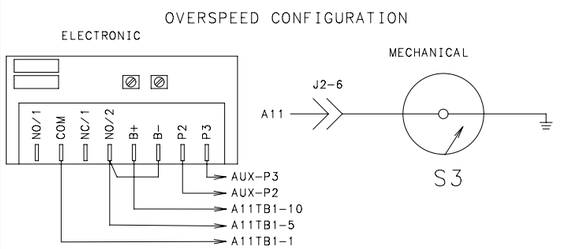


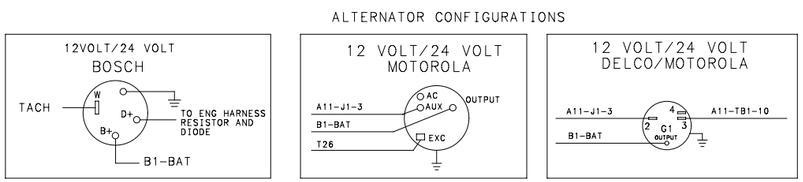
BATTERY CONFIGURATIONS











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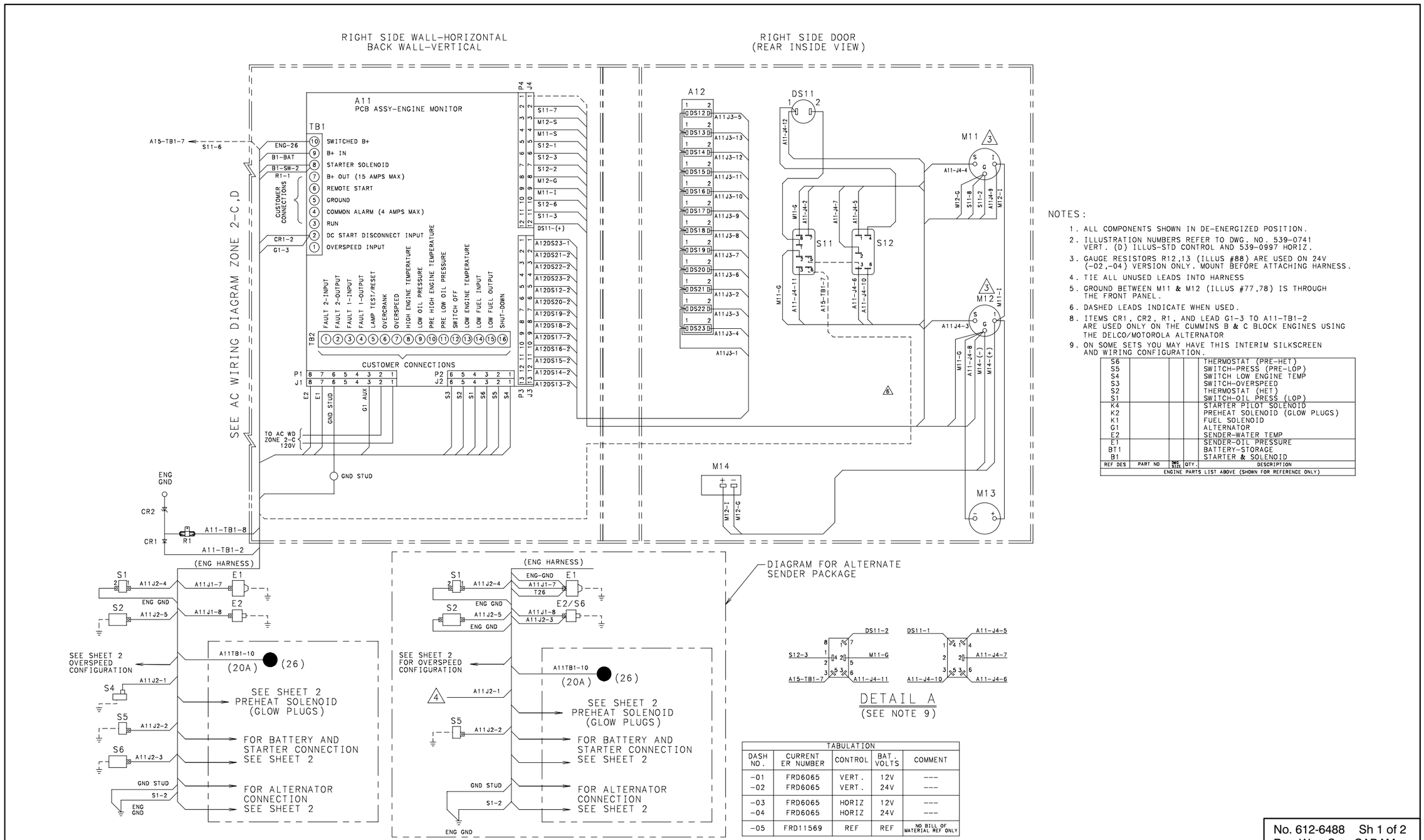
7-LIGHT DC CONTROL WIRING DIAGRAM, SHEET 2



NOTES:

1. ALL COMPONENTS SHOWN IN DE-ENERGIZED POSITION.
2. ILLUSTRATION NUMBERS REFER TO DWG. NO. 539-0741 VERT. (D) ILLUS-STD CONTROL AND 539-0997 HORIZ.
3. GAUGE RESISTORS R12,13 (ILLUS #88) ARE USED ON 24V (-02,-04) VERSION ONLY. MOUNT BEFORE ATTACHING HARNESS.
4. TIE ALL UNUSED LEADS INTO HARNESS
5. GROUND BETWEEN M11 & M12 (ILLUS #77,78) IS THROUGH THE FRONT PANEL.
6. DASHED LEADS INDICATE WHEN USED.
8. ITEMS CR1, CR2, R1, AND LEAD G1-3 TO A11-TB1-2 ARE USED ONLY ON THE CUMMINS B & C BLOCK ENGINES USING THE DELCO/MOTOROLA ALTERNATOR
9. ON SOME SETS YOU MAY HAVE THIS INTERIM SILKSCREEN AND WIRING CONFIGURATION.

REF DES	PART NO	SMS SIZE	QTY.	DESCRIPTION
S6				THERMOSTAT (PRE-HET)
S5				SWITCH-PRESS (PRE-LOP)
S4				SWITCH LOW ENGINE TEMP
S3				SWITCH-OVERSPEED
S2				THERMOSTAT (HET)
S1				SWITCH-OIL PRESS (LOP)
K4				STARTER PILOT SOLENOID
K2				PREHEAT SOLENOID (GLOW PLUGS)
K1				FUEL SOLENOID
G1				ALTERNATOR
E2				SENDER-WATER TEMP
E1				SENDER-OIL PRESSURE
BT1				BATTERY-STORAGE
B1				STARTER & SOLENOID
ENGINE PARTS LIST ABOVE (SHOWN FOR REFERENCE ONLY)				

TABULATION

DASH NO.	CURRENT ER NUMBER	CONTROL	BAT. VOLTS	COMMENT
-01	FRD6065	VERT.	12V	---
-02	FRD6065	VERT.	24V	---
-03	FRD6065	HORIZ	12V	---
-04	FRD6065	HORIZ	24V	---
-05	FRD11569	REF	REF	NO BILL OF MATERIAL REF ONLY

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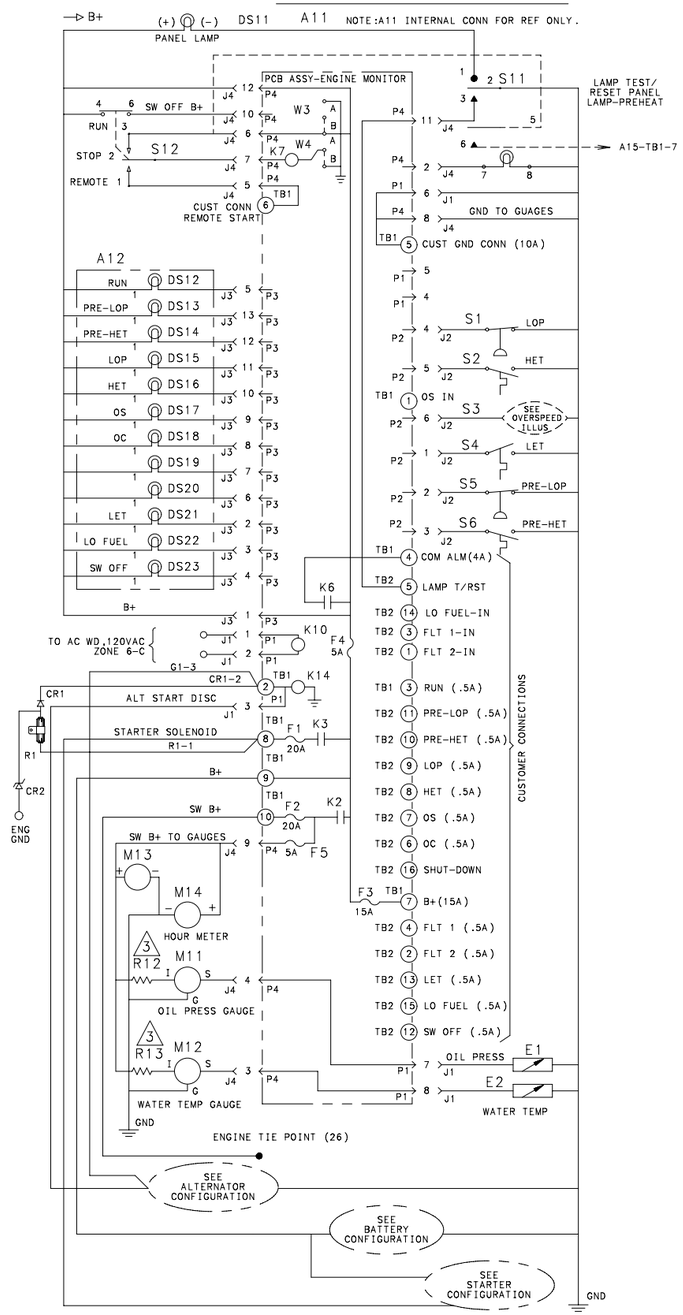
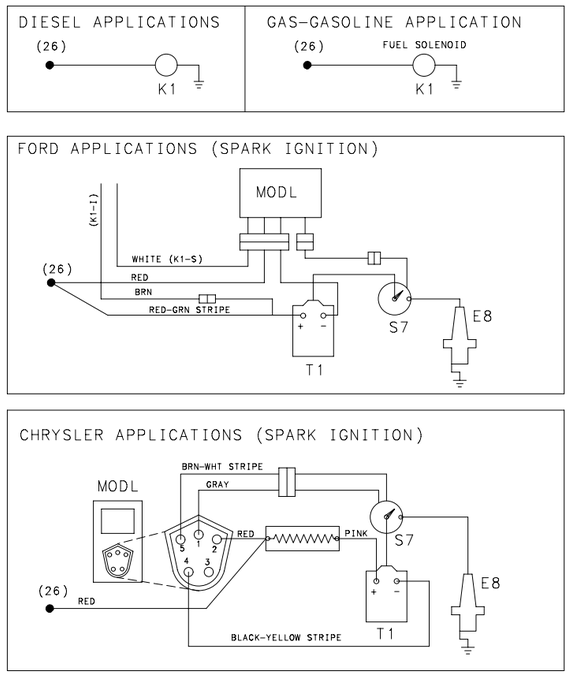
Modified 1/2002

12-LIGHT DC CONTROL WIRING DIAGRAM, SHEET 1

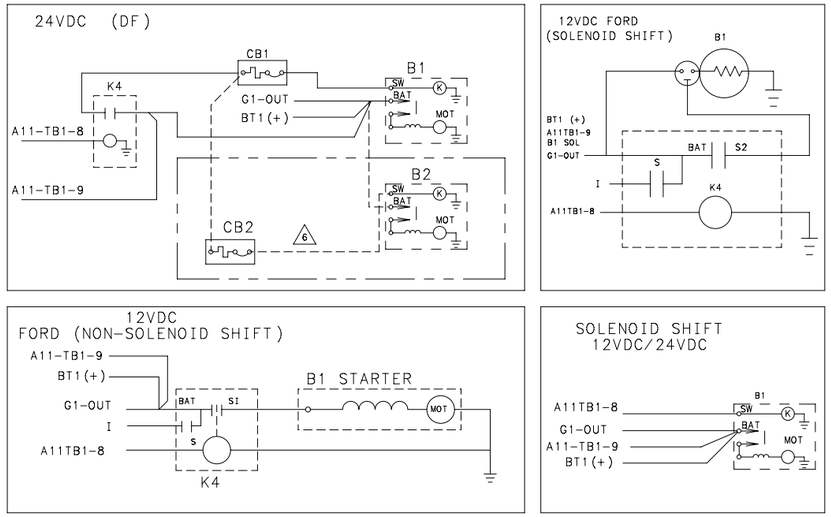
SCHEMATIC DIAGRAM



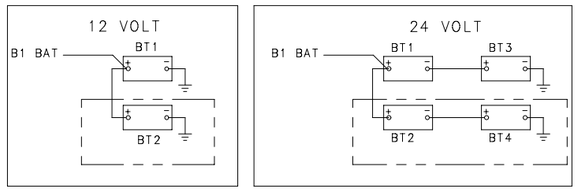
IGNITION SYSTEMS



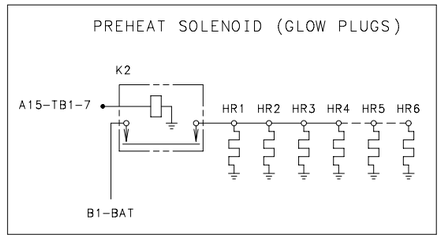
STARTER CONFIGURATIONS



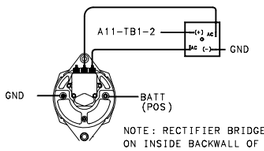
BATTERY CONFIGURATIONS



PREHEAT SOLENOID (GLOW PLUGS)

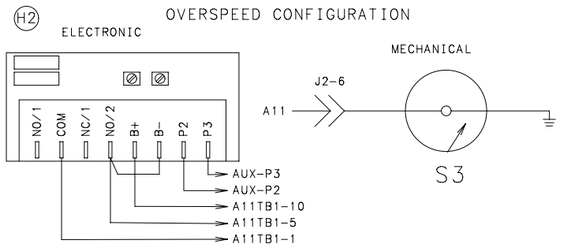


24V., 75 AMP HI-OUTPUT (MOTOROLA)

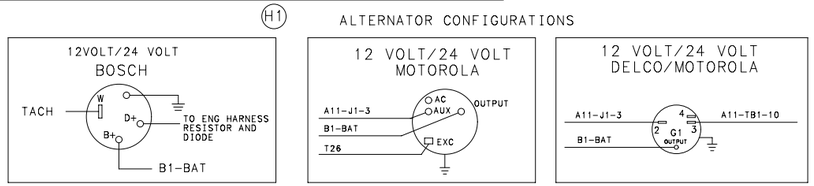


NOTE: RECTIFIER BRIDGE MOUNTED ON INSIDE BACKWALL OF CONTROL BOX BELOW AC VOLTAGE REGULATOR

(H2) OVERSPEED CONFIGURATION



(H1) ALTERNATOR CONFIGURATIONS



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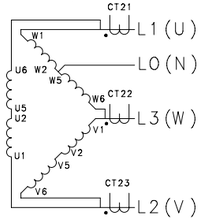
12-LIGHT DC CONTROL WIRING DIAGRAM, SHEET 2

UC GENERATORS

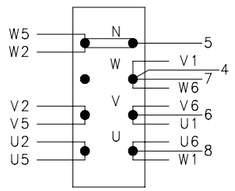
3 PHASE RECONNECTABLE, 12 LEAD

CURRENT TRANSFORMER SECONDARY CONN 1-3

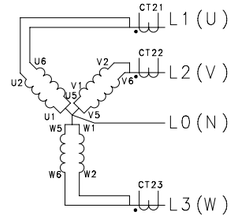
100/200V, 50HZ (R79)
110/220V, 50HZ (R028)
115/230V, 50HZ (R071)
120/240V, 60HZ (R106)
* RANGE *
100-130/200-240 VOLTS



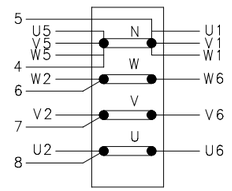
SERIES DELTA
3 PHASE 4 WIRE
OUTPUT TERMINALS
U.V.W.N.



110/190V, 50HZ (R004) 133/230V, 50;60HZ (R057)
115/200V, 50HZ (R050) 139/240V, 60HZ (R067)
120/208V, 50;60HZ (R098)
127/220V, 50;60HZ (R020)
* RANGE *
110-139/190-240 VOLTS

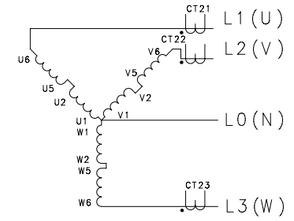


PARALLEL STAR
3 PHASE 4 WIRE
OUTPUT TERMINALS
U.V.W.N.

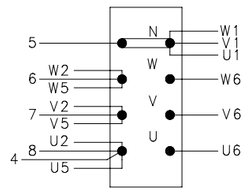


CURRENT TRANSFORMER SECONDARY CONN 1-2

220/380V, 50; 60HZ (R099) 200/346V, 50HZ (R068)
260/450V, 50;60HZ (R109) 230/400V, 50HZ (R029)
240/416V, 50;60HZ (R003) 277/480V, 60 HZ (R002)
255/440V, 50HZ (R023) 266/460V, 60HZ (R027)
* RANGE *
220-277/380-480 VOLTS



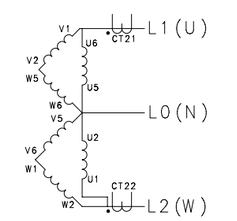
SERIES STAR
3 PHASE 4 WIRE
OUTPUT TERMINALS
U.V.W.N.



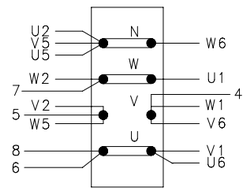
1 PHASE RECONNECTABLE, 12 LEAD

CURRENT TRANSFORMER SECONDARY CONN 1-3

100/200V, 50HZ (R054)
110/220V, 50HZ (R046)
115/230V, 60HZ (R041)
120/240V, 60HZ (R104)
* RANGE *
100-120/200-240 VOLTS



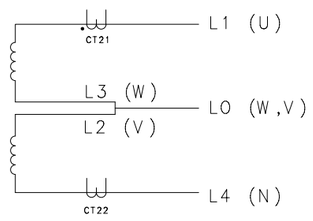
DOUBLE DELTA
1 PHASE 3 WIRE
OUTPUT TERMINALS
U.W. CENTER TAP N.



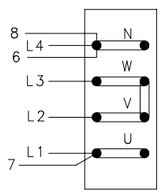
1 PHASE NON-RECONNECTABLE, 4 LEAD

CURRENT TRANSFORMER SECONDARY CONN 1-3

100/200V, 50HZ (R054)
110/220V, 50HZ (R046)
115/230V, 50HZ (R041)
120/240V, 60HZ (R104)
* RANGE *
100-120/200-240 VOLTS

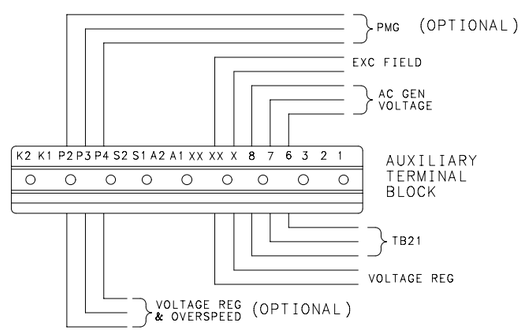


1 PHASE 3 WIRE
OUTPUT TERMINALS
U,N



NOTES:

1. UVW PHASE SEQUENCE WITH C.W. ROTATION FACING DRIVE END.
2. 347/600 VOLTS - IF VOLTAGE REGULATOR SX440 ONAN P/N 300-3607 IS SPECIFIED, CONNECT GENERATOR TAP STATOR LEADS 7 & 8 TO VR21-P2 & VR21-P3 REPECTIVELY. INSULATE AND TIE #6 LEAD BACK.
3. 347/600 VOLTS - IF VOLTAGE REGULATOR ONAN P/N 300-3606 INSULATE AND TIE BACK GENERATOR TAP STATOR LEADS 6,7 & 8.
4. 240/480 VOLTS - IF VOLTAGE REGULATOR SX440 ONAN P/N 300-3607 IS SPECIFIED, CONNECT LEAD FROM W1 (U) AND W2 (N) TO VR21-P2 AND VR21-P3 RESPECTIVELY.



CONTROL INPUT				
CONTROL INPUT TB21	SERIES DELTA	PARALLEL STAR	SERIES STAR	DOUBLE DELTA
22	8	8	8	8
23	7	7	7	7
24	4	4	4	4
25	6	6	6	6
26	5	5	5	5
JUMPER	—	—	—	—

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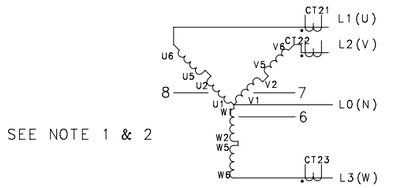
GENERATOR RECONNECTION DIAGRAMS, SHEET 1

UC GENERATORS

3 PHASE RECONNECTABLE

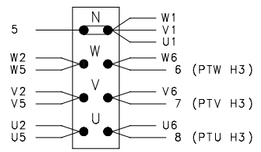
CURRENT TRANSFORMER SECONDARY CONN 1 – 2

347/600V, 60HZ (R114)

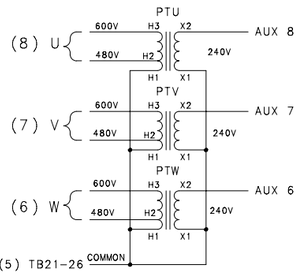


SEE NOTE 1 & 2

SERIES STAR
3 PHASE 4 WIRE
OUTPUT TERMINALS
U.V.W.N.

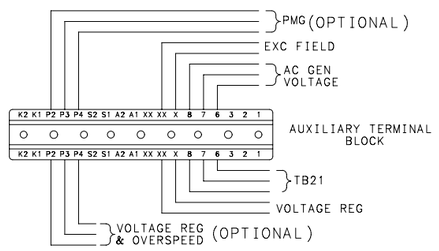


TRANSFORMER

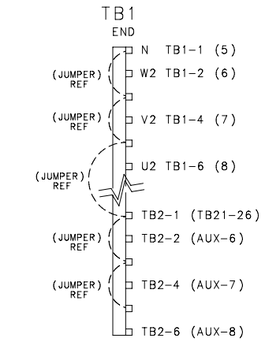


REFERENCE ONLY
P/N 319-1246

NOTE: JUMPER TB21-21 TO TB21-24 IN THE CONTROL



CONTROL INPUT			
6 OR 12 LEAD			
CONTROL INPUT TB21	AUX TERM CON	SERIES STAR 347/600V	SERIES DELTA 240/480V
22	8	8	8
23	7	7	7
24	—	—	—
25	6	6	6
26	—	5	5
JUMPER	—	21 – 24	21 – 24

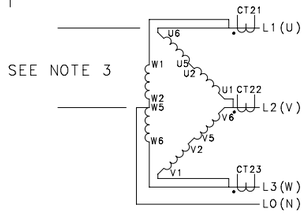


TRANSFORMER CONNECTIONS ASSEMBLY

3 PHASE NON-RECONNECTABLE

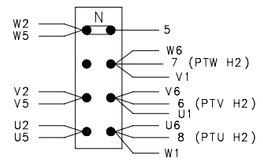
CURRENT TRANSFORMER SECONDARY CONN 1 – 2

220/440V, 50 HZ (R019)
240/480V, 60 HZ (R119)

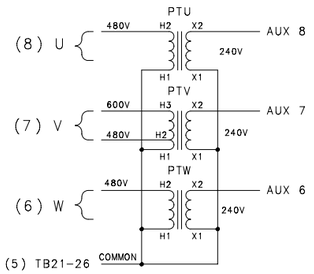


SEE NOTE 3

SERIES DELTA
3 PHASE 4 WIRE
OUTPUT TERMINALS
U.V.W.N.



TRANSFORMER



REFERENCE ONLY
P/N 319-1246

NOTE: JUMPER TB21-21 TO TB21-24 IN THE CONTROL

NOTES:

1. 347/600 VOLTS – IF VOLTAGE REGULATOR SX440 ONAN P/N 300-3607 IS SPECIFIED, CONNECT GENERATOR TAP STATOR LEADS 7 & 8 TO VR21-P2 & VR21-P3 REPECTIVELY. INSULATE AND TIE #6 LEAD BACK.
2. 347/600 VOLTS – IF VOLTAGE REGULATOR ONAN P/N 300-3606 INSULATE AND TIE BACK GENERATOR TAP STATOR LEADS 6,7 & 8.
3. 240/480 VOLTS – IF VOLTAGE REGULATOR SX440 ONAN P/N 300-3607 IS SPECIFIED, CONNECT LEAD FROM W1 (U) AND W2 (N) TO VR21-P2 AND VR21-P3 RESPECTIVELY.

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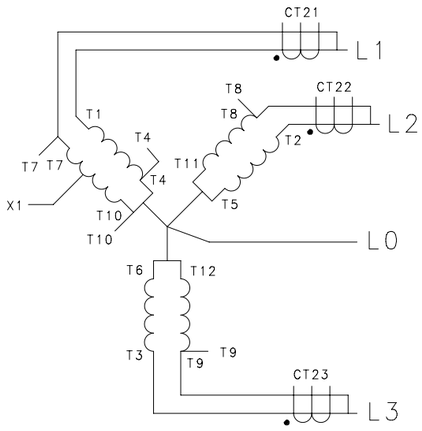
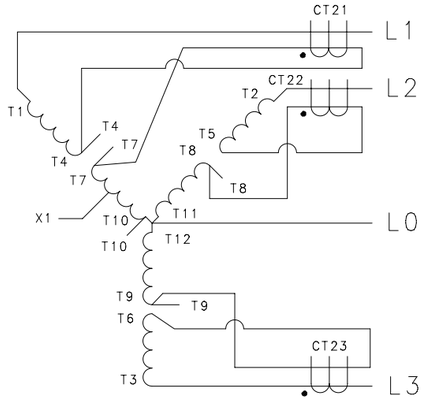
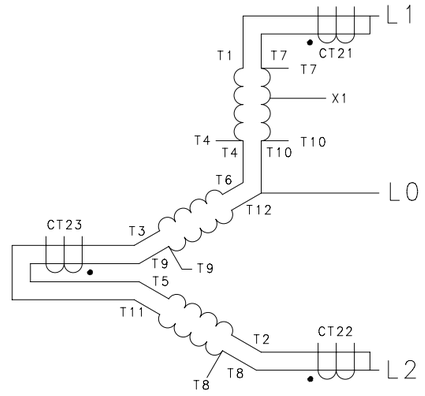
MODEL QS GENERATOR RECONNECTION WITH GENERATOR SWITCH OPTION







CONT INPUT TB21	
22	T7
23	T8
24	T4
25	T9
26	T10

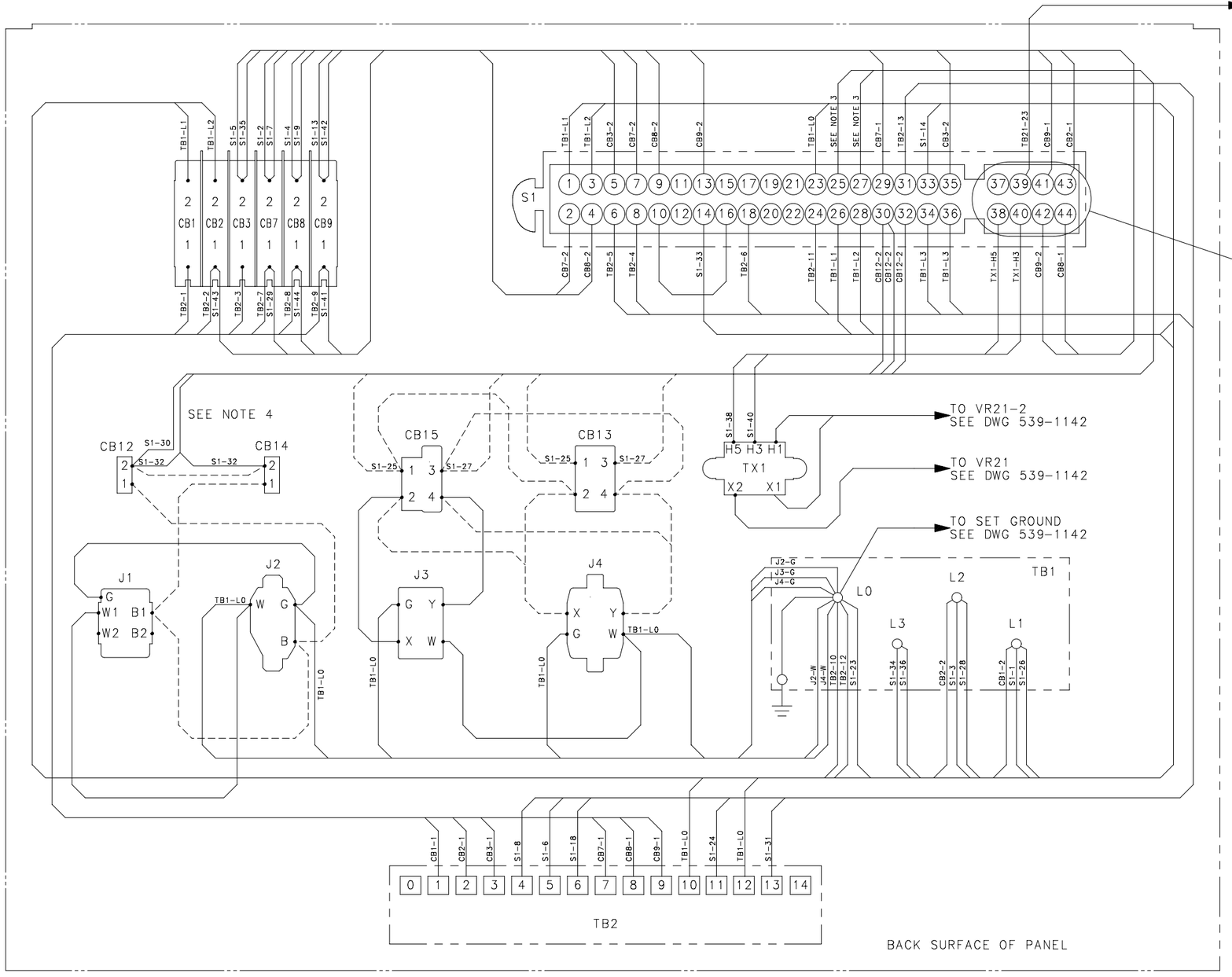
RECONNECT PANEL TB2	TAP
13	X1
12	T12
11	T11
10	T10
9	T9
8	T8
7	T7
6	T6
5	T5
4	T4
3	T3
2	T2
1	T1

NOTES:

1. SECONDARY CURRENT TRANSFORMER CONN 1-3 FOR ALL APPLICATIONS.

No. 625-2256
Rev. B Sys: Revisio
Modified 10/1989

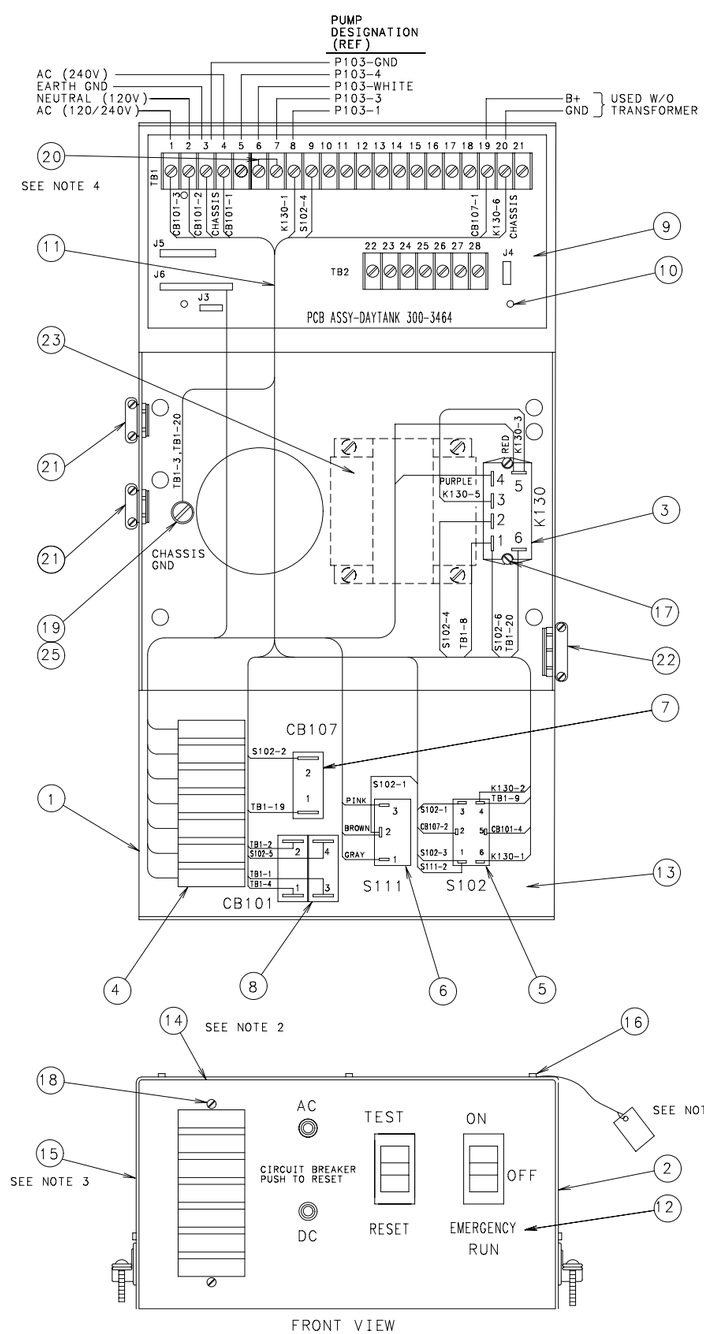
QS-SERIES GENERATOR CONNECTIONS WHEN THE VOLTAGE SELECTOR SWITCH IS PROVIDED



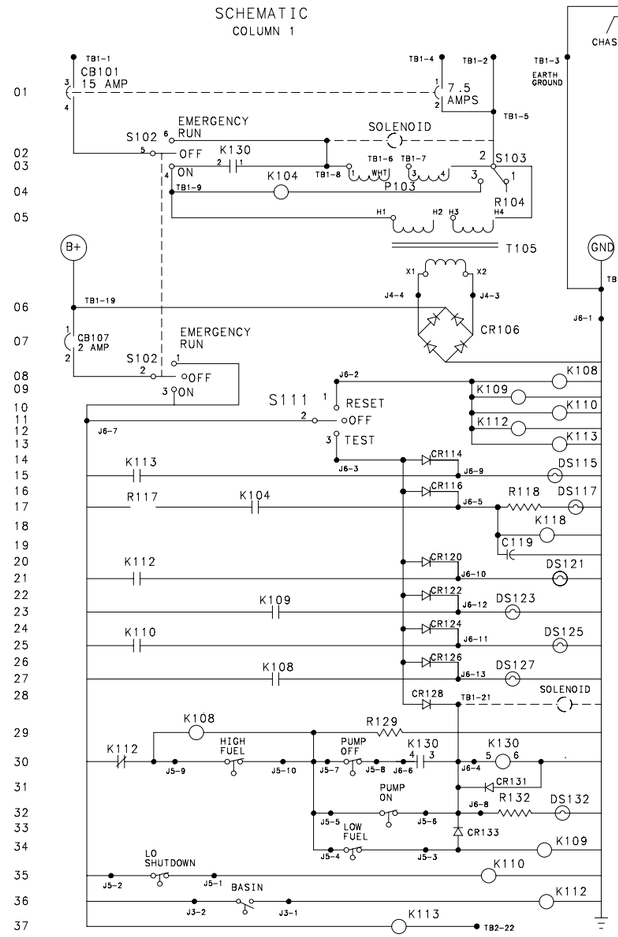
WIRING DIAGRAM NOTES

1. SWITCH (S1) 308-0933 SHOWN. ON 308-0932 TERMINAL NUMBER 1=37, 2=38, 3=39, 4=40, 5=41, 6=42, 7=43, 8=44.
2. DASHED LINES INDICATE LEADS WHERE USED.
3. ON TAB -01, DESTINATION OF S1-25 IS CB15-1, S1-27 IS CB15-3. ON ALL OTHER TABS, DESTINATION OF S1-25 IS CB13-1, S1-27 IS CB13-3.
4. S1-32 CONNECTS TO CB12-2 ON 338-2566-01,-02, AND CB14-2 ON -03, -04,-05.

No. 319-0969
Rev. G Sys: Revisio
Modified



SCHEMATIC
COLUMN 1



CB101-2 POLE AC CIRCUIT BREAKER, 15 AMP, 7.5 AMP

S102-2 POLE SWITCH
P103 - 120/240V PUMP MOTOR

K104 - SYSTEM READY INTERLOCK 17

T105 - 120/240V TRANSFORMER

CR106- RECTIFIER BRIDGE

CB107 - 2 AMP CIRCUIT BREAKER

K108-HIGH FUEL RESET 27, (29),38
K109-LOW FUEL RESET 23,(34),39
K110-LO SHUTDOWN RESET 25,(35),40
S111-SINGLE POLE SWITCH
K112-BASIN FAULT RESET 21,(36),41,30
K113-OPTIONAL FAULT RESET 15 (37),43,44

DS115-OPTIONAL FAULT LAMP

DS117-SYSTEM READY LAMP

K118-SYSTEM READY RELAY 42

DS121-BASIN FAULT LAMP

DS123-LOW FUEL FAULT LAMP

DS125-LO SHUTDOWN FAULT LAMP

DS127-HIGH FUEL FAULT LAMP

K108-HIGH FUEL SET (08), 27, 38

K130-PUMP RELAY 03, 30

DS132-PUMP RUN LAMP

K109-LOW FUEL SET (09), 23,39

K110-LO SHUTDOWN SET (10), 25,40

K112-BASIN FAULT SET (12), 21,41,30

K113-OPTIONAL FAULT SET (3) 15,43,44

NOTES:

1. SCHEMATIC KEY:
   EACH COMPONENT IS LOCATED BY PART NUMBER. ON THE RIGHT HAND SIDE, A DESCRIPTION IS GIVEN OF THE PART AND ITS FUNCTIONAL LOCATIONS.

   K 1 12 - BASIN FAULT RESET 21,41 (36) 30
   - LINE 12 / COLUMN 1 / RELAY
   - WRITTEN DESCRIPTION
   - N/C CONTACTS ON LINE 30
   - RELAY SET COIL ON LINE 36
   - N/O CONTACTS ON LINES 21 AND 41

2. SILKSCREEN ONAN #98-5955 OF CIRCUIT SCHEMATIC LOCATED ON THE INSIDE TOP OF THE COVER.

3. TWO TERMINAL JUMPERS ARE SUPPLIED BETWEEN TERMINALS 6 & 7 WITH THE FACTORY SUPPLIED 240 AC CONNECTION. FOR 120 VAC FIELD OPERATION PLACE ONE JUMPER BETWEEN TERMINALS 5 & 6 AND THE SECOND JUMPER BETWEEN 7 AND 8. CHANGE JUMPERS ON TRANSFORMER IF EQUIPPED. SEE SILKSCREEN ONAN #98-5954 ON THE INSIDE OF THE COVER FOR FULL 120/240 CONVERSION INSTRUCTIONS.

4. PIGGYBACK TERMINALS S111-2, S102-1, AND S102-4 SHOULD BE ASSEMBLED WITH THE INSULATED FASTON TO THE OUTSIDE OF THE SWITH TO PROVIDE THE MAXIMUM AMOUNT OF ELECTRICAL PROTECTION.

5. A TAG SHOULD BE PLACED ON CONTROL INDICATING VOLTAGE THE CONTROL IS WIRED TO.

38	TB1-10 — K108	TB1-11	HIGH FUEL FAULT CONTACTS
39	TB1-12 — K109	TB1-13	LOW FUEL FAULT CONTACTS
40	TB1-14 — K110	TB1-15	LOW SHUTDOWN FAULT CONTACTS
41	TB1-16 — K112	TB1-17	BASIN FAULT CONTACTS
42	TB2-26 — K118	TB2-27	SYSTEM READY CONTACTS
43	TB2-23 — K113	TB2-24	OPTIONAL FAULT CONTACTS
44	K113	TB2-25	

TABULATION		
DASH NO.	ITEM 23	CURRENT ER NO.
-01	---	FRD9012
-02	1	FRD9012

No. 625-2141
Rev. P Sys: Revisio
Modified 6/2001

DAY TANK PUMP CONTROL WIRING

TB1-10 (SWITCHED B + OUTPUT) FUSED AT 20 AMPS, ENERGIZED WHEN THE START SIGNAL IS APPLIED AND DE-ENERGIZED AT SHUTDOWN (NORMAL AND FAULT)

TB1-9 (B + INPUT) BATTERY POSITIVE (+) CONNECTION

TB1-8 (START SOLENOID) FUSED AT 20 AMPS

TB1-7 (B + OUTPUT) OUTPUT TO TIME DELAY START/STOP MODULE A15 (WHEN USED), FUSED AT 15 AMPS, AVAILABLE WHEN THE STARTING BATTERIES ARE CONNECTED

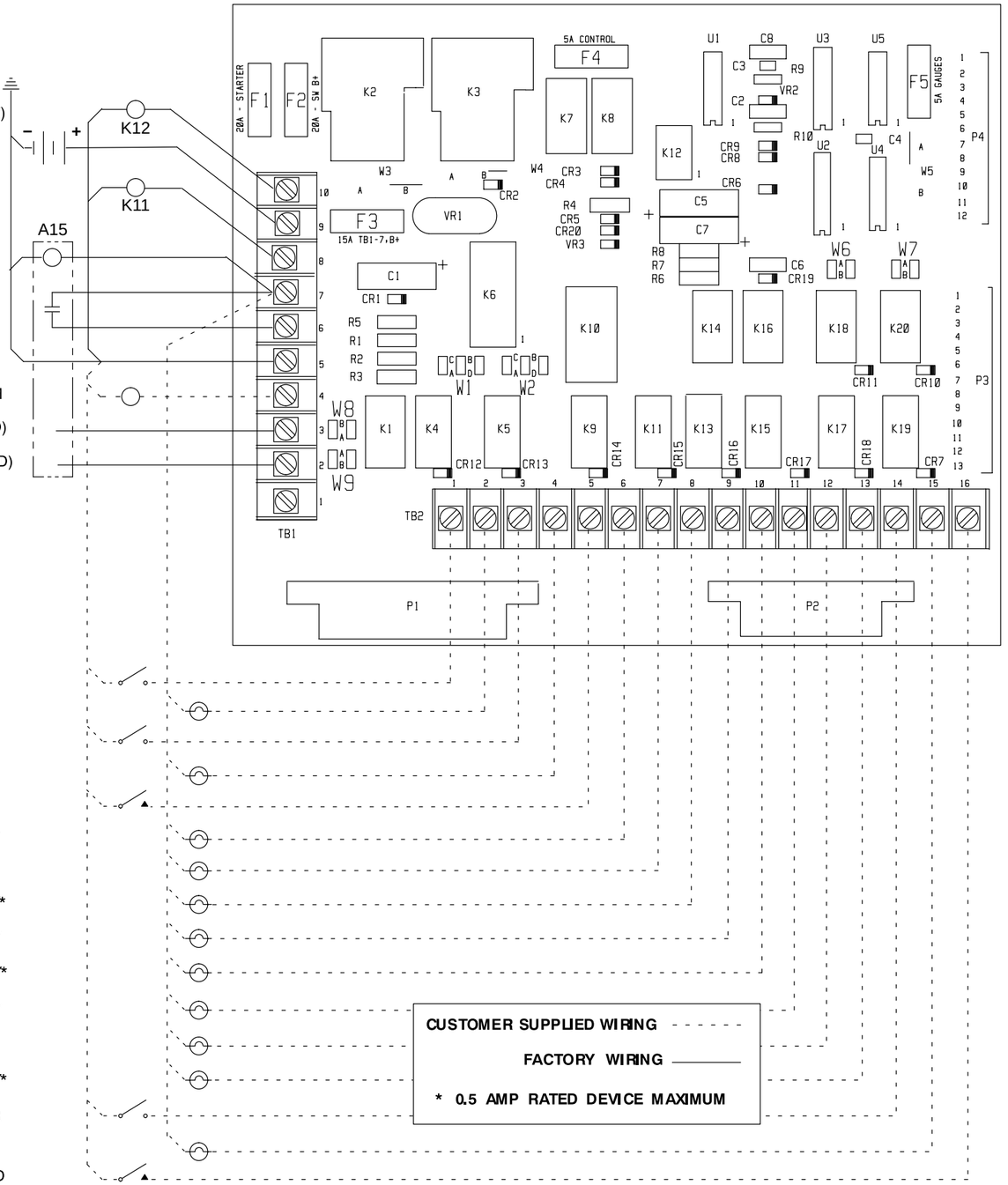
TB1-6 (REMOTE START) CONNECTED TO TIME DELAY START/STOP MODULE A15 (WHEN USED). CONNECT REMOTE START CONTACT OF THE AUTOMATIC TRANSFER SWITCH TO TERMINAL TB1-5 OF MODULE A15 (WHEN USED) OR TB1-6 OF EMB

TB1-5 (GROUND)

TB1-4 (COMMON ALARM B + OUTPUT) 4 AMP RATED DEVICE MAXIMUM

TB1-3 (RUN) CONNECTED TO TIME DELAY START/STOP MODULE A15 (WHEN USED)

TB1-2 (DC DISCONNECT) CONNECTED TO TIME DELAY START/STOP MODULE A15 (WHEN USED)



THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.

TB2-1 (FAULT 2) GROUND INPUT FROM SENDER

TB2-2 (FAULT 2) GROUND OUTPUT TO LIGHT/RELAY*

TB2-3 (FAULT 1) GROUND INPUT FROM SENDER

TB2-4 (FAULT 1) GROUND OUTPUT TO LIGHT/RELAY*

TB2-5 (REMOTE RESET) MOMENTARY CONTACT TO GROUND

TB2-6 (OVERCRANK FAULT) GROUND OUTPUT TO LIGHT/RELAY*

TB2-7 (OVERSPEED FAULT) GROUND OUTPUT TO LIGHT/RELAY*

TB2-8 (HIGH ENGINE TEMPERATURE FAULT) GROUND OUTPUT TO LIGHT/RELAY*

TB2-9 (LOW OIL PRESSURE FAULT) GROUND OUTPUT TO LIGHT/RELAY*

TB2-10 (PRE-HIGH ENGINE TEMPERATURE WARNING) GROUND OUTPUT TO LIGHT/RELAY*

TB2-11 (PRE-LOW OIL PRESSURE WARNING) GROUND OUTPUT TO LIGHT/RELAY*

TB2-12 (SWITCH OFF WARNING) GROUND OUTPUT TO LIGHT/RELAY*

TB2-13 (LOW ENGINE TEMPERATURE WARNING) GROUND OUTPUT TO LIGHT/RELAY*

TB2-14 (LOW FUEL WARNING) GROUND INPUT FROM SENDER

TB2-15 (LOW FUEL WARNING) GROUND OUTPUT TO LIGHT/RELAY*

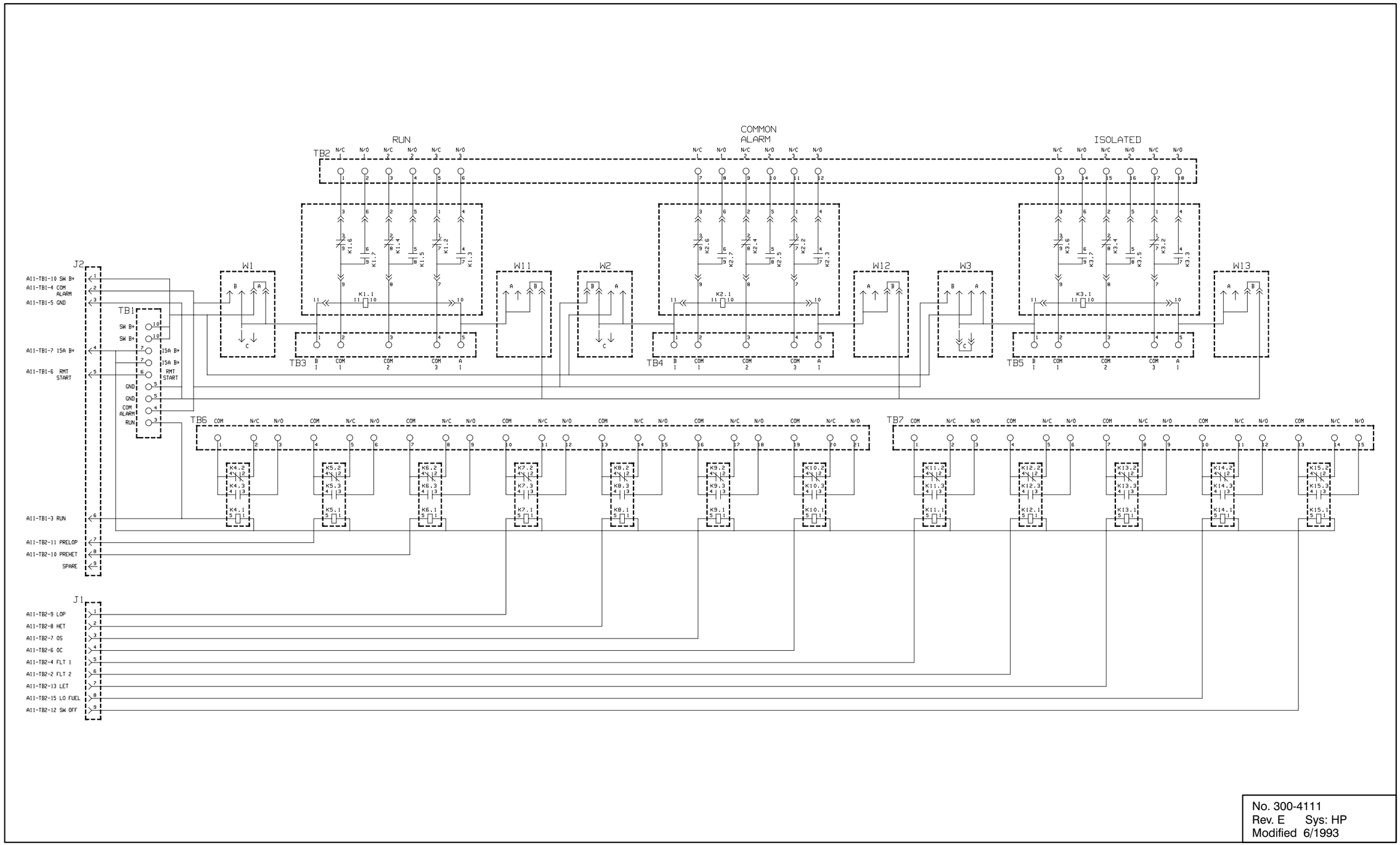
TB2-16 (EMERGENCY SHUT DOWN) MOMENTARY CONTACT TO GROUND

CUSTOMER SUPPLIED WIRING - - - - - -

FACTORY WIRING ———

*** 0.5 AMP RATED DEVICE MAXIMUM**

TYPICAL CUSTOMER CONNECTIONS AT THE ENGINE CONTROL MONITOR (ECM)



AUXILIARY RELAY BOARD (ARB)

Cummins Power Generation
1400 73rd Avenue N.E.
Minneapolis, MN 55432
1-800-888-6626
763-574-5000 International Use
Fax: 763-574-8087

Power Generation

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