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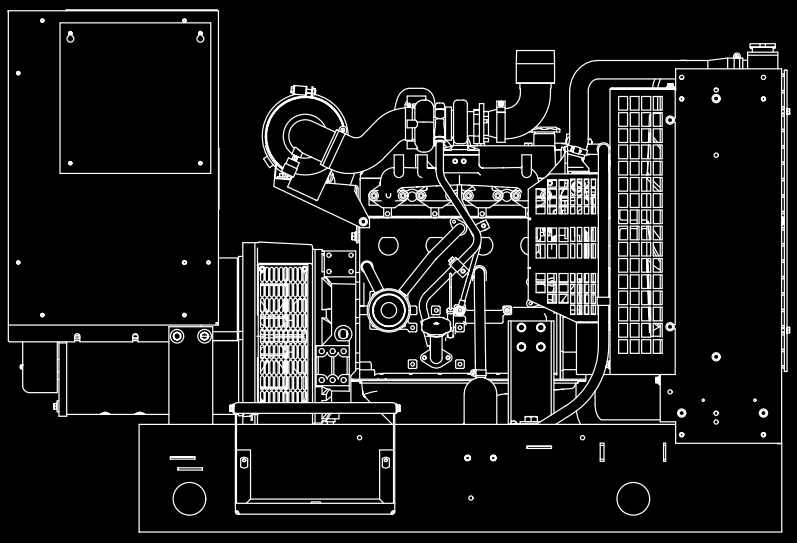
Power Generation

Service Manual

Detector™ Control

Generator Sets



Models

DGGD, DGHD, DGHE

Printed in U.S.A.

960-0517 2-2002

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 Cummins Power Generation 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.

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

ABOUT THIS MANUAL

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

This manual provides troubleshooting and repair information regarding the Detector™ control and generators for the generator set (genset) models listed on the front cover. Engine service instructions are in the applicable engine service manual. Operating and maintenance instructions are in the applicable Operator's Manual.

This manual does not have instructions for servicing printed circuit board assemblies. After determining that a printed circuit board assembly is faulty, replace it. Do not repair it. Attempts to repair a printed circuit board can lead to costly damage to the equipment.

This manual contains basic (generic) wiring diagrams and schematics that are included to help in troubleshooting. Service personnel must use the actual wiring diagram and schematic shipped with each unit. The wiring diagrams and schematics that are maintained with the unit should be updated when modifications are made to the unit.

Read ***Safety Precautions*** and carefully observe all instructions and precautions in this manual.

TEST EQUIPMENT

Most of the tests in this manual can be done with an AC-DC multimeter, frequency meter, Wheatstone bridge (0.001 ohm precision is necessary for measuring stator winding resistance) and load test panel.

HOW TO OBTAIN SERVICE

Always give the complete Model, Specification and Serial number of the generator set as shown on the nameplate when seeking additional service information or replacement parts. The nameplate is located on the side of the generator output box.

⚠WARNING ***Incorrect service or replacement of parts can result in severe personal injury or death, and/or equipment damage. Service personnel must be trained and experienced to perform electrical and mechanical service. Read and follow Safety Precautions, on pages iii and iv.***

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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. Refer to *Section 8* for the AC control wiring diagrams.

AC CONTROL PANEL COMPONENTS

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

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.

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

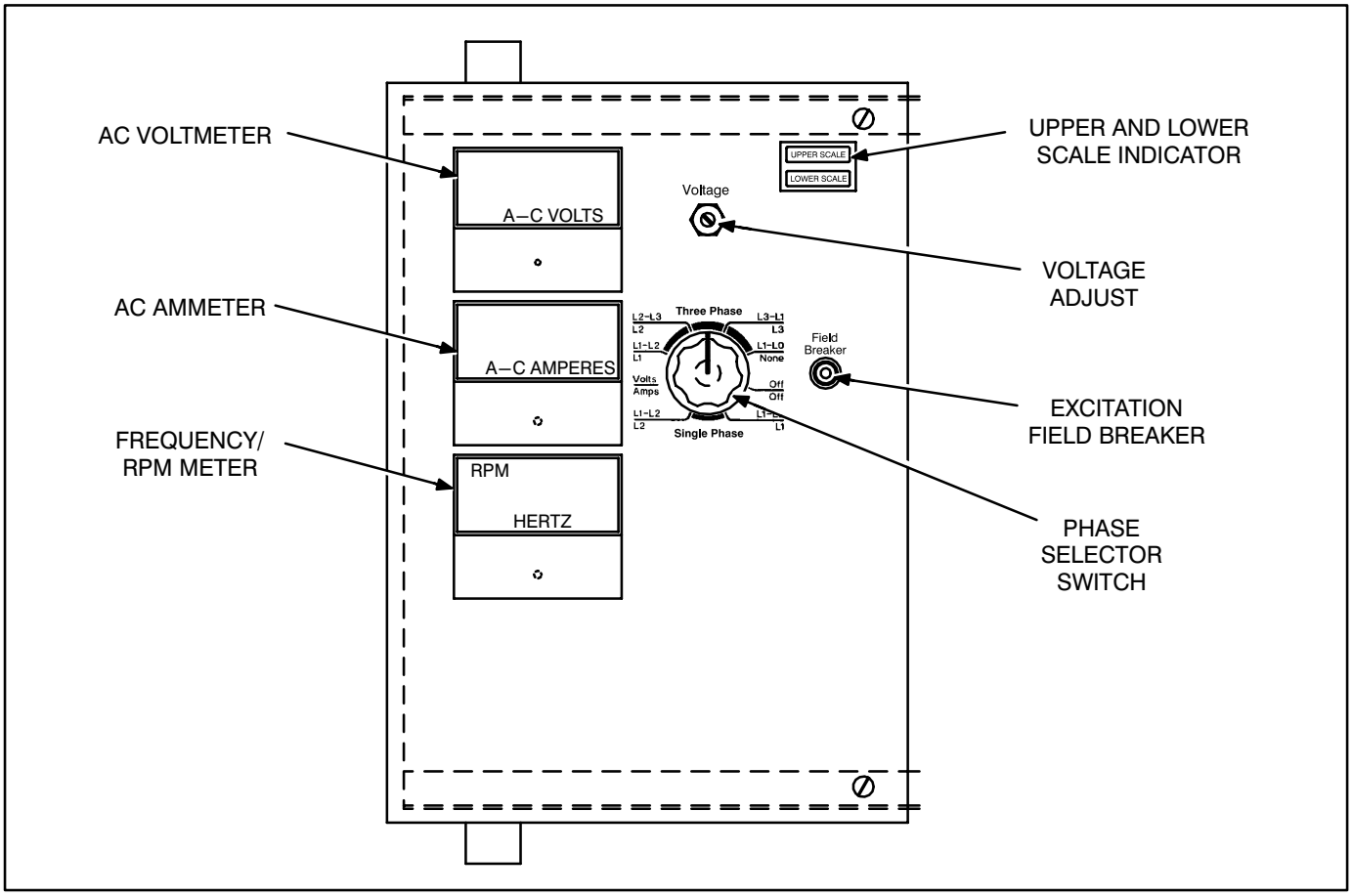


FIGURE 2-1. AC CONTROL PANEL

AUTOMATIC VOLTAGE REGULATOR (AVR) ADJUSTMENTS

The automatic voltage regulator (AVR) is mounted inside of the control cabinet. The location of the AVR is shown in Figure 2-2.

Three AVR's are available – MX321, SX421 and SX460. The AVR's are adjusted by means of the potentiometers (pots) shown in Figures 2-3 and 2-4. Differences in adjustments are noted in the following control descriptions. Figures 2-5 (MX321/SX421) and 2-6 (SX460) 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.

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

Stand on a dry wooden platform or rubber insulating mat, make sure your clothing and shoes are dry, remove jewelry and use tools with insulated handles.

Jumper Reconnections (MX321 and SX421)

Jumpers provide for reconnections to adapt the AVR to the application. See Figure 2-3. With the generator set shut down, reconnect the following jumpers, if necessary, to correspond to the operating characteristics of the generator set.

- **Jumper 1–2–3 or 60-C-50:**

  Jumper 1 – 3 or 60 – C: Selects 60Hz

  Jumper 2 – 3 or 50 – C: Selects 50Hz

- **Jumper A–B–C:**

  Jumper A – C: Selects 90 kW or less

  Jumper B – C: Selects greater than 90 kW but less than 550 kW

  Jumper A – B: Selects greater than 550 kW

Jumper Reconnections (SX460 only)

Jumpers provide for reconnections to adapt the AVR to the application. See Figure 2-4. With the generator set shut down, reconnect the following jumpers, if necessary, to correspond to the operating characteristics of the generator set.

- **Jumper 60–C–50:**

  Jumper 60 – C: Selects 60Hz

  Jumper 50 – C: Selects 50Hz

- **Jumper 1 – 2:**

  Jumper installed – Without output voltage trimmer (R21)

  Jumper removed – With output voltage trimmer (R21)

- **Jumper 3 – 4:**

  Jumper installed – Selects 110/120V sensing voltage input (not used)

  Jumper removed – Selects 240V sensing voltage input (standard)

Voltage and Voltage Stability Adjustments (MX321, SX421 and SX460)

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 (MX321, SX421 and SX460)

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. Determine threshold frequency by lowering generator frequency until the LED lights.

If adjustment is required, pre-set the UFRO by adjusting the generator frequency to 59 Hz for 60 Hz applications and 49 Hz for 50 Hz applications. Turn UFRO pot clockwise until the LED is lit, then counterclockwise until the LED is off. Set UFRO pot by turning the pot slowly clockwise until the LED just lights.

Note that Dip and Dwell adjustments, below, are related.

Dip Adjustments (MX321 and SX421)

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 (MX321 only)

The **DWELL** pot adjusts voltage recovery time 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 (MX321 and SX421)

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 (MX321 and SX421)

The **V** / **Trim** (MX321) or **Trim** (SX421) 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 (MX321 and SX421)

These pots are factory preset and do not require adjustment.

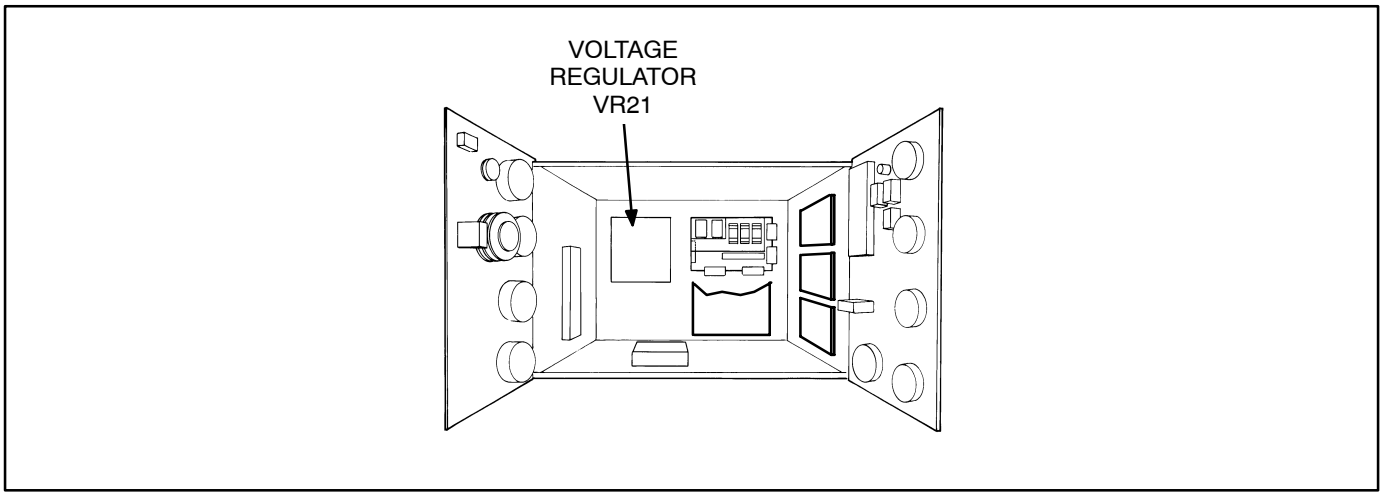
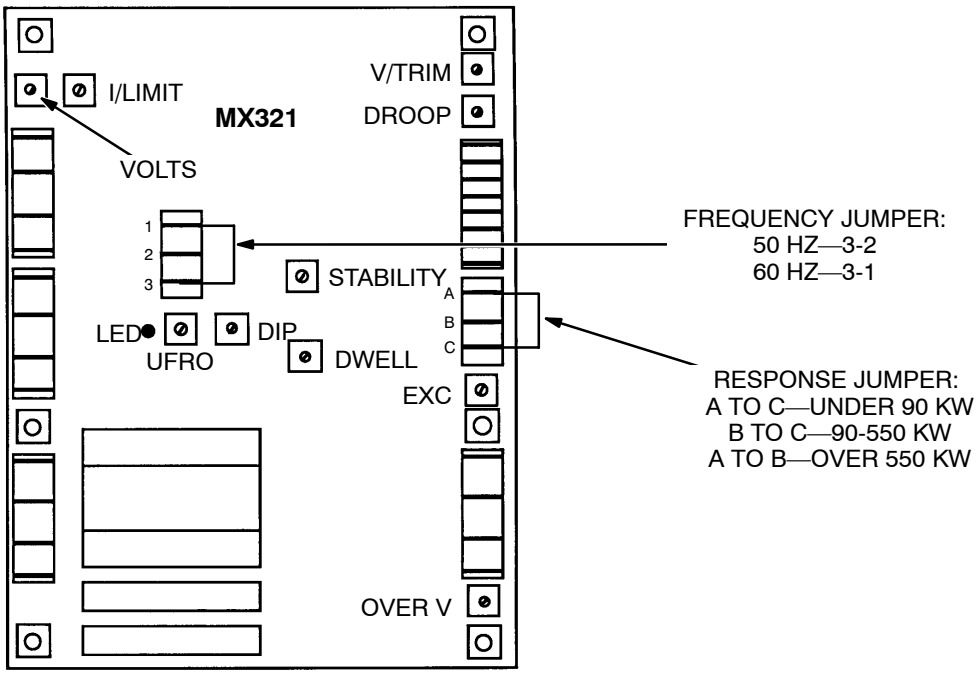


FIGURE 2-2. VOLTAGE REGULATOR LOCATION

PMG-EXCITED GENERATORS
(MX321)



PMG-EXCITED GENERATORS
(SX421)

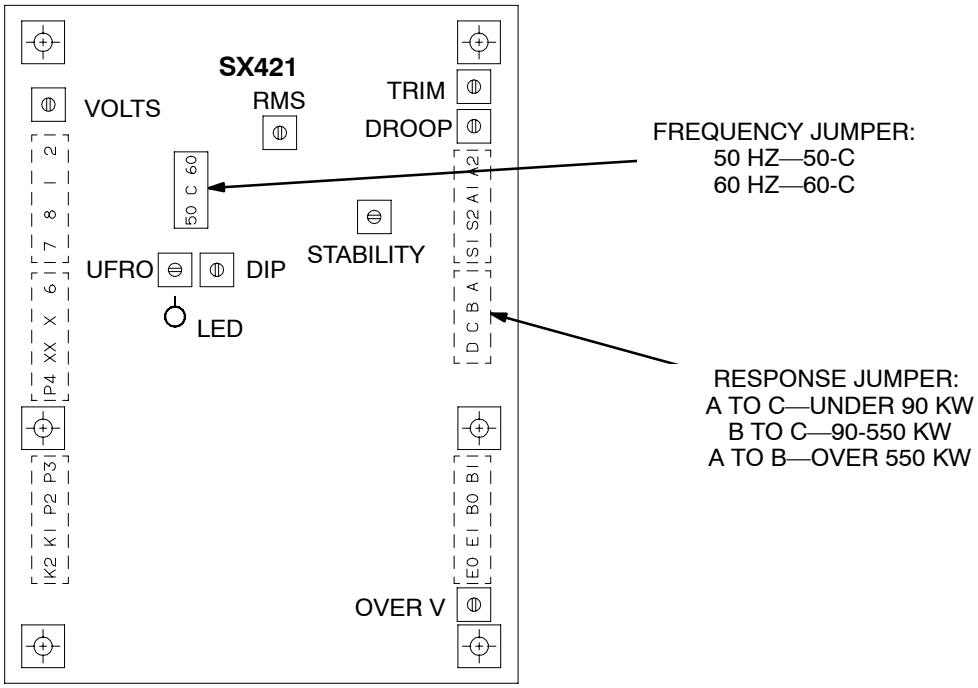


FIGURE 2-3. VOLTAGE REGULATOR ADJUSTMENT POTS AND SELECTION JUMPERS (MX321/SX421)

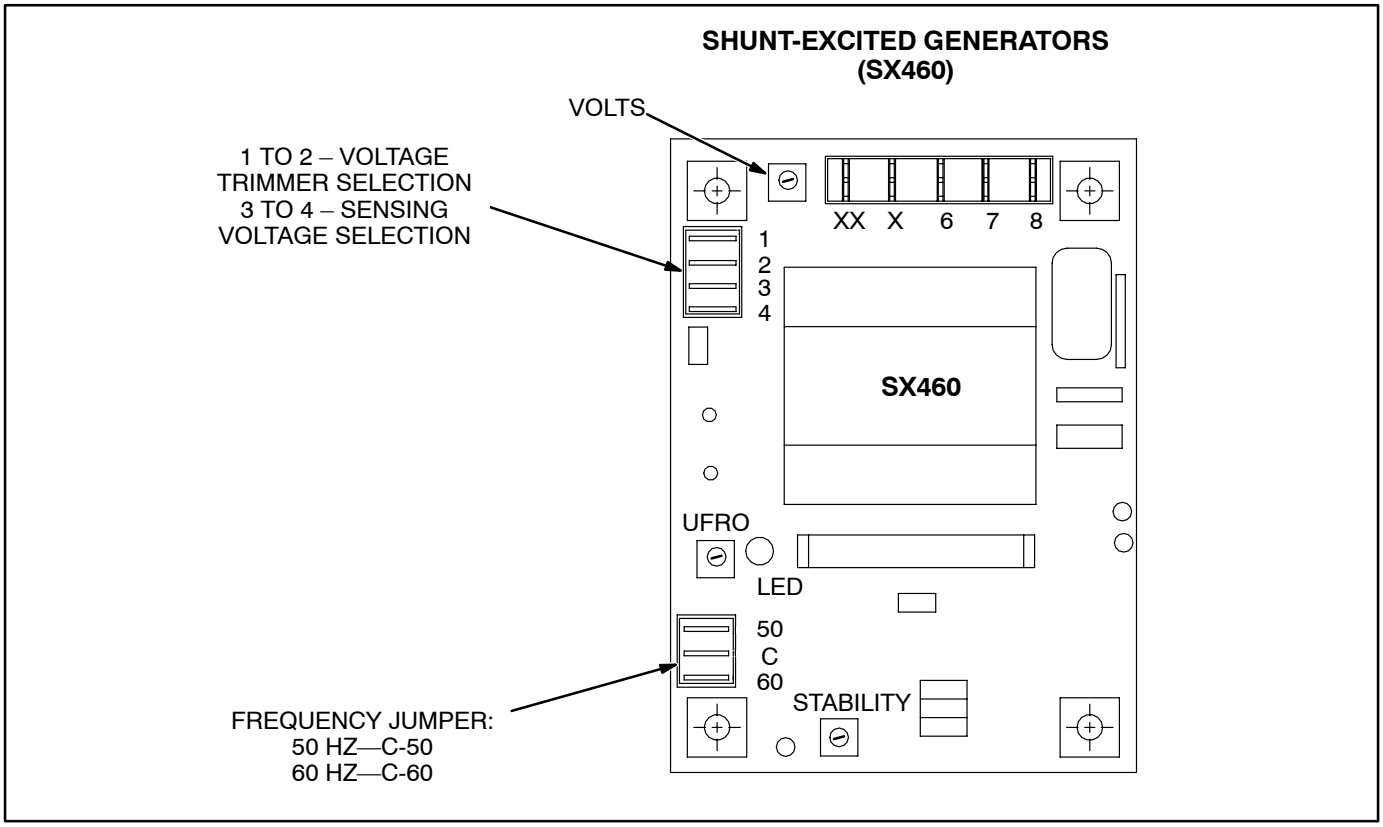
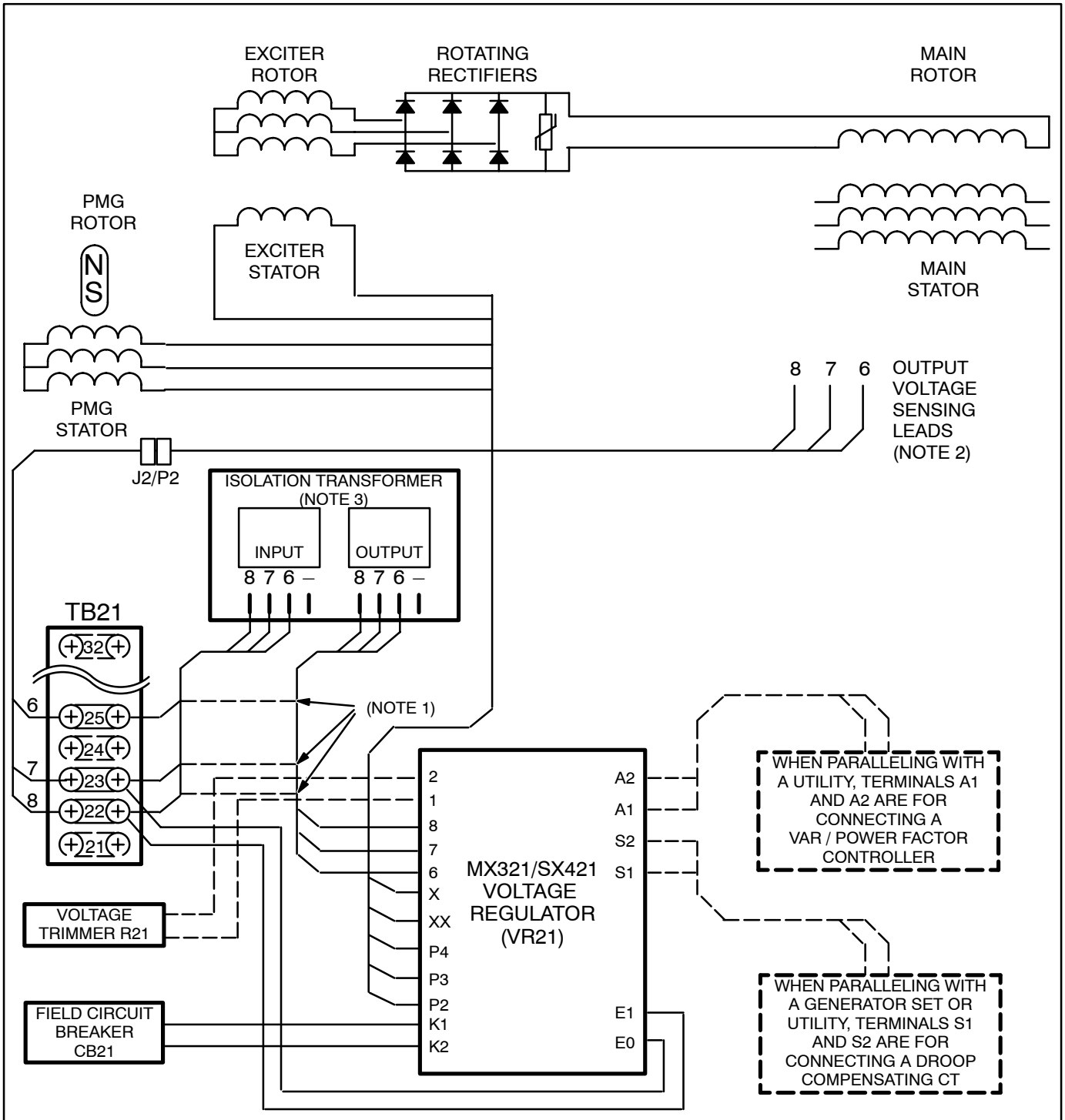


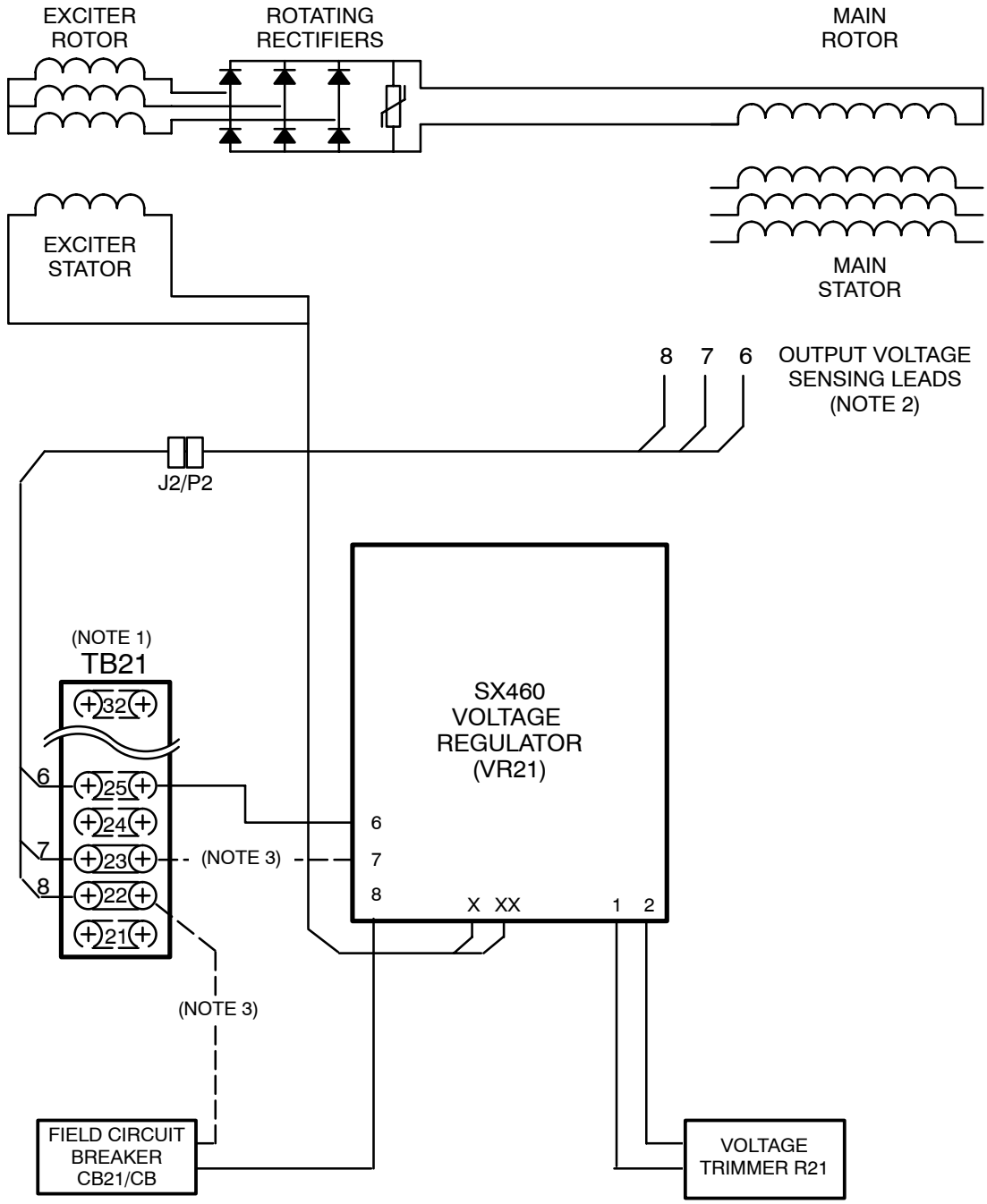
FIGURE 2-4. VOLTAGE REGULATOR ADJUSTMENT POTS AND SELECTION JUMPERS (SX460)



— NOTES —

1. Leads go directly to TB21 when Isolation transformer is not used in 1) 600V applications with AC meters or 2) using SX421 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.

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



— NOTES —

1. Detector Control only.
2. See the appropriate reconnection diagram for connecting sensing leads 6, 7, and 8.
3. 600V Gensets: Generator tap leads 7 and 8 are used in place of these two leads.

FIGURE 2-6. TYPICAL VOLTAGE REGULATING CIRCUITS FOR SHUNT-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. **Shunt-Excited Generators.** Exciter field current is supplied by the generator stator through the voltage regulator. Residual field magnetism initiates “self-excitation” during startups.

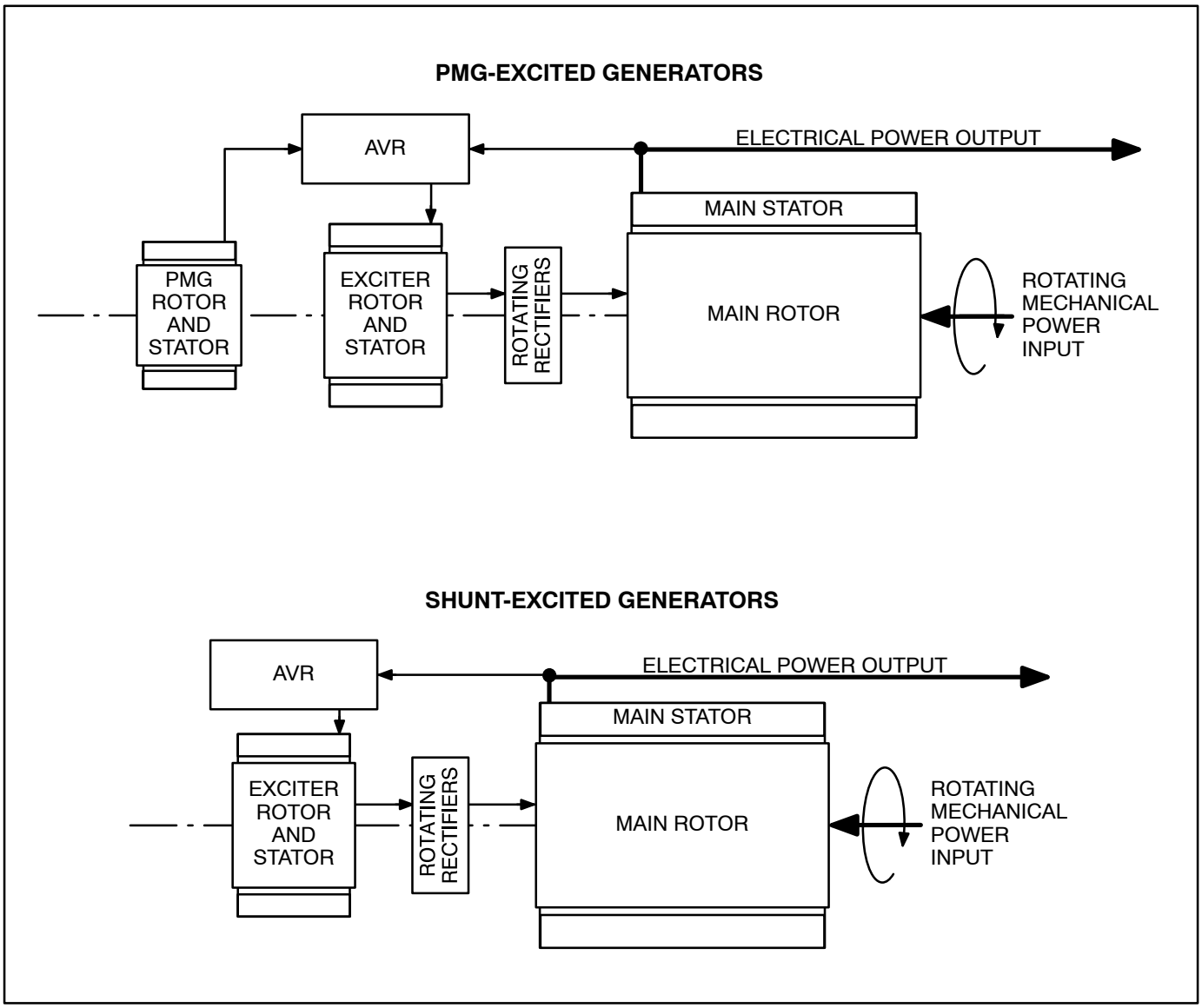


FIGURE 2-7. SCHEMATIC OF GENERATOR OPERATION

3. Engine Control

GENERAL

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

CONTROL PANEL COMPONENTS

Run / Stop / Remote Switch (S12) Starts and stops the set locally, or from a remote location wired to the control engine monitor board.

Reset / Lamp Test / Panel Lamp Switch (S11) Resets the fault circuit only when the Run/Stop/Remote switch is in the Stop position. Tests fault lamps and turns on the control panel lamp.

Oil Pressure Gauge (M11) Indicates pressure of lubricating oil in engine. Normal oil pressure is 40 to 65 psi (276 to 449 kPa) at normal operating temperature.

Coolant Temperature Gauge (M12) The coolant temperature gauge indicates engine coolant temperature. Engine coolant temperature is typically between 165° to 195° F(74° to 91° C).

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.

Emergency Stop Button (S14) (Optional) Push-in switch for emergency shutdown of the engine. To reset, pull switch out and move Run/Stop/Remote switch to Stop position. Then push test switch to Reset/Lamp Test position.

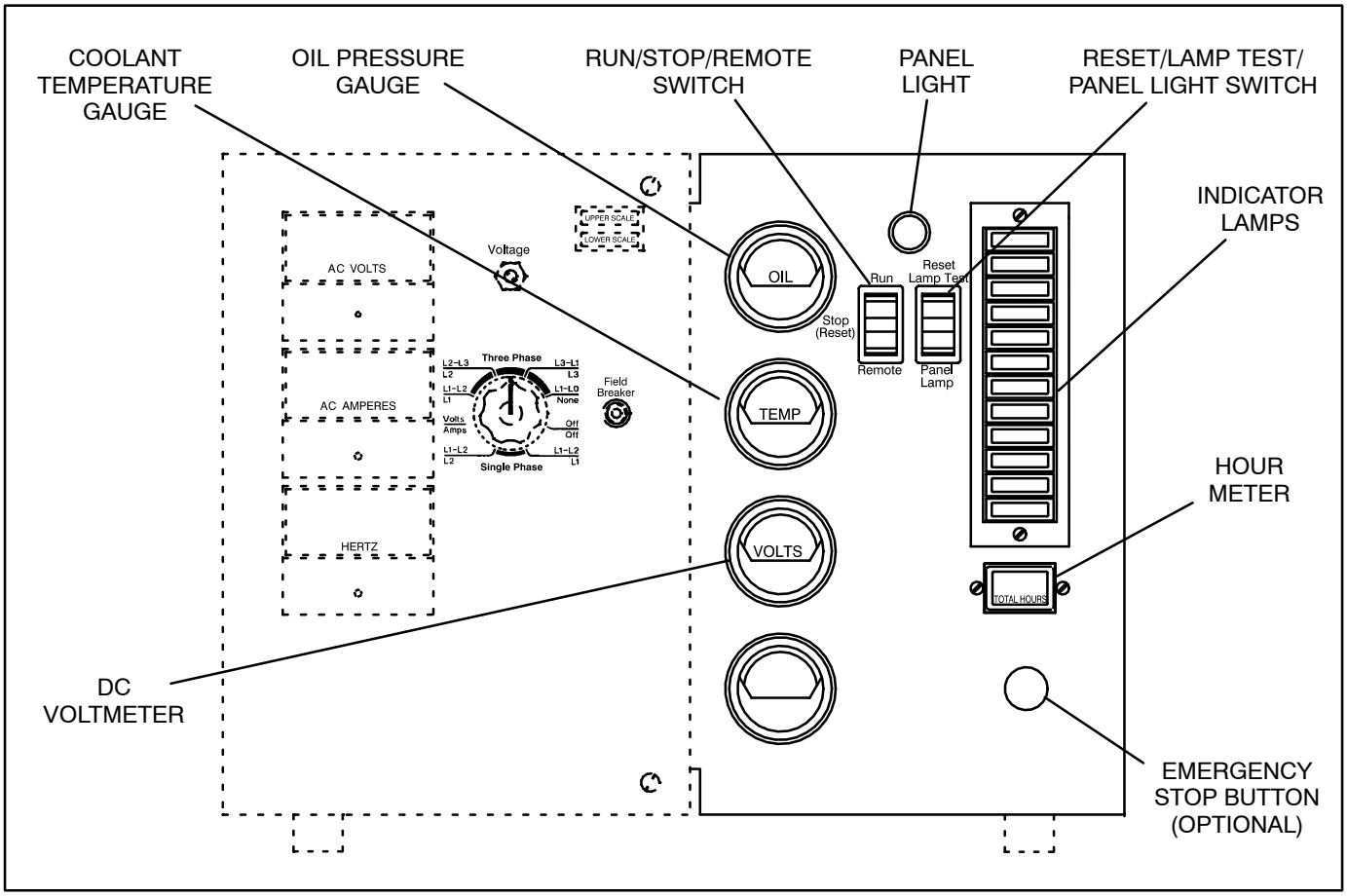


FIGURE 3-1. ENGINE CONTROL PANEL

Fault and Status Indicator Lamps (A12)

- **Run (Green)** Indicates that the starter has disconnected and that the set is running.
- **Pre Low Oil Pressure (Yellow)** Indicates that engine oil pressure is abnormally low (less than 20 psi [138 kPa]).
- **Pre High Engine Temperature (Yellow)** Indicates that engine coolant temperature is abnormally high (greater than 220° F [104° C]).
- **Low Oil Pressure (Red)** Indicates that the engine shut down because of excessively low engine oil pressure (less than 14 psi [97 kPa]).
- **High Engine Temperature (Red)** Indicates that the engine shut down because of excessively high engine coolant temperature (greater than 230° F [110° C]).
- **Overspeed (Red)** Indicates that the engine shut down because of overspeed. The overspeed shut down range for 50/60 Hz is 2250 ±30 RPM
- **Overcrank (Red)** Indicates that the engine shut down because it did not start during the timed cranking period (approximately 75 seconds, including two rest periods).
- **Fault 1 (Red)** 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.
- **Fault 2 (Red)** 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.
- **Low Engine Temperature (Yellow)** Indicates that engine temperature is less than 70° F (21° C) and the possibility that the engine might not start.
- **Low Fuel (Yellow) (Optional)** Indicates fuel supply is marginally low.
- **Switch-off (Flashing Red)** Indicates that the **Run**/**Stop**/**Remote** switch is in the **Stop** position, which prevents remote, automatic operation.

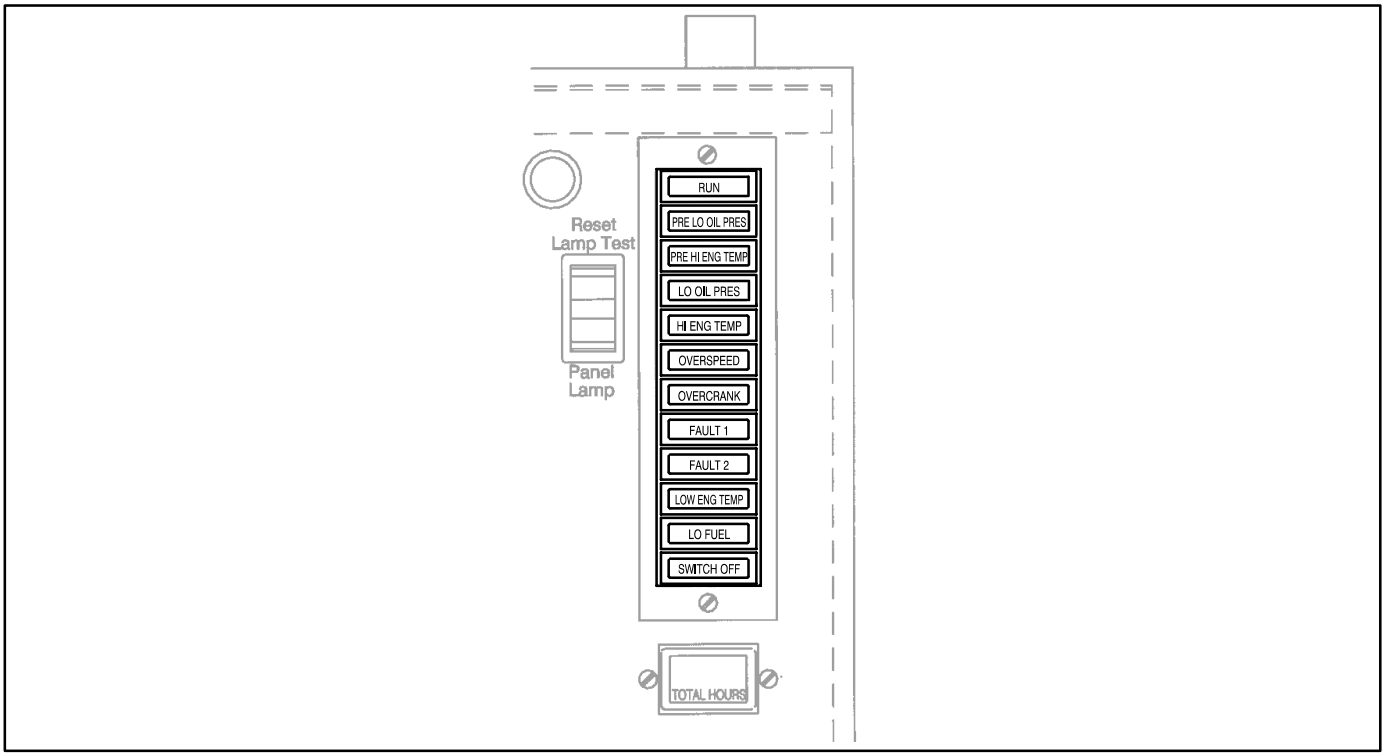


FIGURE 3-2. INDICATOR LAMPS

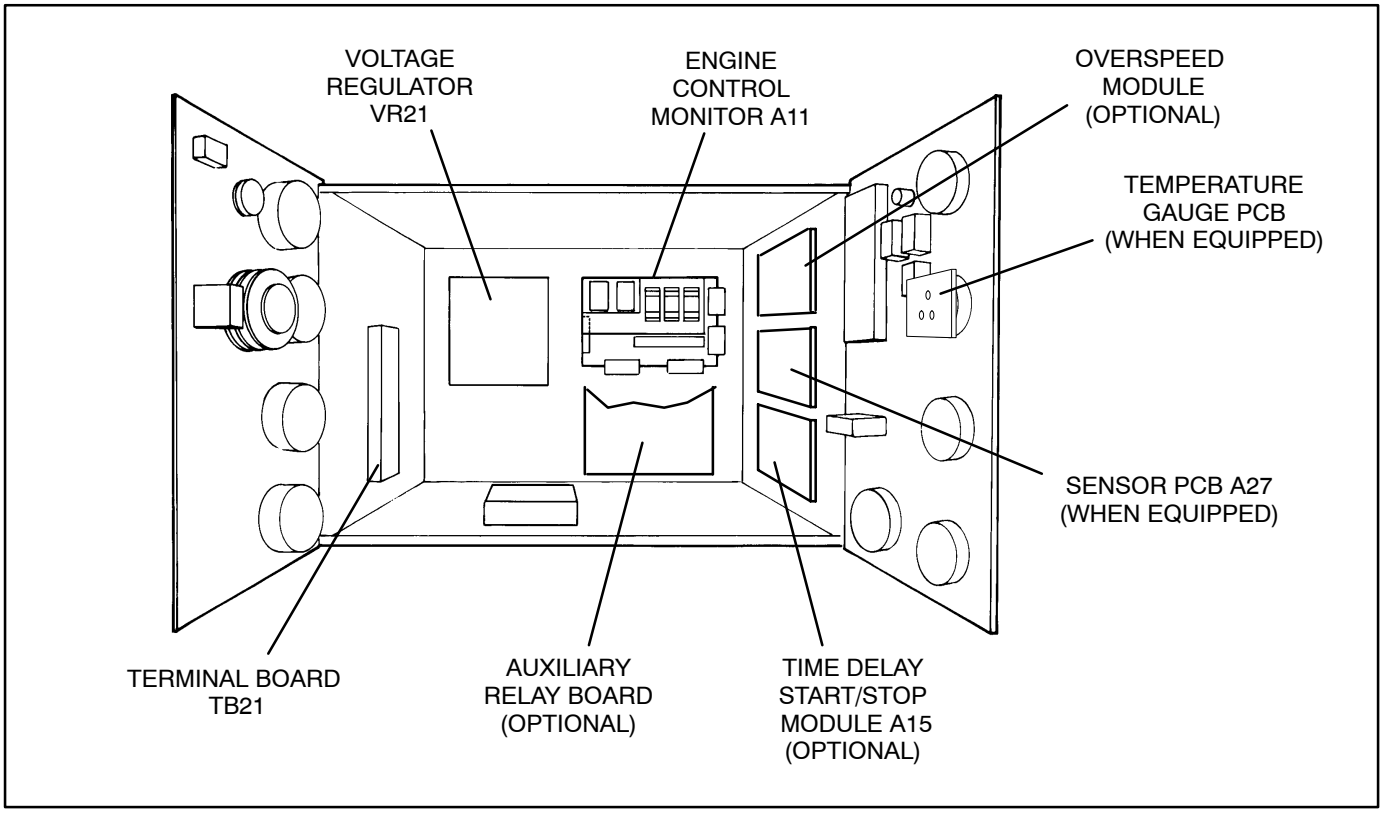


FIGURE 3-3. ARRANGEMENT OF COMPONENTS INSIDE THE CONTROL BOX

CONTROL BOX INTERIOR

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

ENGINE CONTROL MONITOR (A11)

The heart of the engine control system is the engine control monitor (ECM) (Figure 3-4). 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.

Note that there are two versions of the ECM board and that they both perform the same functions. They only differ in that one version contains additional components, which are, LED's (**DS1 – DS9**), terminal board (**TB3**) and function selection jumper **W10**. Figure 3-4 illustrates the ECM version which contains the additional components.

LED's DS1 through DS9

The ECM LED's are provided as an aid in troubleshooting the control circuitry. The LED's indicate the following conditions:

LED	STATUS WHEN ILLUMINATED
DS1	B+ is connected to ECM and fuse F4 is good.
DS2	RUN relay is energized.
DS3	Start Command signal enabled.
DS4	Crank signal enabled.
DS5	DC Starter Disconnect signal enabled.
DS6	AC Starter Disconnect signal enabled.
DS7	LOP/HET signal active (time delay circuit has timed-out).
DS8	Reverse battery voltage.
DS9	Remote Shutdown signal active (ground at TB2-16)

Terminals and Connectors

See Pages 8-8 and 8-9 for the appropriate connection and schematic drawings for the DC control system. See Page 8-10 for typical customer connections at terminal boards **TB1** and **TB2** on the ECM and page 8-11 if the set is also equipped with the auxiliary relay board.

Terminal board **TB3** provides an alternative direct connection to the ECM for the RUN/STOP/REMOTE switch for troubleshooting or if desired, customer connection.
TB3-1 = REMOTE
TB3-2 = RUN
TB3-3 = STOP

Fuses

The ECM has five replaceable fuses to protect it from overloads and ground faults. 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

ECM board has seven selection jumpers that can be repositioned to provide the following timed or non-timed warnings or timed or non-timed shutdowns with warnings, and control of the SWITCH OFF indicator:

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

- **A** Non-timed warning under **FLT 2** conditions.
- **B** Non-timed shutdown under **FLT 2** conditions.
- **C** Timed warning under **FLT 2** conditions.
- **D** Timed shutdown 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 under **FLT 1** conditions.
- **C** Timed warning under **FLT 1** conditions.
- **D** Timed shutdown under **FLT 1** conditions.

W6 Jumper Position:

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

W7 Jumper Position:

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

W10 Jumper Position (**SWITCH OFF** Indicator):

- **A** Flashing
- **B** Constant ON
- **C** OFF

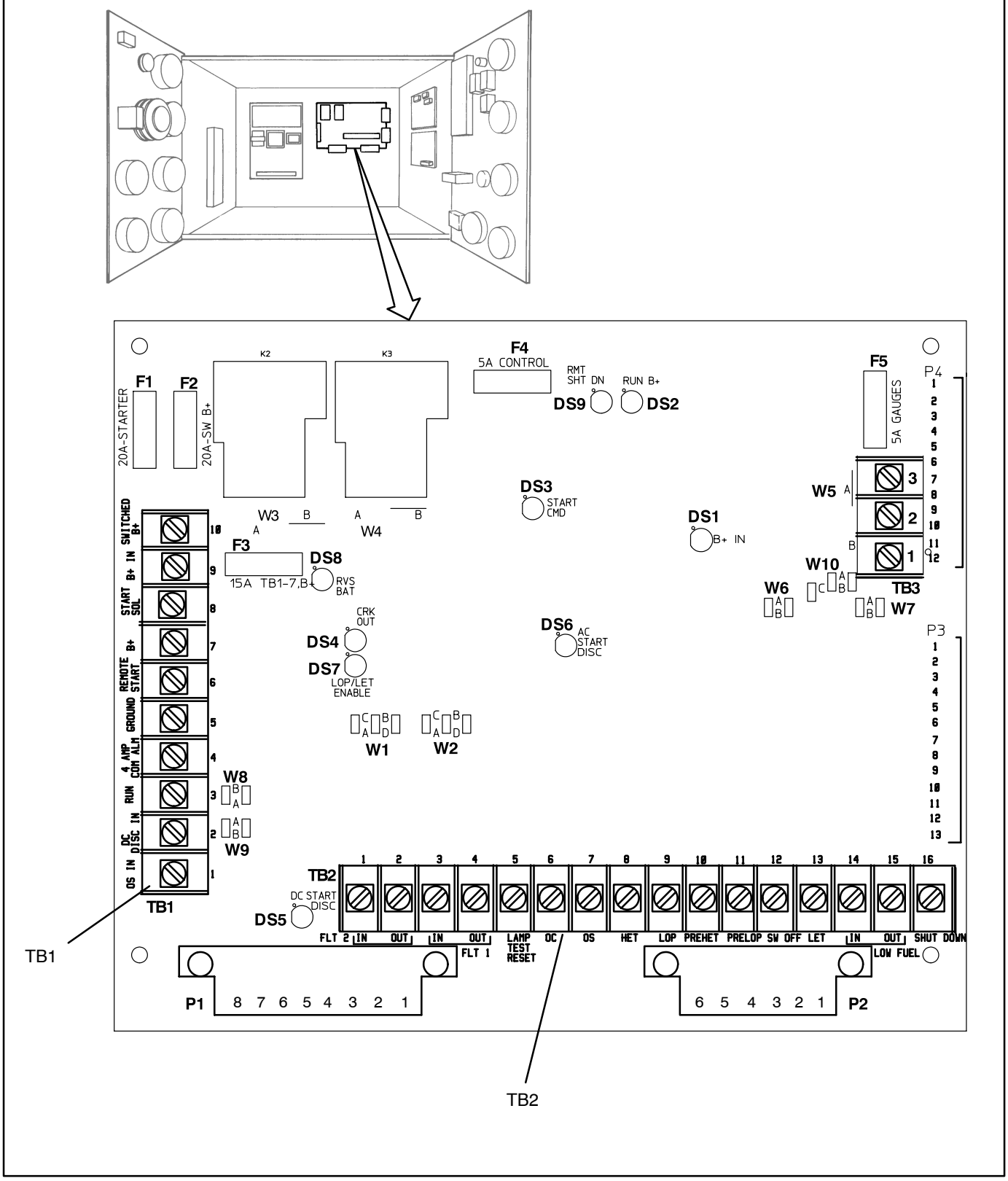


FIGURE 3-4. ENGINE CONTROL MONITOR FUSES AND FUNCTION SELECTION JUMPERS

ENGINE SENSORS

Figures 3-5 shows 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 [-]).

Always use pipe thread sealant on gauge senders and warning and shutdown switches.

⚠ CAUTION ***Teflon tape is not recommended for switches and senders that are grounded to the engine by thread contact as it may interfere with the ground path.***

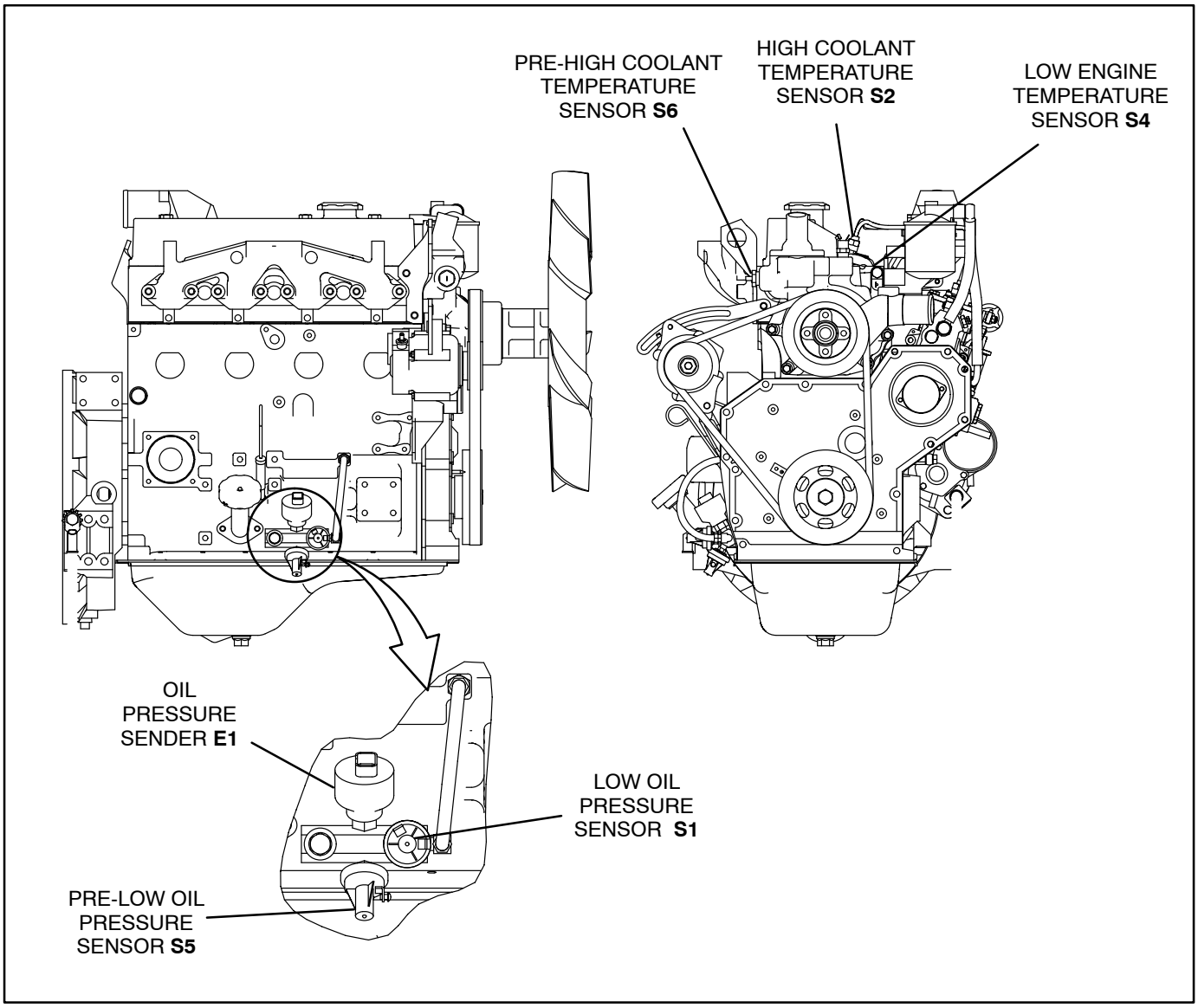


FIGURE 3-5. 3.3L ENGINE SENSOR LOCATIONS

Low Coolant Level Cutout Switch

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.

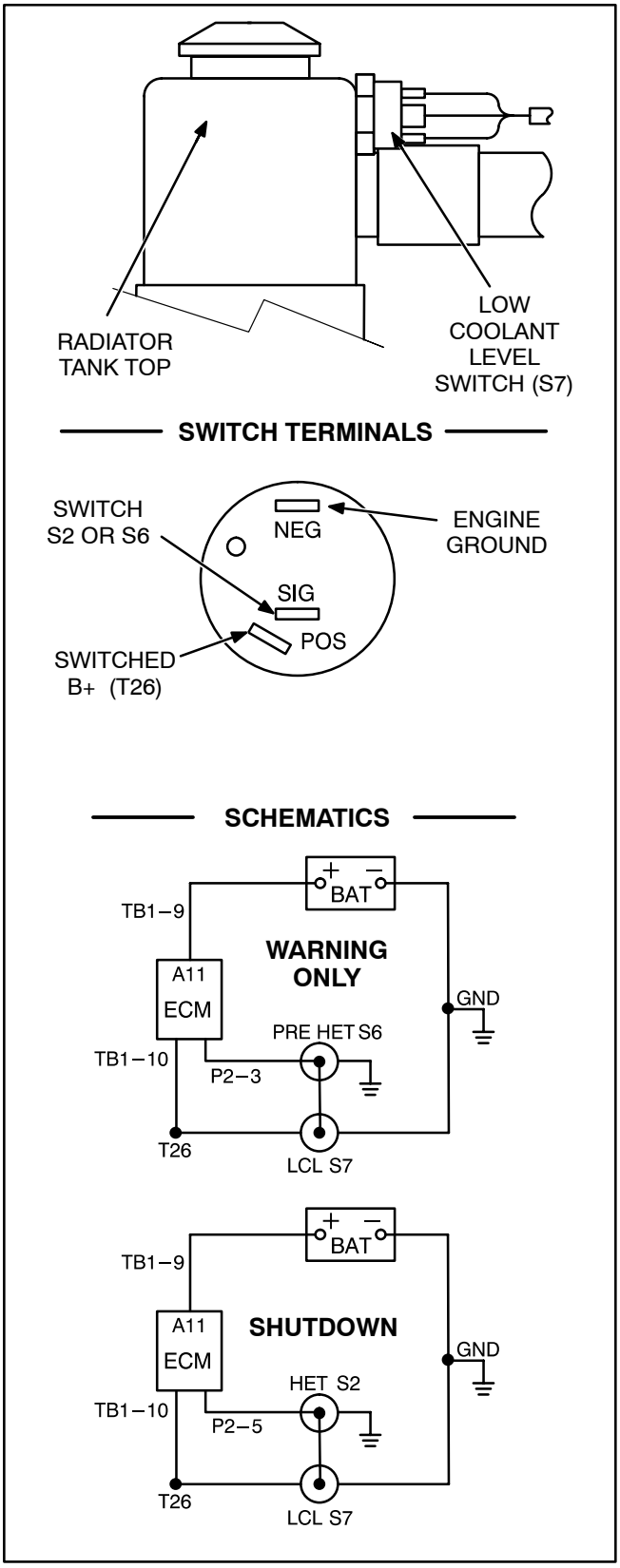


FIGURE 3-6. LOW COOLANT LEVEL SWITCH

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.

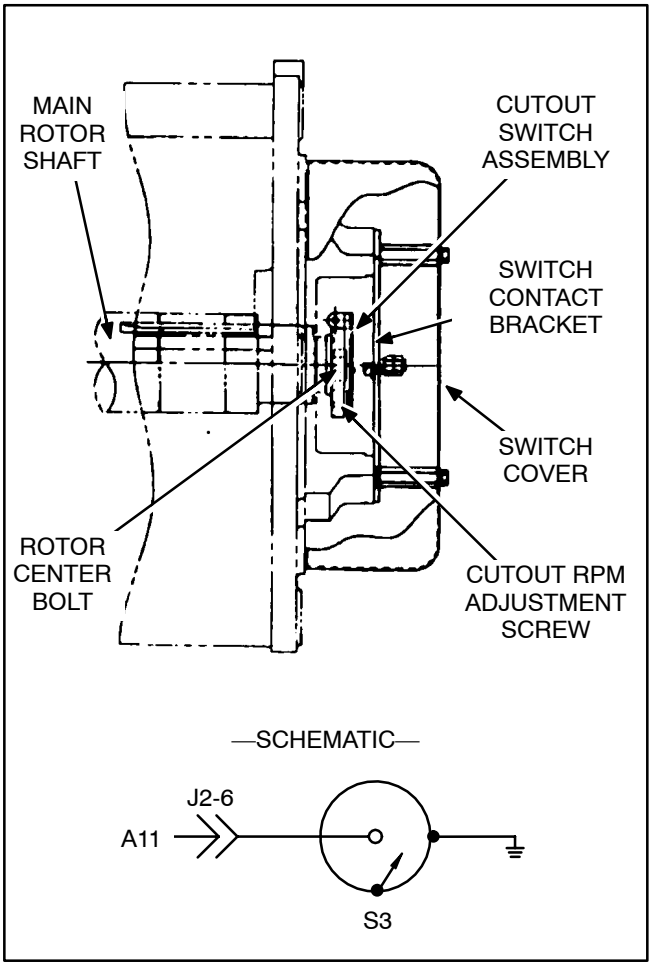


FIGURE 3-7. MECHANICAL OVERSPEED SWITCH

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 (HIGH) to cut out at 1800 to 1900 RPM for 50 Hz sets and 2100 to 2200 RPM for 60 Hz sets.

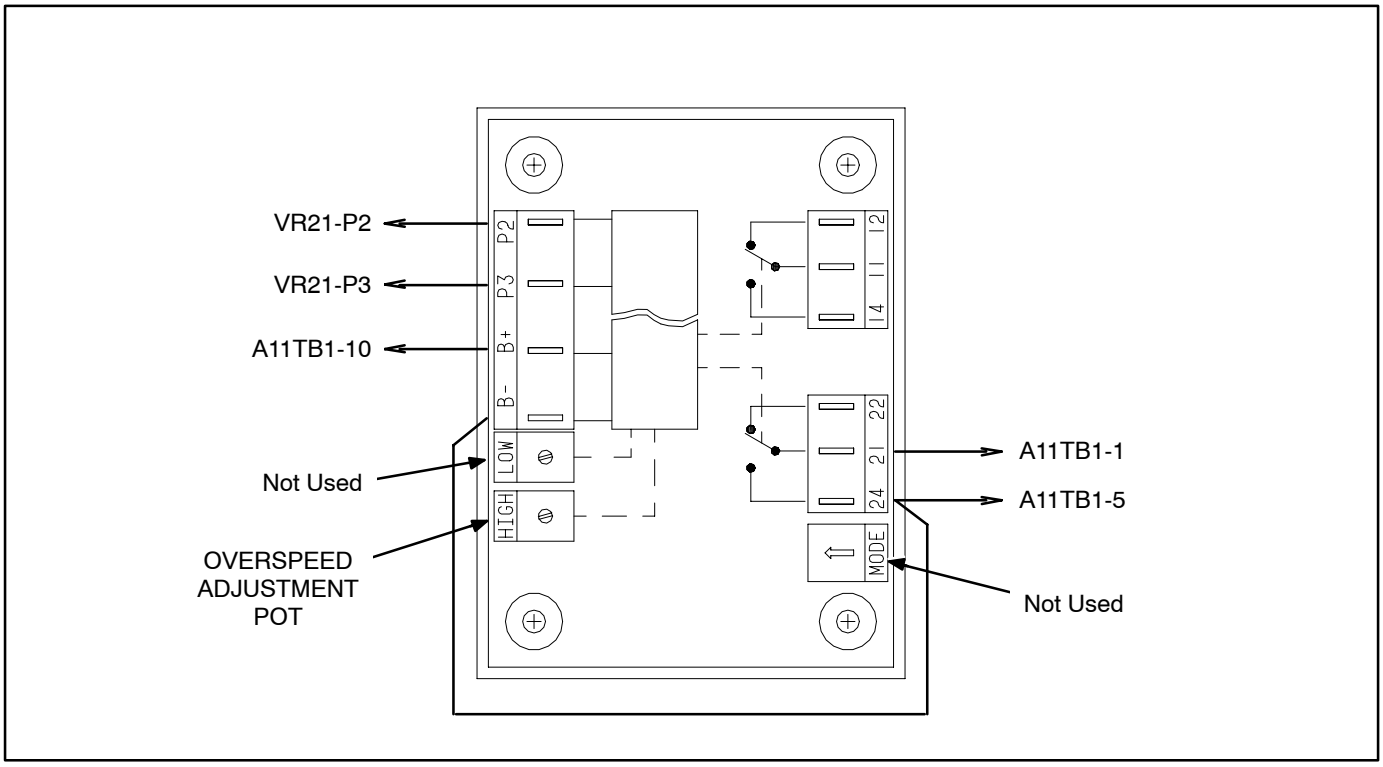


FIGURE 3-8. ELECTRONIC OVERSPEED MODULE

Auxiliary Relay Board (ARB) (Optional)

The following describes the design/functional criteria for the auxiliary relay board (ARB) (Figure 3-9). The board is mounted directly on top of the ECM using standoffs and has access holes for the fuses located on the ECM. Page 8-11 is a detailed connection diagram for the ARB.

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.

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

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

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 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

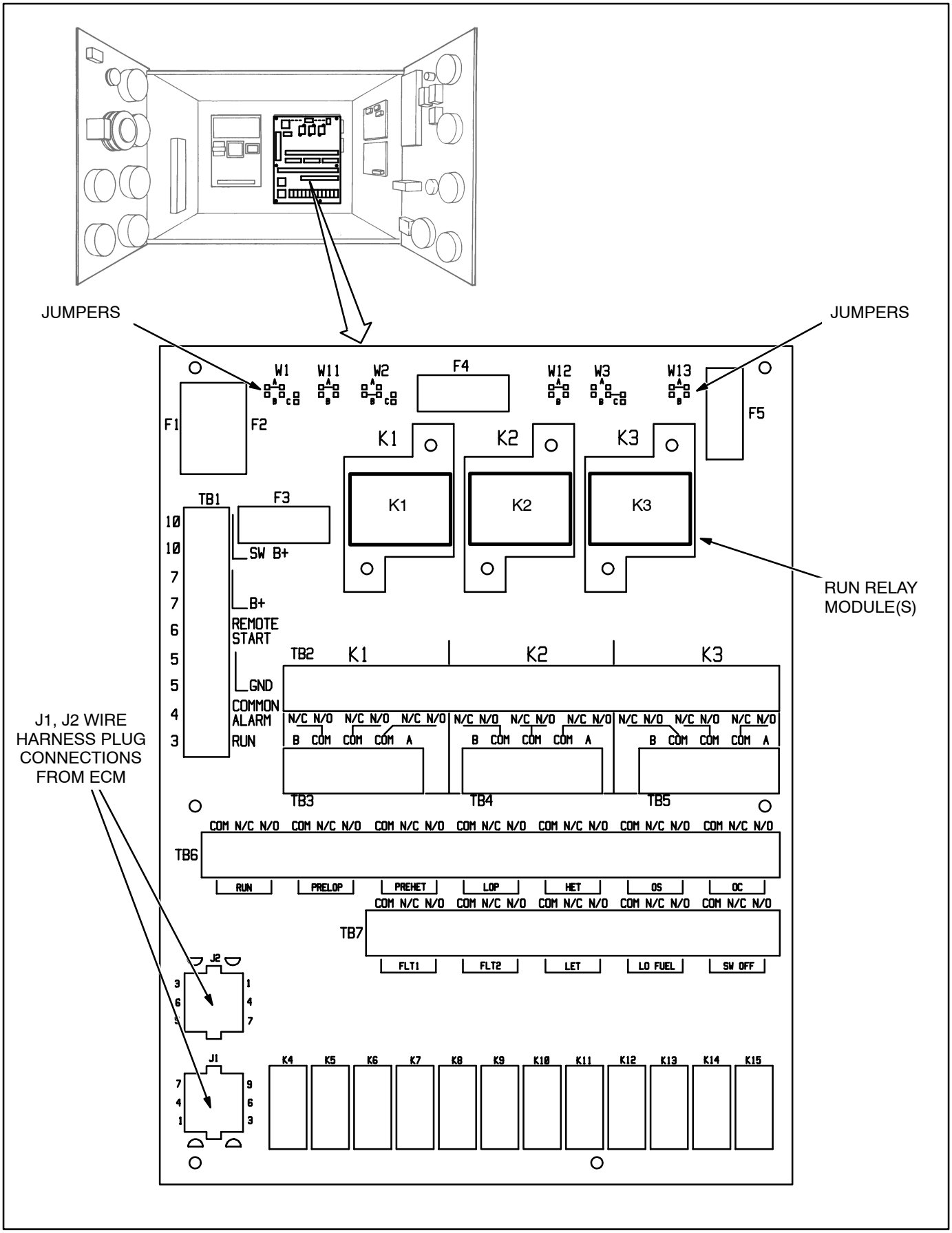


FIGURE 3-9. AUXILIARY RELAY BOARD

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 and the generator set to cool down.

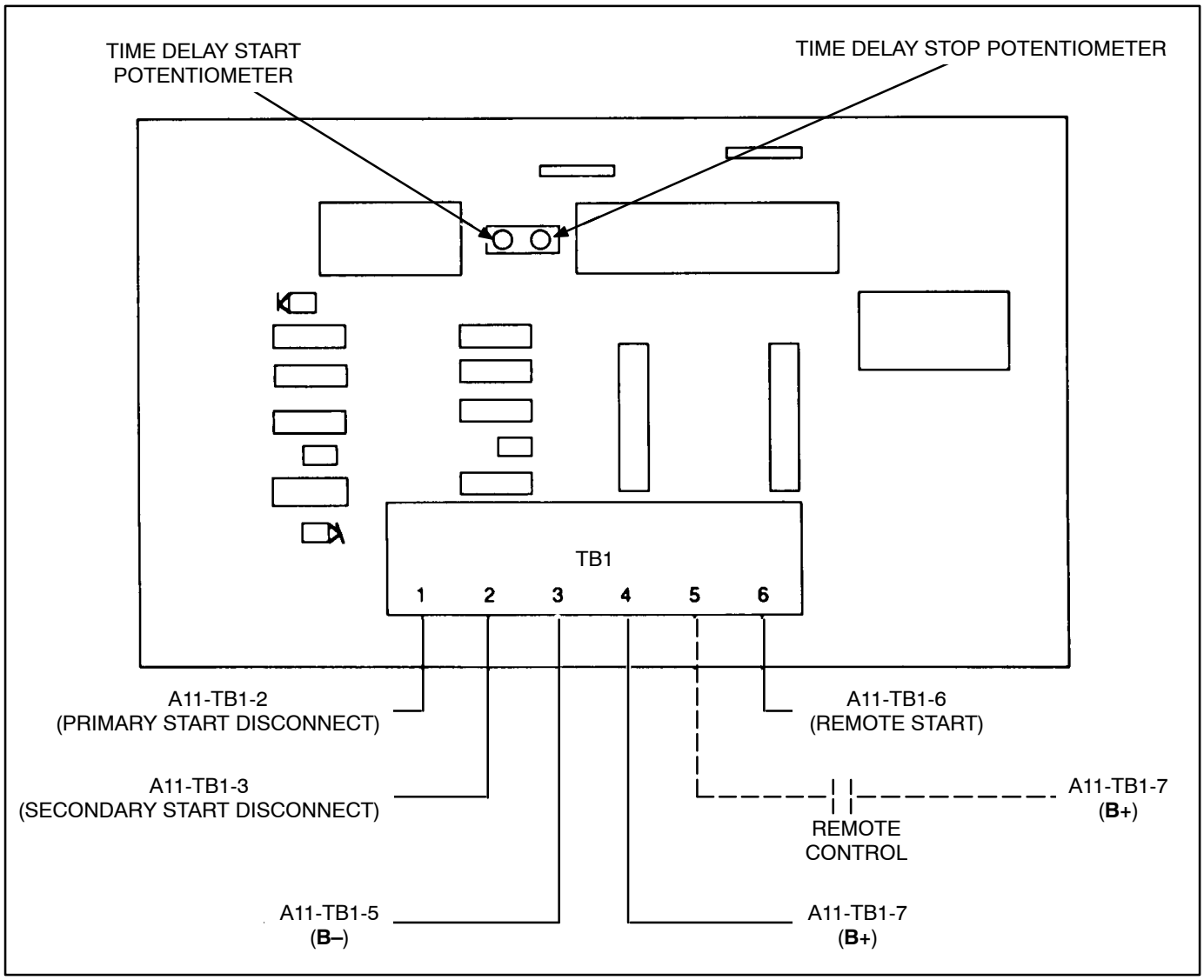


FIGURE 3-10. TIME DELAY START / STOP MODULE

SEQUENCE OF OPERATION

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

1. The ECM is powered by cranking battery voltage (12 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 is connected.
5. Relay **K3** powers terminal **TB1-8** to which either starter relay **K4** or B1-SW 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 (12 VDC) through plug-in connector **P1-3**. The panel **Run** indicator lamp should light. Relays **K10** and **K14** are redundant.

   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.
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 and switch S11 lamp will light 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 de-energized (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 switch button will light, however, and the light in switch S11.)

    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. The 10 second time delay begins after K10 or K14 is energized.
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.)

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4. Troubleshooting

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

THE ENGINE DOES NOT CRANK IN RUN MODE	
⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***	
Possible Cause	**Corrective Action**
1. The **Emergency Stop** switch has been used. (The switch button is lit.)	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**.
2. 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**.
3. A **LO Shutdown** is being indicated on the day tank pump control panel.	Determine the cause and service as necessary (See *Section 7*). 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.
4. Cranking voltage is too low to crank the engine.	a. Clean and tighten or replace the positive (+) and negative (–) battery cable connectors and cables at the battery and the set. b. Recharge or replace the battery. Specific gravity for a fully charged battery is approximately 1.260 at 80° F (27° C). c. If the set is in standby service, install a battery charger. d. Replace the engine-driven battery charging alternator if normal battery charging voltage (12 to 14 VDC) is not obtained.

THE ENGINE DOES NOT CRANK IN RUN MODE (CONT.)

⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***

Possible Cause	Corrective Action
5. Fuse **F1** (see Figure 3-4) on ECM has blown (no voltage [B+] at ECM **TB1-8**).	The wire between ECM **TB1-8** and starter terminal **B1-SW** or the wires between **TB1-8** – **resistor** /**diode assembly** – **battery charging alternator** may be loose and shorting to ground. Repair as necessary and replace the fuse with one of the same type and amp rating (20 A). If fuse continues to blow, service or replace the starter, relay **K4**, or the resistor/ diode assembly.
6. The wire between ECM **TB1-9** and starter terminal **BAT** is loose damaged or missing.	Check for battery voltage (12 VDC) between ECM **TB1-9** (B+) and the grounding stud (–) on the floor of the control cabinet. Check, clean and tighten the connectors at both ends and replace the wire if it is damaged.
7. The grounding strap between the control box and the battery negative (–) terminal or the ground wire between the control and engine ground is loose, damaged or missing.	Check for continuity (zero ohms) between the grounding stud on the bottom of the control box and the battery negative (–) terminal. If there is no continuity or the grounding strap is loose or damaged, repair as necessary.
8. The **Run-Stop-Remote** switch (S12) or wiring is faulty.	a. Disconnect pin connector **J4** from the ECM and check for electrical continuity (zero ohms) between switch terminals **2** and **3** when the switch is in the **Run** position and between terminals **1** and **2** when it is in the **Remote** position. Replace the switch if either set of contacts is faulty. b. If the switch works, check for electrical continuity (zero ohms) between **J4-6** and **J4-7** on the wire harness when the switch is in the **Run** position and between **J4-5** and **J4-7** when the switch is in the **Remote** position. Repair the wire harness if there is no electrical continuity in either position of the switch.
9. ECM is faulty. (Check fuses **F1** and **F4** and for B+ at **TB1-9** again.)	Push the **Run-Stop-Remote** switch to **Run** and check for battery voltage (12 VDC) at ECM **TB1-8**. Replace ECM if there is no voltage at ECM **TB1-8** but 12 VDC at ECM **TB1-9**.
10. The wire between ECM **TB1-8** and starter solenoid terminal **SW** is loose, damaged or missing.	Push the **Run-Stop-Remote** switch to **Run** and check for battery voltage (12 VDC) at starter solenoid terminal **SW**. If there is no voltage repair the wiring as necessary.

THE ENGINE DOES NOT CRANK IN RUN MODE (CONT.)	
⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***	
Possible Cause	**Corrective Action**
11. The **starter motor** or **solenoid** is malfunctioning.	Push the **Run-Stop-Remote** switch to **Run** and check for battery voltage (B+) at starter solenoid terminal **SW**. Replace the starter motor if there is voltage but the motor does not function.
12. The **Time Delay Start**/**Stop Module (A15)** is malfunctioning.	Check for constant B+ at A15 terminal **TB1-4**. Check for run signal at ECM **TB1-5**. Voltage at A15 **TB1-6** should be at B+ at the end of the start delay period. Check wiring and connections from A15 **TB1-6** to ECM **TB1-6**.

THE ENGINE DOES NOT CRANK IN REMOTE MODE

⚠ **WARNING** ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***

Possible Cause	Corrective Action
1. The **Run-Stop-Remote** switch is at **Stop.** (The **Switch-Off** light will be flashing, if provided.)	Push the **Run-Stop-Remote** switch to **Remote.**
2. The **Emergency Stop** switch has been used. (The switch button is lit.)	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 **Remote**.
3. 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 **Remote.**
4. There is no remote circuit signal (12 VDC at auxiliary relay board **A28-TB1-6**) because fuse **F3** on the ECM has blown.	a. Replace the fuse with one of the same type and amp rating (15 A). b. If fuse **F3** blows again, find and repair the fault in the remote control circuit, such as a loose wire that may be shorting to ground or a shorted relay coil or other component. See *Section 8* for remote connections.
5. There is no remote circuit signal (12 VDC at auxiliary relay board **A28-TB1-6**) because the remote circuit is not functioning properly.	Apply 12 VDC to **A28-TB1-6**. If the engine cranks, find and repair the fault in the remote control circuit. See *Section 8* for remote connections.
6. Auxiliary relay board **A28** is not functioning properly.	Check for misconnections (see *Section 8*) or loose connections and replace auxiliary relay board **A28** if there is 12 VDC at terminal **A28-TB1-6** but not at **A28-J2-6**.
7. Same as Steps 3 through 11 in the **RUN** mode.	See steps 3 through 11 in the preceding **RUN** mode.

THE ENGINE CRANKS BUT DOES NOT START

⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***

Possible Cause	Corrective Action
1. The engine is not getting fuel.	a. Open any closed fuel shutoff valve. b. Fill the main fuel supply tank. c. Restore fuel pump prime according to the engine service manual.
2. Fuse **F2** on the ECM has blown.	Replace fuse with one of the same type and amp rating. If fuse **F2** blows again, the wire between ECM **TB1-10** and engine block terminal **T26**, or a wire between terminal **T26** and an accessory may be loose or shorting to ground.
3. Fuel solenoid **K1** does not energize.	a. Fuel solenoid not energized by the ECM. Check for B+ at ECM **TB1-10** when cranking. If no voltage present and fuse **F2** is good replace ECM. b. Connect B+ to fuel solenoid (K1) terminal **BAT**. Replace the fuel solenoid if does not “click” when energized. If fuel solenoid is working, check for blocked fuel line or fuel filter.
4. Low engine temperature is causing too low a cranking speed for starting.	a. Increase room temperature. b. Plug in, repair or install engine coolant heater. c. Replace the engine oil if it is not of the recommended viscosity for the ambient temperature.
5. Cranking voltage is too low to reach required cranking speed.	a. While cranking the engine, measure voltage directly across the battery terminals and then immediately across the starter motor terminal and the grounding bolt on the block. Cable, terminal or relay contact resistance is too high if the difference is more than 2 volts. Service as necessary. b. Recharge or replace the battery. Specific gravity for a fully charged battery is approximately 1.260 at 80° F (27° C). c. Replace the engine-driven battery charging alternator if normal battery charging voltage is not between 12 and 14 volts.
6. The air cleaner is blocked.	Service as necessary.
7. Ignition system, fuel system or other engine malfunction.	Service according to the engine service manual.

THE ENGINE RUNS UNTIL FAULT SHUTDOWN

⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***

Possible Cause	Corrective Action
1. The **OVERSPEED** lamp comes on and the engine shuts down.	a. 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).* b. Adjust the governor (see *Section 6*). c. 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.) d. 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. e. 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. f. Replace the governor controller if the set still shuts down due to overspeed.
2. The **LO OIL PRES** lamp comes on and the engine shuts down.	a. Check the engine oil level, repair any oil leaks and fill to the proper level. Then reset the ECM by pushing the **Run-Stop-Remote** switch to **Stop** and the **Reset** switch to **Reset**. b. If the set still shuts down due to low oil pressure, restart the set 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 14 psi (97 kPa). Replace the low oil pressure cutout switch if oil pressure is greater than 14 psi (97 kPa). See *Section 3* to locate the switch.

THE ENGINE RUNS UNTIL FAULT SHUTDOWN (CONT.)	
⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***	
Possible Cause	**Corrective Action**
3. The **HI ENG TEMP** lamp comes on and the engine shuts down.	a. Check the engine coolant level, repair any coolant leaks and refill as necessary. Then reset the ECM by pushing the **Run-Stop-Remote** switch to **Stop** and the **Reset** switch to **Reset**. b. 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 230° F (110° C), replace the high engine temperature cutout switch. If coolant temperature exceeds 230° F (110° C), clean and service the entire cooling system as required to restore full cooling capacity. See *Section 3* to locate the switch.
4. The **FAULT 1** or **FAULT 2** lamp comes on and the engine shuts down.	Service as required. (The customer has supplied the system fault indication switches. Either fault can be chosen to display the warning only. See *Section 3*.) If the shutdown was due to low frequency, the set probably ran out of fuel or the governor is out of adjustment. If the shutdown was due to over/under voltage, the voltage regulator may be out of adjustment.

THE ENGINE LACKS POWER OR IS UNSTABLE

⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***

Possible Cause	Corrective Action
1. Fuel delivery to the genset is inadequate.	a. Check for clogged fuel lines and filters. a. Check for air in the fuel lines and repair all air leaks. b. Check fuel inlet and outlet restriction. Refer to Cummins B3.3 Series Engines Operation and Maintenance Manual Specifications section.
2. The fuel is contaminated.	Connect the set to a supply of good quality fuel and run the set under various loads. Replace the contents of the fuel supply tank if there is a noticeable improvement in performance.
3. The engine air filter element is dirty.	Replace the air filter element.
4. The governor settings or linkage adjustment is incorrect.	a. Make governor settings and adjustments according to *Section 6, Governor.* b. If the governor cannot be adjusted for full power or stable speed, shut down the set and check for binding in the linkage. Repair and adjust the linkage as necessary. (A spring inside the actuator will resist opening the movement, which is normal.) c. Check the magnetic speed pick-up unit (MPU) clearance with flywheel. Replace the MPU if output voltage at cranking speed is less than 2.5 VDC measured at terminals **10** (–) and **11** (+) on the governor controller. d. 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. e. 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. f. Replace the governor controller if it still cannot be adjusted for full power or stable speed.

THE ENGINE LACKS POWER OR IS UNSTABLE (CONT.)	
⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***	
Possible Cause	**Corrective Action**
5. The engine fuel system (lift pump, injection pump, injectors, timing) is faulty.	Service the fuel system according to the engine service manual.
6. The engine is worn.	Service the engine according to the engine service manual.

AN AMBER WARNING LAMP IS ON	
⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***	
Possible Cause	**Corrective Action**
1. The **PRE LO OIL PRES** 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 [138 kPa] but greater than 14 psi [97 kPa.]) Service the engine lubricating system according to the engine service manual.
2. The **PRE HI ENG TEMP** 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 [104° C] but less than 230° F [110° C.]) Service the engine cooling system to restore full cooling capacity.
3. The **LOW ENGINE TEMPERATURE** lamp comes on while the set is in standby.	Plug in, repair or install engine coolant heater.
4. The **LO 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.)
5. The **Basin** lamp comes on.	Indicates fuel is leaking from inner tank to outer basin or the sensor may be defective. Service as required. (The customer has supplied this sensor to make use of this warning.)
6. The **FAULT 1** or **FAULT 2** lamp (may be a specifically labeled amber lamp) comes on.	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 *Section 3, Engine Control*.)

THE GREEN RUN LAMP STAYS OFF BUT THE SET RUNS NORMALLY

⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***

Possible Cause	Corrective Action
1. The set mounted **RUN** lamp does not light, although the starter has disconnected normally and the engine is running. The remote **RUN** lamp does light (AC start disconnect is okay).	a. Press the panel **Lamp Test** switch and replace the run lamp bulb if it does not light. b. If the **RUN** lamp, wiring connections and battery charging alternator are all good and the **RUN** lamp does not light, replace the ECM.
2. Both the remote and set mounted **RUN** lamps do not light, although the starter has disconnected normally and the engine is running.	a. 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. b. If both lamps are good, this indicates that the AC disconnect circuit 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 in *Troubleshooting*. c. 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. d. Replace the ECM if there is 120 VAC across pin connectors **P1-1** and **P1-2** but neither **RUN** lamp lights during normal operation.

NO OUTPUT VOLTAGE	
⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***	
Possible Cause	**Corrective Action**
1. 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**.
2. 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.
3. 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.
4. Field circuit breaker **CB21** has **TRIPPED**.	**RESET** the circuit breaker. If it keeps tripping, troubleshoot according to the chart, *Field Circuit Breaker Keeps Tripping*.
5. 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.

NO OUTPUT VOLTAGE (CONT.)

⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***

Possible Cause	Corrective Action
Determine if the problem is in the voltage regulating or generator circuits as follows: a. 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.*** b. Open the control panel and disconnect the field leads **X (F1)** and **XX (F2)** from the voltage regulator. See Figure 2-4. Perform the exciter stator winding resistance test (*Section 5*). The exciter stator resistance must test okay before proceeding. c. Prepare to measure output voltage across the generator terminals while the set is running. d. Bring two jumpers from a **12 volt battery** for connection to the **X (F1)** and **XX (F2)** leads inside the control box. Connect the jumper from the positive (+) post of the battery to the **F1 (X)** lead. Be prepared to connect the jumper from the negative (–) post of the battery to the **XX (F2)** lead. e. 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. **⚠ DANGER** ***HAZARDOUS VOLTAGE. Touching uninsulated parts inside the control box can result in severe personal injury or death. Measurements and adjustments must be done with care to avoid touching hazardous voltage parts. Stand on a dry wooden platform or rubber insulating mat, make sure your clothing and shoes are dry, remove jewelry and use tools with insulated handles.*** f. Start the set and connect the jumper wire from the battery negative (–) terminal to the **XX (F2)** lead. g. 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 the 12 volt battery. Refer to the Voltage Regulator fault chart (step 6) for troubleshooting. (Normal excitation voltage ranges approximately from10 VDC at no-load to 40 VDC at full-load.) h. Use the Generator fault chart If the output voltages are not balanced, or are less than ninety percent of rated output voltage; the problem is probably in the generator. If the voltages are unbalanced, first troubleshoot the main stator—Step 11, If the voltages are uniformly low, first troubleshoot the exciter and field circuits—Steps 7, 8, 9 and 10.	
6. Voltage regulating faults **(PMG-excited generators)**.	a. Follow the PMG test described in *Section 5* to determine if it is okay. b. Check all connections against the applicable reconnection diagram (*Section 8*) and rewire as necessary. Replace the voltage regulator if the PMG checks okay, the wiring is correct and there is no output voltage. **⚠ CAUTION** ***Replacing the voltage regulator before servicing other faults can lead to damage to the new voltage regulator.***

NO OUTPUT VOLTAGE (CONT.)	
⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***	
Possible Cause	**Corrective Action**
7. Voltage regulating faults **(Shunt-excited generators)**.	a. Flash the field as described in *Section 5*. b. Check all connections against the applicable reconnection diagram (*Section 8*) and rewire as necessary. Replace the voltage regulator if the wiring is correct and there is no output voltage. ⚠ CAUTION ***Replacing the voltage regulator before servicing other faults can lead to damage to the new voltage regulator.***
8. The exciter field winding is open.	Shut down the set and check exciter field winding resistance according to *Section 5*. Replace the exciter field assembly if winding resistance does not meet specifications.
9. The rotating rectifier assembly (diodes **CR1** through **CR6**) is faulty.	Shut down the set and check each diode according to *Section 5*. Service as necessary.
10. The exciter rotor windings are open.	Shut down the set and check exciter winding resistances according to *Section 5*. Replace the generator rotor assembly if exciter rotor winding resistances do not meet specifications.
11. The main rotor winding is open.	Shut down the set and check main rotor winding resistance according to *Section 5*. Replace the generator rotor assembly if main rotor winding resistance does not meet specifications.
12. The stator windings are open.	Shut down the set and check stator winding resistances according to *Section 5*. Replace the generator stator assembly if stator winding resistances do not meet specifications.

OUTPUT VOLTAGE IS TOO HIGH OR TOO LOW

⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***

Possible Cause	Corrective Action
1. Engine speed is unstable.	Troubleshoot according to the chart, *The Engine Lacks Power or is Unstable*.
2. The voltage has been adjusted improperly.	Adjust output voltage according to *Section 2, AC Control*.
3. Improper connections have been made at the generator output terminals.	Shut down the set and reconnect according to the appropriate reconnection diagram. See *Section 8*.
4. 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.
5. 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.***

OUTPUT VOLTAGE IS UNSTABLE

⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***

Possible Cause	Corrective Action
1. The voltage has been adjusted improperly.	Adjust output voltage according to *Section 2, AC Control.*
2. The voltage adjusting rheostat on the control panel is faulty (if provided).	Unlock the voltage adjusting screw on the front of the control panel and disconnect either lead from the rheostat. Measure resistance between terminals **1** and **2** while turning the adjusting screw fully one way and then the other. Replace the rheostat if it is open at any point, or if resistance does not vary smoothly from zero to approximately 1,500 ohms for sets with the SX460 voltage regulator (shunt excited) or 5,000 ohms for sets with the MX321 voltage regulator (PMG-excited).
3. 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.***

THE FIELD CIRCUIT BREAKER KEEPS TRIPPING

⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***

Possible Cause	Corrective Action
1. The rotating rectifier assembly (diodes **CR1** through **CR6**) is faulty.	Shut down the set and check each diode according to *Section 5*. Service as necessary.
2. The exciter field winding is shorted.	Shut down the set and check exciter field winding resistance according to *Section 5*. Replace the exciter field assembly if winding resistance does not meet specifications.
3. The exciter rotor windings are shorted.	Shut down the set and check exciter winding resistances according to *Section 5*. Replace the generator rotor assembly if exciter rotor winding resistances do not meet specifications.
4. The main rotor winding is shorted.	Shut down the set and check main rotor winding resistance according to *Section 5*. Replace the generator rotor assembly if main rotor winding resistance does not meet specifications.
5. The stator windings are shorted.	Shut down the set and check stator winding resistances according to *Section 5*. Replace the generator stator assembly if stator winding resistances do not meet specifications.
6. 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.***

THE PHASE CURRENTS ARE UNBALANCED	
⚠ WARNING ***Hazards present in troubleshooting can cause equipment damage, severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Read Safety Precautions page and observe all instructions and precautions in this manual.***	
Possible Cause	**Corrective Action**
1. The connected loads are distributed unevenly among the phases.	Shut down the set and redistribute the loads as evenly as possible.
2. Improper connections have been made at the generator output terminals.	Shut down the set and reconnect according to the reconnection diagram. See *Section 8*.
3. The stator windings are faulty (open or shorted).	Shut down the set and check stator winding resistances according to *Section 5*. Replace the generator stator assembly if stator winding resistances do not meet specifications.
4. 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 negative (–) cable from the battery to make sure the engine will not start while performing these tests.

⚠WARNING ***Ignition of explosive battery gases can cause severe personal injury or death. Arcing at battery terminals, light switch or other equipment, flame, pilot lights and sparks can ignite battery gas. Do not smoke, or switch trouble light ON or OFF near battery. Discharge static electricity from body before touching batteries by first touching a grounded metal surface.***

Ventilate battery area before working on or near battery—Wear goggles—Stop genset and disconnect charger before disconnecting battery cables—Disconnect negative (–) cable first and reconnect last.

⚠CAUTION ***Disconnect battery charger from AC source before disconnecting battery cables. Otherwise, disconnecting cables can result in voltage spikes damaging to DC control circuits of the set.***

⚠WARNING ***Accidental starting of the generator set can cause severe personal injury or death. Prevent accidental starting by disconnecting the negative (–) cable from the battery terminal.***

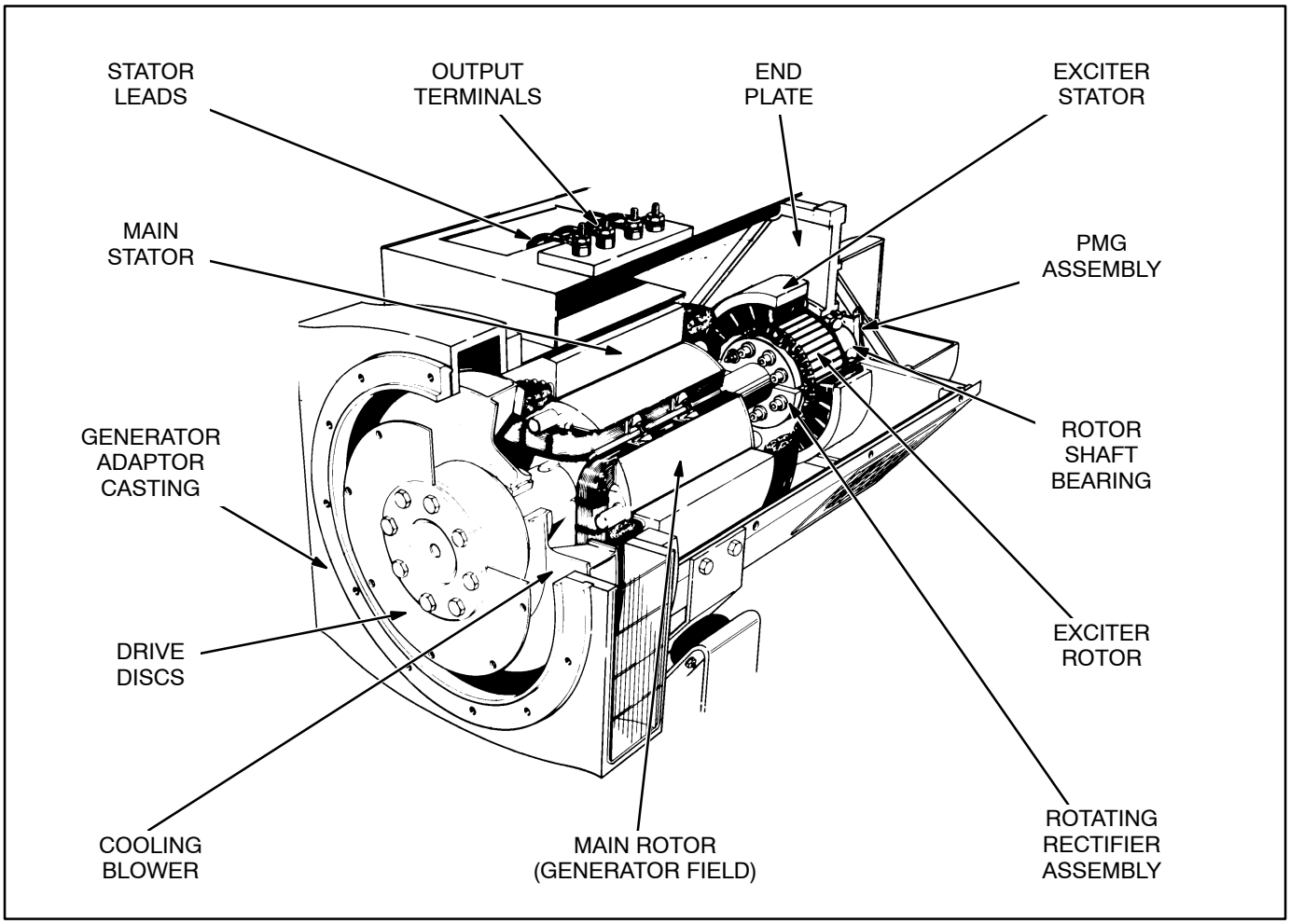


FIGURE 5-1. GENERATOR

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**.

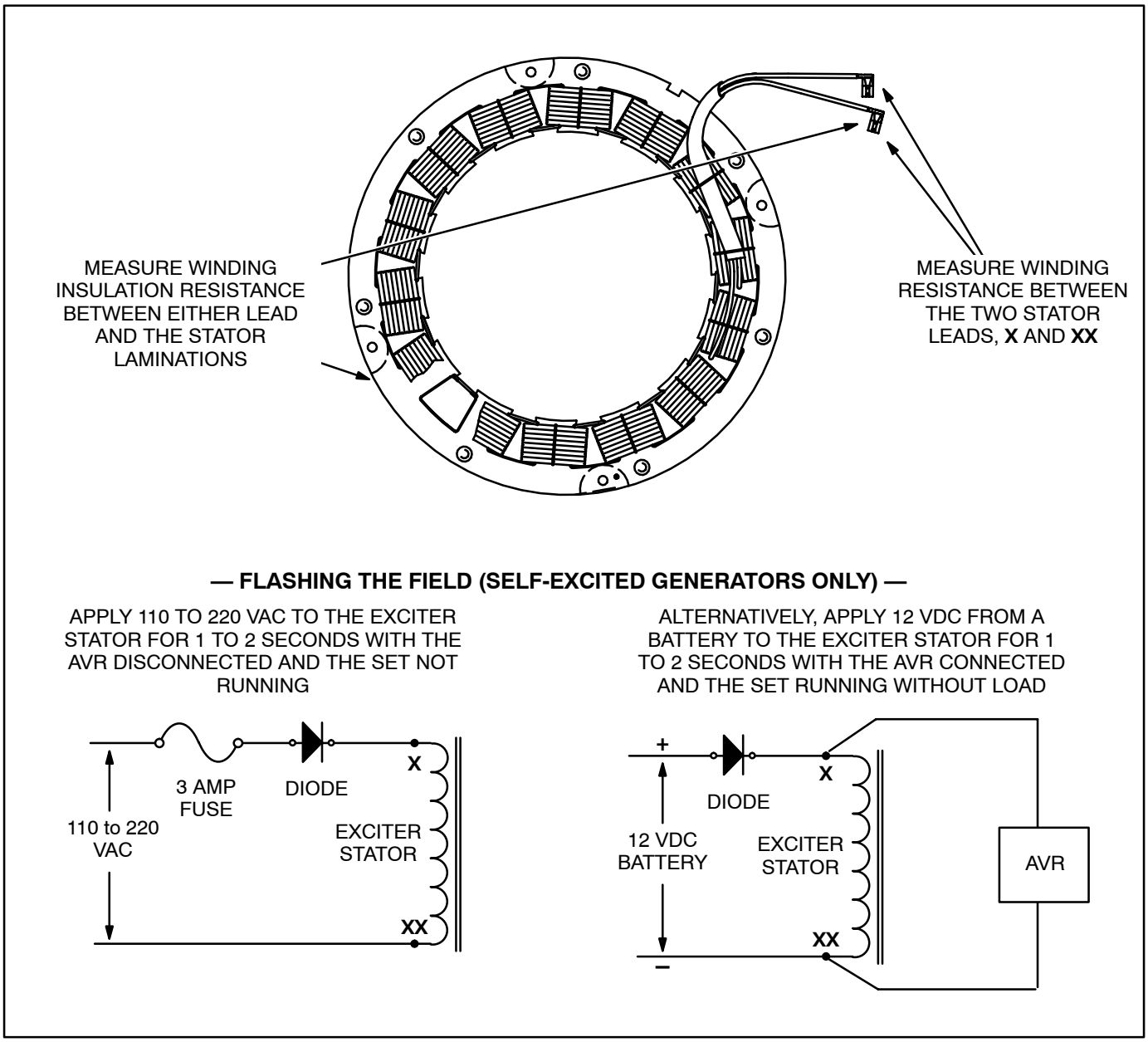


FIGURE 5-2. TESTING AND FLASHING THE EXCITER STATOR

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.***

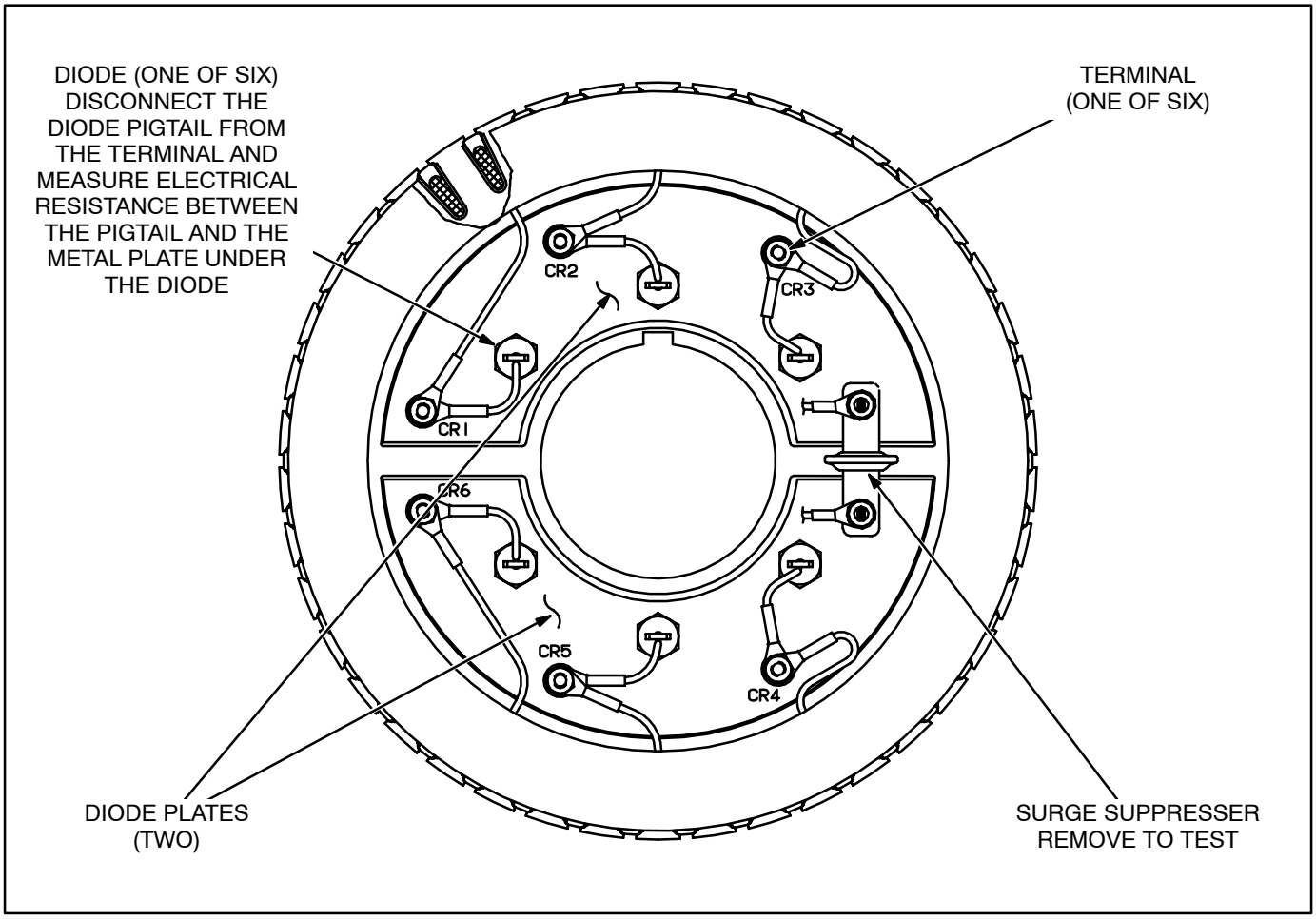


FIGURE 5-3. TESTING THE ROTATING RECTIFIER ASSEMBLY

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.

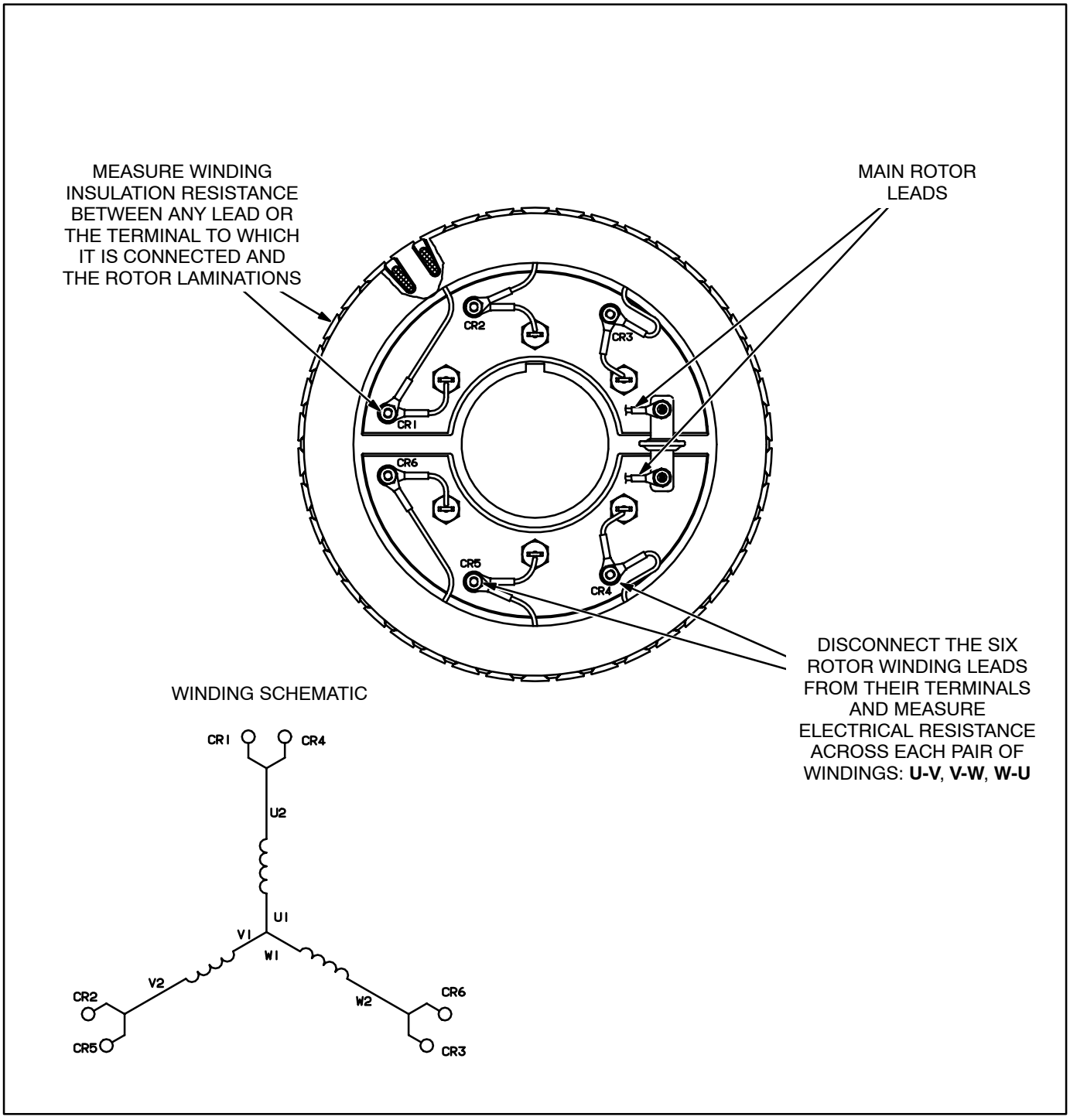


FIGURE 5-4. TESTING THE EXCITER ROTOR

Main Rotor (Generator Field)

Testing Winding Resistance: Disconnect the two leads of the main rotor from the terminals on the rotating rectifier assembly (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.

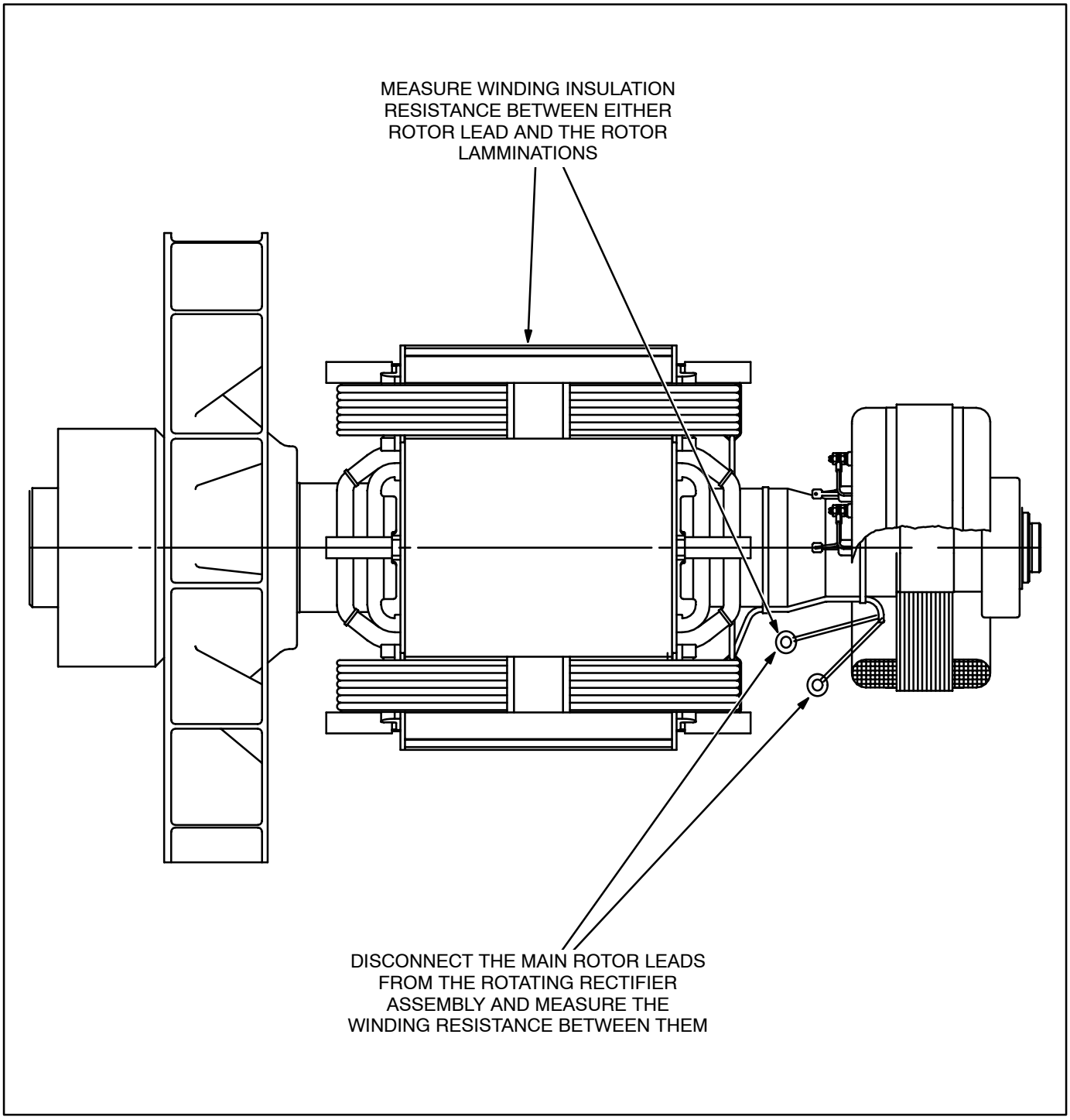


FIGURE 5-5. TESTING THE MAIN ROTOR

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.

Alternatively, winding resistance can be measured line-to-line at the generator terminals (U-V, V-W, W-U) on “star” connected generators. On a 600 volt generator, line-to-line resistance should be twice the table value (two winding elements in series). On a “series star” connected generator, line-to-line resistance should be four times the table value (four winding elements in series). On a “parallel star” connected generator, line-to-line resistance should be the same as the table value (two sets of two winding elements in series). Single phase only windings can be measured at W-V and should be twice the table value.

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.

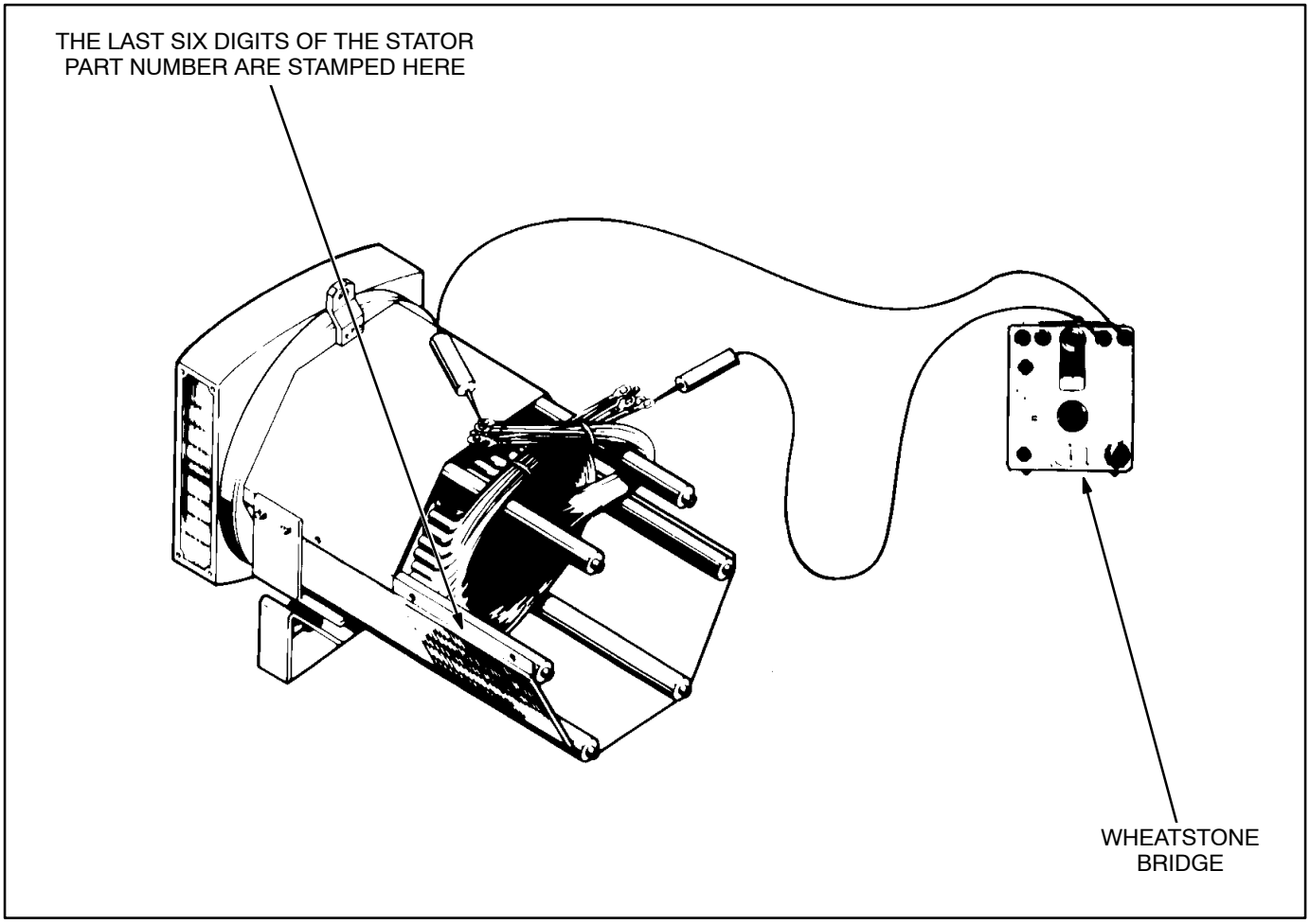


FIGURE 5-6. TESTING THE GENERATOR STATOR

TABLE 5-1. GENERATOR WINDING RESISTANCES

MAIN STATOR PART NUMBER***	MAIN STATOR (OHMS*)	MAIN ROTOR (OHMS**)	EXCITER STATOR (OHMS**)	EXCITER ROTOR (OHMS*)
220-4447-06	0.0561–0.0620	0.57	20.3	0.167
220-4447-07	0.0466–0.0515	0.64	20.3	0.167
220-4447-08	0.0371–0.0410	0.67	19.5	0.180
220-4447-09	0.0228–0.0252	0.80	19.5	0.180
220-4447-10	0.0181–0.0200	0.93	19.5	0.180
220-4447-11	0.0860–0.0950	0.57	20.3	0.167
220-4447-12	0.0613–0.0677	0.64	20.3	0.167
220-4447-13	0.0480–0.0530	0.67	19.5	0.180
220-4447-14	0.0309–0.0341	0.80	19.5	0.180
220-4447-15	0.0261–0.0289	0.93	19.5	0.180
220-4447-16	0.0561–0.0620	0.57	20.3	0.167
220-4447-17	0.0428–0.0473	0.64	20.3	0.167
220-4447-18	0.0333–0.0368	0.67	19.5	0.180
220-4447-19	0.0228–0.0252	0.80	19.5	0.180
220-4447-20	0.0171–0.0189	0.93	19.5	0.180
220-4447-26	0.1354–0.1496	0.57	20.3	0.167
220-4447-27	0.0960–0.1050	0.64	20.3	0.167
220-4447-28	0.0713–0.0788	0.67	19.5	0.180
220-4447-29	0.0485–0.0536	0.80	19.5	0.180
220-4447-30	0.0404–0.0446	0.93	19.5	0.180
220-4448-07	0.0209–0.0231	1.11	19.5	0.180
220-4448-08	0.0162–0.0179	1.20	19.5	0.180
220-4448-09	0.0143–0.0158	1.31	19.5	0.210
220-4448-10	0.0095–0.0105	1.50	19.5	0.210
220-4448-11	0.0076–0.0084	1.66	19.5	0.210
220-4448-12	0.0066–0.0072	1.80	19.5	0.210
220-4448-13	0.0260–0.0310	1.11	19.5	0.180
220-4448-14	0.0214–0.0236	1.20	19.5	0.180
220-4448-15	0.0147–0.0163	1.31	19.5	0.210
220-4448-16	0.0114–0.0126	1.50	19.5	0.210
220-4448-17	0.0100–0.0110	1.66	19.5	0.210
220-4448-18	0.0071–0.0079	1.80	19.5	0.210
220-4448-19	0.0204–0.0226	1.11	19.5	0.180
220-4448-20	0.0152–0.0168	1.20	19.5	0.180
220-4448-21	0.0105–0.0116	1.31	19.5	0.210
220-4448-22	0.0090–0.0100	1.50	19.5	0.210
220-4448-23	0.0076–0.0084	1.66	19.5	0.210
220-4448-24 (CONT.)	0.0062–0.0068	1.80	19.5	0.210

* - These values are approximate, plus or minus 10 percent at 68° F (20° C).
** - These values are approximate, plus or minus 10 percent at 77° F (25° C).
*** - See Figure 5-6 for the location of the stator part number.

TABLE 5-1. GENERATOR WINDING RESISTANCES (CONT.)

MAIN STATOR PART NUMBER***	MAIN STATOR (OHMS*)	MAIN ROTOR (OHMS**)	EXCITER STATOR (OHMS**)	EXCITER ROTOR (OHMS*)
220-4448-31	0.0413–0.0457	1.11	19.5	0.180
220-4448-32	0.0229–0.0331	1.20	19.5	0.180
220-4448-33	0.0238–0.0263	1.31	19.5	0.210
220-4448-34	0.0181–0.0200	1.50	19.5	0.210
220-4448-35	0.0124–0.0137	1.66	19.5	0.210
220-4448-36	0.0133–0.0147	1.80	19.5	0.210
220-4448-37	0.0085–0.0095	2.05	19.5	0.210
220-4448-38	0.0095–0.0105	2.05	19.5	0.210
220-4448-39	0.0074–0.0082	2.05	19.5	0.210
220-4448-40	0.0066–0.0074	2.05	19.5	0.210
220-4448-41	0.0065–0.0073	2.05	19.5	0.210
220-4448-42	0.0131–0.0145	2.05	19.5	0.210

* - These values are approximate, plus or minus 10 percent at 68° F (20° C).
** - These values are approximate, plus or minus 10 percent at 77° F (25° 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 negative (**–**) cable from the battery to make sure the set will not start while working on it.

⚠WARNING ***Ignition of explosive battery gases can cause severe personal injury or death. Arcing at battery terminals, light switch or other equipment, flame, pilot lights and sparks can ignite battery gas. Do not smoke, or switch trouble light ON or OFF near battery. Discharge static electricity from body before touching batteries by first touching a grounded metal surface.***

Ventilate battery area before working on or near battery—Wear goggles—Stop genset and disconnect charger before disconnecting battery cables—Disconnect negative (–) cable first and reconnect last.

⚠ CAUTION ***Disconnect battery charger from AC source before disconnecting battery cables. Otherwise, disconnecting cables can result in voltage spikes damaging to DC control circuits of the set.***

⚠WARNING ***Accidental starting of the generator set can cause severe personal injury or death. Prevent accidental starting by disconnecting the negative (–) cable from the battery terminal.***

Removing The Generator Output Box

14. Disconnect the line cables and conduit. For reconnections later, make sure each cable is clearly marked to indicate the correct terminal.
15. Disconnect the remote control wiring and conduit. For reconnections later, make sure each wire is clearly marked to indicate the correct terminal.
16. 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.
17. 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.
18. 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.
19. 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

⚠ CAUTION ***Do not use fan blade to bar over engine. That can damage blades and cause property damage and personal injury.***

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.***

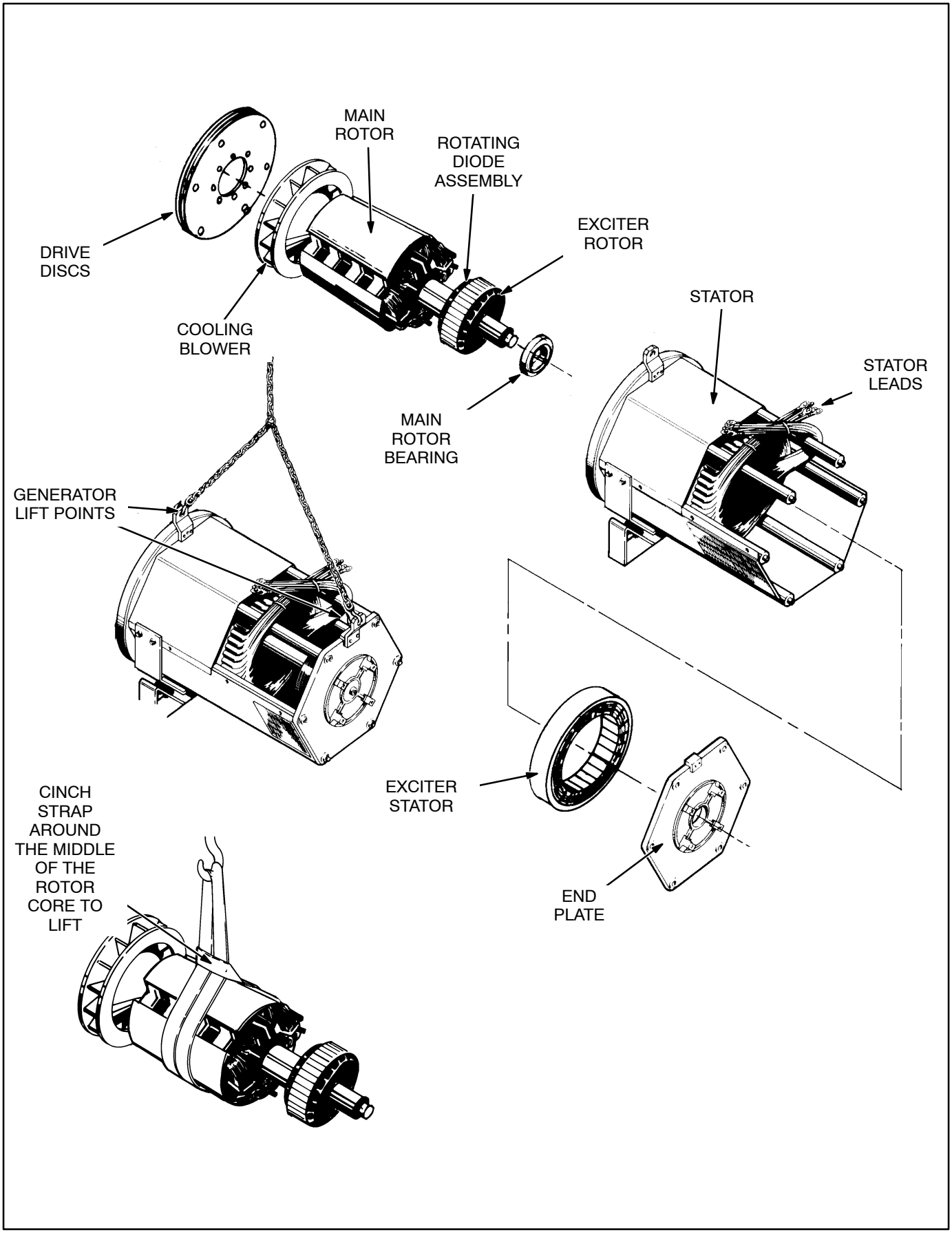


FIGURE 5-7. GENERATOR ASSEMBLY

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 re-cinch 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 8-2 or 8-3.

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.

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

   Stand on a dry wooden platform or rubber insulating mat, make sure your clothing and shoes are dry, remove jewelry and use tools with insulated handles.
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 negative (–) cable from the battery to make sure the set will not start while working on it.

   ⚠WARNING ***Ignition of explosive battery gases can cause severe personal injury or death. Arcing at battery terminals, light switch or other equipment, flame, pilot lights and sparks can ignite battery gas. Do not smoke, or switch trouble light ON or OFF near battery. Discharge static electricity from body before touching batteries by first touching a grounded metal surface.***

   Ventilate battery area before working on or near battery—Wear goggles—Stop genset and disconnect charger before disconnecting battery cables—Disconnect negative (–) cable first and reconnect last.

   ⚠CAUTION ***Disconnect battery charger from AC source before disconnecting battery cables. Otherwise, disconnecting cables can result in voltage spikes damaging to DC control circuits of the set.***

   ⚠WARNING ***Accidental starting of the generator set can cause severe personal injury or death. Prevent accidental starting by disconnecting the negative (–) cable from the battery terminal.***

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.

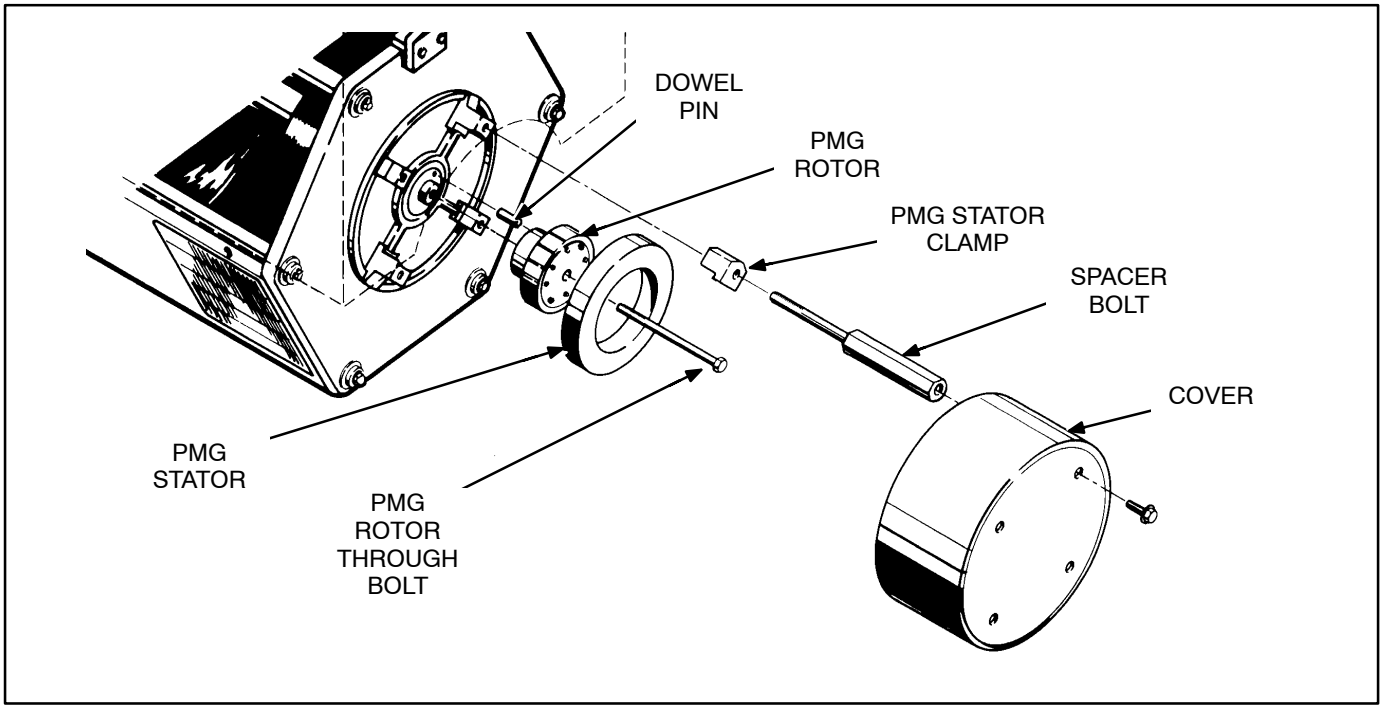


FIGURE 5-8. PMG ASSEMBLY

6. Governors

ELECTRIC GOVERNOR

There are two types of governor controllers that are used with this engine. Refer to Figures 6-1 (Type A) and 6-2 (Type B) to determine which governor adjustment procedure to use.

Governor Adjustments (Type A)

If necessary, wire the controller according to Figure 6-1 and install the magnetic speed pickup unit as noted in the following subsection. Then adjust the governor controller as follows:

1. 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.
2. 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.
3. Interrupt the governor by momentarily removing power from the governor. The engine should recover in 3 to 5 diminishing speed oscillations.
4. If engine continues to hunt, slightly reduce the **Gain** setting (turn pot counterclockwise). Repeat Step 3.

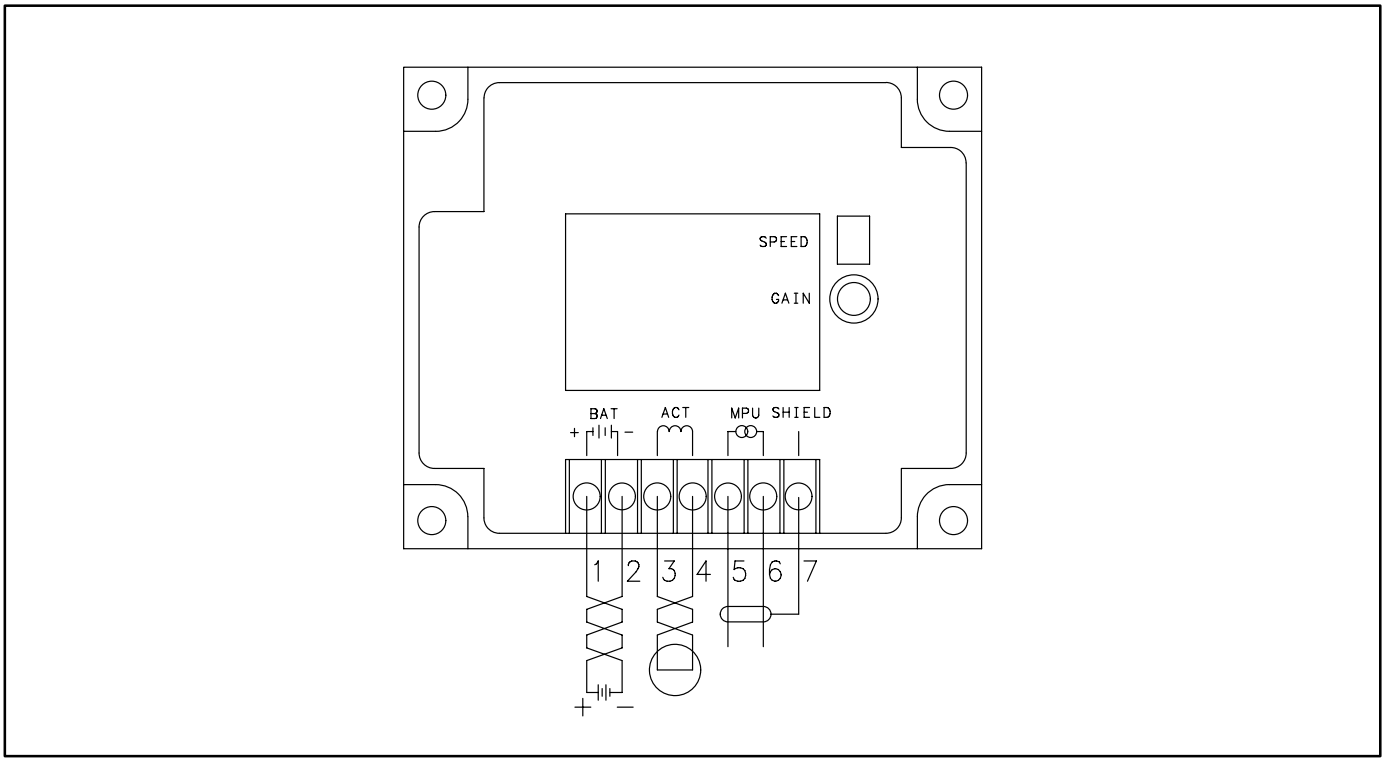


FIGURE 6-1. GOVERNOR CONTROLLER (TYPE A)

Governor Adjustments (Type B)

If necessary, wire the controller according to Figure 6-2 and install the magnetic speed pickup unit as noted in the following subsection. Then adjust the governor controller as follows:

1. 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 30%

   Integral Upper Limit 0% (fully CCW)

   Droop 0% (fully CCW)
2. If a remote speed pot is used, set it at its midpoint.
3. Start the set and adjust the **Run 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.
4. 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.
5. Interrupt the governor by momentarily removing power from the governor. The engine should recover in 3 to 5 diminishing speed oscillations.
6. If engine continues to hunt, slightly reduce **Gain** setting (turn pot counterclockwise). Repeat Step 5.
7. After the **Run Speed** and **Gain** are adjusted, apply 100% rated load to generator.

   A. While observing Frequency or RPM meter, turn **Integral Upper Limit** pot slowly clockwise until frequency or RPM starts to decrease.

   B. Turn **Integral Upper Limit** pot slowly counterclockwise until the frequency or RPM returns to the original set speed.
8. Readjust **Run Speed** if necessary.

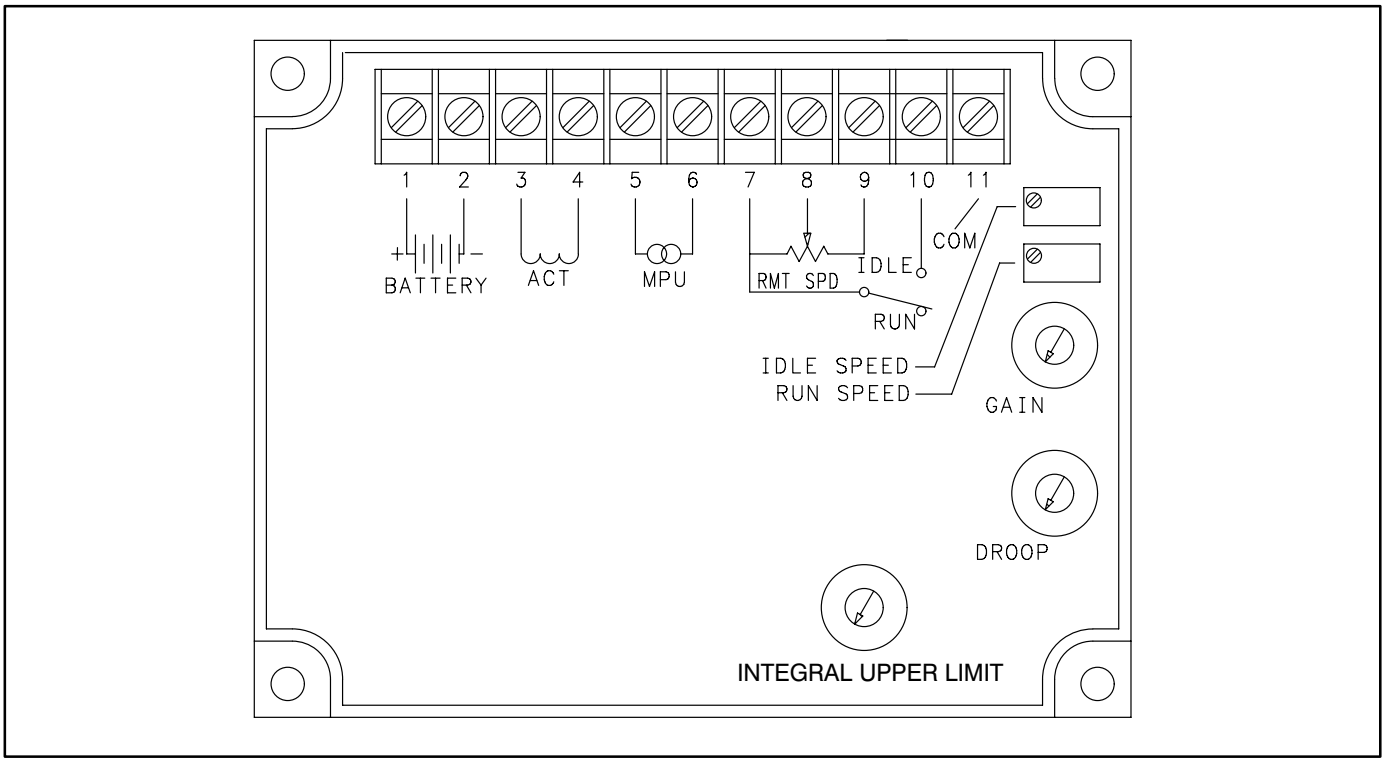


FIGURE 6-2. GOVERNOR CONTROLLER (TYPE B)

ELECTRIC GOVERNOR THROTTLE LEVER/LINKAGE ADJUSTMENT

Figure 6-3 illustrates the arrangement of the electric governor components on the engine.

If the injection pump has been replaced, no linkage adjustment is required. If the linear actuator is replaced, make sure that the end rod is threaded all the way onto the actuator shaft before tightening the lock nut.

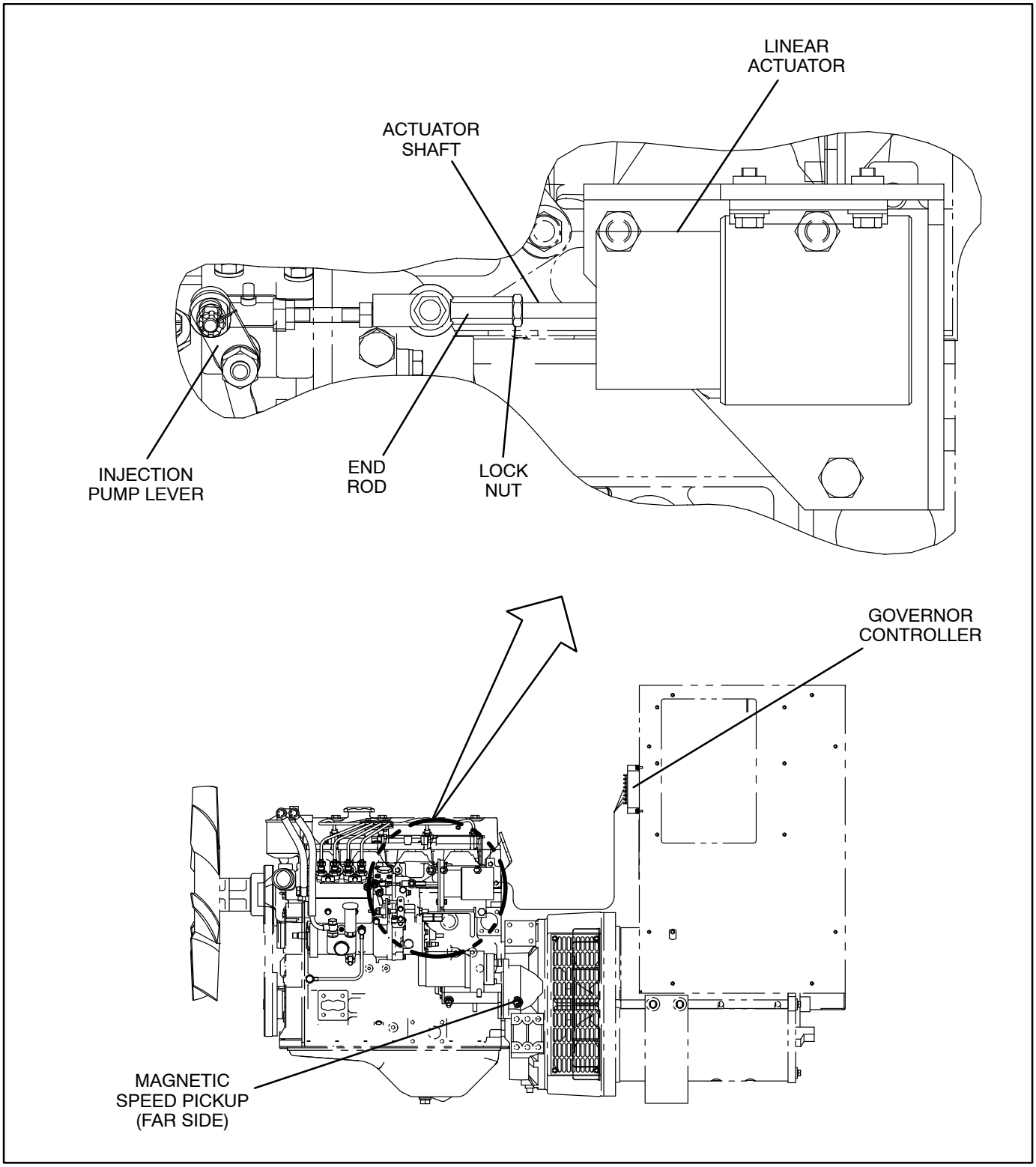


FIGURE 6-3. ELECTRIC GOVERNOR LINKAGE

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.

7. Fuel Transfer Pump and Control

GENERAL

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 sub-base or in-skid day tank. Figure 7-1 illustrates a typical sub-base installation.

⚠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 trained and experienced service personnel in accordance with the applicable codes.***

Do not smoke near fuel and keep flames, pilot lights, sparks, arcing switches or equipment and other sources of ignition well away.

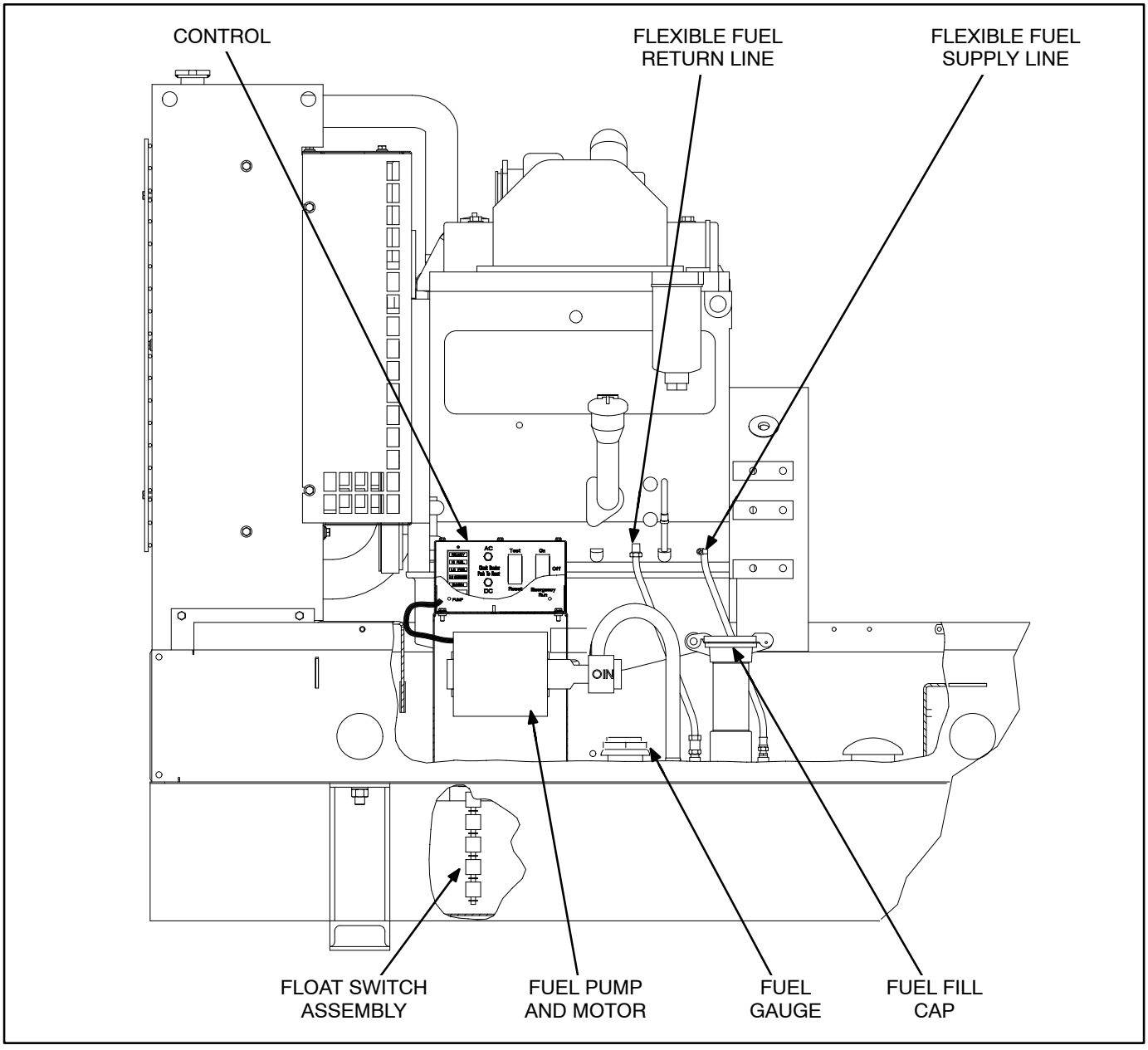


FIGURE 7-1. TYPICAL SUB-BASE INSTALLATION

OPERATION

9. 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.

10. 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.

11. 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 pump may continue to run after enabling the Emergency Run switch to complete the filling cycle of the tank.)

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

12. 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 or environmental damage.***

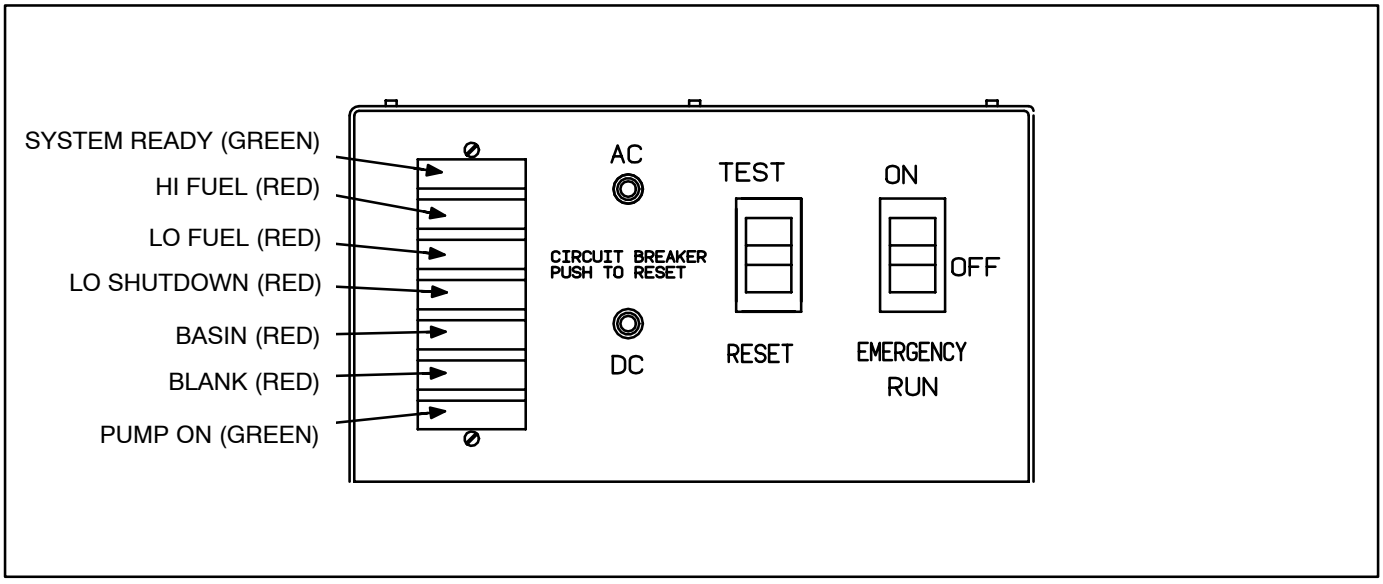


FIGURE 7-2. FUEL PUMP CONTROL PANEL

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. 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.

Note that connections should have been made to activate an engine fault shutdown under this condition to avoid running the engine pump out of fuel.

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.

13. 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.

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

WIRING CONNECTIONS

See Day Tank Pump Control Wiring, *Section 8*, 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.

   To convert the day tank controller from 240 VAC to 120 VAC, perform the following steps.

   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. On the control transformer, remove the two jumpers between terminals **H2** and **H3** and connect one between **H1** and **H3** and the other between **H2** and **H4**.

   To convert the day tank controller from 120 VAC to 240 VAC, perform the following steps.

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

   B. Move selector switch S103 on the control PCB to the down position for 240 VAC.

   C. On the control transformer, remove the jumpers between terminals **H1** and **H3**, and **H2** and **H4** and connect the two jumpers between **H2** and **H3**.

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

3. 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 **A11 TB2-1** or **A11 TB2-3** (Customer Fault inputs) of the Detector control ECM.

4. Terminals **TB1-10** through **TB1-17** and **TB2-23** through **TB2-27** are available for connections to remote annunciators or to either of the two customer fault inputs of the Detector control.

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

6. 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.

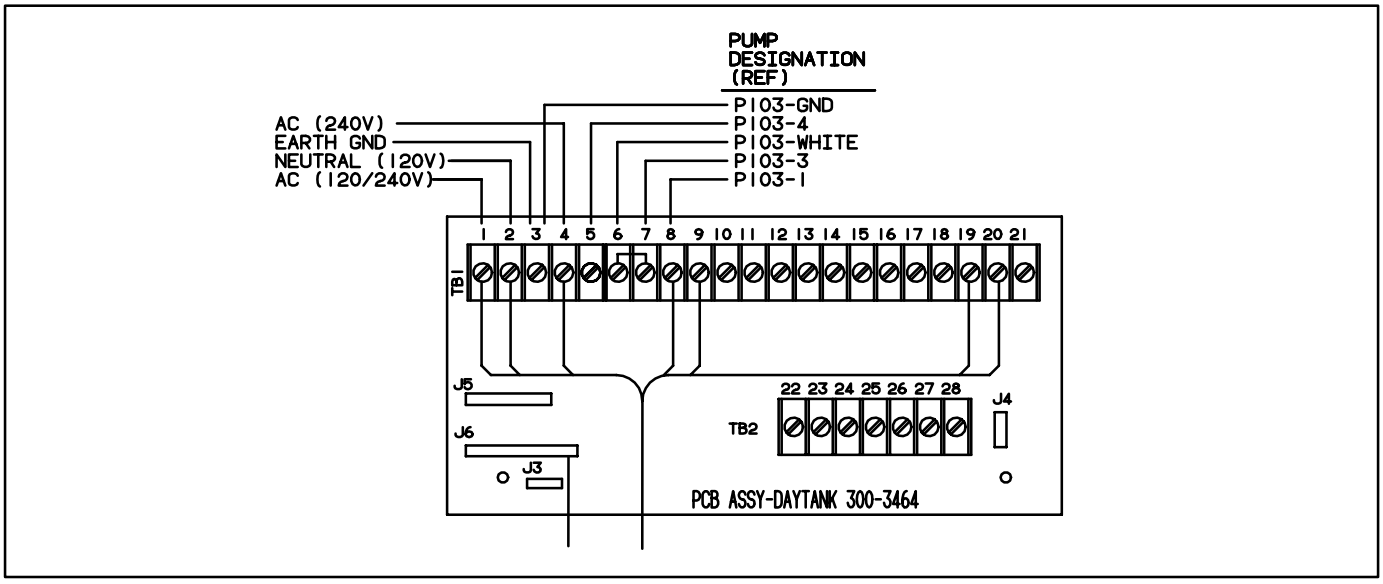


FIGURE 7-3. FUEL PUMP CONTROL TERMINAL BOARD

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.

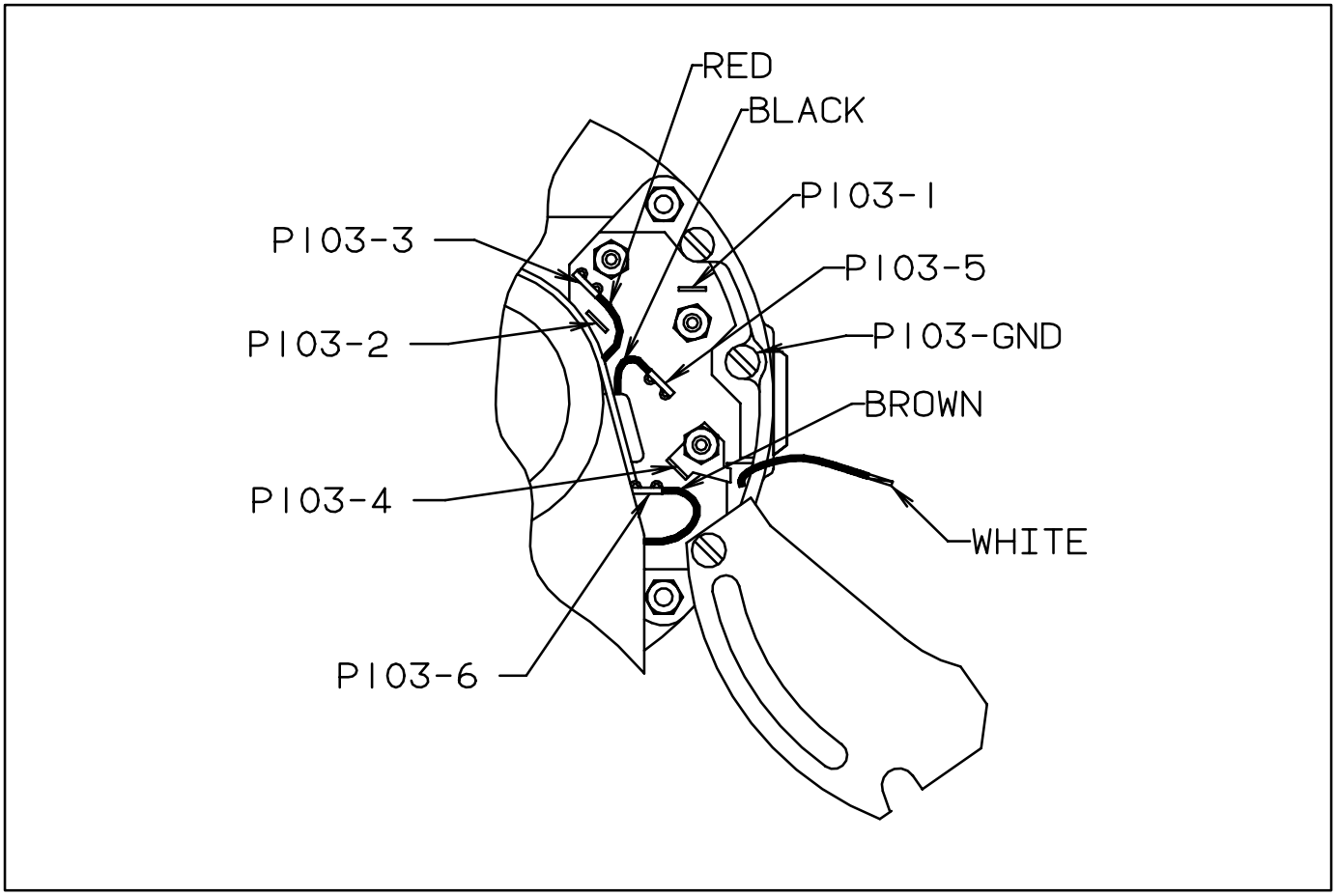


FIGURE 7-4. FUEL TRANSFER PUMP MOTOR CONNECTIONS

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.

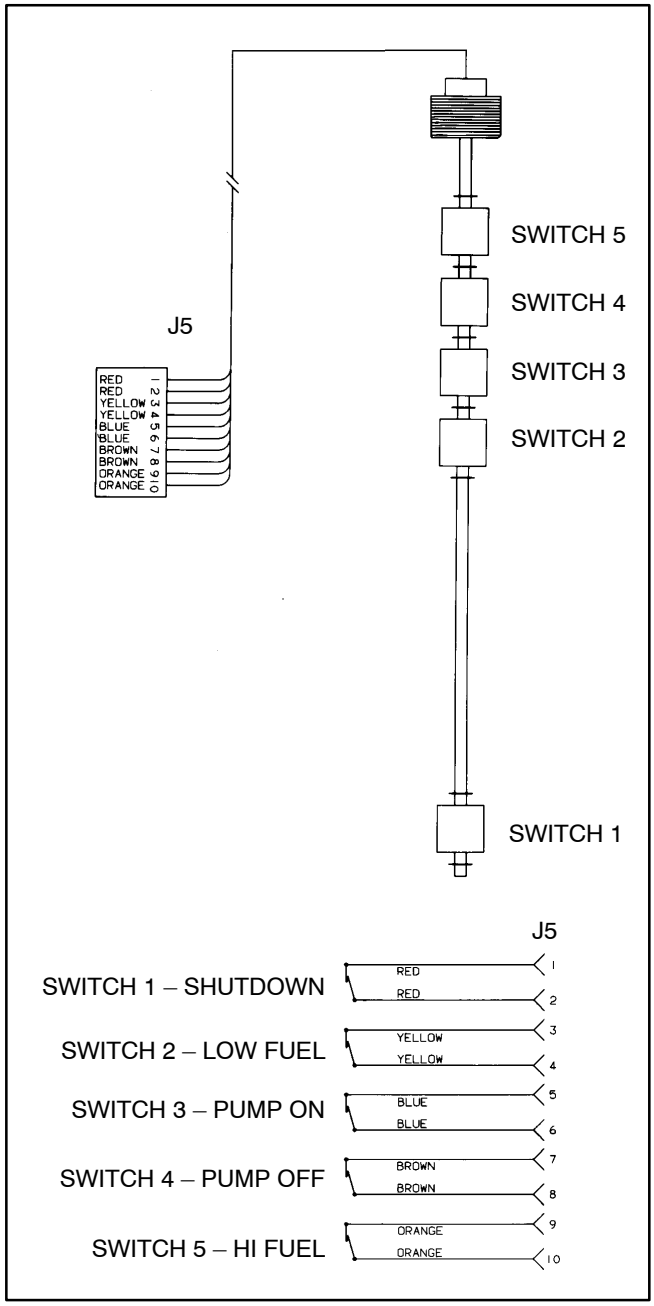


FIGURE 7-5. FLOAT SWITCH ASSEMBLY

8. Wiring Diagrams

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

UC GENERATORS

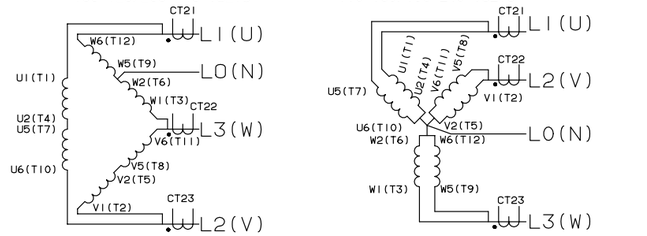
3 PHASE RECONNECTABLE, 12 LEAD

-01

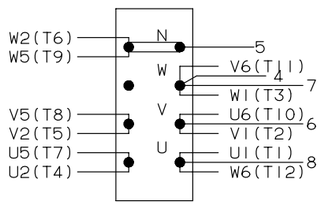
CURRENT TRANSFORMER SECONDARY CONN 1-3

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

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

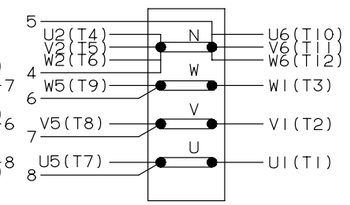


SERIES DELTA
3 PHASE 4 WIRE
OUTPUT TERMINALS
U.V.W.N.



-02

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

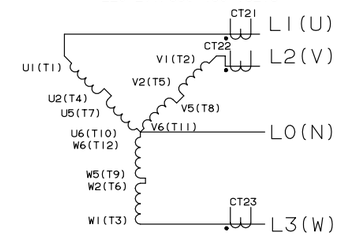


3 PHASE RECONNECTABLE, 12 LEAD

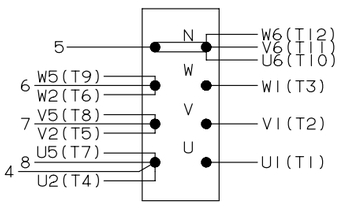
-03

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.

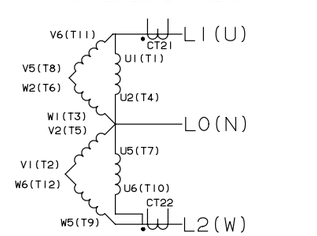


1 PHASE RECONNECTABLE, 12 LEAD

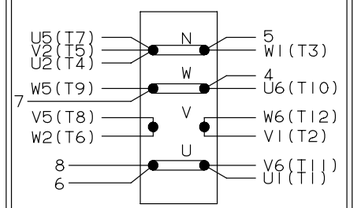
-04

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.

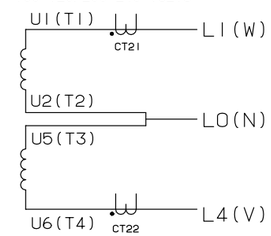


1 PHASE NON-RECONNECTABLE, 4 LEAD

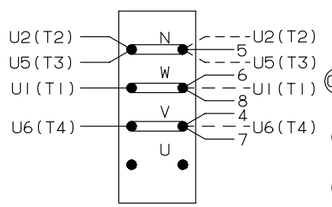
-05

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



(C2)
1 PHASE 3 WIRE
OUTPUT TERMINALS
W, V, CENTER TAP N



(C3)

NOTES:

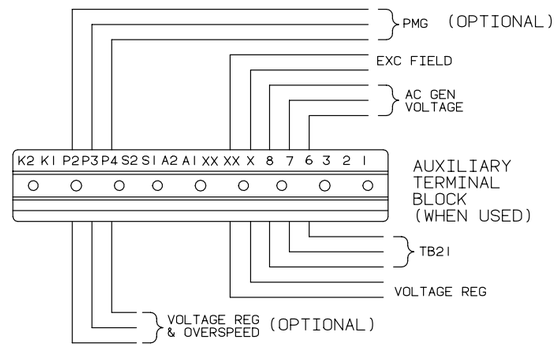
1. UVW PHASE SEQUENCE WITH C.W. ROTATION FACING DRIVE END.
2. 347/600 VOLTS - IF VOLTAGE REGULATOR SX440 ONAN P/N 300-3607 IS SPECIFIED, CONNECT GENERATOR TAP STATOR LEADS 7 & 8 TO VR21-P2 & VR21-P3 REPECTIVELY. INSULATE AND TIE #6 LEAD BACK.
3. 347/600 VOLTS - IF VOLTAGE REGULATOR ONAN P/N 300-3606 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 W6 (U) AND W5 (N) TO VR21-P2 AND VR21-P3 RESPECTIVELY.

(C1) 5. 1 PHASE NON-RECONNECTABLE: LARGER KW GENSETS HAVE 8 OUTPUT TERMINALS SMALLER KW HAVE 4.

(D1) 6. WHEN RECONNECTING GENERATOR LEADS, BOLTS SHOULD BE TORQUED AT 22 ±2 FT-LBS.

(F1) 7. 347/600 VOLTS - IF VOLTAGE REGULATOR SX460 ONAN PART #300-4830 IS SPECIFIED, CONNECT STATOR TAP LEAD 8 TO CB21-1 ON CONTROL PANEL. CONNECT TAP LEADS 6 & 7 TO AVR-6 & 7.

8. WHEN NON-DETECTOR CONTROLS ARE USED AT 600V
   8.1 SX460 AVR
   CONNECT STATOR TAP LEAD 8 TO CB21-1 ON CONTROL PANEL. CONNECT TAPS 6 & 7 TO AVR
   8.2 MX321 AVR WITHOUT AC METERS:
   CONNECT STATOR TAP LEADS 6, 7, & 8 TO ISOLATION XFMR BOARD T30-INPUT-6, 7, & 8.
   8.3 MX321 WITH AC METERS:
   INSULATE AND TIE BACK STATOR TAP LEADS 6, 7, & 8.



CONTROL INPUT "DETECTOR"				
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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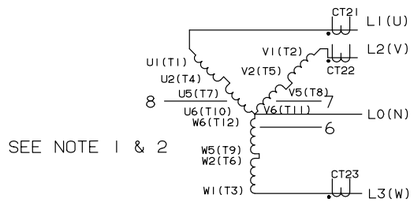
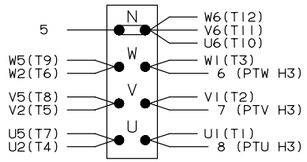
3 PHASE RECONNECTABLE

CURRENT TRANSFORMER SECONDARY CONN 1 - 2

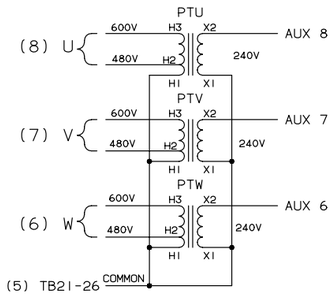
347/600V, 60HZ (R114)



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



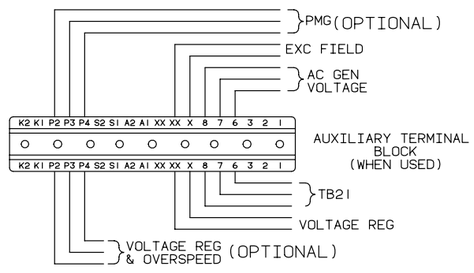
TRANSFORMER



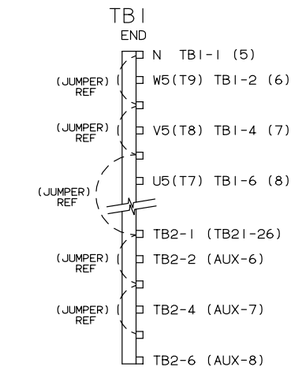
REFERENCE ONLY
P/N 319-1246

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

-06



CONTROL INPUT "DETECTOR"			
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

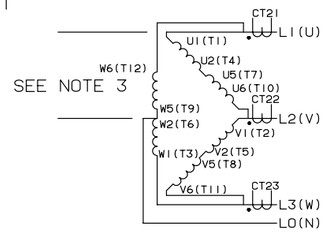


TRANSFORMER CONNECTIONS ASSEMBLY

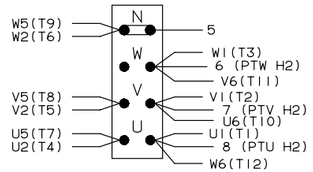
3 PHASE NON-RECONNECTABLE

CURRENT TRANSFORMER SECONDARY CONN 1 - 2

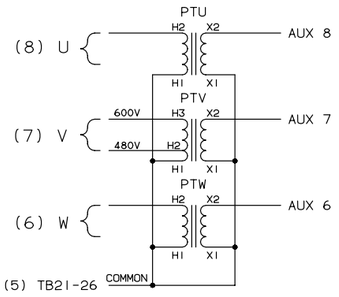
220/440V, 50 HZ (R019)
240/480V, 60 HZ (R119)



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

-07

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 W6 (U) AND W5 (N) TO VR21-P2 AND VR21-P3 RESPECTIVELY.
4. (D2) WHEN RECONNECTING GENERATOR LEADS, BOLTS SHOULD BE TORQUED AT 22 ±2 FT-LBS.
5. 347/600 VOLTS - IF VOLTAGE REGULATOR SX460 ONAN PART #300-4830 IS SPECIFIED, CONNECT (F2) STATOR TAP LEAD 8 TO CB21-1 ON CONTROL PANEL. CONNECT TAP LEADS 6 & 7 TO AVR-6 & 7.
6. WHEN NON-DETECTOR CONTROLS ARE USED AT 600V
   6.1 SX460 AVR
   CONNECT STATOR TAP LEAD 8 TO CB21-1 ON CONTROL PANEL. CONNECT TAPS 6 & 7 TO AVR
   6.2 MX321 AVR WITHOUT AC METERS:
   CONNECT STATOR TAP LEADS 6, 7, & 8 TO ISOLATION XFMR BOARD T30-INPUT-6, 7, & 8.
   6.3 MX321 WITH AC METERS:
   INSULATE AND TIE BACK STATOR TAP LEADS 6, 7, & 8.

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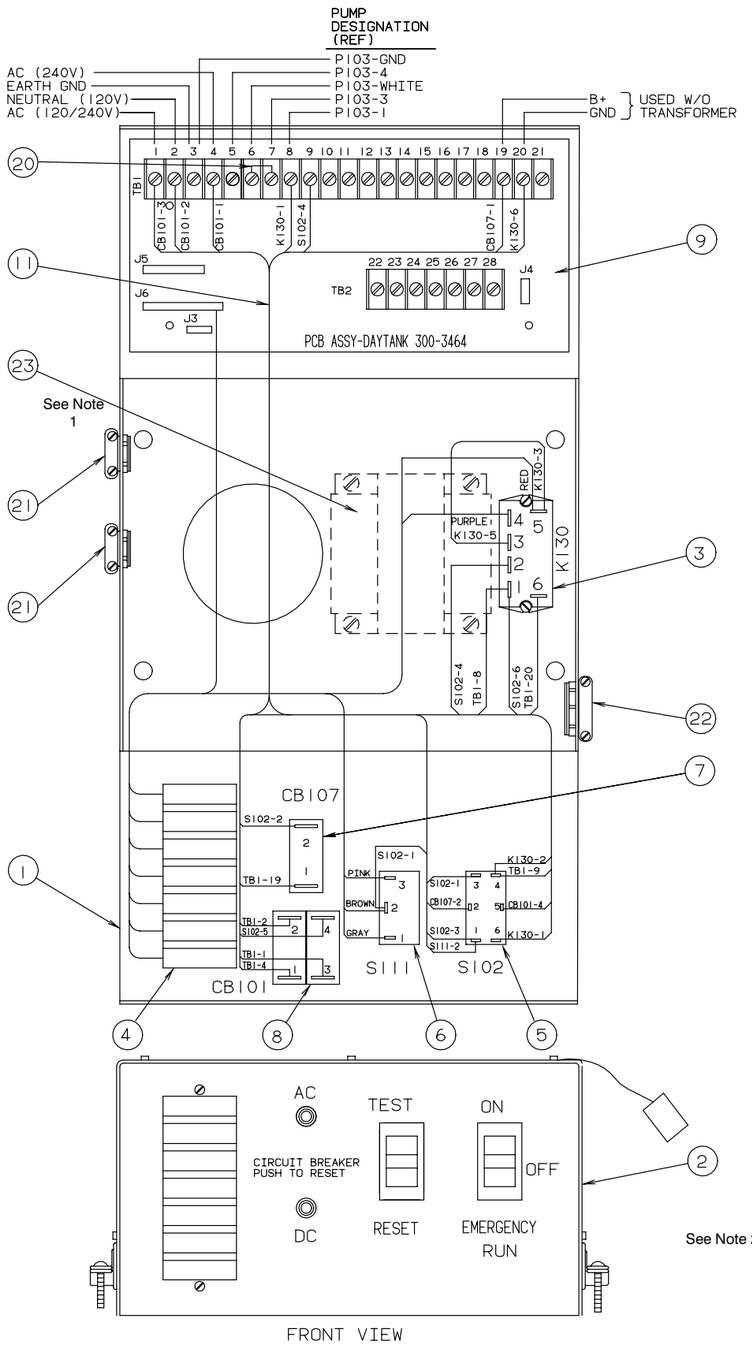
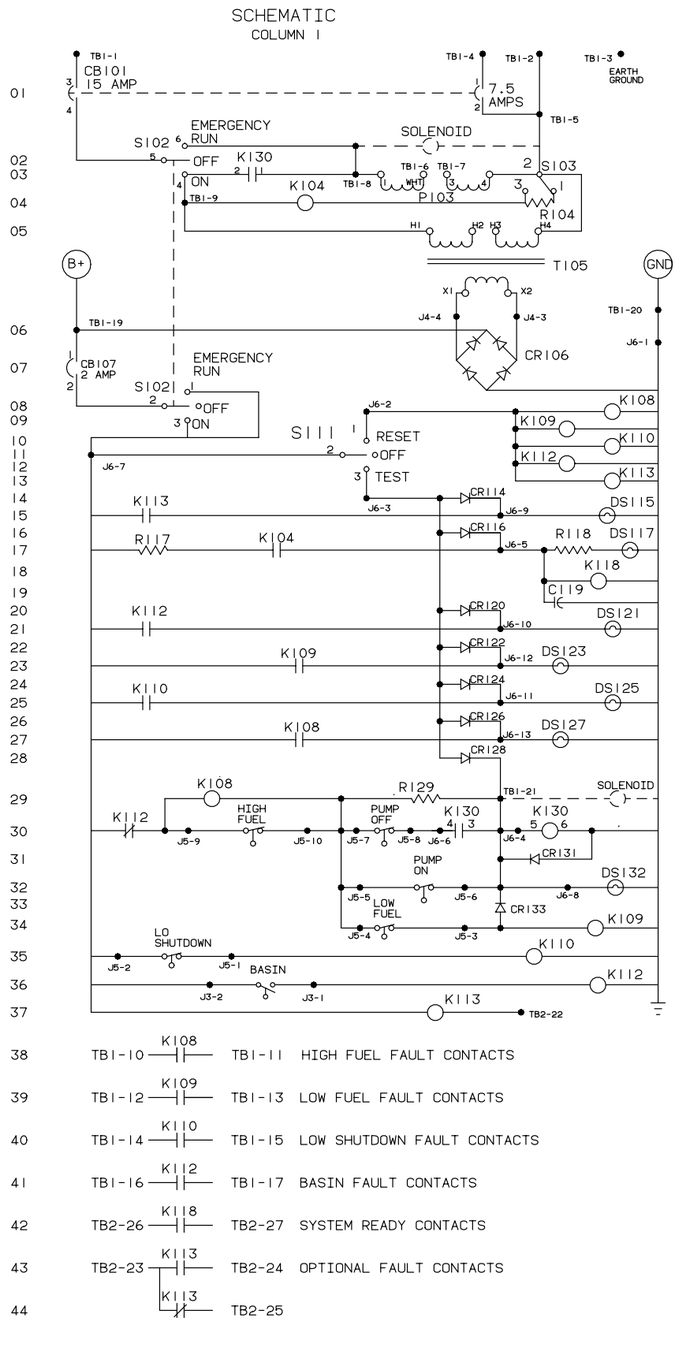
Modified 5/1/96





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 (13), 15, 43, 44

ITEM	DESCRIPTION OR MATERIAL
23	TRANSFORMER
22	CONNECTOR-KNOCKOUT
21	CONNECTOR-ROMEX
20	JUMPER-TERMINAL
19	
18	
17	
16	
15	
14	
13	
12	
11	HARNESS-CONTROL
10	
9	CIRCUIT BOARD ASSY.
8	CIRCUIT BREAKER 2 POLE
7	CIRCUIT BREAKER 1 POLE
6	SWITCH-ROCKER
5	SWITCH-ROCKER
4	LAMP ASSY.-7 LITE
3	RELAY-2PST
2	COVER-CONTROL
1	CONTROL BOX

NOTES:

1. **Item 23, transformer, is not included for kits where battery connections will be made at TB1-19 and TB1-20.**
2. **Tag the control box to indicate supply voltage.**

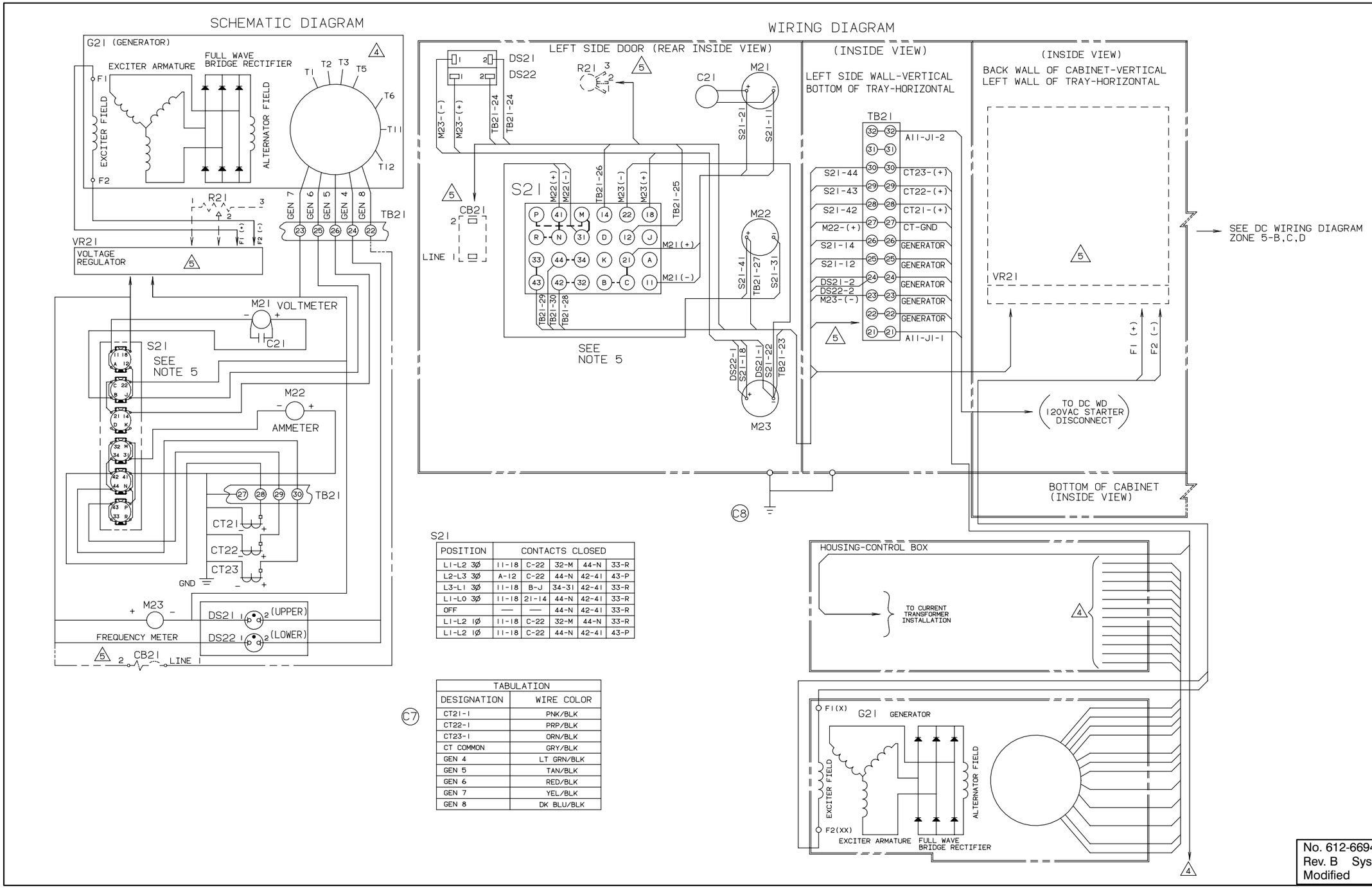
SCHEMATIC KEY:
EACH COMPONENT IS LOCATED BY PART NUMBER. ON THE RIGHT HAND SIDE, A DESCRIPTION IS GIVEN OF THE PART AND ITS FUNCTIONAL LOCATIONS.

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

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

No. 625-2141 sh 1 of
Rev. H Sys:
Modified

DAY TANK PUMP CONTROL WIRING



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

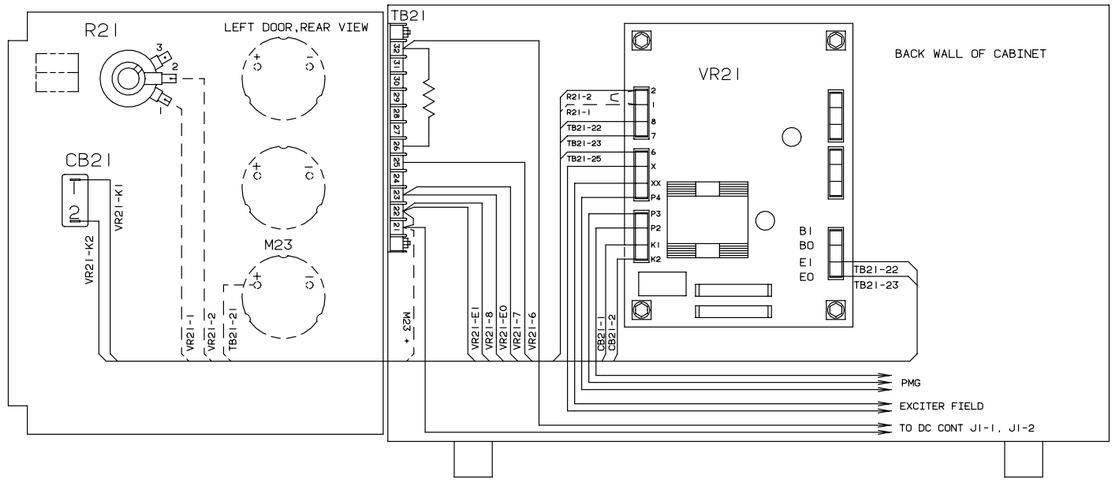
C7

TABULATION	
DESIGNATION	WIRE COLOR
CT21-1	PNK/BLK
CT22-1	PRP/BLK
CT23-1	ORN/BLK
CT COMMON	GRY/BLK
GEN 4	LT GRN/BLK
GEN 5	TAN/BLK
GEN 6	RED/BLK
GEN 7	YEL/BLK
GEN 8	DK BLU/BLK

No. 612-6694 sh 2 of 3
Rev. B Sys: CADAM
Modified

AC CONTROL WIRING DIAGRAM

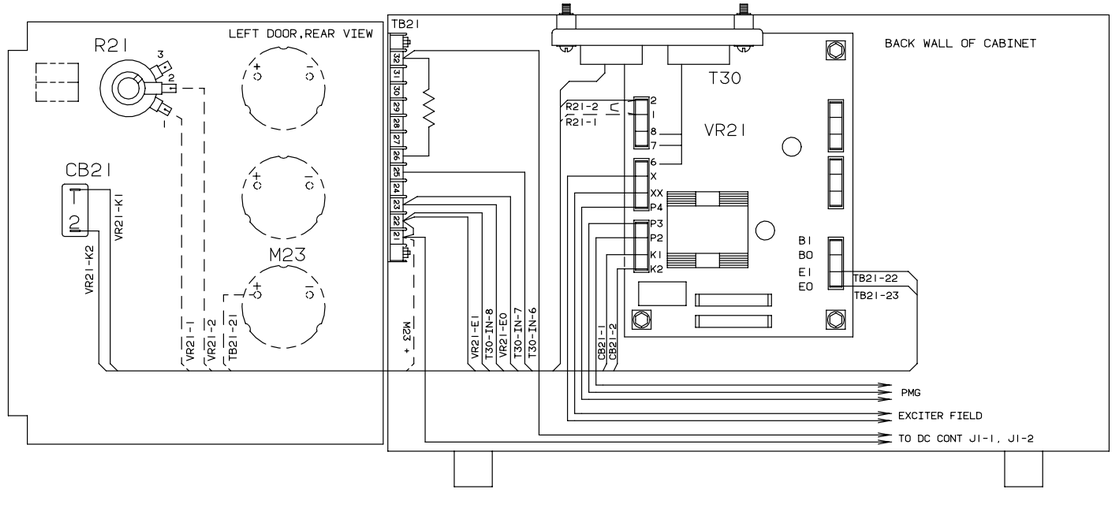
(–05 & –06 ALL VOLTAGES)
(–03 & –04, 600 V)



NOTES

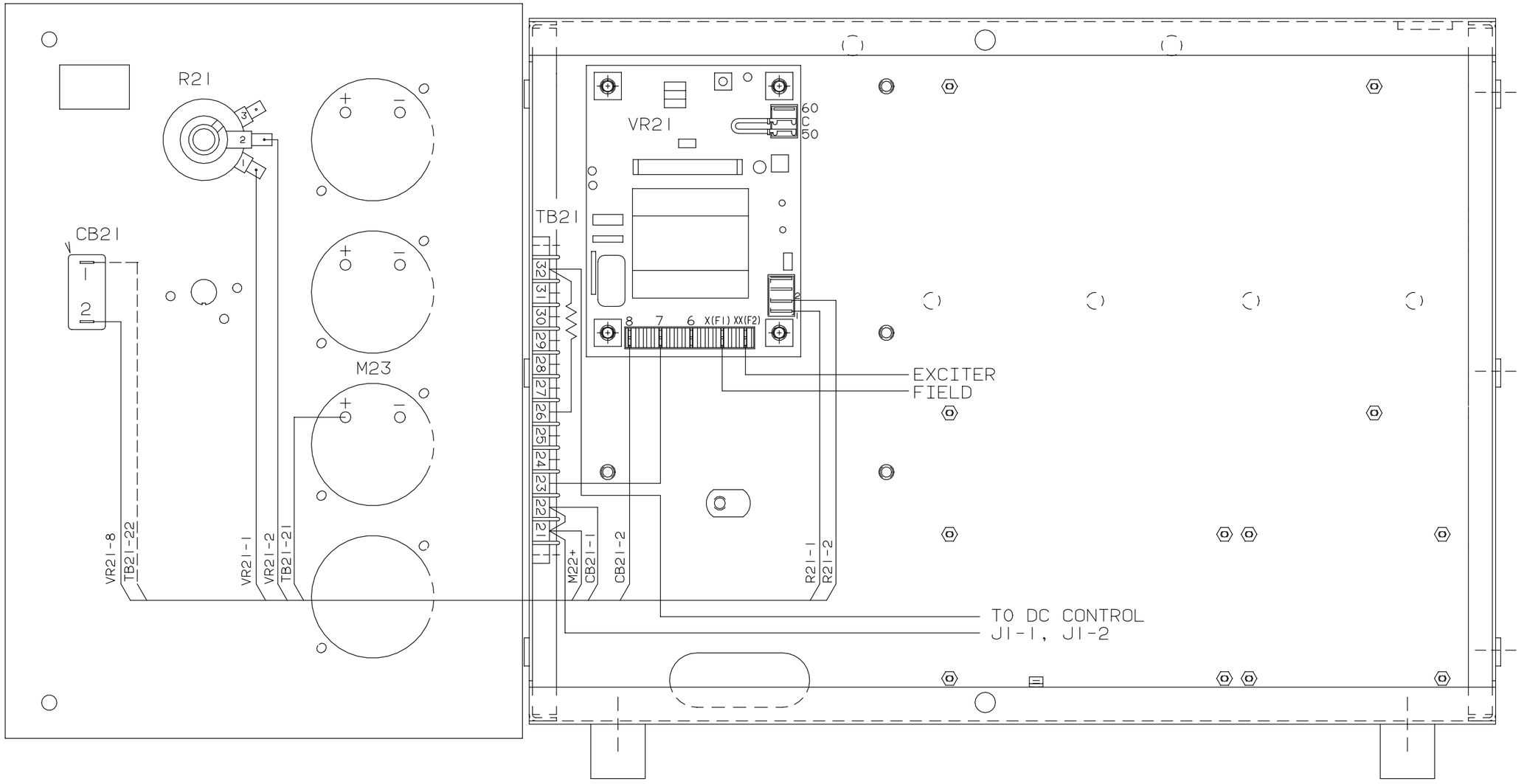
1. DASHED LEADS INDICATE WHEN USED
2. FOR 1∅ GENERATOR OPERATION:
   DISCONNECT LEAD FROM TB21-25
   TO T30-IN-6 AND DISCARD.
   MOVE LEAD END ON T30-OUT-6 TO VR21-8.
3. –01, –03 & –05: NO AC METERS.
   –02, –04 & –06: WITH AC METERS.
4. PMG NOT USED WITH AVR SX421: –05 & –06.

(–01 & –02, <600 V)

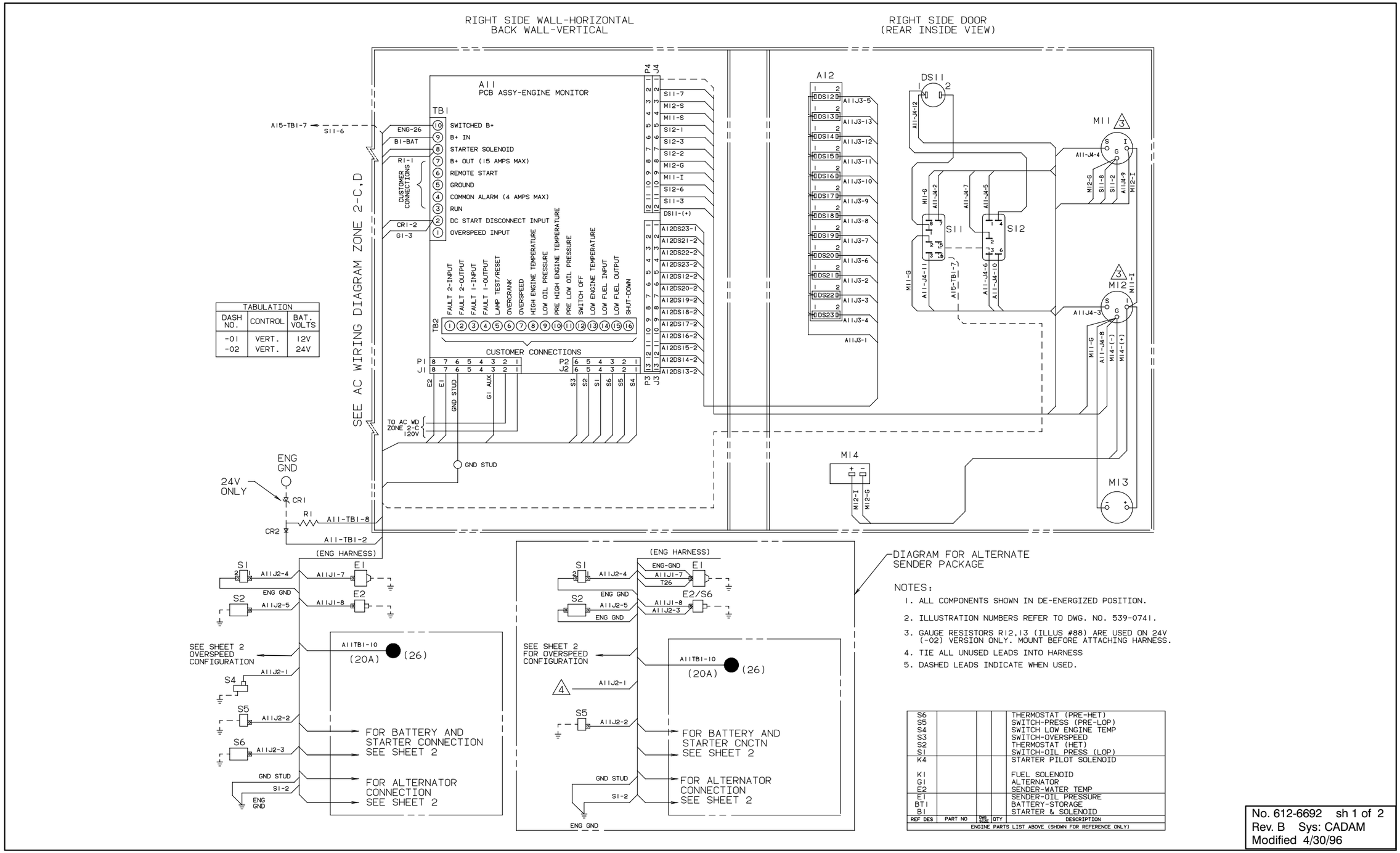


MX321
SX421

No. 300-4890 sh 1 of 1
Rev. D Sys: CADAM
Modified 10/24/96



No. 300-4830 sh 1 of 1
Rev. E Sys: CADAM
Modified 10/24/96



TABULATION		
DASH NO.	CONTROL	BAT. VOLTS
-01	VERT.	12V
-02	VERT.	24V

DIAGRAM FOR ALTERNATE SENDER PACKAGE

NOTES:

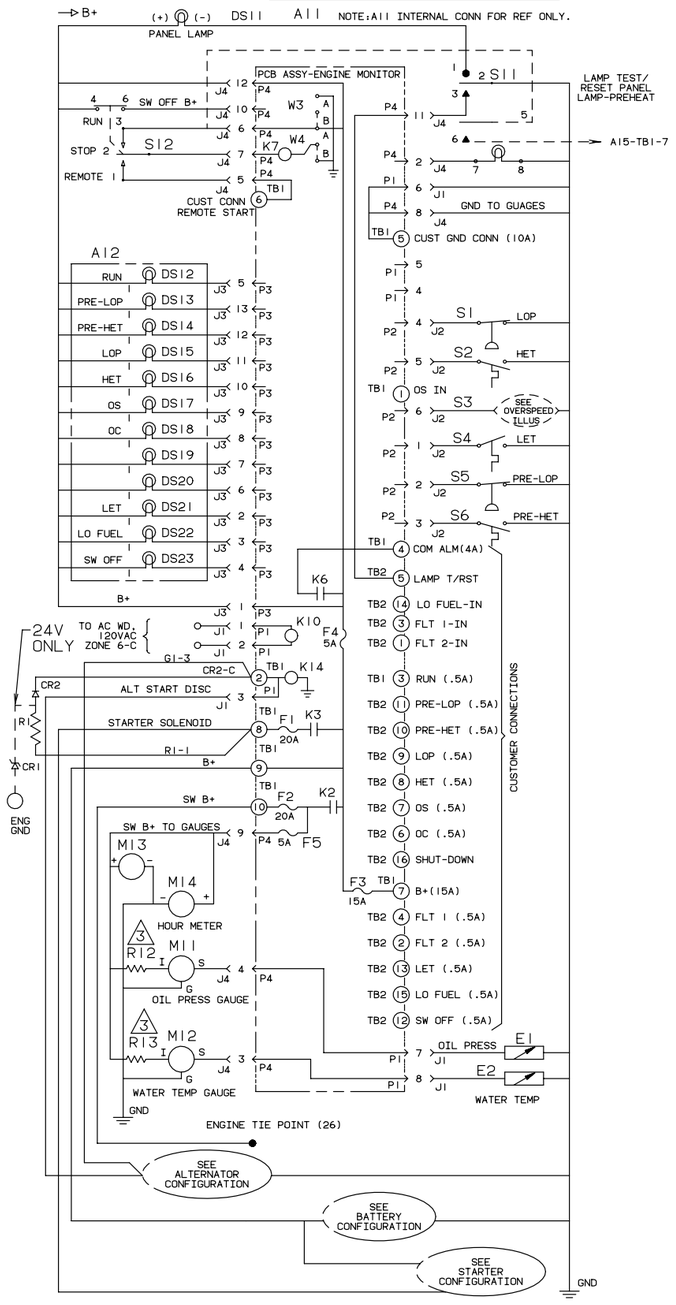
1. ALL COMPONENTS SHOWN IN DE-ENERGIZED POSITION.
2. ILLUSTRATION NUMBERS REFER TO DWG. NO. 539-0741.
3. GAUGE RESISTORS R12,13 (ILLUS #88) ARE USED ON 24V (-02) VERSION ONLY. MOUNT BEFORE ATTACHING HARNESS.
4. TIE ALL UNUSED LEADS INTO HARNESS
5. DASHED LEADS INDICATE WHEN USED.

REF DES	PART NO	DWG 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
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)				

No. 612-6692 sh 1 of 2
Rev. B Sys: CADAM
Modified 4/30/96

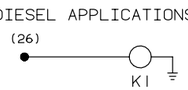
DC CONTROL WIRING DIAGRAM, SHEET 1

SCHEMATIC DIAGRAM

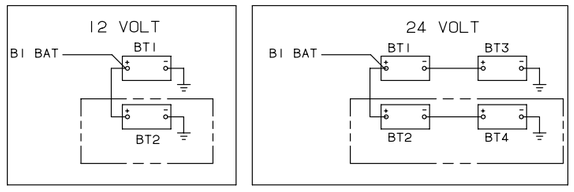


IGNITION SYSTEMS

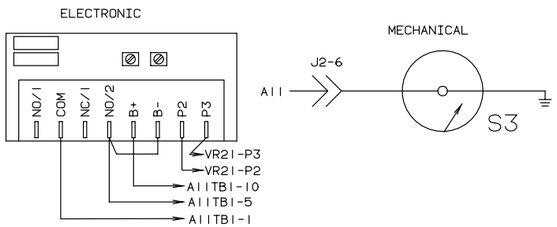
DIESEL APPLICATIONS



BATTERY CONFIGURATIONS

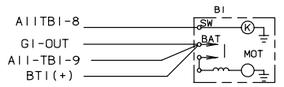


OVERSPEED CONFIGURATION

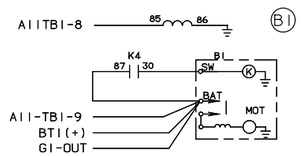


STARTER CONFIGURATIONS

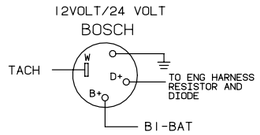
SOLENOID SHIFT "C" BLOCK
12VDC/24VDC



SOLENOID SHIFT "B" BLOCK
12VDC/24VDC



ALTERNATOR CONFIGURATIONS



No. 612-6692 sh 2 of 2
Rev. B Sys: CADAM
Modified 5/1/96

DC CONTROL WIRING DIAGRAM, SHEET 2

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)

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*

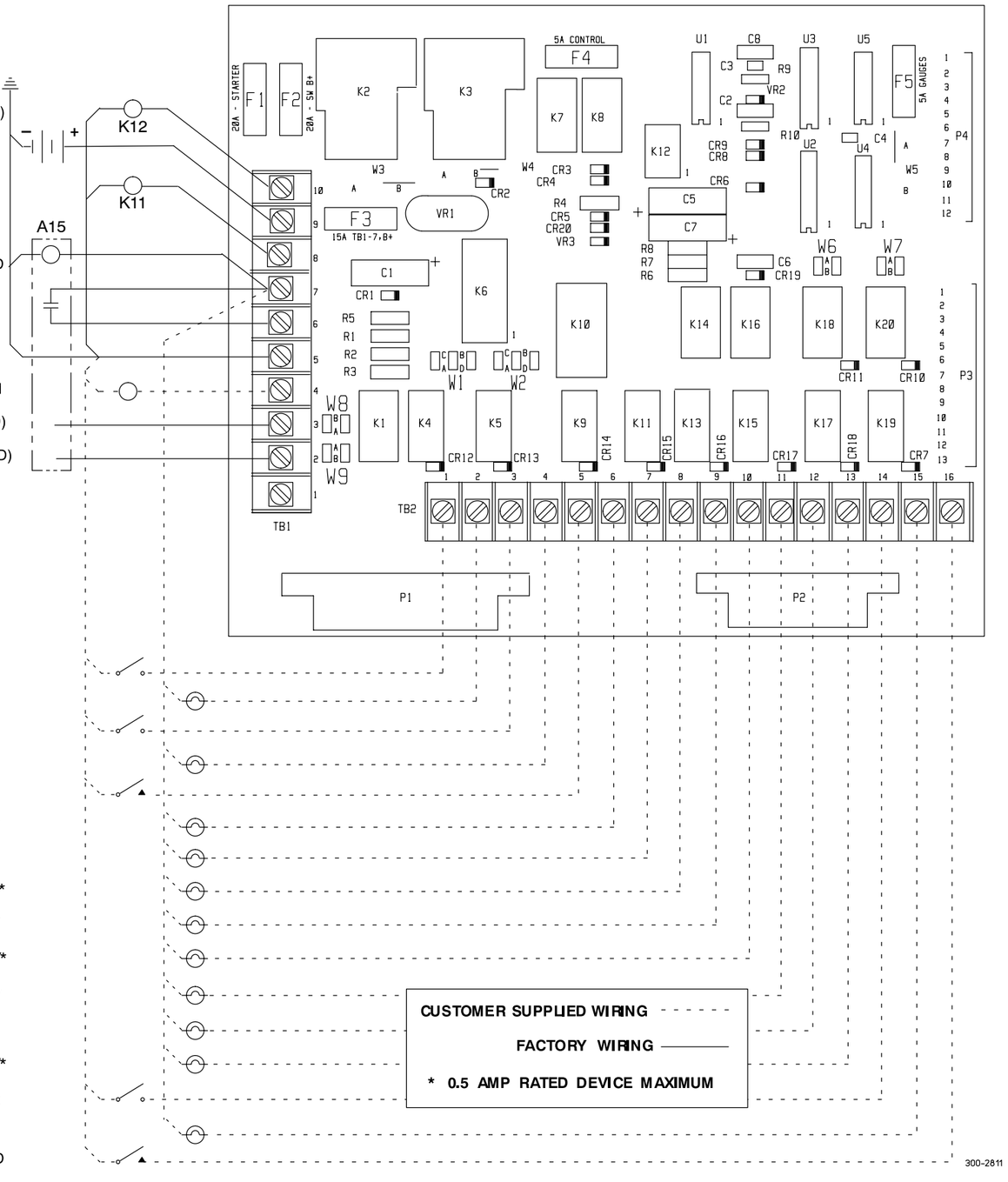
TB2-12 (SWITCH OFF WARNING) GROUND OUTPUT TO LIGHT/RELAY*

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

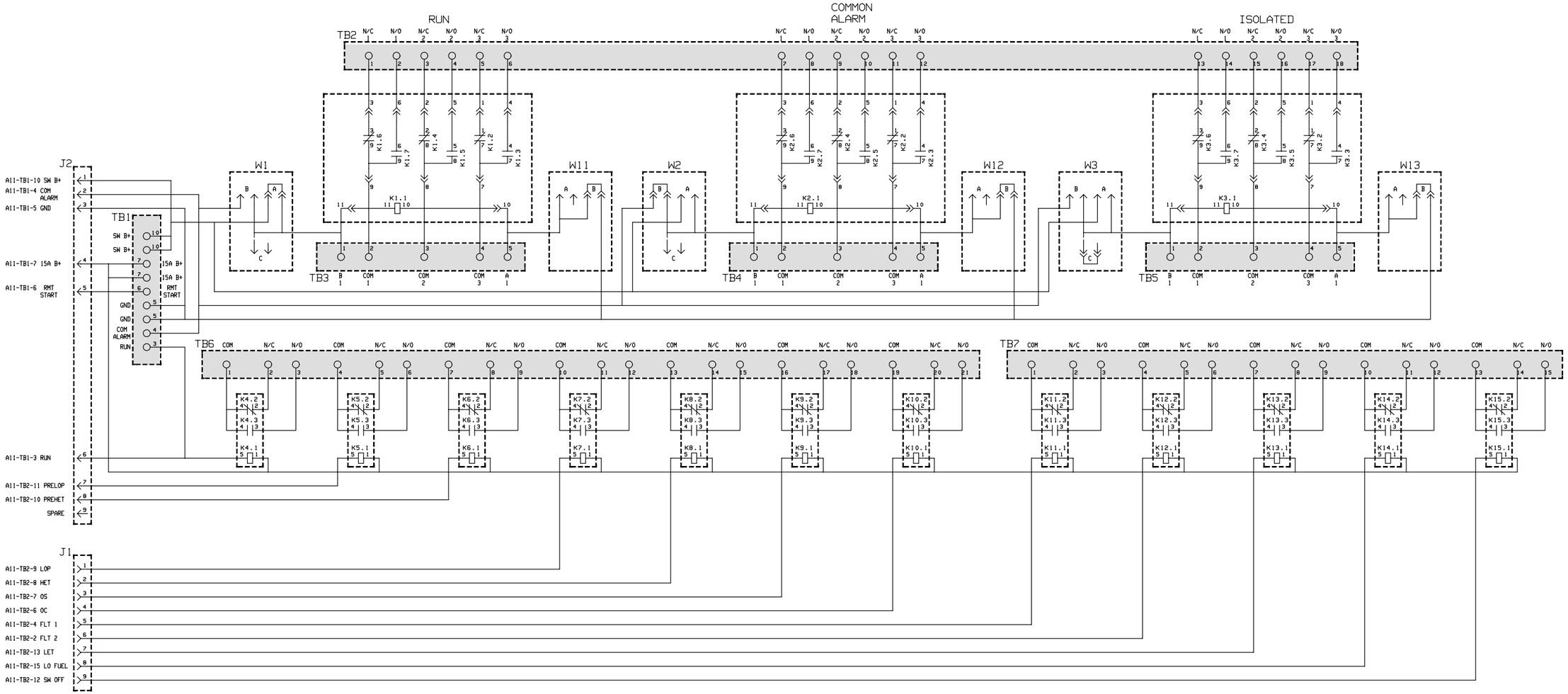
TB2-14 (LOW FUEL WARNING) GROUND INPUT FROM SENDER

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

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



TYPICAL CUSTOMER CONNECTIONS AT THE ENGINE CONTROL MONITOR (ECM)



THE TERMINALS IN THE SHADED BOXES ARE FOR CUSTOMER CONNECTIONS

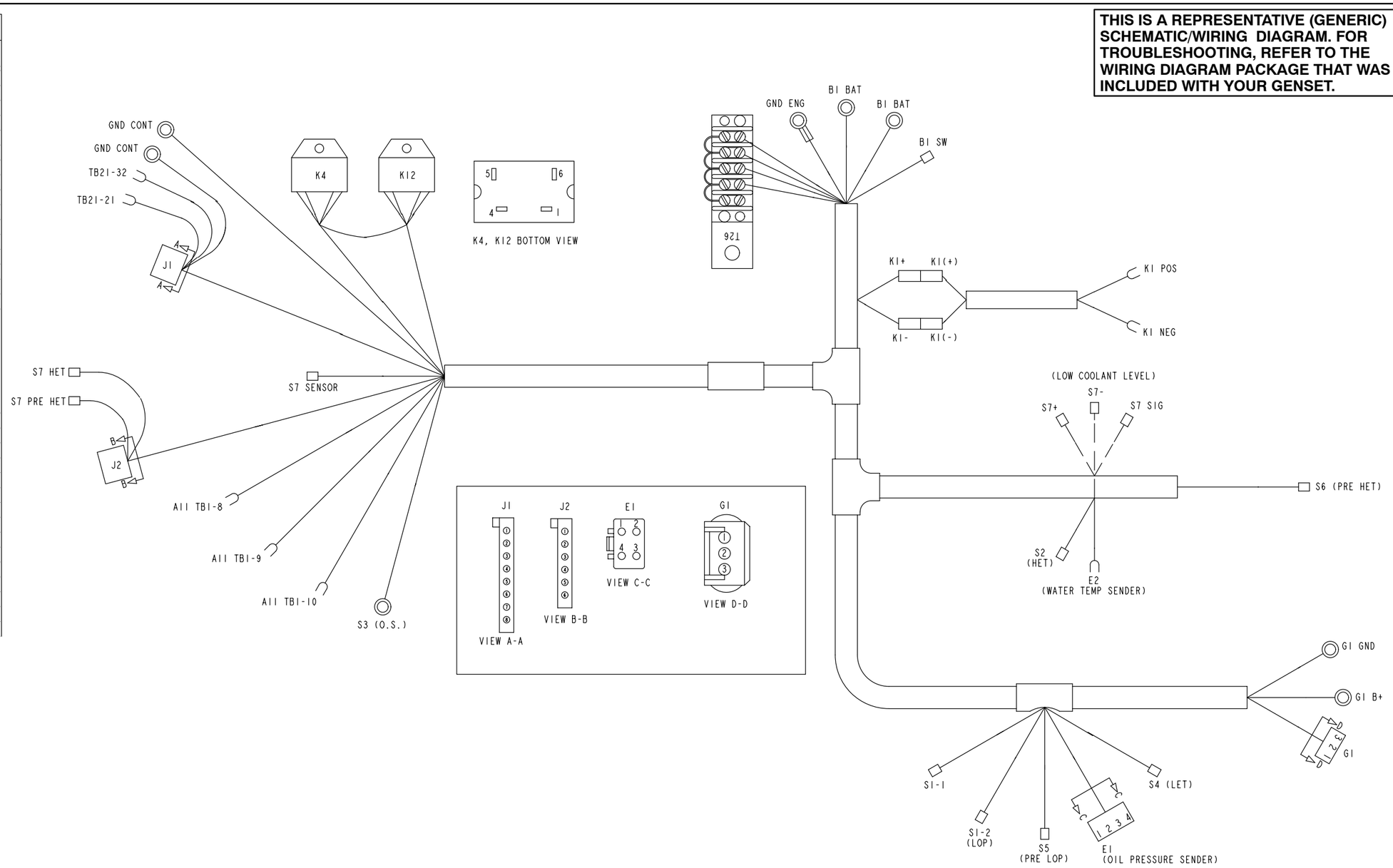
THIS IS A REPRESENTATIVE (GENERIC) SCHEMATIC/WIRING DIAGRAM. FOR TROUBLESHOOTING, REFER TO THE WIRING DIAGRAM PACKAGE THAT WAS INCLUDED WITH YOUR GENSET.

LEAD TABULATION

FROM	TO
J1-1	TB21-21
J1-2	TB21-32
J1-5	CR1-A
J1-6	GND CONT
J1-7	E1-4
J1-8	E2 ENG TEMP
J2-1	S4 LET
J2-2	S5 PRE LOP
J2-3	S6 PRE HET
	S7 PRE HET
J2-4	S1-1 LOP
J2-5	S2 HET
	S7 HET
J2-6	S3 O.S.
K4-6	A11 TB1-8
K4-4	B1 SW
K1-	ENG GND
GND CONT	
E1-2	
S7-	
G1 GND	
S1-2 LOP	
K4-5	
	K12-5
K1+	K12-4
A11 TB1-10	K12-6
	T26
G1-2	T26
S7+	T26
E1-1	T26
G1 B+	B1 BAT
K4-1	B1 BAT
K4-1	K12-1
A11 TB1-9	K12-1
CR1-C	G1-1
S7 SENSOR	S7 SIG
K1 (+)	K1 POS
K1(-)	K1 NEG

KEY

A11	ENGINE MONITOR BOARD
A12	GOVERNOR
B1	STARTER AND SOLENOID
BAT	BATTERY
CR1	DIODE-ZENER
E1	OIL PRESSURE SENDER
E2	WATER TEMP SENDER
G1	ENGINE ALTERNATOR
K1	FUEL SOLENOID
K4	STARTER RELAY
K12	FUEL SOLENOID RELAY
S1	LOW OIL PRESSURE
S2	HIGH ENGINE TEMP
S3	OVERSPEED SWITCH
S4	LOW ENGINE TEMP
S5	PRE LOW OIL PRESSURE
S6	PRE HIGH ENGINE TEMP
S7	LOW COOLANT SENDER
T26	SWITCHED B+ TERMINAL



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Rev. A
Modified 10-01

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