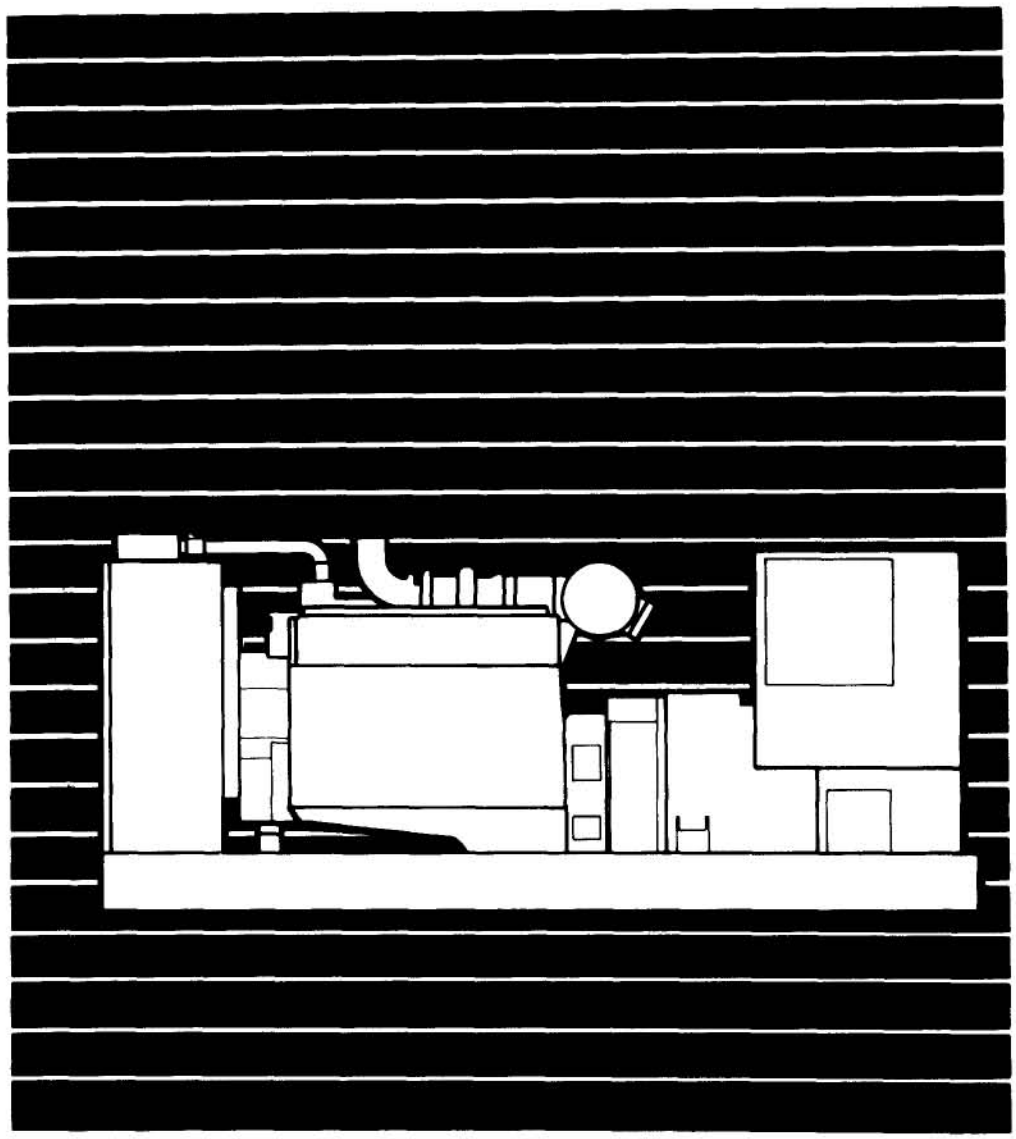
Cummins Onan

Service Manual

MODEL SERIES

DGAB	DL4	4A2.3-GS	QSA3
DGAC	DL6	6A3.4-GS	QSA4
DGAD	DL6T	6AT3.4-GS	QSA6
DGAE			

GENERATOR AND DETECTOR CONTROL



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934-0502 3-91

Safety Precautions

Before operating the generator set, 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 and explosion 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, 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 copper piping on flexible lines as copper will become brittle if continuously vibrated or repeatedly bent.
- Be sure all fuel supplies have a positive shutoff valve.
- Do not smoke while servicing lead acid batteries. Lead acid batteries emit a highly explosive hydrogen gas that can be ignited by electrical arcing or by smoking.

EXHAUST GASES ARE DEADLY

- Provide an adequate exhaust system to properly expel discharged gases. Visually and audibly inspect the exhaust daily for leaks per the maintenance schedule. Ensure that exhaust manifolds are secured and not warped. Do not use exhaust gases to heat a compartment.
- Be sure the unit is well ventilated.

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 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. Jewelry can short out electrical contacts and cause shock or burning.
- If adjustment must be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

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.
- 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 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.
- Benzene and lead, found in some gasoline, have been identified by some state and federal agencies as causing cancer or reproductive toxicity. When checking, draining or adding gasoline, take care not to ingest, breathe the fumes, or contact gasoline.
- 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.
- Provide appropriate fire extinguishers and install them in convenient locations. Consult the local fire department for the correct type of extinguisher to use. Do not use foam on electrical fires. Use extinguishers rated ABC by NFPA.
- Make sure that rags are not left on or near the engine.
- 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.

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Section 1. Introduction

ABOUT THIS MANUAL

For servicing purposes, the genset can be divided into three basic parts: engine, generator, and control. This manual contains troubleshooting and repair information for the generator and control. Refer to the applicable Engine Service Manual for servicing the engine.

Study this manual carefully and observe all warnings and cautions. It is extremely important that the genset installation maintain compliance with the applicable codes and standards. The most critical areas of concern include the exhaust system, fuel system, electrical wiring, and ventilation system. Improper servicing can create an unsafe installation that can result in damage to the equipment or can cause severe personal injury or death to the users.

Refer to the genset Operators's Manual as an additional source of information. This Service Manual covers many models, and the components and options listed might not apply to all models.

Always use genuine Onan replacement parts obtained from an authorized Onan Dealer or Distributor. Universal replacement parts may look similar but might not perform to Onan specifications. Only genuine Onan replacement parts are designed and tested for the application to provide reliable service and dependable operation.

Information for printed circuit board repair is limited. The solid state boards lend themselves more to field replacement than repair. Application of meters or hot soldering irons to printed circuit boards by other than qualified personnel can cause unnecessary and expensive damage. Repair of the printed circuit boards is not recommended.

HOW TO OBTAIN ASSISTANCE

When seeking additional service information or replacement parts, always give the complete model and serial number as shown on the genset data tag or nameplate. The genset data tag or nameplate is on the A.C. output box.

TEST EQUIPMENT

Most of the test procedures in this manual can be performed with a multimeter like the Simpson Model 260 VOM, or a digital VOM. Other instruments that should be available are:

AC Voltmeter
DC Voltmeter
Frequency Meter
Jumper Leads
Load Test Panel
Variac
Tachometer or Strobotach
Megger or Insulation Resistance Meter
Wheatstone Bridge or Digital Ohmmeter

See Onan Tool Catalog 900-0019.

⚠WARNING

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

Section 2. AC Control

CONTROL DESCRIPTIONS

The control cabinet has an AC panel for generator-related components on the left side, Figure 2-1. A DC panel for engine-related components is on the right side (see Section 3, DC Control).

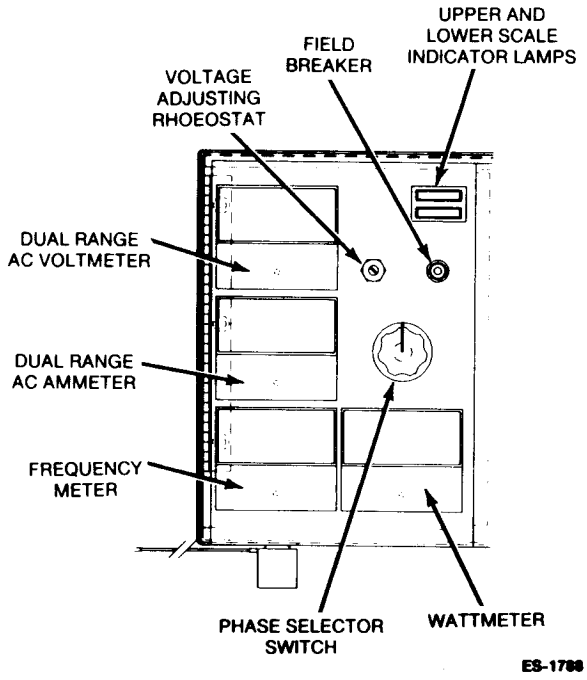


FIGURE 2-1. AC CONTROL PANEL

The components shown in Figure 2-1 are optional, except for the field breaker. They are as follows:

AC Voltmeter: Dual range instrument indicating generator AC voltage. Measurement range in use shown by the indicator lamp.

AC Ammeter: Dual range instrument indicating generator AC current. Measurement range in use shown by the indicator lamp.

Frequency Meter: Indicates generator output frequency in hertz. It can be used to check engine speed (each hertz equals 30 r/min).

Wattmeter (optional): Indicates generator output in kilowatts.

Voltage Adjust: Rheostat providing about plus or minus five percent adjustment of the rated output voltage.

Field Breaker: Provides generator exciter and regulator protection from overheating in the event of a failure mode of the generator, exciter, and voltage regulator.

Phase Selector Switch: Selects phases of generator output measured by AC voltmeter and AC ammeter.

Upper and Lower Scale Indicator Lamps: Indicates which scale to use on the AC voltmeter and ammeter.

CONTROL PANEL INTERIOR

The following describes the internal components and their function.

Voltage Regulator

The voltage regulator circuit is connected directly to the AC generator. Because it regulates excitation in response to generator output, the regulator is covered in detail in Section 6, Generator and Voltage Regulator.

Control Heater

The optional control heater provides a means of humidity/temperature control for the control box interior. The heater protects the components from varying environmental conditions during extended periods of nonuse. The heater element is controlled by an adjustable thermostat. See Figure 2-2. The resistance of the element is 192 ohms, and dissipates 75 watts at 120 VAC.

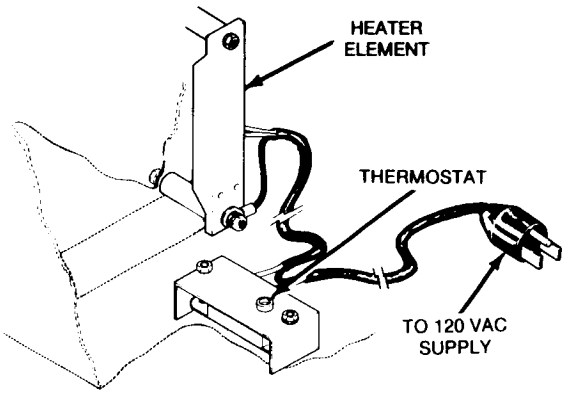


FIGURE 2-2. TYPICAL CONTROL HEATER

Section 3. DC Control

CONTROL DESCRIPTIONS

A typical DC control panel with options is shown in Figure 3-1. The right side DC panel is for engine-related components, and the left side AC panel is for generator-related components (see Section 2, AC Control).

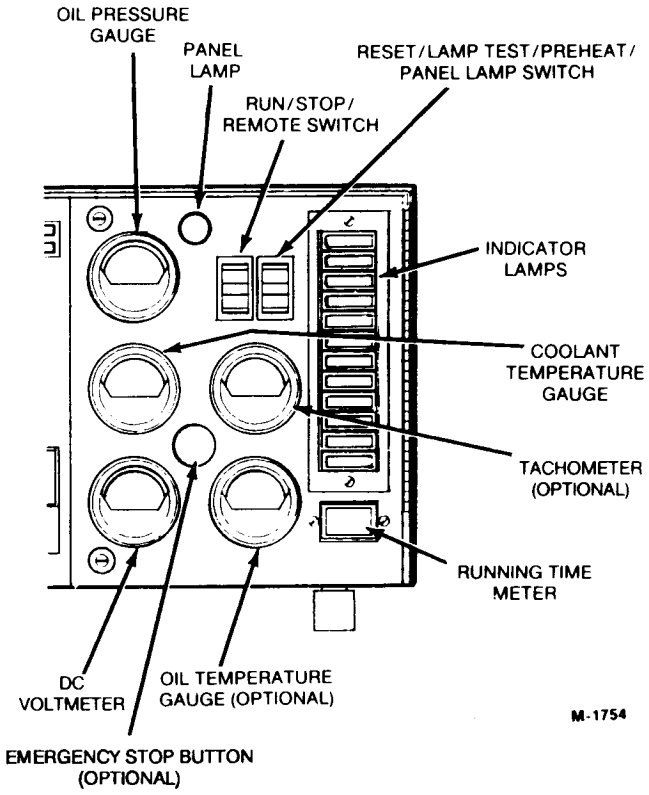


FIGURE 3-1. DC CONTROL PANEL

The components shown in Figure 3-1 are standard unless identified as optional in the following descriptions. The panel has 4, 7, 10 or 12 indicator lamps.

Oil Pressure Gauge: Indicates lubricating oil pressure in the engine (wired to a sensor unit on the engine).

Water Temperature Gauge: Indicates temperature of circulating coolant in the engine (wired to a sensor unit on the engine).

Battery Charge Rate DC Voltmeter: Indicates the battery charging voltage.

Oil Temperature Gauge (Optional): Indicates temperature of lubricating oil in the engine (wired to a sensor unit on the engine).

Tachometer (Optional): Provides constant monitor of engine r/min.

Speed Adjust Potentiometer (Optional): Operator control for adjusting engine speed (available only with optional electronic governor).

Run/Stop/Remote Switch: Starts and stops the genset locally, or from a remote location wired to the control engine monitor board.

Preheat, Lamp Test, Reset/Panel Lamp Switch: Multiple function switch used to provide momentary warm-up of glow plugs, test the fault lamps, and reset the fault circuits when the Run/Stop/Remote switch is in the stop (reset) position. This switch is also used to turn on the control panel lamp. Some models might not have the preheat function.

Emergency Stop Switch (Optional): Round, red, push/-pull switch used for stopping the genset when pushed in. Pull out to reset.

Running Time Meter: Registers the total number of hours that the genset has run. Use it to keep a record for periodic servicing. Time is cumulative and cannot be reset.

Control Panel Lamp: Convenience lamp that illuminates control panel for the operator.

Indicator Lamps

Depending on the genset model and the options ordered, the control might have a 4-, 7-, 10-, or 12-lamp monitoring system. Refer to the applicable lamp descriptions that follow. Red lamps when lit indicate genset shutdown.

- RUN (green) This lamp comes on when both starter-disconnect circuits are opened after genset start.
- PRE LO OIL PRES (yellow) Indicates engine oil pressure is marginally low.
- PRE HIGH ENG TEMP (yellow) Indicates engine temperature is marginally high.
- LOW OIL PRES (red) Indicates engine has shut down because of critically low oil pressure.
- HI ENG TEMP (red) Indicates engine has shut down because of critically high engine temperature, or a low coolant level.
- OVERSPEED (red) Indicates engine has shut down because of excessive speed.
- OVERCRANK (red) Indicates the starter has been locked out because of excessive cranking time.

- LOW ENG TEMP (yellow) Indicates the engine temperature is marginally low for starting. Indicates inoperative coolant heater on gensets with this option.
- LO FUEL (yellow) Indicates fuel supply is marginally low.
- SWITCH OFF (flashing red) Indicates genset is not in automatic start operation mode.
- FAULT 1 (red) A customer installed auxiliary equipment fault switch. The lamp is part of the timed factory-set (10 second) shutdown circuit.
- FAULT 2 (red) A customer installed auxiliary equipment fault switch. The lamp is part of the factory set, non-timed delayed shutdown circuit.

CONTROL PANEL INTERIOR

The following describes the engine control components and how they function (Figures 3-1, 3-2). Some of the following descriptions may not apply depending on options included on each individual control system.

Engine Control Monitor (ECM-A11)

This solid state printed circuit board monitors basic engine control system functions (Figure 3-3). This includes starting, stopping, and fault system operation. Terminal blocks are included for making remote connections and adding further control options.

The ECM provides the following functions for genset protection:

Overcrank: Limits engine cranking to 75 seconds. If engine fails to start, the module lights a fault lamp and opens the cranking circuit. The cycle cranking option allows three 15-second cranking cycles with two 15-second rest periods on 10- and 12-light controls.

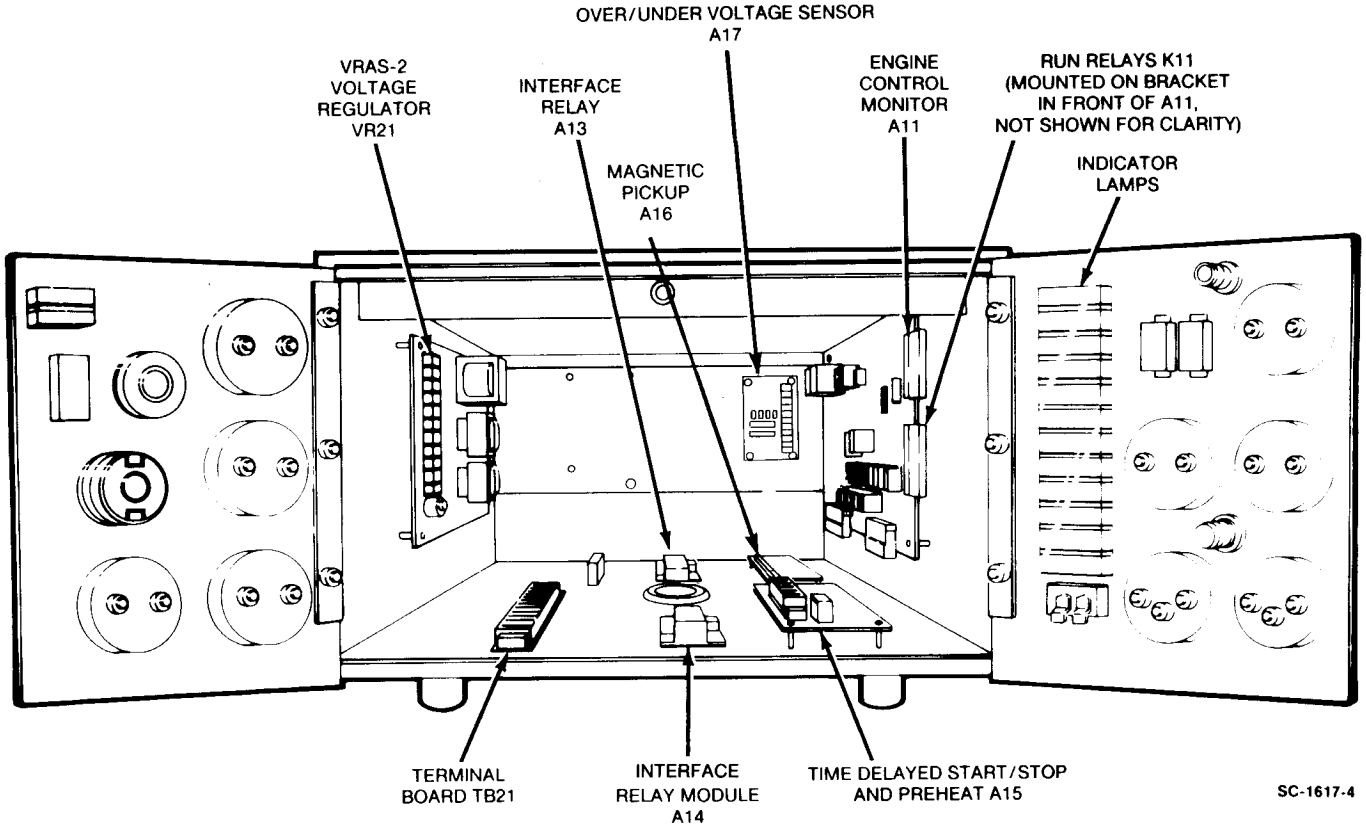


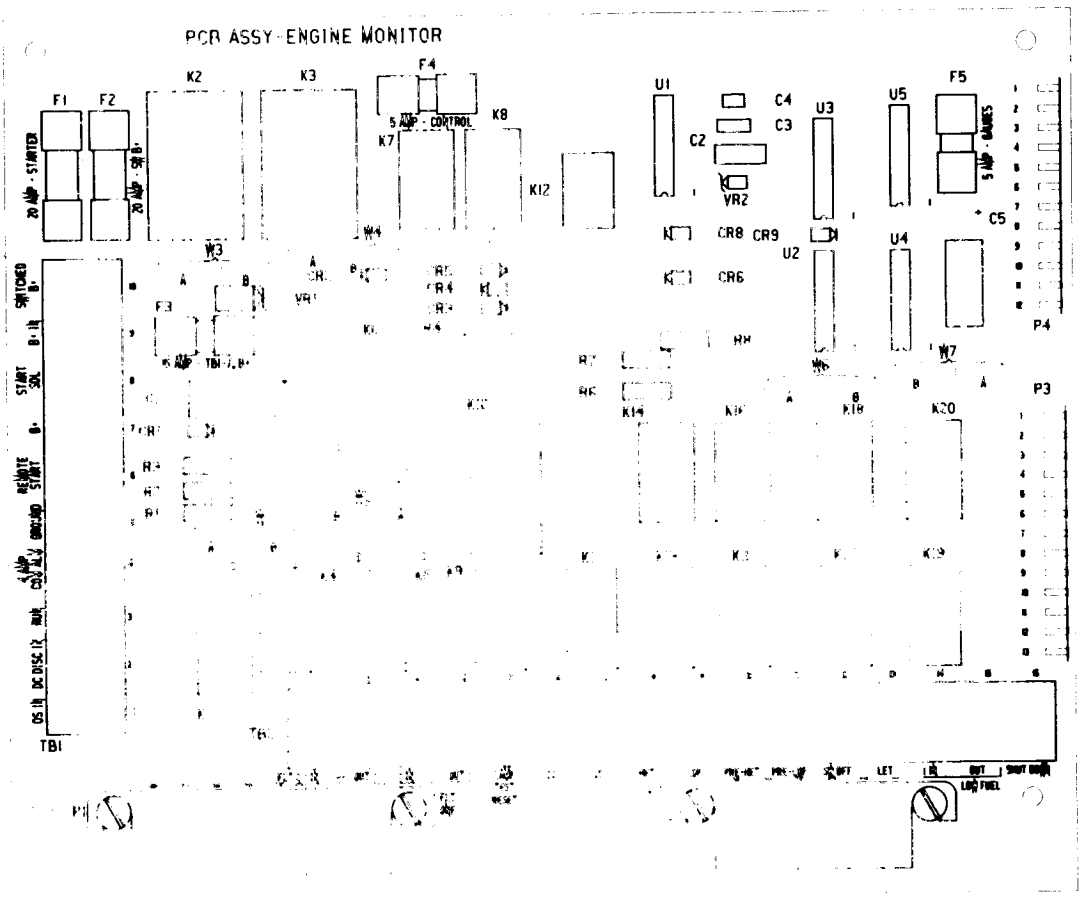
FIGURE 3-2. CONTROL INTERIOR (WITH OPTIONS)

Overspeed: Shuts down the engine immediately if overspeed occurs and turns on the fault lamp. The sensor switch is mounted in the end bell on the generator shaft. It is factory adjusted to shut down 1800 r/min gensets at 2200 ±100 r/min, and 1500 r/min gensets at 1900 ±100 r/min.

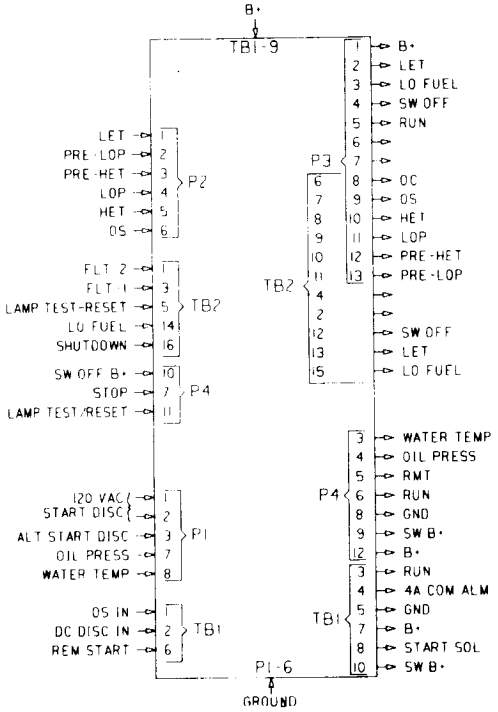
Low Oil Pressure: Shuts down the engine immediately if oil pressure drops below 14 psi (97 kPa) and turns on a fault lamp. The fault is time delayed about 10 seconds following starter disconnect and is inhibited during cranking. The delay allows oil pressure to rise to normal before the electronic control module monitors the pressure.

Pre-Low Oil Pressure: Sensor and lamp option provides an alarm indicating that oil pressure is marginally low, 20 psi (138 kPa) or less. The cause should be found and corrected as soon as possible. This fault is delayed with low oil pressure function.

High Engine Temperature: Shuts down the engine immediately if coolant temperature rises above 222°F (106°C) and turns on a fault lamp. The fault is time delayed about 10 seconds following starter disconnect and is inhibited during cranking. This delay allows coolant in a hot engine time to circulate and return the water jacket temperature to normal before the electronic control module monitors the system.



BLOCK DIAGRAM



TB1-6 IS SIGNAL MODE SELECTABLE AS FOLLOWS:

W3 & W4 POSITION	REMOTE START SIGNAL
A	GND TO START
B	B+ TO START

P2-2&3 ARE FUNCTION MODE SELECTABLE AS FOLLOWS

P2-2:W7	P2-3:W6 POSITION	FUNCTION MODE
	A	NON-SHUTDOWN
	B	SHUTDOWN

FIGURE 3-3. ENGINE CONTROL MONITOR

Pre-High Engine Temperature: Sensor and lamp option provides an alarm that engine temperature is marginally high, 202°F (94°C). The cause should be found and corrected as soon as possible. This fault is delayed with the high engine temperature function.

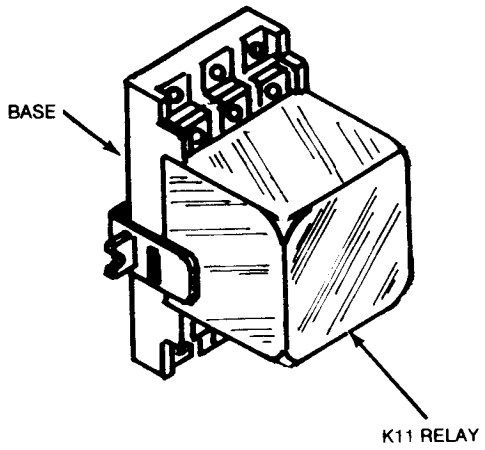
⚠CAUTION ***The high engine temperature shutdown system will not operate if coolant level is low, and the engine does not have the low coolant sensor option. The high engine temperature sensor monitors coolant temperature. Loss of coolant will prevent sensor operation and allow the engine to overheat and cause severe engine damage. Therefore, maintain adequate coolant level for proper operation of the high engine temperature shutdown system.***

Low Coolant Level - an optional solid-state sensor/switch that provides engine shutdown if coolant level falls too low. It also turns on the high engine temperature fault lamp.

Low Engine Temperature: Lamp comes on when water jacket temperature is 70°F (21°C) or lower. Lamp turn-on should be no cause for alarm, even during initial genset operation, since the lamp should go out after the coolant warms up. It indicates an inoperative coolant heater on gensets with this option.

Run Relay (K11)

This relay option, Figure 3-4, provides wiring connections for external functions of the site installation. The relay operates functions that are controlled by the starting and/or stopping of the genset such as ventilation air louvres, blowers, etc. The terminals on the relay base provide for either closing or opening a circuit upon energizing or de-energizing. The run relay is energized when the genset starts by connecting it to the ECM switched B+ terminal TB1-10. Up to three run relays can be used to operate external functions.



K11 BLOCK DIAGRAM

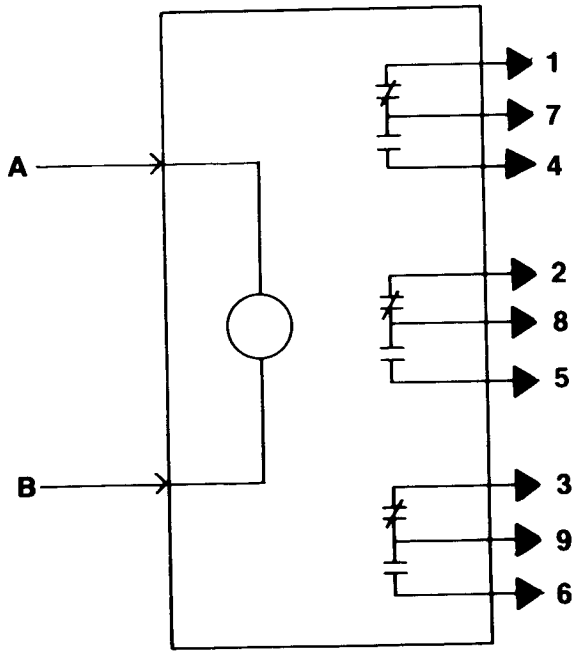


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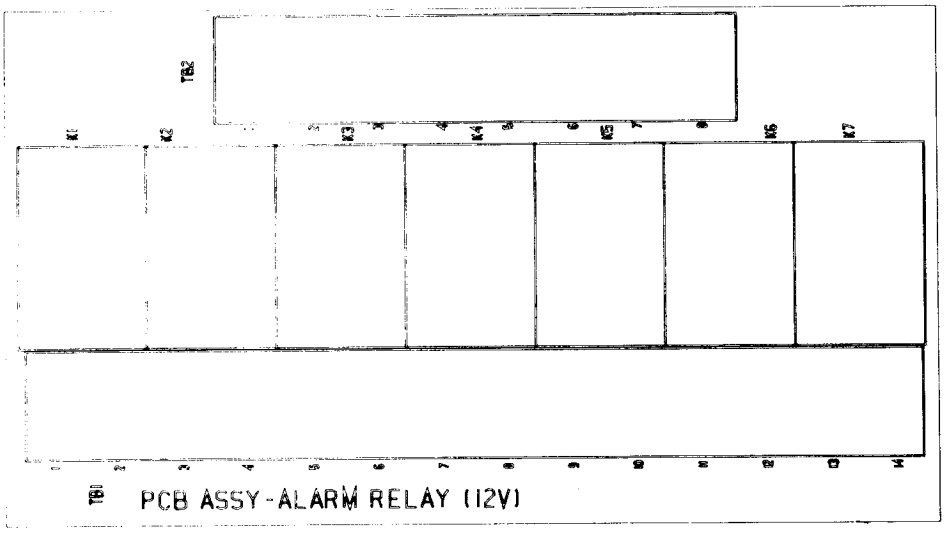
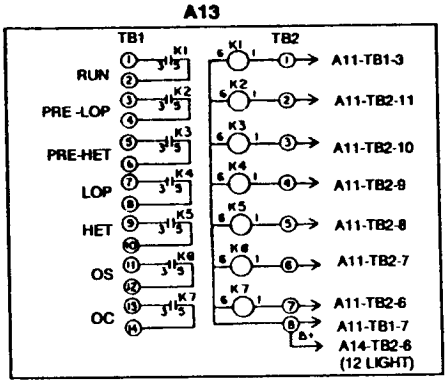
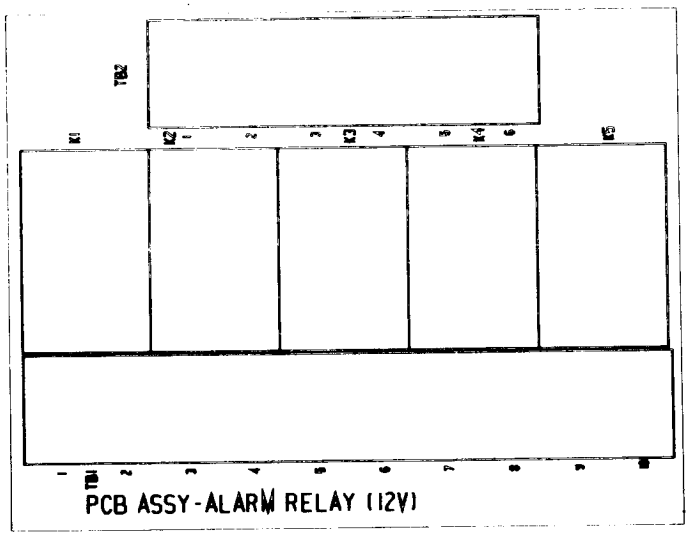
FIGURE 3-4. RUN RELAY

Interface Relay Modules (A13, A14)

These optional relay modules are used to provide external monitoring of the genset at the customers control panel (Figure 3-5). As add-on circuit boards, they interface with the remote annunciator signals from the engine control monitor and allow the use of either AC or DC for alarm drives. The relays are configured for low side switching by the control and supply sets of contacts for external alarm connections.







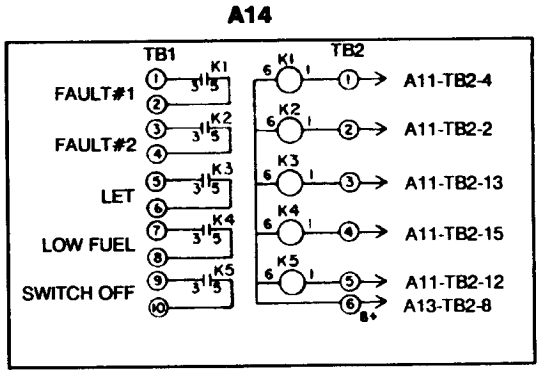
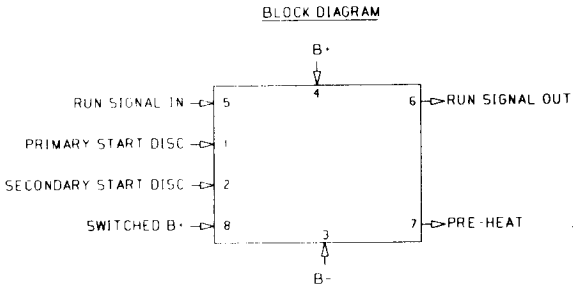


FIGURE 3-5. INTERFACE RELAY MODULES



TERMINAL #5 IS SIGNAL MODE SELECTABLE AS FOLLOWS

W1 & W2 POSITION	RUN SIGNAL IN MODE
A	GND TO RUN
B	B+ TO RUN

Time Delayed Start/Stop, and Preheat Module (A15)

This optional module includes the preheat feature with the time delayed start/stop option. See Figure 3-6. The functions are as follows.

Preheat: The preheat circuit provides a signal during time delayed start and during cranking to activate the engine glow plugs.

Delayed Starting: The time delay start function precludes automatic start-up of the genset for a determined amount of time (adjustable from 1 to 15 seconds). It is used for installations that might experience power interruptions of short duration, and not want the genset to start.

Delayed Stopping: The time delay stop function (adjustable from 1 to 15 minutes) provides for automatic cool-down running of the genset for a preset amount of time (approximately 3 to 5 minutes is recommended).

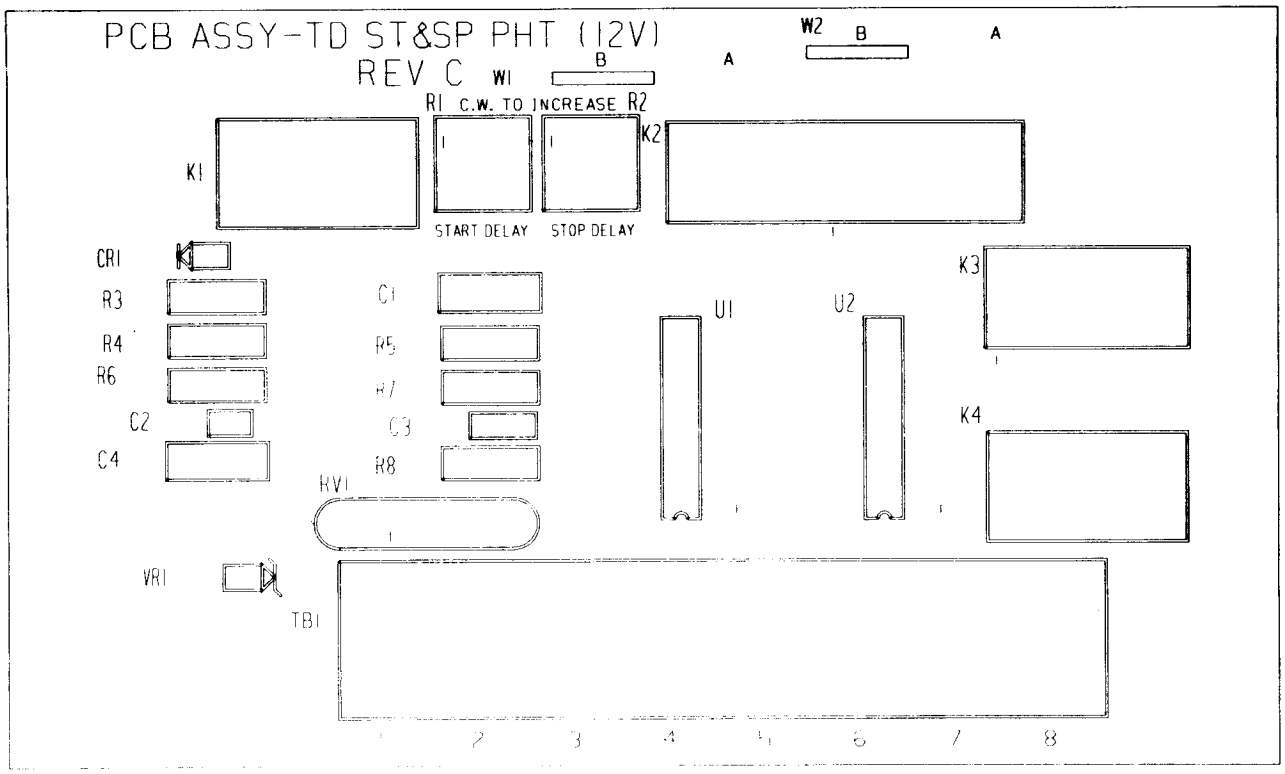


FIGURE 3-6. PREHEAT MODULE WITH OPTIONAL TIME DELAYED START/STOP

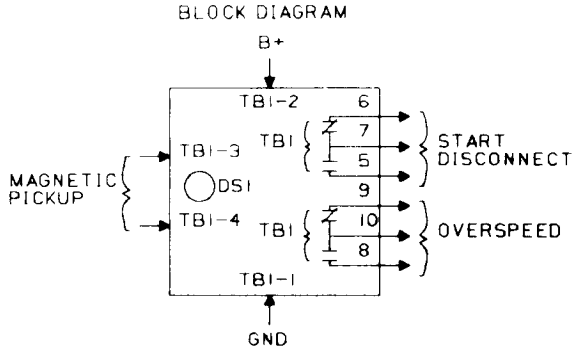
Magnetic Pickup Interface Module (A16)

The optional magnetic pickup module, Figure 3-7, senses engine speed and provides a starter disconnect signal and an engine overspeed signal. Engine speed is sensed using a magnetic pickup mounted on the end-bell and a toothed wheel mounted on the rotor shaft. A signal LED (DS1) provides an indication that a usable input signal is received from the magnetic pickup.

The magnetic pick-up module is designed to operate at the following preset output values:

- ***Start Disconnect:*** 510 ±60 r/min
- ***Overspeed Trip Point:*** 2200 r/min ±8 percent for 50 or 60 Hz.

The starter reconnect value is from 0 to 30 r/min, and the overspeed reconnect is 50 percent of the trip point.



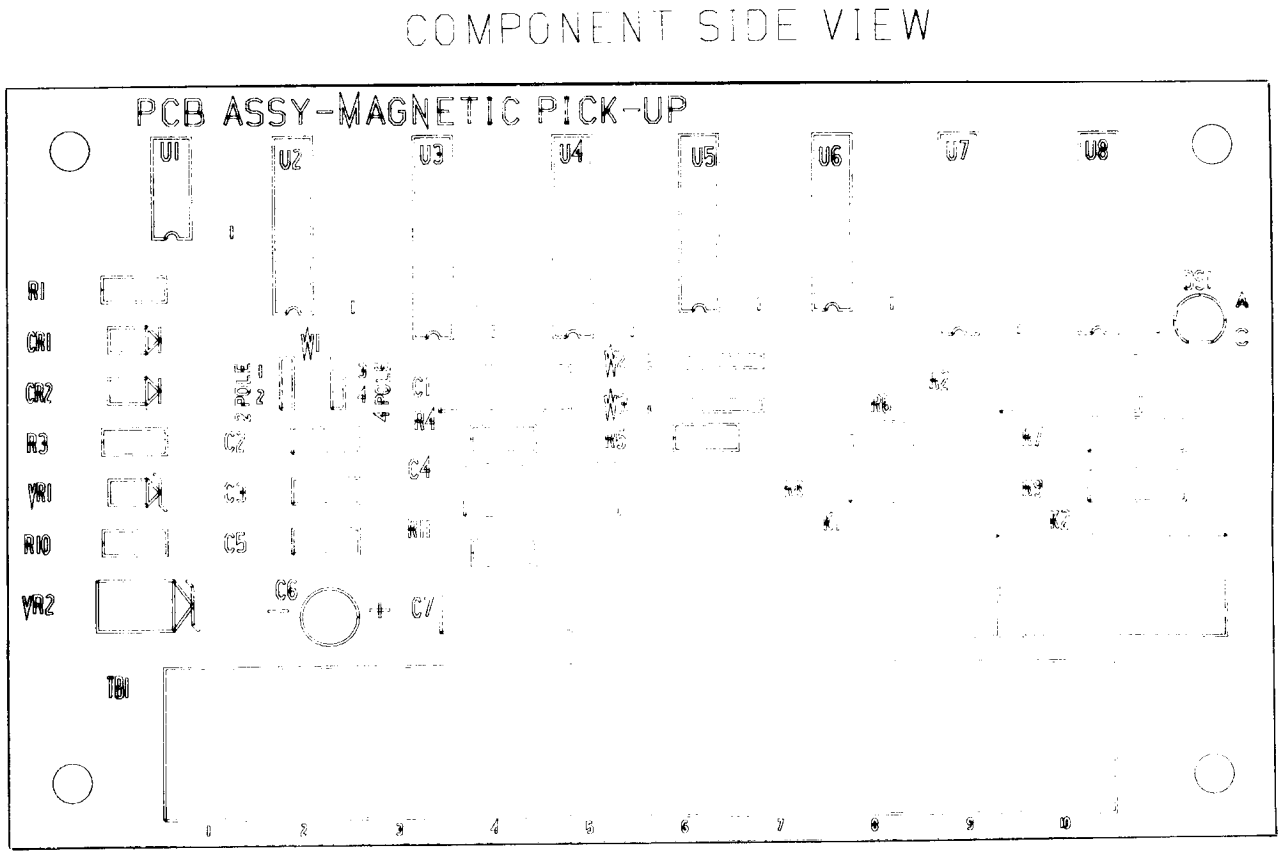


FIGURE 3-7. MAGNETIC PICKUP INTERFACE MODULE

CONTROL OPERATION

Because of the many different control options and combinations, the following operating descriptions will cover all options. Read the sections that apply to gain a full understanding of the options and how they interact with the ECM (engine control monitor).

If you are reviewing this operation information for troubleshooting purposes, be sure to eliminate all other malfunction checks external to the control prior to troubleshooting the control.

Regardless of the type of control on the set, the ECM includes the shutdown fault commands. Controls with options provide prealarm of the shutdown faults, time delayed starting and stopping, and additional monitoring and control features that are all controlled through the ECM.

Starting Sequence

Manual: For cold weather starting of the genset, the preheat switch S11 (if used) is held in the preheat position for the necessary period of time (30 seconds maximum). This energizes the glow plug solenoid and the plugs. The starting sequence begins by placing the Run/Stop/Remote Switch (S12) in the Run position.

Placing S12 in the Run position energizes the ECM Run Relay (K7). By energizing K7, B+ is supplied through the electrical circuits of the ECM to energize the engine run circuits (i.e. fuel solenoid), front panel gauges, and the starter solenoid (through K3).

The engine cranking period is determined by the Overcrank Timer and Cycle Crank Relay (K12). They control energizing and deenergizing of power relays K2 and K3 that supply current to the starter and fuel solenoids.

Automatic: With S12 in the Remote position, a start command to the control activates the Time Delayed Start/Stop and Preheat Module (A15), which initializes its time delay start and preheat period.

Upon completion of the time delay start/preheat period, the ECM begins the cranking and startup by energizing Run Relay (K7) as described in Manual starting.

After the engine successfully cranks and the starter disconnects, input signals from either start disconnect system of the ECM will activate the Start Disconnect Relay of Module A15 (K1). This deactivates the preheat output and programs the module for Time Delayed Stop mode.

During genset operation, all safety systems function to protect and monitor the genset. At the end of the genset duty cycle, the generator output is disconnected from the load and the remote run signal is discontinued. The time delayed stop function of module A15 will continue the genset run time for the prescribed engine cooldown period of 5 minutes before deactivating the run circuits of the ECM.

Starter-Disconnect Operation

This control requires two means of starter disconnect to protect the starter in case one means should fail. The first uses a DC relay (K14). A B+ signal taken from the battery charging alternator energizes this relay to disconnect the starter. The second method uses an AC relay (K10). Voltage from the generator energizes K10 to provide a back-up to the DC relay.

The control uses this method to provide uninterrupted genset operation even if only one means of start disconnect is operational. However, the local Run lamp does not turn on unless both start disconnect relays operate. If the genset is equipped with a remote Run lamp, the operator can then determine which means of start disconnect has failed for such an occurrence. If the remote Run lamp turns on and the local Run lamp does not, the DC relay is not functioning.

All power paths leaving the ECM are protected by fuses so that the circuit board paths are protected from excessive current. These fuses are described below.

F1 - Starter circuit fuse (20-ampere) protects circuit board, K3 and associated wiring.

F2 - Switched B+ fuse (20-ampere) protects circuit board, K2 and associated wiring.

F3 - B+ out fuse (15-ampere) to protect circuit board.

F4 - Main ECM circuit fuse (5-ampere) to protect circuit board paths and components on the ECM.

F5 - Gauge fuse (5-ampere) to protect circuit board, gauges on the front panel, and all associated wiring.

High Engine Temperature (HET) and Low Oil Pressure (LOP) faults are time delayed about 10 seconds following starter disconnect and are inhibited during cranking. This allows the coolant in a hot engine some time to circulate and return the water jacket to normal temperature before the ECM begins monitoring it. It also allows the oil pressure to build to normal before monitoring this system. Following this delay, these faults become immediate shutdowns for engine protection.

If conditions are correct, the engine will start and the starter will disconnect. If not, the overcrank fault circuit times out to energize Fault Relay (K6). This opens the start circuit of the ECM. The reset switch (S11) must be pushed to clear any fault before attempting to restart.

Start-Disconnect Sequence

When the genset starts, output voltage from the DC alternator, or from the Magnetic Pickup Module, energizes Start-Disconnect relay K14. Relay K14 then closes its normally-open contacts to illuminate the control panel RUN lamp. Also, when the genset starts, output voltage from the generator stator energizes Starter-Disconnect relay K10. Energizing K10 closes its normally-open contacts and illuminates a Remote Run lamp (if equipped).

After the starter disconnects, the LOP and HET fault shutdowns will remain inhibited for another 10 seconds to allow oil pressure and engine temperature to stabilize within the operating range.

Normal Operating Parameters

After a successful engine start-up, with all conditions satisfied, the engine will gain r/min to the governor setting. Should the engine go into an overspeed condition, the Magnetic Pickup Module (A16) will reach the trip point and ground the ECM overspeed circuit to cause shutdown.

If the genset does not use Magnetic Pickup Module/toothed-wheel speed sensing, a mechanical overspeed switch is used. Either means of controlling overspeed activates the overspeed fault lamp. After the problem is corrected, starting will not occur until the Reset switch is pressed.

Continuous operation of the genset also depends on the proper oil pressure and engine temperature being maintained, and also any customer required fault conditions connected to the ECM.

Stopping Sequence

Placing the Run/Stop/Remote switch at Stop position de-energizes Run Relay K7. This opens the circuit through the ECM (K2) and de-energizes the genset fuel solenoid (stops fuel flow which stops the engine).

Emergency Shutdown

The K6 fault relay energizes when fault sensors respond to any one of several fault conditions such as overcrank, low oil pressure, low coolant, high engine temperature, overspeed, over/under voltage output. Energizing the K6 fault relay opens its normally-closed (N.C.) contacts and closes its normally-open (N.O.) contacts.

Opening K6 N.C. contacts disconnects B+ from the Power Relays K3 and K2. This stops cranking (if the engine is being cranked) and shuts off the fuel flow. Closing one of the K6 contacts activates the K8 relay. This relay breaks power to the fault interface relays so that only the indicator associated with the fault will activate. Closing the other N.O. contacts of K6 connects B+ to the remote alarm terminal.

Emergency Stop Switch

Pushing in the Emergency Stop button energizes the fault shutdown circuit and stops the genset. Pull out the Emergency Stop button to reset the fault circuit.

Section 4. Engine Control Service

TROUBLESHOOTING PROCEDURES

Regardless of the controller model the genset is equipped with, basic troubleshooting is fundamentally the same. The basic fault conditions are as follows:

A. Engine does not crank.

B. Engine cranks, but does not start.

C. Engine starts, but stops after running several seconds.

D. Genset is in operation,then a fault condition occurs.

Because the troubleshooting tables in this section include information about various control options, read through this section to identify which options relate to the specific genset. This will save time when an actual fault condition occurs. Before starting the troubleshooting procedures, make the following simple checks.

- Review troubleshooting information as outlined in the Operator's manual.
- Check all modifications, repairs, or parts replacements performed since the last satisfactory operation of the genset. A poor wire connection, an open switch or circuit breaker, or a loose plug-in device are all potential problems that can be eliminated by a visual check.
- Unless absolutely sure that panel instruments are accurate, use portable test meters for troubleshooting.

Remember to keep the problem solving process factual and methodical, and always use safe troubleshooting practices.

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on page ii.***

TABLE 4-1. ENGINE DOES NOT CRANK

SYMPTOM	CAUSE	CORRECTIVE ACTION
1. SWITCH OFF indicator lamp flashing.	Run/Stop/Remote switch in Stop position.	Press to desired, Run or Remote position.
2. Other fault indicator lamps illuminated, but no fault exists.	Lamp Reset switch not actuated after a previous fault was remedied.	Press Lamp Reset switch to de-energize fault lamp relays of ECM, after Run/Stop/Remote switch is pressed to Stop position.
3. No indication.	Fuses blown on ECM board A11.	Check fuses F1 and F4. Replace if necessary with proper fuse: F1 - 20 Ampere F4 - 5 Ampere
	Starter solenoid will not energize.	Inspect starter solenoid per proper test procedure.
	Possible defective ECM board A11.	Check A11 board TB1-9 for B+ voltage in. With S12 switch in Run position, check for voltage out to starter solenoid at TB1-8 of board A11.
	Broken wiring or poor connections between board A11 TB1-8 and starter solenoid.	Check and repair as necessary.
4. Time delay start is initiated, but starter solenoid does not energize after desired time delay period.	Possible defective Time Delayed Start/ Stop Module A15.	Check A15 board TB1-4 for constant B+ voltage in. Check A15 board TB1-5 for Run Signal In voltage. Voltage at A15 board TB1-6 should be at B+ at end of start delay period. Check wiring and connections from A15 TB1-6 to ECM TB1-6.

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on page ii.***

TABLE 4-2. ENGINE CRANKS BUT DOES NOT START

SYMPTOM	CAUSE	CORRECTIVE ACTION
1. Overcrank Fault shutdown lamp illuminated.		
A. Low Fuel lamp also illuminated.	Insufficient fuel supply in tank.	Fill with correct fuel.
B. Fuel solenoid does not energize.	Fuse blown on ECM board A11.	Check fuse F2. Replace if necessary with proper fuse: F2-20 Ampere.
	Possible defective ECM board A11.	Check for voltage out at A11 TB1-10 when engine is cranking.
	Broken wiring or poor connections between board A11 TB1-10 and fuel solenoid.	Check and rectify as necessary.
C. Fuel solenoid energizes, but no fuel flows.	Blockage of fuel supply system.	Check fuel supply system, fuel tank shutoff valves, fuel lines and connections, fuel filters and transfer pump.
D. Engine hard to start due to cold ambient air temperature.	Heater system not keeping engine warm.	Check heater system power supply, controls, etc., and correct as necessary.
	Engine glow plugs not being energized.	Improper start-up procedures used. Depress Preheat switch S11 to energize glow plugs.
	Time delayed Start/ Stop and Preheat module A15 not energizing Preheat solenoid for glow plugs.	Initiate a restart and check for voltage at A15 TB1-7 to Preheat solenoid.
		Depress Preheat switch S11 to bypass A15. Check if Preheat solenoid energized.
		Check Preheat solenoid per proper test procedure.

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on page ii.***

TABLE 4-2. ENGINE CRANKS BUT DOES NOT START (Continued)

SYMPTOM	CAUSE	CORRECTIVE ACTION
D. (Continued) Engine hard to start due to cold ambient air temperature		Check wiring and connections from switch S11 and module A15 to Preheat solenoid.
	Fuel supply line freeze to engine.	Refer to Symptom 1.C of this table.
2. Fault shutdown occurs, but no fault lamp indication.	Lamp burned out.	Depress Lamp Test switch S11 to check fault lamps.
	Possible defective ECM board A11.	Refer to Symptom 3.
3. Short cranking period.		
A. Controller ECM (A11 is equipped to perform cycle cranking, but stops cranking before 15 ± 3 seconds.	Defective ECM board A11.	Replace ECM (A11).
B. Controller ECM (A11) is equipped to provide constant cranking to fault limit, but stops cranking before 75 ± 15 seconds.	Defective ECM board A11.	Replace ECM (A11).

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on page ii.***

TABLE 4-3. ENGINE STARTS BUT STOPS AFTER RUNNING SEVERAL SECONDS.

SYMPTOM	CAUSE	CORRECTIVE ACTION
1. Fault lamp illuminated: A. Overspeed	Mechanical Switch overspeed sensing faulty or out of adjustment.	Refer to *Generator Disassembly/ Assembly* section for adjustment specifications.
	Magnetic Pickup Module (A16) overspeed sensing faulty or out of adjustment.	Refer to Magnetic Pickup Module description in the *DC Control* section. Perform start-up and monitor engine speed to overspeed shutdown. Fixed Setpoint If shutdown occurs before limit, replace A16 module. Adjustable Setpoint If shutdown occurs before desired, setpoint, readjust module A16. If adjustment does not correct fault conditions, replace module A16.
	Engine governor faulty or out of adjustment.	If shutdown occurs within module A16 limits, refer to *Governor Adjustments* section
B. Low Oil Pressure	Low oil level in engine.	Replenish as necessary.
	LOP switch S1 faulty.	Check oil level, perform restart, and monitor oil pressure gauge M11. If gauge reading is within normal range, switch S1 is faulty. Replace.

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on page ii.***

TABLE 4-3. ENGINE STARTS BUT STOPS RUNNING AFTER SEVERAL SECONDS. (Continued)

SYMPTOM	CAUSE	CORRECTIVE ACTION
C. High Engine Temperature.	Low coolant level in engine.	Replenish as necessary.
	HET switch S2 faulty.	Check coolant level, perform restart, and monitor engine temperature gauge M12. If gauge reading is within normal range, switch S2 is faulty. Replace.
	Thermostat defective.	Replace thermostat.
	Fan belt slipping.	Tighten fan belt.
	Radiator core or fins clogged.	Clean radiator.
2. No fault condition.	Intermittent control wiring connections.	Check condition of all control wiring to ensure correct and secure terminal connections.
	Low fuel level.	Replenish fuel supply.

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on page ii.***

TABLE 4-4. ENGINE GENERATOR IS IN OPERATION, THEN A FAULT SHUTDOWN OCCURS

SYMPTOM	CAUSE	CORRECTIVE ACTION
1. Fault indicator lamp illuminated.		
A. LOP, HET, Overspeed, etc.	As indicated.	Refer to Table 4-3.
2. No fault lamp indication.	Possible defective ECM board A11.	Check fuses F4 and F2 of ECM board A11. F4-(Main) - 5 Ampere F2- (Fuel solenoid or ignition) - 20 ampere Perform restart and check for B+ voltage in at TB1-9 and voltage out at TB1-10 to fuel solenoid. If there is voltage out at TB1-10, check fuel supply solenoid, shutoff valves, etc. If there is no voltage out at TB1-10, ECM board A11 is defective. Replace.
	Other customer required shutdown command.	Refer to installation reference material.
	Defective lamp.	Replace lamp.

TESTS

Refer to the following tests when isolating circuit problems caused by faulty engine control components. Follow instructions closely to protect test instruments and components from damage.

All external engine control components such as leads, switches, indicator lamps, senders, and gauges plug into the engine control monitor board. When testing external components, disconnect the corresponding jack (J1, J2, J3, or J4) from the board. Refer to the appropriate wiring diagram to determine the jack number. Engine sender locations are shown in Figure 4-1.

⚠WARNING ***Contact with rotating machinery can result in severe personal injury or death. Keep hands clear while performing tests on operating equipment.***

Battery Check

Check battery charge condition with a hydrometer (non-maintenance free battery). The electrolyte specific gravity should be about 1.260 for a fully charged battery at 80° F (27° C). If not, add distilled water to keep electrolyte at proper level and recharge the battery. If battery will not recharge, it should be replaced.

⚠WARNING ***Ignition of explosive battery gasses can cause severe personal injury. Do not smoke while servicing batteries.***

If the battery loses water, the alternator charge rate may be too high. If the battery state of charge is not maintained, the charge rate may be too low. Refer to the alternator check below.

Battery Cable Check

With the starter motor operating, check the voltage drops from the battery negative (-) post (not the cable clamp) to the cylinder block, and from the battery positive (+) post to the battery terminal stud on the starter solenoid. Normally each of these should be less than 0.3 volts DC. If extra long cables are used, slightly higher voltage drops may result. Thoroughly clean all connections in any part of the circuit showing excessive voltage drop.

Alternator Check

With the genset running, check the reading on the DC voltmeter. (If the control panel is not equipped with a DC voltmeter, attach a voltmeter, positive (+) lead to the output terminal and negative (-) lead to ground.) Start the genset and run for a few minutes to allow the voltage to stabilize. If the alternator is operating properly, the voltmeter should show a reading of approximately 13.8 to 14.8 volts.

If the output voltage is high (over 15 volts), check for loose or corroded voltage regulator leads. If this does not correct the problem, the regulator is probably shorted and should be replaced.

If the output voltage is low (equals battery voltage), the problem could be worn or defective brushes, an open regulator, or an open field diode. Refer to the engine service manual for additional service information.

Solenoid Check

1. Apply battery positive (B+) to the terminal marked S.
2. Jumper a ground wire to the solenoid ground bracket. Solenoid should activate.
3. If the contacts are good, 12 volts DC should be read between terminal 1 and ground. The voltage drop measure across the contact should never exceed one volt in circuit application.

Relay Check

The run and interface relays can be checked as follows:

1. Connect 12 volts DC across the relay coil terminals. Relay should activate if coil is okay.
2. Connect 12 volts DC to one side of the relay contacts.
3. Connect a voltmeter between the other side of the contacts and the 12-volt source. If 12 volts appear when relay is energized, contact is okay. The 12-volt reading appears in reverse order when checking normally closed contacts.

Fuel Solenoid Check

If there is fuel to the injection pump, but no fuel at the injection nozzle, the fuel solenoid might be defective.

To check fuel solenoid operation, remove the harness B+ lead connection from the solenoid and jumper a separate B+ connection to this terminal. The injection pump should click. If no click is heard, the fuel solenoid must be replaced.

Control Switch Check

1. Remove battery B+ cable.
2. Place ohmmeter across switch contacts.
3. Open and close the switch while observing the ohmmeter. A normally open switch should indicate infinite resistance when open and continuity when closed. A normally closed switch should indicate continuity when closed and infinite resistance when open.

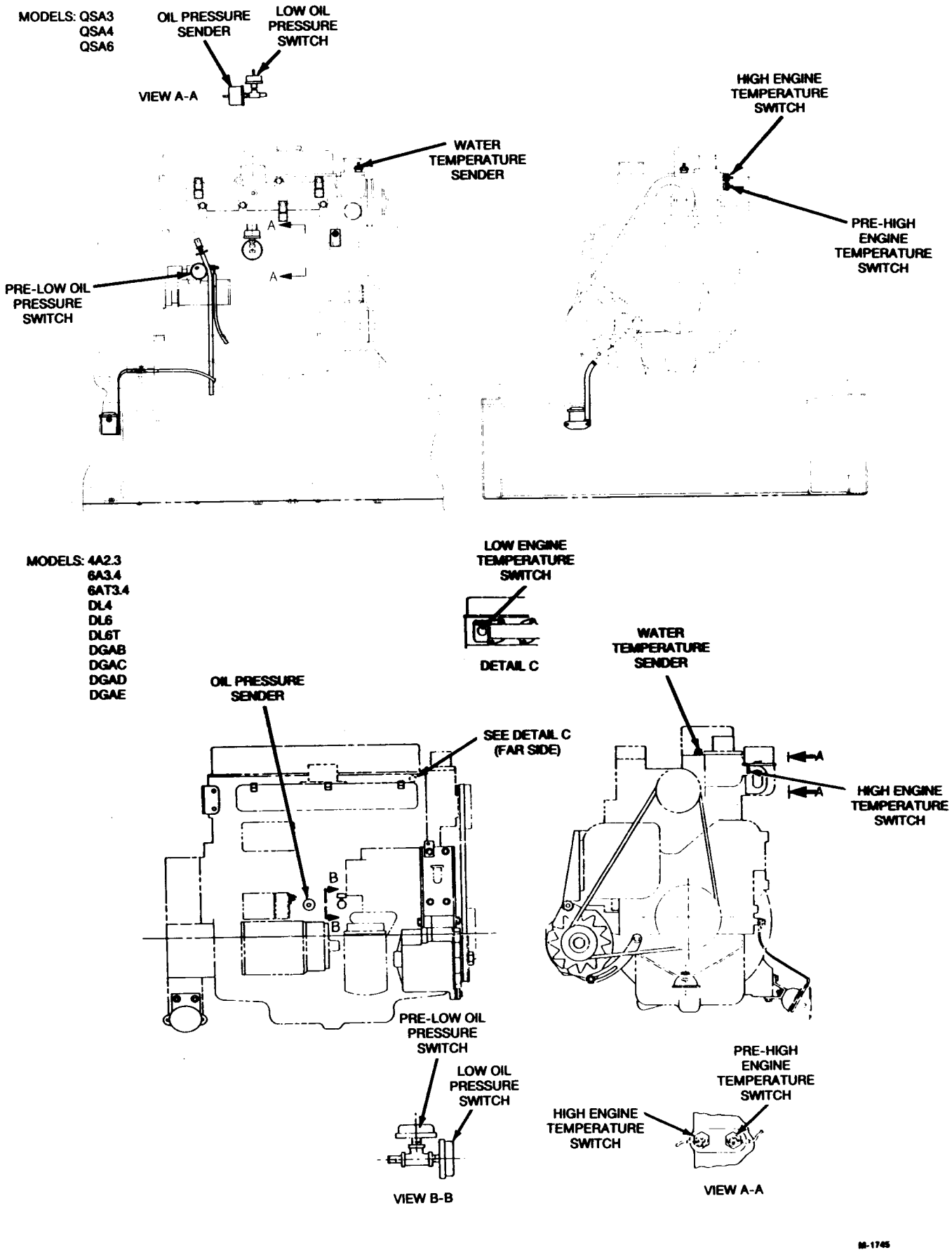


FIGURE 4-1. ENGINE SENSOR LOCATIONS

Section 5. Generator and Voltage Regulator

GENERATOR DESCRIPTION

The generator is a four-pole, revolving field, brushless exciter design. Single and three phase generators are available in both 50 and 60 hertz.

The generator rotor is directly coupled to the engine flywheel with a flexible drive disc (Figure 5-1). The engine speed determines output frequency. A centrifugal blower on the drive disc pulls cooling air through the end bell and discharges it through an outlet near the blower.

A ball bearing in the end bell supports the rotor shaft. The end bell is attached with four studs that thread into the generator adapter casting. The exciter stator mounts in the end bell; the exciter rotor and its rotating rectifier assemblies mount on the rotor shaft. Within the end bell, leads F1(+) and F2(-), from the exciter stator winding, connect to the output terminals of the voltage regulator.

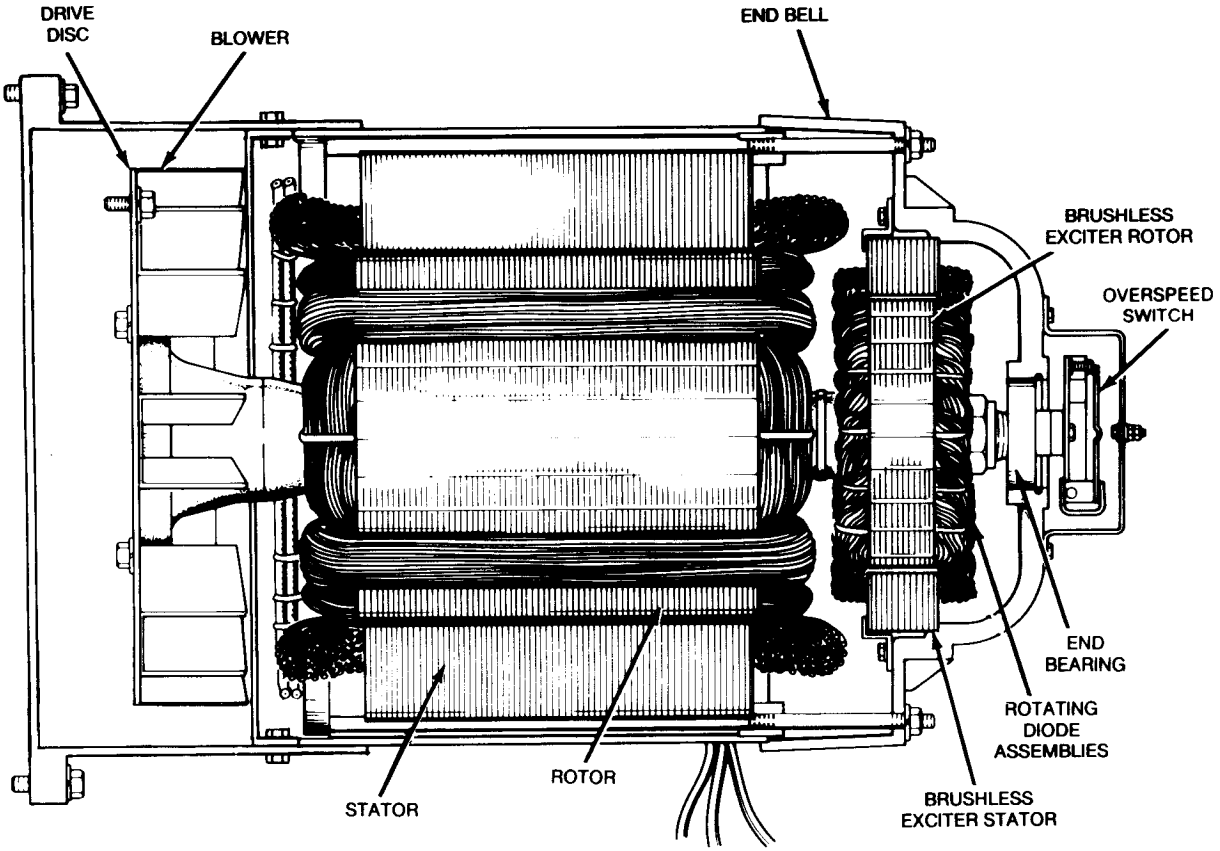


FIGURE 5-1. TYPICAL GENERATOR

The composite illustration in Figure 5-2 shows the generator output and control/meter leads for the various voltage options.

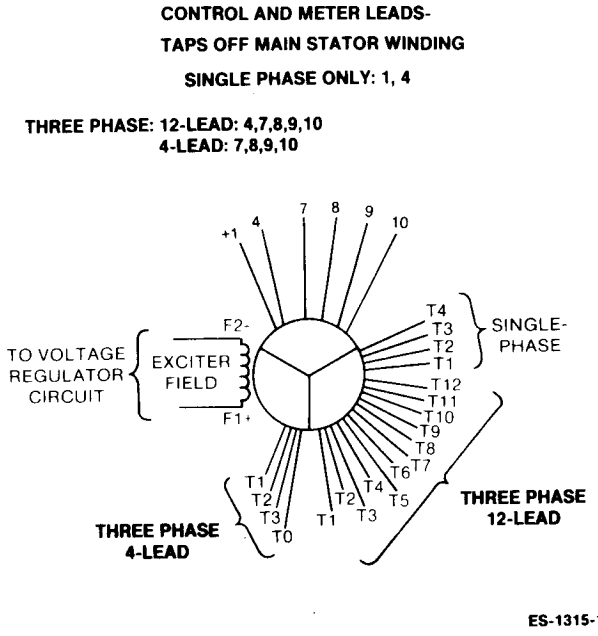


FIGURE 5-2. SINGLE AND THREE PHASE GENERATOR SCHEMATIC (COMPOSITE)

Voltage reconnection diagrams appear in Section 7. Generator/Regulator Tests/Adjustment, and in Section 10, Wiring Diagrams. Gensets ordered with the optional circuit breaker have the leads connected for the nameplate voltage.

GENERATOR OPERATION

Power generation involves the generator components shown in Figure 5-3. These components are italicized in the following text. A permanent magnet embedded in an exciter stator field pole begins the voltage build-up process as the genset starts. Single phase AC voltage, taken from a main stator winding, is connected to the voltage regulator as a reference for regulating the generator output voltage. The regulator DC output is coupled to the exciter stator.

The exciter rotor produces three phase AC voltage that is converted to DC by the full wave rotating rectifier assemblies. The DC voltage excites the rotor main field winding to produce main stator AC for the load.

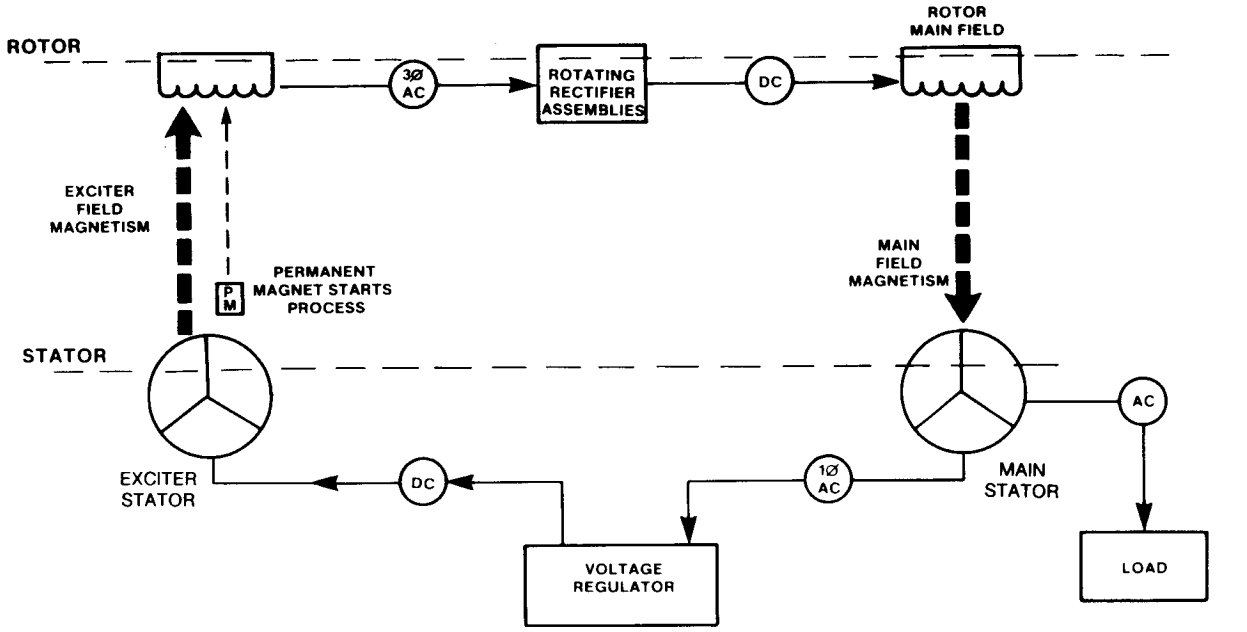


FIGURE 5-3. GENERATOR EXCITATION BLOCK DIAGRAM

VOLTAGE REGULATOR

Description

The voltage regulator (Figure 5-4) provides switch selections that alter its sensing and command signals for maximum performance in a variety of generator sizes and applications. Review the sections titled Operation Modes and Operating Stability, then the Adjustments section for switch locations and settings specific for the genset kilowatt rating.

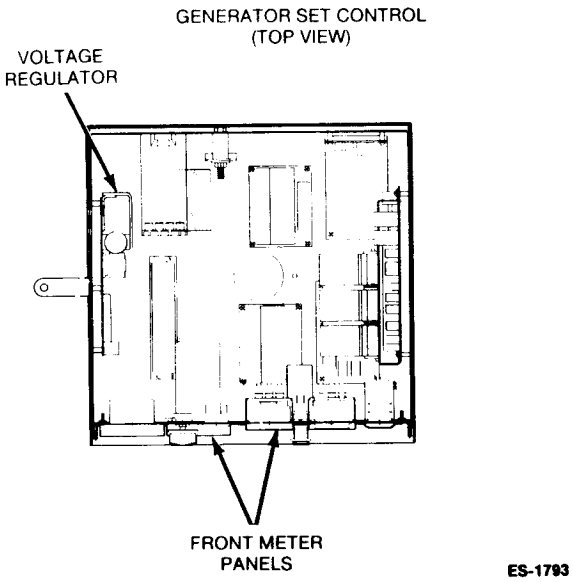


FIGURE 5-4. LOCATION OF VOLTAGE REGULATOR (CONTROL TOP VIEW)

Operating Modes

Torque-Matching: Matching the torque characteristics of the engine and generator is required to properly manage momentary application of overloads such as motor starting. Because of variance in engine characteristics, different torque matching may be applied. Switches on the regulator provide flexibility to test and set the torque-matching function for different engine/generator combinations.

When properly set, the regulator is able to maintain output voltage within reasonable limits under transient conditions. It allows use of the engine's full power to prevent an unstable response.

Non-Torque-Matching: Even though the voltage regulator can also be switch-selected to a non-torque-matching constant voltage mode, independent of engine speed, this mode will not prevent the genset from stalling during momentary overload conditions. This setting is not recommended. Consult a service representative before selecting this mode to be sure that load demands specific to the installation would not cause unstable operation of the genset.

Operating Stability

Different regulator gain compensation is required for different generator sizes and exciter/main field time constants. The voltage regulator is switch-selectable to a kilowatt range that best suits the genset application.

Voltage Regulator Adjustments

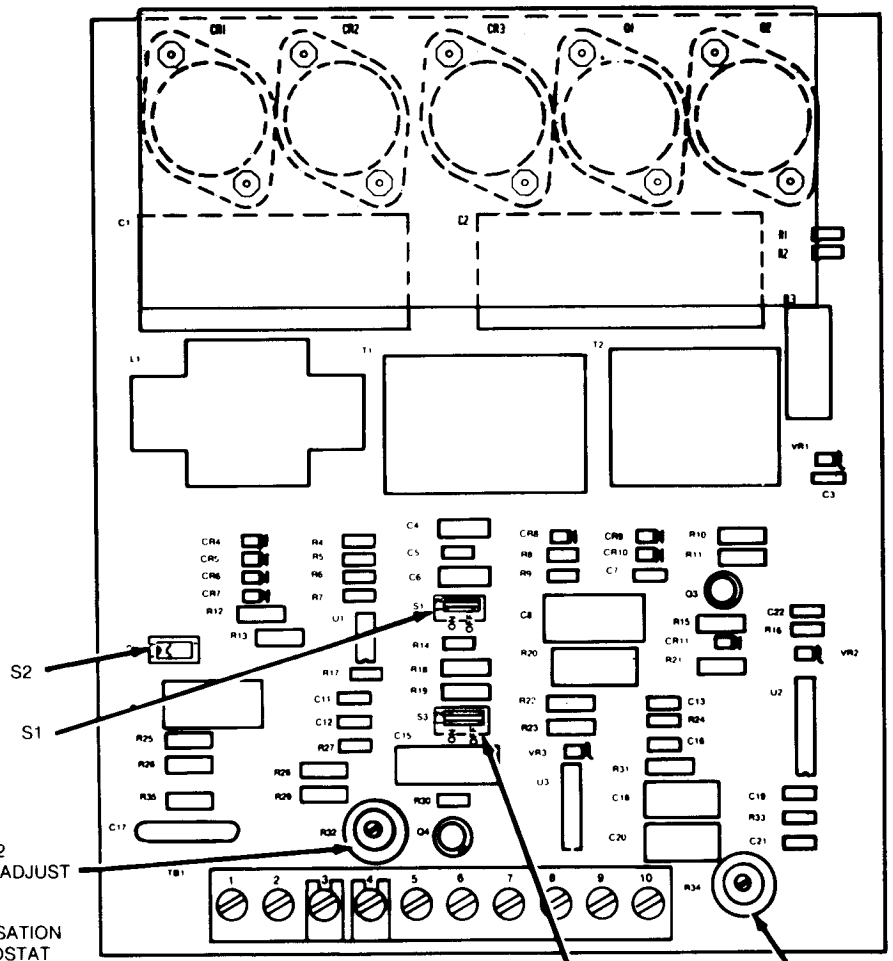
The Voltage Regulator board is shown in Figure 5-5. Three switches and two potentiometers provide the following functions:

- ***Switch S1:*** Selects the overall range of operation for the regulator. Refer to Table 5-1.
- ***Switches S2 and S3:*** Determine the mode of regulation (Torque-Matched or Non-Torque-Matched). Refer to Table 5-1.
- ***Potentiometer R32:*** Provides adjustment to increase or decrease generator voltage to proper setting.
- ***Potentiometer R34:*** Is adjusted at the factory to set the frequency breakpoint, and does not require further adjustment.

See Section 7 of this manual for replacement and adjustment procedures.

TABLE 5-1. VOLTAGE REGULATOR SWITCH SETTINGS

GENSET kW RATING	STABILITY RANGE		REGULATION MODE								
			60 Hz TORQUE-MATCHING			50 Hz TORQUE-MATCHING			NON-TORQUE-MATCHING		
	S1-1	S1-2	S2	S3-1	S3-2	S2	S3-1	S3-2	S2	S3-1	S3-2
16-35	OFF	OFF	POS 2	OFF	ON	POS 2	ON	ON	POS 2	OFF	OFF
40	OFF	ON	POS 2	OFF	ON	POS 2	ON	ON	POS 2	OFF	OFF



TB1-2,-3 AC INPUT VOLTS
TB1-3, -4 CROSS-CURRENT COMPENSATION
TB1-7, - 8 VOLTAGE ADJUSTING RHEOSTAT
TB1-9, -10 EXCITER FIELD
F1—TB1-9
F2—TB1-10

FIGURE 5-5. VOLTAGE REGULATOR ADJUSTMENTS

LINE CIRCUIT BREAKER

Depending on site specifications and code requirements, an optional line circuit breaker may be mounted in the generator AC output box.

Description

All factory supplied line circuit breakers are thermal and magnetic trip type. Depending on customer requirements, the breaker may also include shunt trip and remote alarm connections. Review the following functions/requirements and Figure 5-6.

- Genset output is connected to the load through the circuit breaker.
- When an overload or short circuit occurs on any one conductor, a common trip bar will disconnect all three conductors.
- The thermal trip action of the breaker is accomplished by bimetal strips. A sustained overcurrent condition will cause a thermal reaction of the bimetal and trip the breaker. Response of the bimetal is proportional to current; high current-fast response, low current-slow response. This action provides a time delay for normal inrush current and temporary overload conditions such as motor starting.
- The magnetic trip action of the breaker is caused by an electromagnet which partially surrounds the internal bimetal strips. If a short circuit occurs, the high current through the electromagnet will attract the bimetal armature and trip the breaker. Some breaker models provide front adjustment of the magnetic trip action. These adjustments are normally set at the factory at the high position, but provide for individual conductor settings to suit customer needs.
- The shunt trip mechanism (if equipped) consists of a solenoid tripping device mounted in the breaker with external lead connections for remote signaling. A momentary signal to the solenoid coil will cause the breaker to trip.

  This feature is available in AC or DC voltages, and is normally installed at the factory to meet customer needs. The shunt trip mechanism is most often connected to a common fault shutdown circuit of the genset. This quickly disconnects the set from the load on shutdown and avoids a reverse power condition.

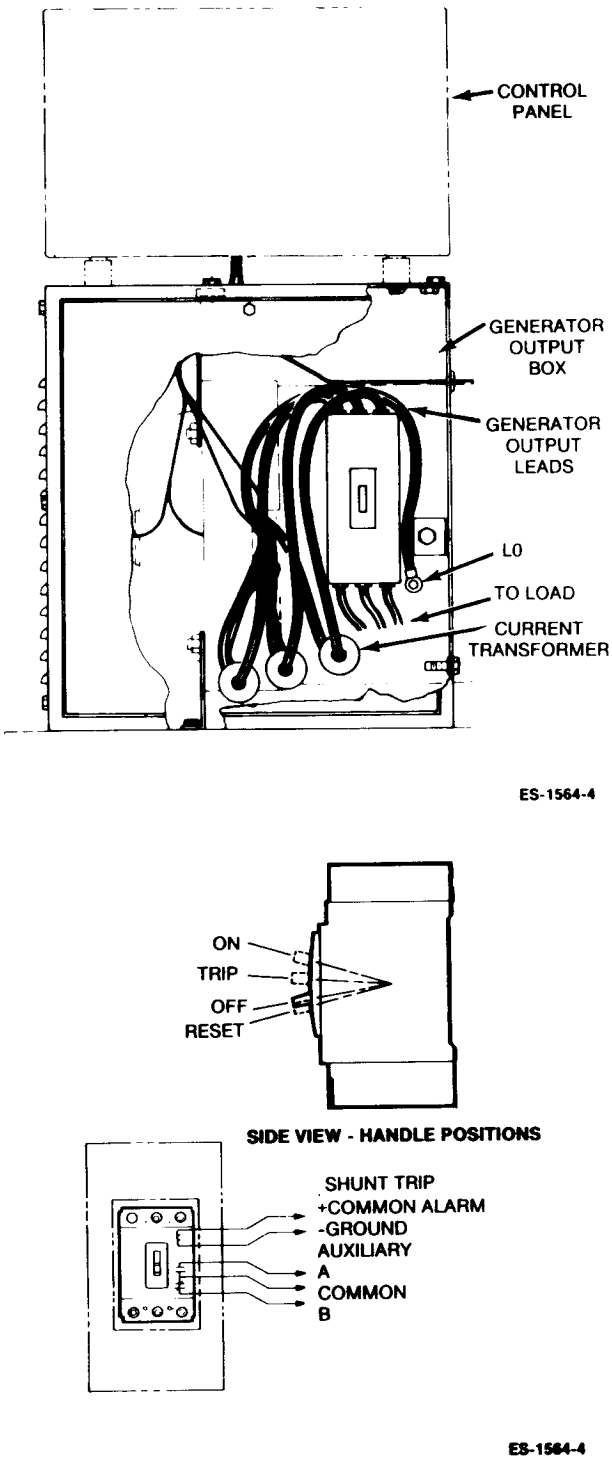


FIGURE 5-6. GENERATOR-MOUNTED CIRCUIT BREAKER

- Auxiliary contacts (if equipped) are used for local or remote annunciation of the breaker status. They usually have one normally open and one normally-closed contact (1 form C contacts) to comply with the annunciator requirement.

- The trip actuator (if applicable) is for periodic exercise of the breaker to clean and maintain its proper operation. Rotating this actuator mechanically simulates over-current tripping through actuation of linkages not operated by the On/Off handle. See Section 7. Generator/ Regulator Tests/Adjustments for further information.

- Operation of the circuit breaker is determined by site-established procedures. In emergency standby installations, the breaker is often placed to the On position, and is intended for safety trip actuation in the event of a fault condition. If the breaker trips open, investigate the cause and perform remedial steps per the troubleshooting procedures. To close the breaker, the handle must be placed to the Reset position and then to On. Refer to manual Sections 6 and 7 for troubleshooting and safety procedures.

Section 6. Generator/Regulator Troubleshooting

COMPONENT LOCATIONS

The following listing of components and their locations are referenced in the troubleshooting charts of the Troubleshooting Procedures section. The charts will only reference components by name, so become familiar with their locations before proceeding. Other components are located on the control panel and are not listed here, or are covered in Section 9. Options.

- ***AC Output Circuit Breaker:*** Mounted in the generator AC output box.
- ***Voltage Regulator:*** Inside the control panel.
- ***Terminal Board TB21:*** Inside the control panel.
- ***Current Transformers CT21, 22, and 23:*** Inside the generator AC output box.
- ***Rotating Rectifiers:*** Within the generator end bell on the exciter rotor.

PREPARATION

Before starting any troubleshooting procedure, be sure to disable the genset by disconnecting the battery cables, the negative (-) cable first. The negative (-) cable is disconnected first to prevent arcing if a tool accidentally touches the frame or other grounded metal parts of the genset while disconnecting the positive (+) cable from the battery. Severe injury can result if arcing ignites the explosive hydrogen gas given off by the battery.

⚠WARNING ***Accidental starting of the generator set can cause severe personal injury or death during service procedures. Be sure to disable the generator set by disconnecting the starting battery cables (negative [-] cable first).***

⚠WARNING ***Ignition of explosive battery gases can cause severe personal injury. Do not smoke. Wear goggles and protective, rubber gloves and apron when servicing battery.***

A few simple checks and a valid troubleshooting procedure can quickly locate the trouble source and cut service time. The following are inspection areas often overlooked when troubleshooting.

- Check all modifications, repairs, and replacements performed since the last satisfactory operation of the set to be sure that all generator leads are correctly connected. A loose or incorrect wire terminal connection, or an open circuit breaker overlooked when replacing a part could cause problems. A thorough visual check can quickly eliminate these potential problems.
- Visually inspect the components of the voltage regulator. Look for dust, dirt, or moisture and cracks in the printed conductors or solder connections. Burned resistors and arcing tracks are easily seen. Do not mark on the board with a graphite pencil as this can cause leakage or short circuit between components.
- Visually inspect the exciter rotor assembly for burned components, broken wires, loose connections, and carbon tracks caused by arcing between parts or between parts and ground. Also check for shorted paths between terminals caused by dust, dirt, and moisture.

Unless absolutely sure that the panel instruments are accurate, use portable test meters for troubleshooting.

⚠CAUTION ***To prevent meter damage, ohmmeter checks must be made with the generator set stopped and the starting battery disconnected.***

TROUBLESHOOTING PROCEDURES

The information in this section is divided into Troubleshooting Flow Charts as follows:

6.1 No AC Output Voltage at Rated Engine Speed.

6.2 Unstable AC Output Voltage, Engine Stable at Rated Speed.

6.3 AC Output Voltage Too High or Low.

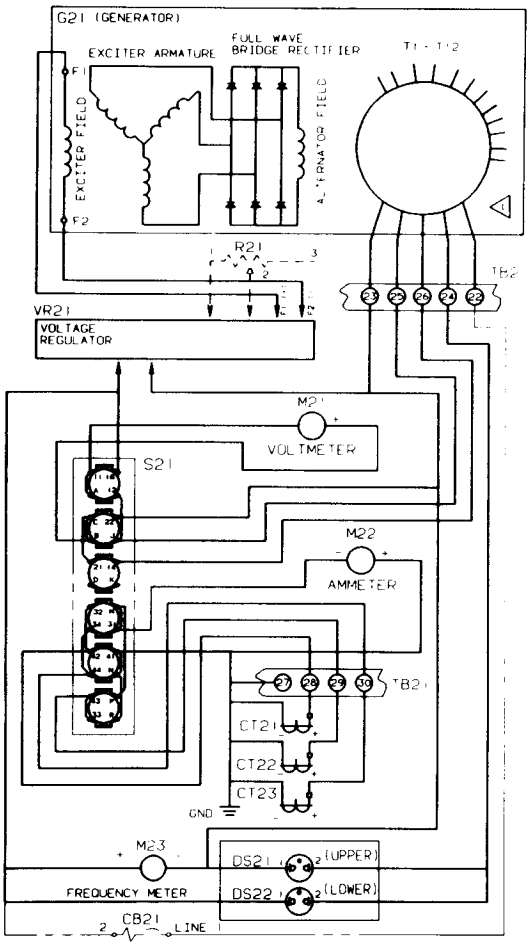
6.4 Exciter Field Breaker Trips.

6.5 Unbalanced AC Output Voltage.

6.6 No AC Output Through Set-Mounted Circuit Breaker.

After determining the problem, refer to the applicable troubleshooting flow chart. Start at the chart upper left-hand corner and answer all the questions either YES or NO. Follow the chart until the problem is found, performing the referenced Adjustment and Test Procedure(s) following the flow charts.

The referenced components in the flow charts and in the Adjustment and Test Procedures can be found on the electrical schematic in Figure 6-1, and on assembly and wiring diagrams in Section 10 of this manual.



SC-1618

COMPONENT DESCRIPTION

REF.	DESCRIPTION
CB21	Field Circuit Breaker
CT21-23	Current Transformer Assembly
DS21-22	Lamp Assembly (Upper/Lower Scale)
G21	Generator
M21	AC Voltmeter
M22	AC Ammeter
M23	Frequency Meter
R21	Volts Adjust Potentiometer
S21	Rotary Switch, Volt & Ammeter
TB21	Terminal Block
VR21	Voltage Regulator

S21 PHASE SELECTOR SWITCH

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	21-13	44-N	42-41	33-R
OFF	—	—	44-N	41-41	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

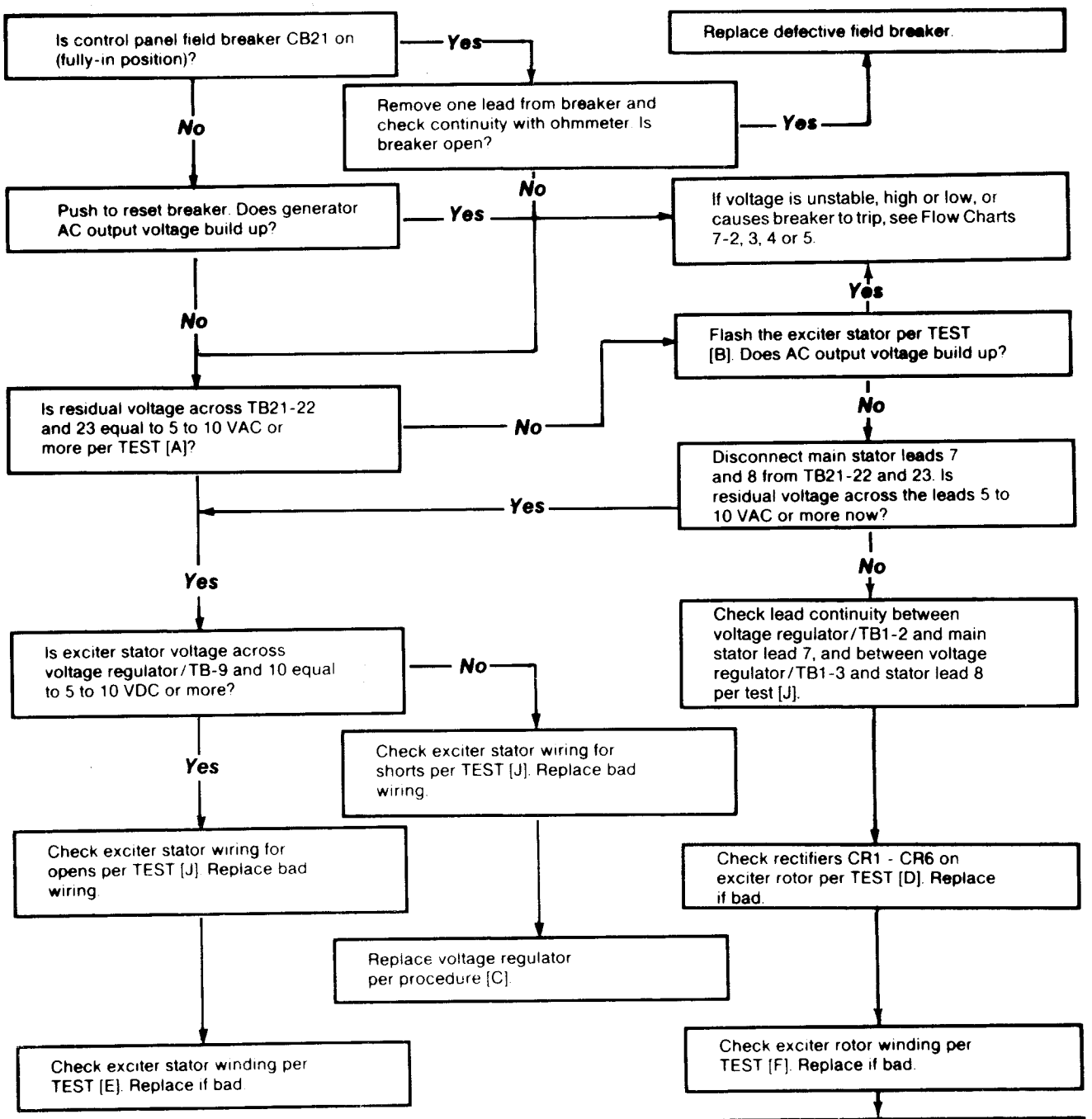
NOTES

1. **See generator connection diagram 625-2108 in Section 10 for input connections.**
2. **Dashed components and leads indicate when used.**
3. **This figure is for reference only. Use the electrical schematic specific to the application when troubleshooting.**

FIGURE 6-1. TYPICAL AC ELECTRICAL SCHEMATIC (INCLUDES METER OPTIONS)

CHART 6-1. NO AC OUPUT VOLTAGE AT RATED ENGINE SPEED

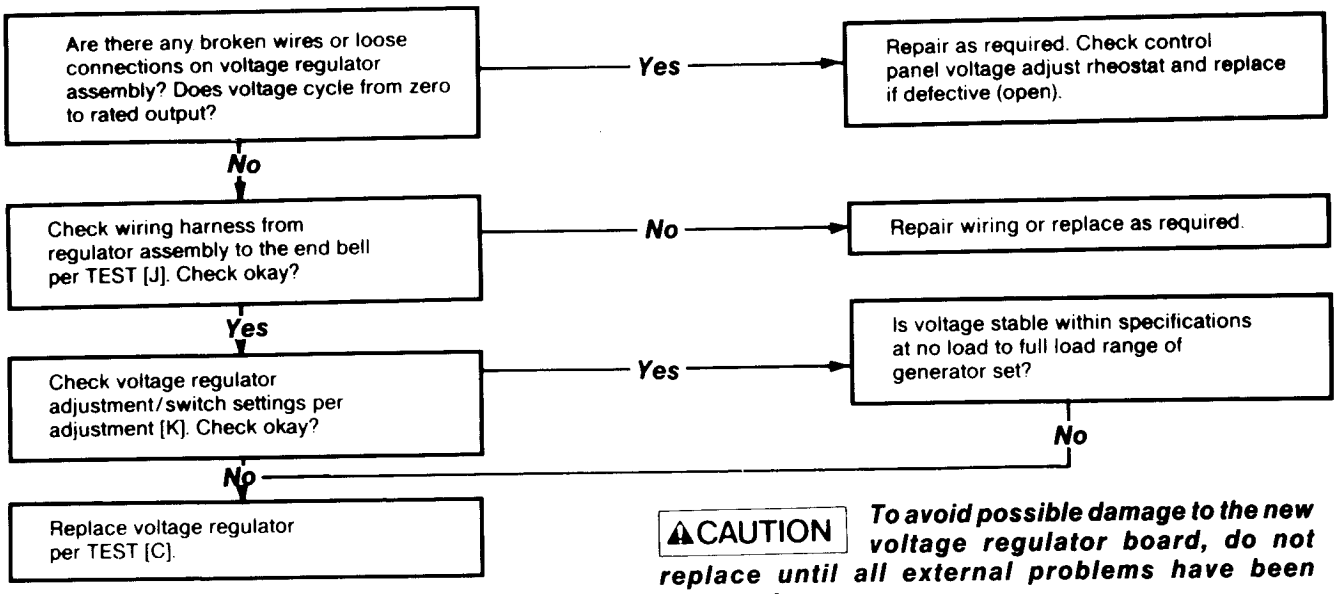
⚠WARNING ***Many troubleshooting procedures present hazards which can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on page ii.***



⚠CAUTION ***To avoid possible damage to the new voltage regulator board, do not replace until all external problems have been corrected.***

CHART 6-2. UNSTABLE AC OUTPUT VOLTAGE, ENGINE STABLE AT RATED SPEED

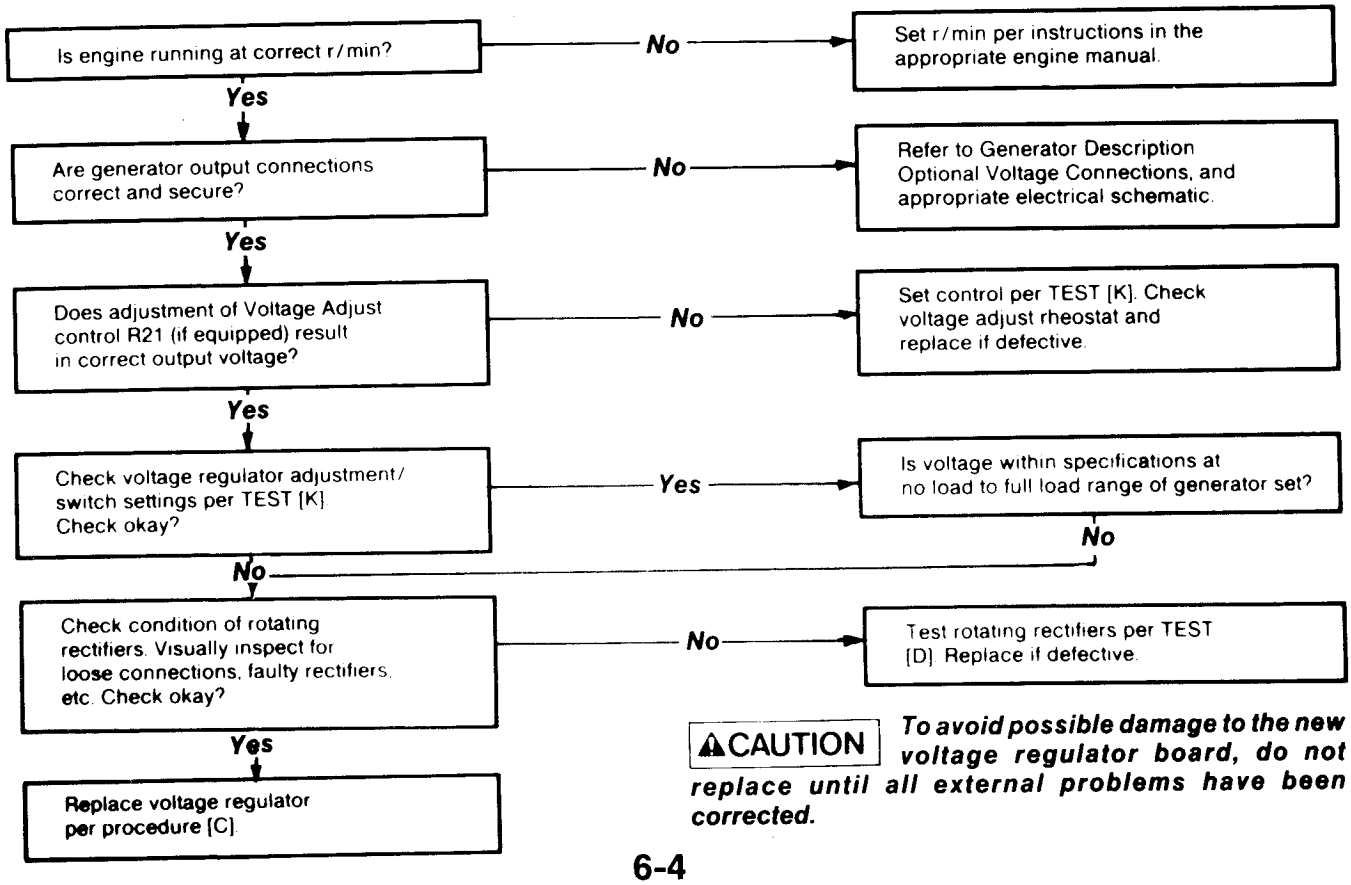
⚠WARNING ***Many troubleshooting procedures present hazards which can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on page ii.***



⚠CAUTION ***To avoid possible damage to the new voltage regulator board, do not replace until all external problems have been corrected.***

CHART 6-3. AC OUTPUT VOLTAGE TOO HIGH OR LOW

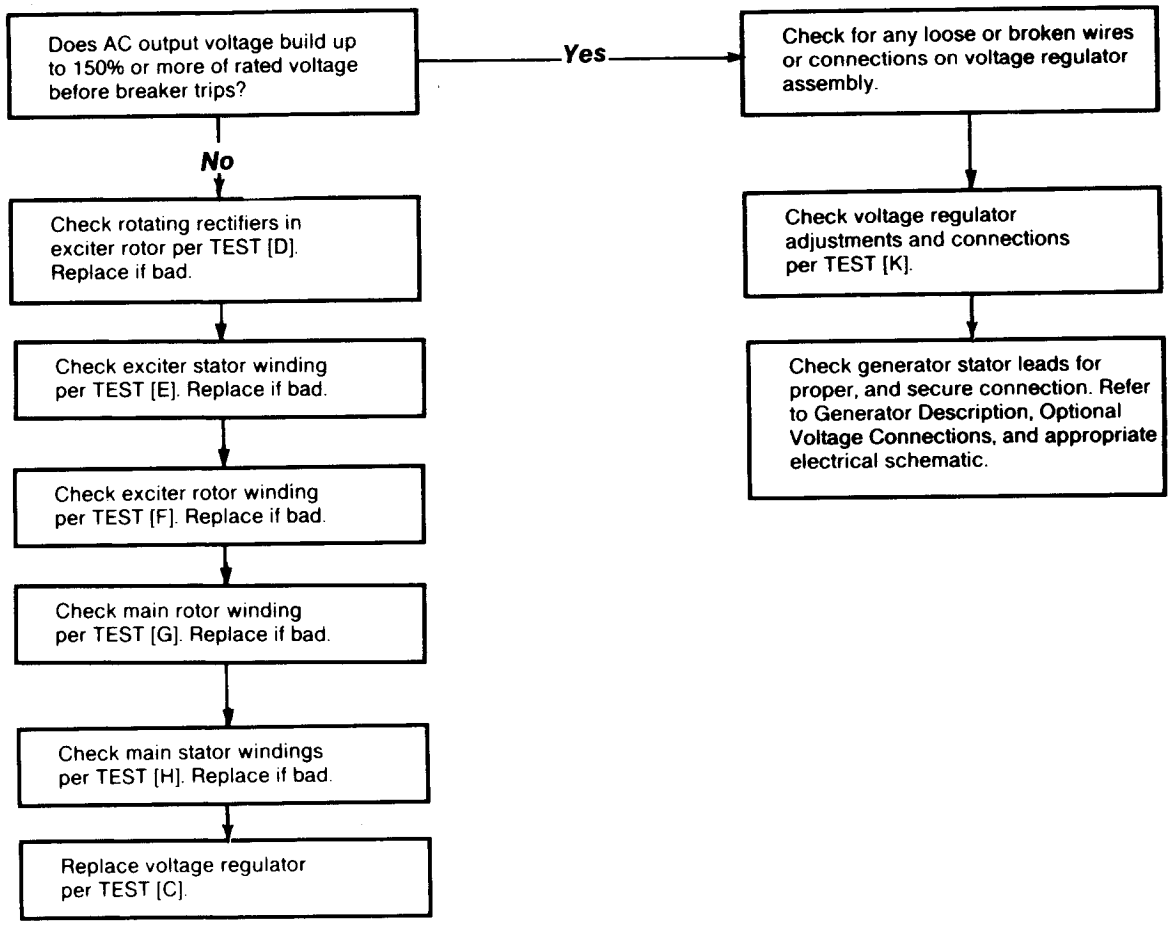
⚠WARNING ***Many troubleshooting procedures present hazards which can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on page ii.***



⚠CAUTION ***To avoid possible damage to the new voltage regulator board, do not replace until all external problems have been corrected.***

CHART 6-4. EXCITER FIELD BREAKER TRIPS

⚠WARNING ***Many troubleshooting procedures present hazards which can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on page ii.***



⚠CAUTION ***To avoid possible damage to the new voltage regulator board, do not replace until all external problems have been corrected.***

CHART 6-5. UNBALANCED AC OUTPUT VOLTAGE

⚠WARNING ***Many troubleshooting procedures present hazards which can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on page ii.***

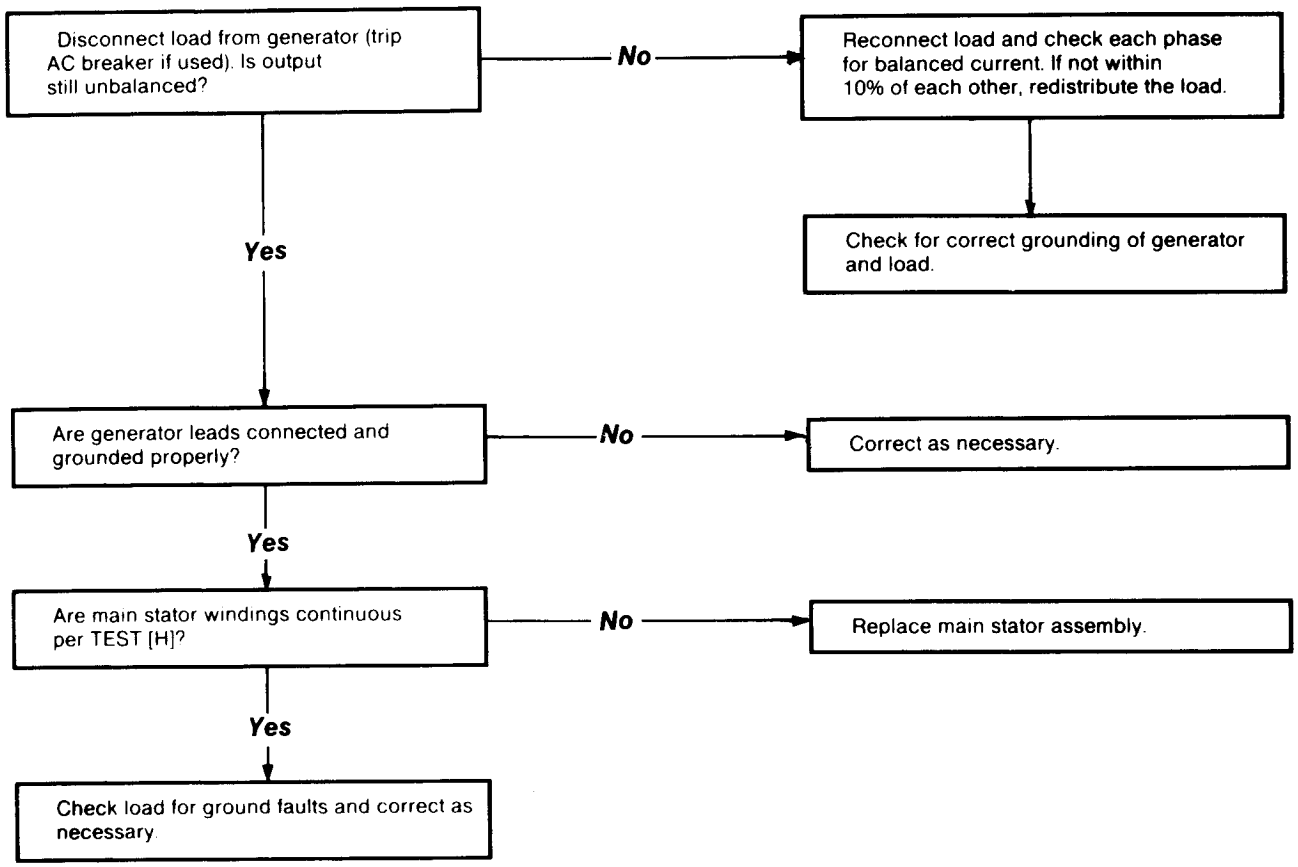
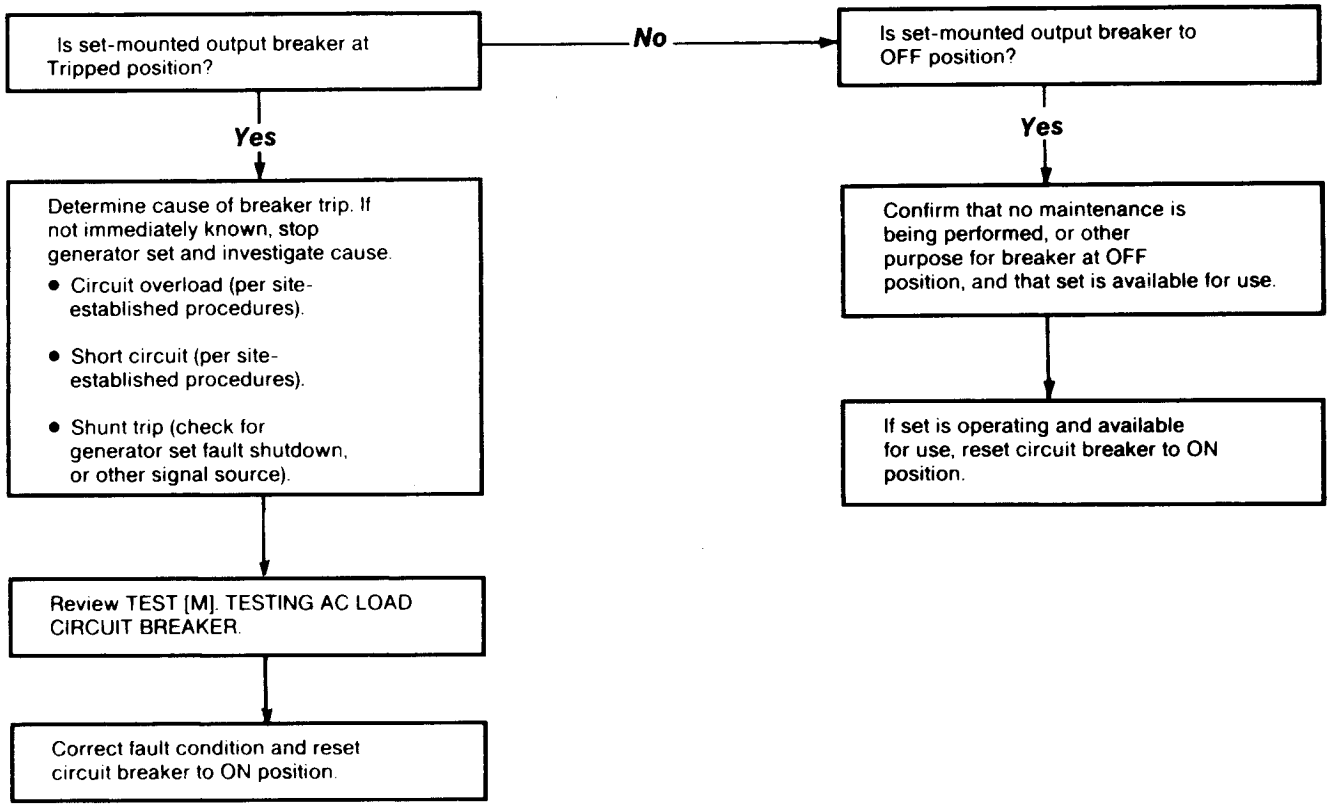


CHART 6-6. NO AC OUTPUT THROUGH SET MOUNTED CIRCUIT BREAKER

⚠WARNING ***Many troubleshooting procedures present hazards which can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on page ii.***



Section 7. Generator/Regulator Tests/Adjustments

⚠WARNING ***Many troubleshooting procedures present hazards which can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on page ii.***

GENERAL

The following tests and adjustments can be performed without disassembly of the generator. They should be used for testing the generator components and regulator together with the troubleshooting flow charts in *Section 6.* All resistance measurements must be made with the genset stopped and battery disconnected (negative [-] cable first) to prevent instrument damage.

[A]

TESTING AC RESIDUAL VOLTAGE

Test for generator residual AC voltage if there is no power output. A good check point is across terminals 22 and 23 at terminal block TB21. See Figure 7-1. Residual voltage should be 5 to 10 VAC minimum at normal operating r/min and no load. The voltage can be as high as 35 to 50 VAC.

If residual voltage is present at TB21, check voltage at the voltage regulator terminals 2 and 3. If zero, check continuity of field circuit breaker CB21, wiring, and connections with the genset shut down.

[B]

FLASHING THE EXCITER FIELD

If the residual voltage is missing, it might be necessary to restore magnetism by flashing the exciter field. This requires a 12-volt battery, 10-ampere fuse, momentary-on switch, and 12-ampere diode assembled as shown in Figure 7-2.

Field flashing can be done during genset operation or when stopped. Either method should be sufficient to restore magnetism.

⚠CAUTION ***Incorrect flashing procedure can damage the voltage regulator. Do not keep excitation circuitry connected longer than five seconds.***

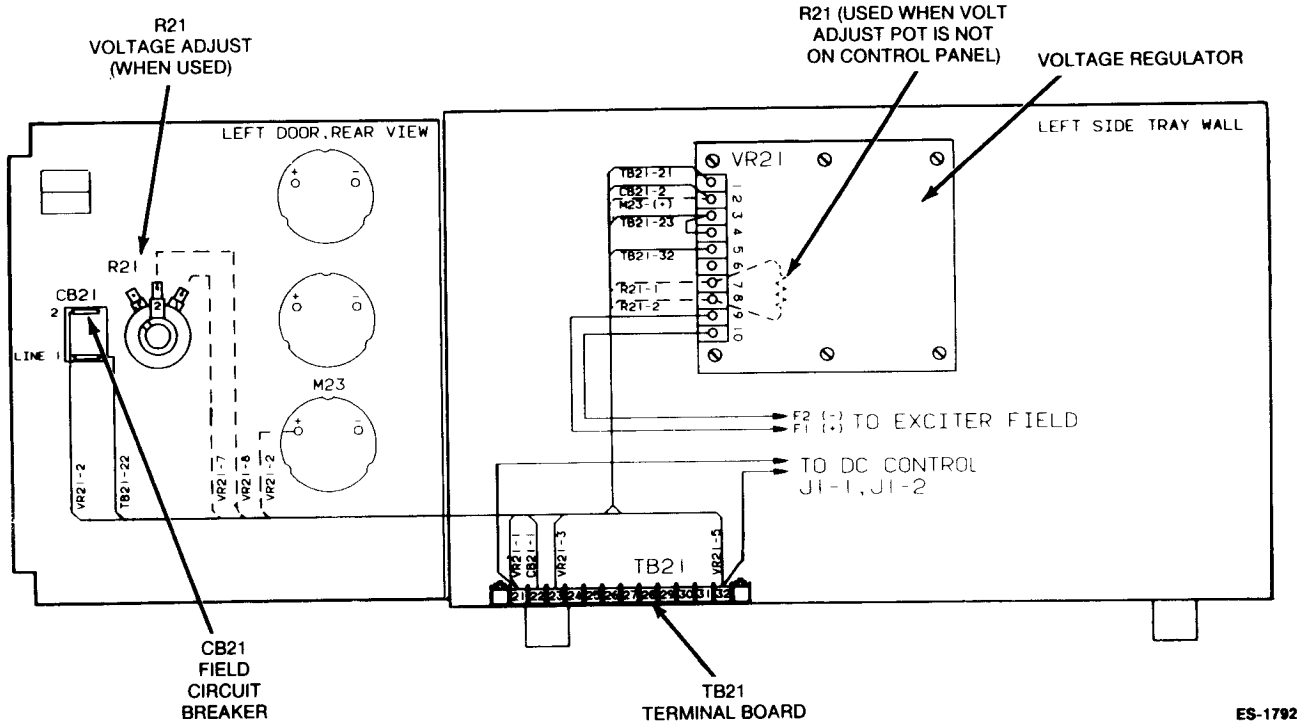


FIGURE 7-1. CONTROL COMPONENT LOCATION

During Genset Operation

1. Connect the positive (+) lead to terminal 9, and the negative (-) lead to terminal 10 on the voltage regulator (Figure 7-1).

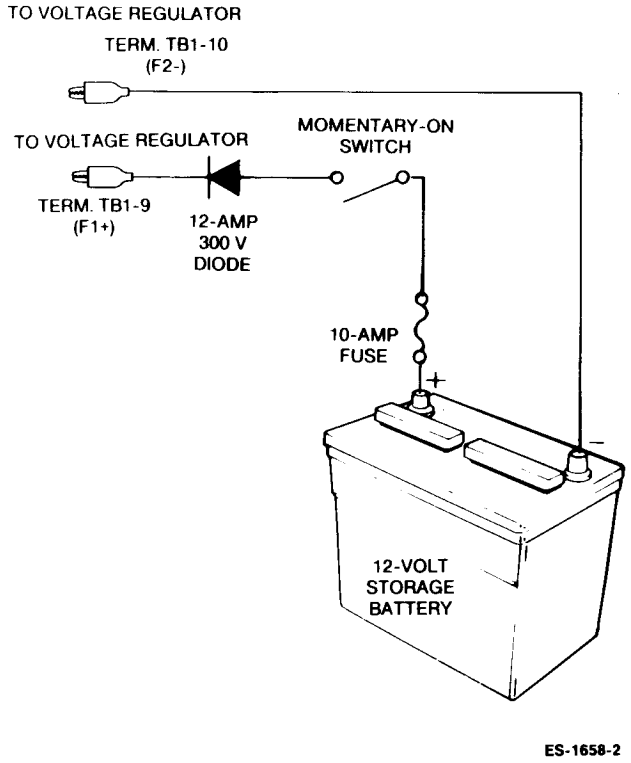


FIGURE 7-2. FIELD-FLASHING CIRCUIT

2. Start the genset and operate at normal speed. Close the switch long enough for the generator output voltage to build up, but not longer than five seconds.

3. Check the output voltage, then shut down the genset. Restart the genset and operate at no load. Output voltage must build up without field flashing. If not, shut down the genset and perform continuity check of all related wiring.

[C]

AC VOLTAGE REGULATOR REPLACEMENT

Use the following procedure to replace the voltage regulator assembly shown in Figure 7-1.

1. Stop the genset and disconnect the starting battery leads, negative (-) lead first.

2. Disconnect (and label if necessary) the wires from voltage regulator TB1. Refer to the AC control wiring diagram.

3. Remove mounting screws from the old voltage regulator, then install new regulator.

4. Reconnect wires removed in Step 2 to the proper terminals.

5. Perform the voltage regulator adjustment/switch settings for specific voltage and method of regulation desired per procedure [J].

[D]

ROTATING RECTIFIERS

Two different rectifier assemblies make up the rotating rectifier bridge assembly, Figure 7-3. Using an ohmmeter, test each CR rectifier using negative (-) and positive (+) polarities. Use the following procedure.

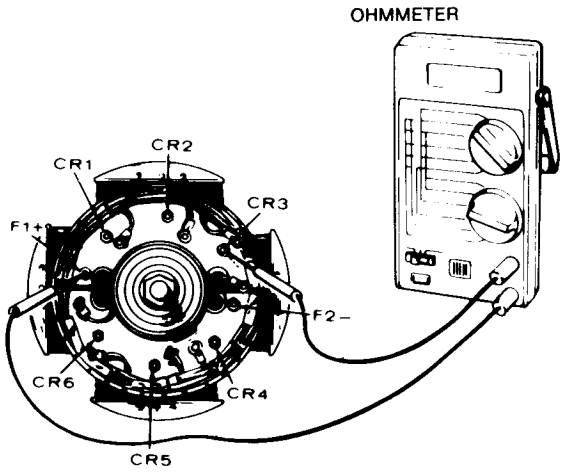


FIGURE 7-3. TESTING ROTATING RECTIFIERS

1. Disconnect all leads from the assembly to be tested.

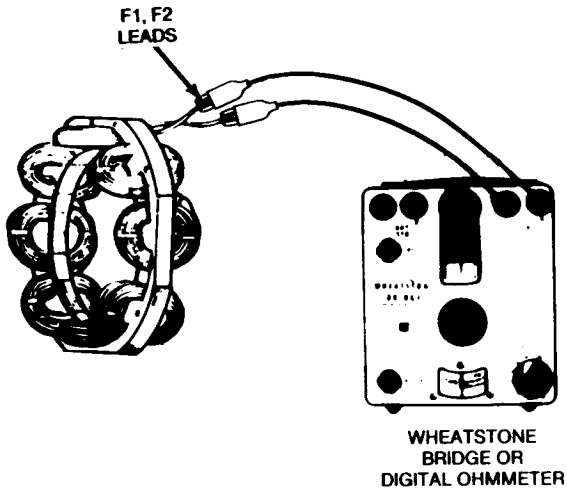
2. Connect one ohmmeter test lead to F1+ stud and connect the other test lead to CR1, CR2, and CR3 in turn. Record resistance value of each rectifier.

3. Connect one lead to F2- stud and connect other test lead in turn to CR4, CR5, and CR6. Record resistance value of each rectifier.

4. Reverse ohmmeter test leads in Steps 2 and 3 and record resistance value of each rectifier.

5. All resistance readings should be high in one test and low in the other test. If any reading is high or low in both tests, rectifier assembly is defective.

   Use 23 to 26 inch pounds (2.6 to 2.9 N•m) torque when replacing nuts of F1+, F2- leads, and on diodes CR1, CR2, CR3, CR4, CR5, and CR6.



TESTING FOR OPEN OR SHORTED WINDING

CA-1010-10

[E]

TESTING EXCITER STATOR

Test the exciter stator (Figure 7-4) for open or shorted windings and grounds as follows.

Testing For Open or Shorted Winding

Use a Wheatstone Bridge or digital ohmmeter for this test. Disconnect F1+ and F2- exciter field leads from the terminal block in the generator end bell. Resistance per model at 77°F (25°C) should be as follows:

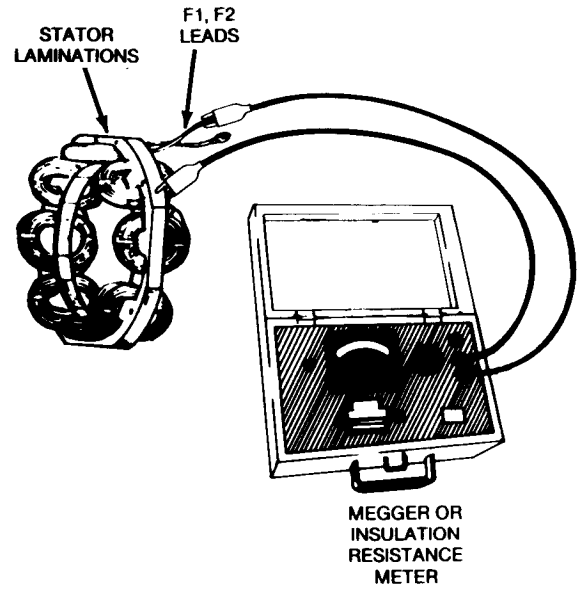
- 20.0 DL4
  25.0 DL6
  40.0 DL6T
  4A2.3
  6A3.4
  6AT3.4
  DGAB
  DGAC
  DGAD
  DGAE

  14.5 ohms ±10%

- 14.0 QSA3
  20.0 QSA4
  30.0 QSA6

  12.4 ohms ±10%

Use 23 to 26 inch pounds (2.6 to 2.9 N•m) torque when replacing nuts of F1+ and F2- leads, CR1, CR2, CR3, CR4, CR5, and CR6.



TESTING FOR GROUND TO LAMINATION

CA-1010-11

FIGURE 7-4. TESTING EXCITER STATOR

Testing for Grounds

Connect a Megger or insulation resistance meter that applies 500 VDC or more between the field and the exciter stator lamination. See Figure 7-4. Be sure both exciter leads are disconnected from the terminal block. Reading should be 100,000 ohms or greater. If not, the exciter stator is questionable and might require removal for oven drying and retest. A shorted stator must be replaced.

[F]

TESTING EXCITER ROTOR

Test the exciter rotor winding (Figure 7-5) for open or shorted winding, or grounds as follows:

Testing For Open or Shorted Windings

Use a Wheatstone Bridge or digital ohmmeter for this test. Disconnect the main rotor leads that connect to rotating rectifier assemblies at terminals F1+ and F2-. Disconnect exciter rotor leads from diodes CR1, CR2, CR3, CR4, CR5 and CR6. Test between exciter lead pairs T1-T2, T2-T3, and T1-T3. See connection diagram in Figure 4-5. Resistance per model at 77°F (25°C) should be as follows:

- 20.0 DL4
  25.0 DL6
  40.0 DL6T
  DGAB
  DGAC
  DGAD
  DGAE
  4A2.3
  6A3.4
  6AT3.4

  0.645 ohms ±10%

- 14.0 QSA3
  20.0 QSA4
  30.0 QSA6

  0.54 ohms ±10%

Testing For Grounds

Test with an insulation resistance meter or Megger that applies at least 500 volts to the test leads. With all generator leads disconnected from rotating rectifiers CR1 through CR6, apply test leads between any CR lead and the rotor laminations. Reading should be 100,000 ohms or higher. If not, the exciter rotor is questionable and might require removal for oven drying and retest. A shorted rotor must be replaced.

Use 23 to 26 inch pounds (2.6 to 2.9 N•m) torque when replacing nuts of F1+ and F2- leads, CR1, CR2, CR3, CR4, CR5, and CR6.

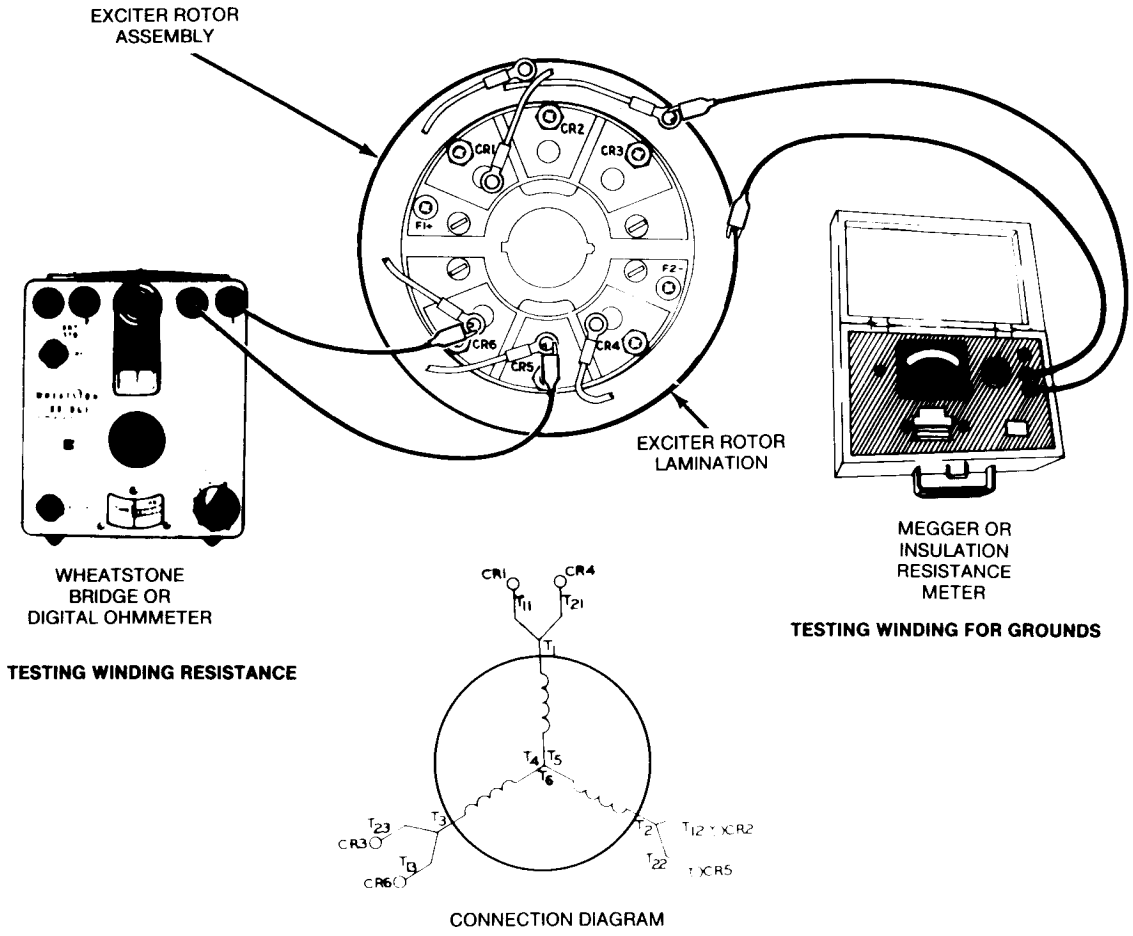


FIGURE 7-5. TESTING EXCITER ROTOR

[G]

TESTING MAIN ROTOR WINDING

Test the main rotor winding (Figure 7-6) for grounds, opens, and shorts as follows.

Testing For Open or Shorted Winding

Perform this test with a known, accurate instrument such as a digital ohmmeter.

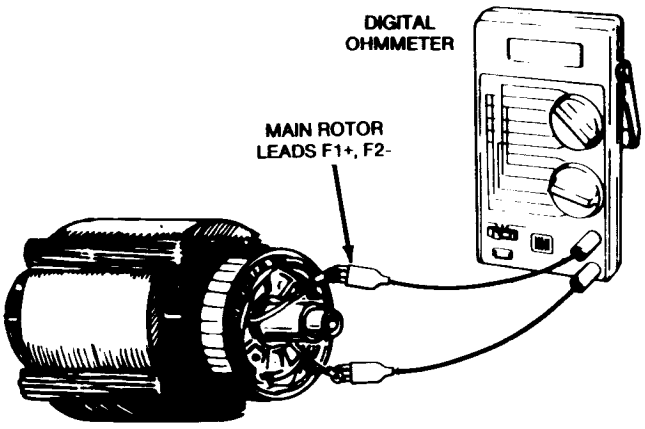
1. Remove rotor leads F1+ and F2- from the rotating rectifier assemblies.

2. Check resistance across F1+ and F2- leads. The resistance values at 77°F (25°C) should be as shown in Table 7-1. See Figure 7-7 for determining the stack length. If resistance is not as shown, replace the defective rotor with a new, identical part.

TABLE 7-1. MAIN ROTOR RESISTANCE

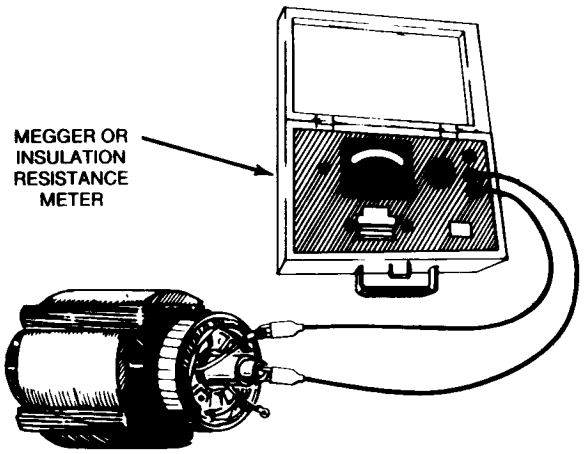
[1]STACK LENGTH	[2]OHMS RESISTANCE
5.88 (149)	2.75
7.12 (181)	1.80
8.75 (222)	2.04
10.50 (267)	2.55
*5.12 (130)	2.55
*5.88 (149)	2.75
*7.12 (181)	1.98
*8.75 (222)	2.24
*10.50 (267)	2.91

[1]Lamination Stack Length in Inches (mm).
[2]Resistance in Ohms @ 77°F (25°C) ±10%.
*QSA-Series Generators (Rental Construction).



TESTING WINDING RESISTANCE

CA-1010-8



TESTING WINDING FOR GROUNDS

CA-1010-12

FIGURE 7-6. TESTING MAIN ROTOR WINDING

Testing For Grounds

Check for grounds between the rotor winding and the rotor shaft as shown. Use a Megger or insulation resistance meter which applies 500 VDC or more at the test leads. Perform test as follows.

1. Remove rotor leads F1+ and F2- from the rotating rectifier assemblies.

   ⚠CAUTION ***Be sure to remove both rotor leads so the rotating rectifiers are isolated. Failure to do this will damage the rectifiers.***

2. Connect test leads between one of the two leads and the rotor shaft. Meter should read 100,000 ohms or greater.

3. If less than 100,000 ohms, the rotor is questionable and might require removal for oven drying and retest.

4. Replace a grounded rotor with a new identical part.

[H]

TESTING MAIN STATOR WINDINGS

Test the main stator (Figure 7-7) for opens, shorted windings, and grounds as follows.

Testing For Open or Shorted Windings

Test for continuity across stator coil leads. Each coil should have equal resistance. Use an accurate instrument for this test such as a Wheatstone Bridge. Resistance readings should be as shown in Table 7-2 at 77°F (25°C) ±10 percent. See Figure 7-7 for determining the stator stack length.

If a winding is shorted, open or grounded, replace the stator assembly. Before replacing the assembly, check leads for broken wires or insulation.

Testing For Grounds

Use a Megger or insulation resistance meter which applies 500 VDC or more at the test leads. Test each stator winding for short to laminations. If less than 100,000 ohms, the stator is questionable and might require removal for oven drying and retest.

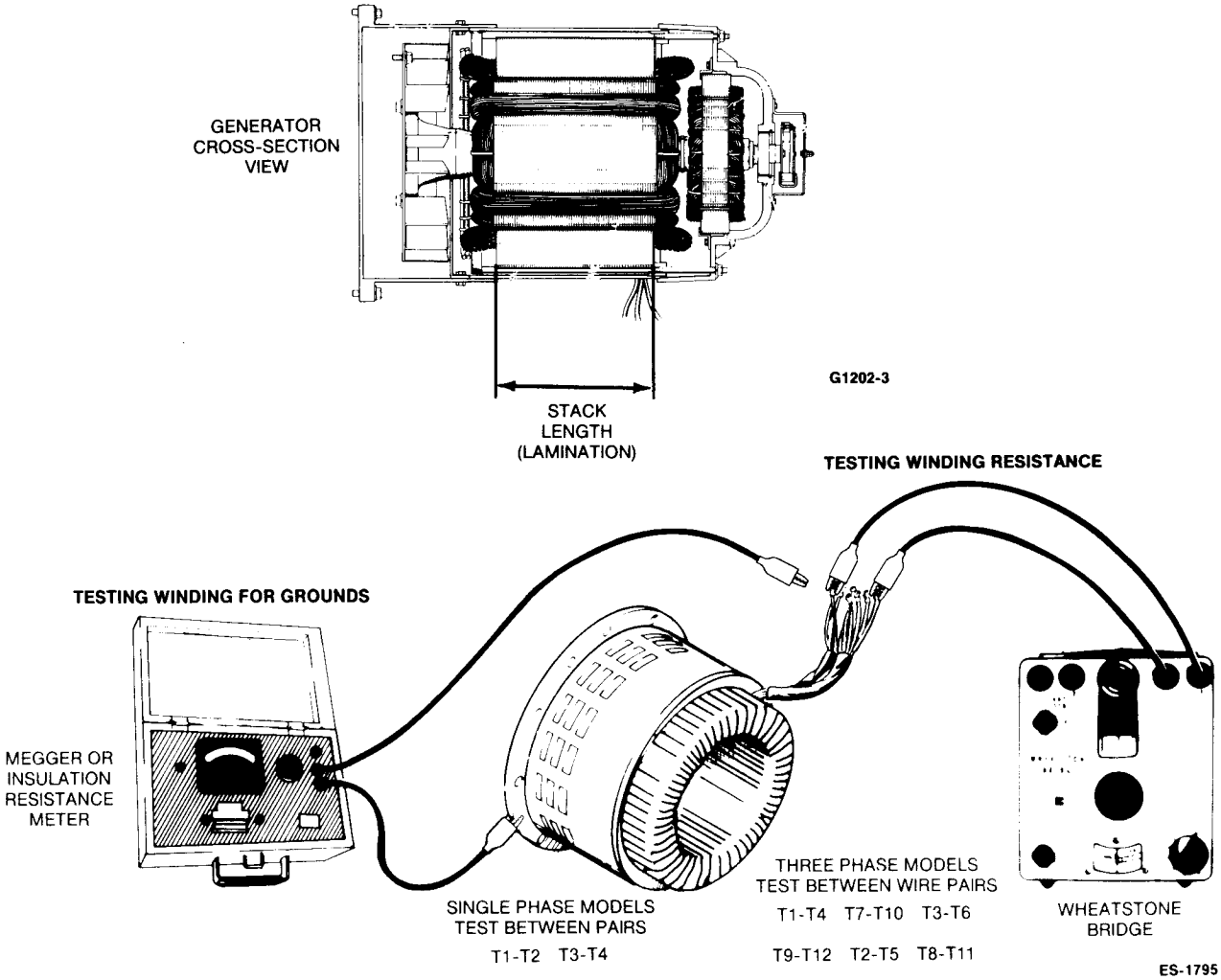


FIGURE 7-7. TESTING MAIN STATOR WINDINGS

TABLE 7-2. MAIN STATOR RESISTANCE

[1]STACK LENGTH	[2]RESISTANCE			
	1Ø GENERATORS		3Ø GENERATORS	
	60 Hz	50 Hz	60 Hz	50 Hz
5.75 (146)			0.127	0.186
7.00 (178)	0.049	0.071	0.100	
8.62 (219)	0.039		0.072	0.084
10.38 (264)	0.029	0.036	0.045	0.059
*5.00 (127)	0.224	0.256	0.224	0.256
*5.75 (146)	0.128	0.150	0.128	0.150
*7.00 (178)	0.105	0.120	0.105	0.120
*8.62 (219)	0.071	0.079	0.071	0.079
*10.38 (264)	0.046	0.063	0.046	0.063

[1]Lamination Stack Length in Inches (mm).
[2]Resistance in Ohms @ 77°F (25°C) ±10%.
*QSA-Series Generators (Rental Construction).

[J]

WIRING HARNESS CHECK

Carefully check the wiring harnesses as follows.

1. Inspect all wires for breaks, loose connections, and reversed connections. Refer to applicable wiring diagram.

2. Remove wires from terminals at each end and using an ohmmeter, check each wire end to end for continuity or opens.

3. Using an ohmmeter, check each wire to other wires and to ground for possible shorts or insulation breaks under areas covered by wrapping material.

4. Reconnect or replace wires/harness per the applicable wiring diagram.

[K]

VOLTAGE REGULATOR ADJUSTMENT

After replacement, the voltage regulator adjustment is performed as follows. Also refer to the Regulator Specifications in Figure 7-8.

1. Open the control panel doors. Refer to Figure 7-8 for the proper setting of S1 (Stability Range) and S2, S3 (Mode Selection) switches.

2. Control with AC meter option: Refer also to adjustment (L).

   Control without AC meter option: Connect an accurate voltmeter to voltage regulator/.TB1-2 and -3 terminals.

3. Start the genset and operate to bring temperature up to normal.

4. As a precaution against electrical shock, place an insulating mat or a dry wood platform on the floor in front of the control panel.

   ⚠WARNING ***Contact with high voltage can cause severe personal injury or death. Do not touch any exposed wiring or components with any part of the body, clothing, tool or jewelry. Do not use non-insulated tools inside the control. Stand on an insulating mat or dry wood platform when the control doors are open.***

5. Using an insulated screwdriver, turn R32 potentiometer on the voltage regulator to increase or decrease the voltage for proper setting with no load. Example: For a 120/240 volt generator connection, set no-load voltage for approximately 246 volts. If voltage is unstable or tends to hunt, refer to the applicable troubleshooting flow chart.

   Potentiometer R34 is for factory adjustment only. Setting requires special calibration equipment. Do not adjust.

6. Stop the genset and close the control panel doors. Set control for operation readiness.

[L]

VOLTAGE ADJUST POTENTIOMETER R21

The following procedure is for gensets equipped with the AC meter option only. Perform adjustment as follows:

1. Loosen the locking nut of R21 Voltage Adjust potentiometer on the control front panel. Adjust R21 to mid-range.

2. Start the genset and operate to bring temperature up to normal.

3. As a precaution against electrical shock, place an insulating mat or a dry wood platform on the floor in front of the control panel.

GENSET kW RATING	STABILITY RANGE		REGULATION MODE								
			60 Hz TORQUE-MATCHING			50 Hz TORQUE-MATCHING			NON-TORQUE-MATCHING		
	S1-1	S1-2	S2	S3-1	S3-2	S2	S3-1	S3-2	S2	S3-1	S3-2
16-35	OFF	OFF	POS 2	OFF	ON	POS 2	ON	ON	POS 2	OFF	OFF
40	OFF	ON	POS 2	OFF	ON	POS 2	ON	ON	POS 2	OFF	OFF

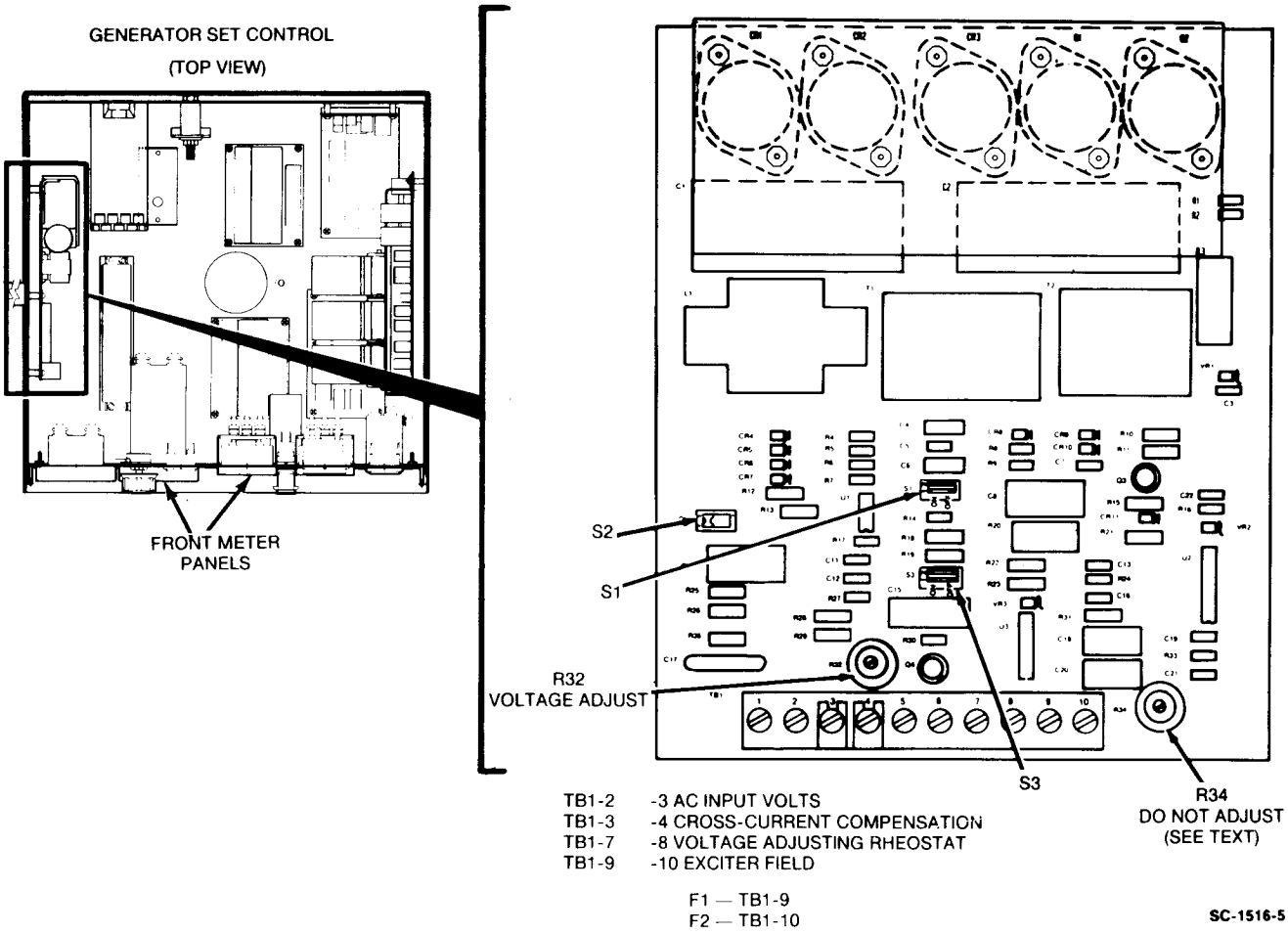


FIGURE 7-8. VOLTAGE REGULATOR LOCATION/ADJUSTMENTS

⚠WARNING ***Contact with high voltage can cause severe personal injury or death. Do not touch any exposed wiring or components with any part of the body, clothing, tool or jewelry. Do not use non-insulated tools inside the control. Stand on an insulating mat or dry wood platform when the control doors are open.***

4. With no load on the generator, turn the Phase Selector switch to read output voltage/current while performing the following adjustments.

   A. Open the control panel doors and adjust R32 on the voltage regulator for the approximate desired voltage .

   B. Fine-adjust the voltage with R21 on the control panel. When set at correct voltage, carefully tighten the locking nut using care not to change the setting.

   C. If correct voltage cannot be obtained by R21 at mid-range, refer to voltage adjustment procedure [K].

5. Move the Phase Selector switch to the Off position.

6. Stop the genset and set the control for unit standby readiness.

[M]

TESTING AC LOAD CIRCUIT BREAKER

General

The AC circuit breaker does not require any special maintenance other than periodic exercise and a check of conductor mounting. Circuit breaker options vary by customer requirements.

Review the Optional Circuit Breaker description in Section 6. Generator/Voltage Regulator and perform checks and adjustment applicable to the breaker. A typical breaker diagram is shown in Figure 7-9 for reference.

When performing tests and adjustments, avoid accidental start-up by placing the Run/Stop/Remote switch in Stop position and disconnecting the battery negative (-) cable.

⚠WARNING ***Accidental starting of the generator set during service procedures can result in severe personal injury or death. Place the Run/Stop/Remote switch in Stop position, and disconnect the battery negative (-) cable.***

Exercising Breaker: Actuate the breaker handle to the On and Off positions several times. If the breaker is equipped with a Trip Test button, the breaker should be tripped, reset and actuated to On several times. This will remove any dust from the mechanism and latch surfaces.

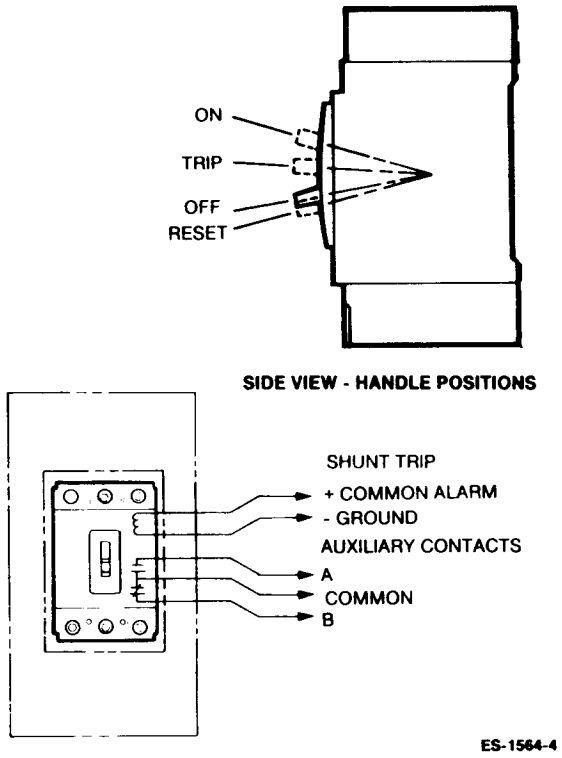


FIGURE 7-9. OPTIONAL CIRCUIT BREAKER DIAGRAM

Checking Insulation Resistance: Disconnect the load and line conductors from the breaker, and place the breaker in the On position. Use an insulation resistance meter that will apply at least 500 volts to the test leads. Measure the insulation resistance between each pole, and to ground. Also test between the line and load terminals with the breaker in the Off position.

A resistance reading less than 100,000 ohms indicates a ground. Investigate for possible contamination on the breaker case surfaces, clean if necessary and retest.

Checking Contact Resistance: Extensive operation of the breaker under load may eventually cause contacts to deteriorate. Test by a Resistance Check, or by a Voltage Drop Check across the breaker poles.

Except when genset operation is required for testing, avoid accidental start-up by placing the Run/Stop/Remote switch in Stop position and disconnecting the battery negative (-) cable.

⚠WARNING ***Accidental starting of the generator set during service procedures can result in severe personal injury or death. Place the Run/Stop/Remote switch in Stop position, and disconnect the battery negative (-) cable.***

Resistance Check:

1. Disconnect the line and load wires from the circuit breaker.

2. Move the breaker handle to the On position and check the resistance across each pole (line to load).

3. Resistance should be very low (near zero) and relatively equal across all poles.

Voltage Drop Check: This test is done with the conductors connected, genset operating, and load applied. As a precaution against electrical shock, place an insulating mat or a dry wood platform on the floor to stand on when taking measurements.

⚠WARNING ***Contact with high voltage can cause severe personal injury or death. Do not touch any exposed wiring or components with any body part, clothing, tool or jewelry. Stand on an insulating mat or dry wood platform when taking measurements.***

1. Operate the genset with the breaker in the On position and load applied.

2. Take voltage readings at the line connections, then the load connections.

3. There should only be slight variation in the voltage dropped across each pole of the breaker. Unequal or excessive millivolt drops across the complete breaker, or one pole, indicates contaminated contacts or loose connections.

4. Stop the genset by placing the Run/Stop/Remote switch in Stop position and disconnecting the battery negative (-) cable.

⚠WARNING ***Accidental starting of the generator set during service procedures can result in severe personal injury or death. Place the Run/Stop/Remote switch in Stop position, and disconnect the battery negative (-) cable.***

Checking Shunt-Trip Operation: The shunt-trip feature is available in varying AC or DC voltages. The circuit breaker model is selected and installed at the factory to meet customer requirements. Check the shunt-trip function as follows:

1. Refer to the original equipment order, installation wiring diagrams, and unit wire routing to identify and confirm proper AC or DC signal source connections.

2. Check security of the wire connections.

3. Apply the appropriate signal voltage (12-VDC; 240-, 480-VAC). The shunt-trip solenoid should energize and trip the breaker open.

4. If the breaker did not trip open, remove the signal source. Perform continuity check of interconnect wiring and shunt-trip solenoid lead wires. Replace interconnect wiring if defective.

Checking Auxiliary Contacts: If equipped, the breaker will have three leads for wiring to an internal single-pole, double throw switch. The switch allows connection of a remote annunciator (see installation wiring diagrams).

Perform continuity checks of the switch with the breaker in On and Off positions to confirm operation.

Adjusting Magnetic Trip Operation: If equipped with front-adjustable magnetic trip controls, the short circuit protection feature for each pole of the breaker can be adjusted equally or individually as required. Surge current above the trip settings will actuate the trip mechanism. These adjustors are set equally to the high position at the factory. Consult on-site requirements and adjust to proper position.

Section 8. Generator Disassembly/ Assembly

GENERAL

If testing determines that the generator needs service, use the following disassembly and assembly procedures. The procedures cover major components of the generator as shown in Figure 8-1.

DISASSEMBLY

Access to the generator requires removal of the control box and the generator output box.

1. Disconnect the genset starting battery (negative [-] cable first) before performing service procedure.

⚠WARNING ***Accidental starting of the generator set can cause severe personal injury or death during service procedures. Be sure to disable the generator set by disconnecting the starting battery cables (negative [-] cable first).***

2. Remove screws securing the back grille to the rear of the generator.

3. Remove screws securing the output box cover.

4. Open control box doors and disconnect the generator control wires. Check wire stamping legibility to ease reassembly (if necessary, attach identification with tape). Arrange leads so they can be withdrawn easily through the control box grommet opening.

5. Remove four screws (5/16-18) and lock washers securing the control box to the generator output box. Carefully lift the control box free of leads and set aside.

6. Remove all leads from the circuit breaker and free the output box of all electric conduit.

7. Remove four 3/8-inch nuts securing the upper and lower output box brackets at the rear of the end bell.

8. Remove three capscrews at the front of the output box. Two capscrews are on the outside (5/16-18 x 1.25 and flat washers), and one inside the output box beside the breaker (5/16-18 x 0.62).

9. Slide the engine harness/grommet free as the output box is removed from the generator.

10. Remove lead from the overspeed switch (if used), and control leads F1+ and F2- from the end bell terminal board.

11. Remove the overspeed switch and bracket (if used) from the end bell and rotor shaft.

12. Remove the end bell and exciter stator assembly. It might be necessary to pry or jar the assembly loose from the main stator assembly.

13. Use a hoist and safe lifting device (stator handling tongs, nylon lifting strap or chain and lifting hooks) to support the main stator assembly.

⚠WARNING ***Generator components are heavy and can result in severe personal injury during removal. Use the recommended removal techniques and keep hands and feet clear while removing mounting bolts.***

14. Remove screws and lock washers securing the main stator assembly to the engine adapter.

15. Remove the main stator being careful not to touch or drag it on the rotor. Place the stator on its side and block to prevent rolling, especially if placed on a workbench.

⚠WARNING ***Falling, heavy objects can cause severe personal injury or death. Be sure to block or support heavy objects to prevent falling. Wear protective shoes and keep hands and feet clear.***

16. Using a hoist and sling to support the rotor, carefully remove the capscrews that attach the drive disk to the engine flywheel (Figure 8-1).

17. Remove the rotor assembly and place upon wood block in the horizontal position. The drive disk and fan should not be resting on anything or distortion might occur.

18. Remove bolts that hold the drive disk and fan to the rotor shaft.

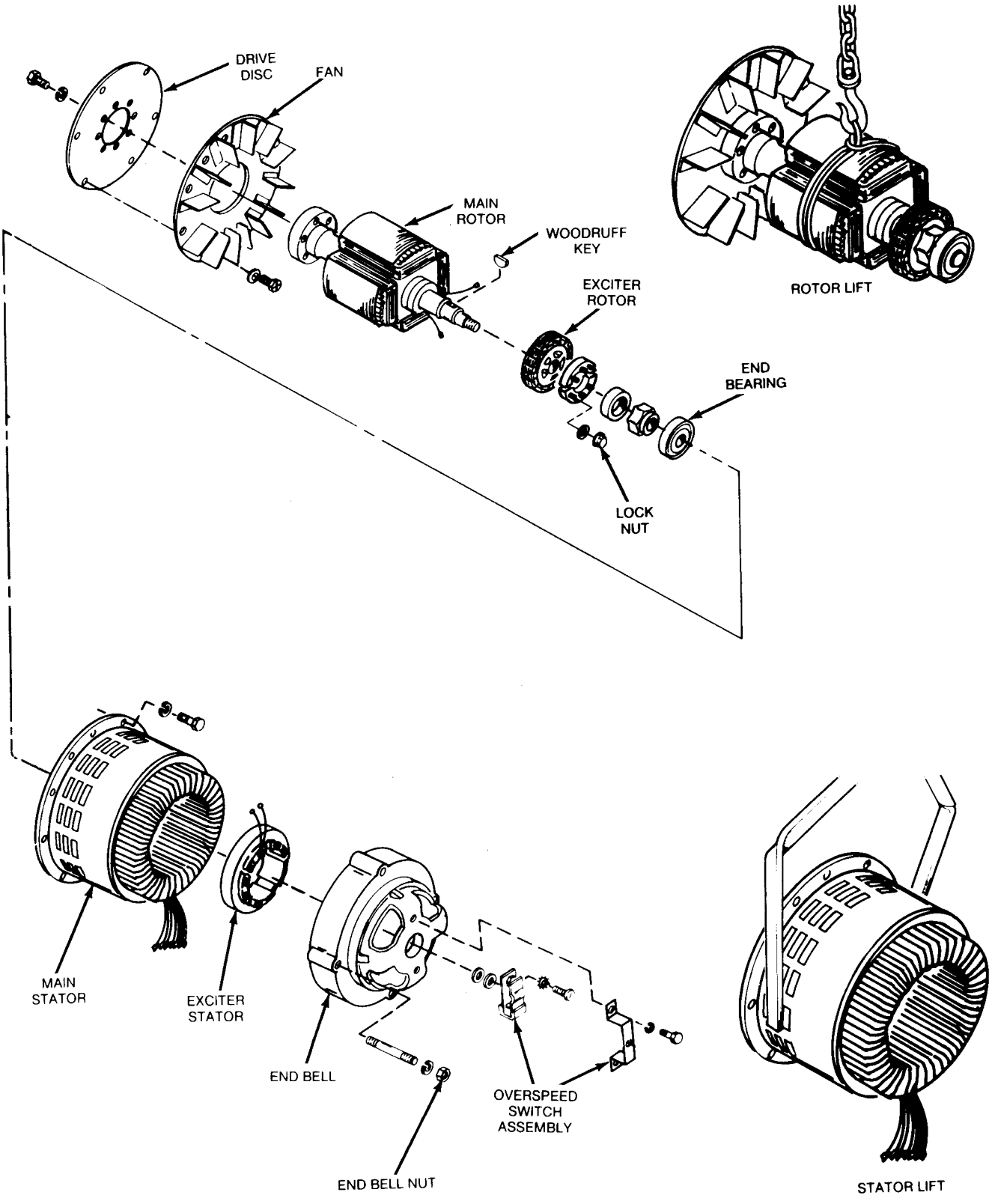


FIGURE 8-1. TYPICAL GENERATOR DISASSEMBLY/ASSEMBLY

19. Use a gear puller to remove the end bearing from the rotor shaft (Figure 8-2). If reusing the bearing, be sure to apply puller to the inner race.

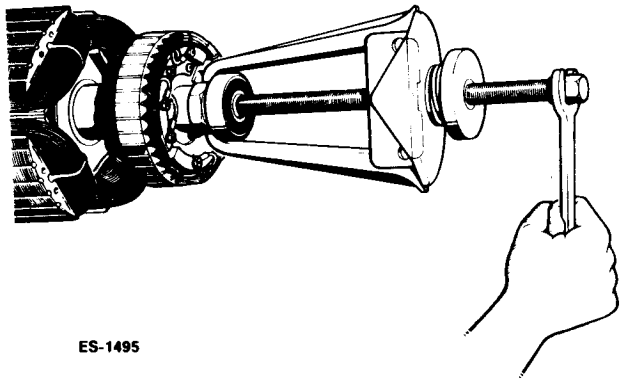


FIGURE 8-2. END BEARING REMOVAL

⚠CAUTION ***Improper removal of the end bearing will damage it. If intended for reuse, the bearing must be pulled off by the inner race.***

20. Clamp the rotor in a fixed position and remove the exciter rotor lock nut.

21. Remove the generator field leads from the exciter rotor and slide the exciter off the rotor shaft.

REASSEMBLY

Reassembly procedures are basically the reverse of disassembly. Use the following steps as a guide. Apply torque as specified in Figure 8-3.

1. Slide the exciter rotor over the generator shaft and woodruff key. Install the exciter nut and torque as specified.

2. Connect the main rotor leads to terminals F1+ and F2- on the exciter rotor and torque as specified.

3. Press the end bearing onto the rotor shaft. Spacing between the shaft end and bearing side surface must be as specified in Figure 8-3.

4. Assemble rotor fan and drive disk to the engine flywheel. Use a hoist and sling to support the rotor. Be sure the drive disk is assembled with the chamfer on the flywheel side. Apply torque values as shown in Figure 8-3.

5. With a hoist and safe lifting device, carefully move the main stator into position over the rotor. The stator leads should exit in the 4 o'clock position.

6. Secure the main stator to the engine adapter with screws and lock washers removed in disassembly. Torque bolts to 39 ft-lb (52 N•m).

7. Apply a thin film of grease to the mating surfaces of the end bearing and the end bell. Install the end bell over the stator stud bolts. Do not install nuts and lock washers until later.

8. Install the overspeed switch and bracket to the rotor shaft and end bell. Apply torque values from Figure 8-3.

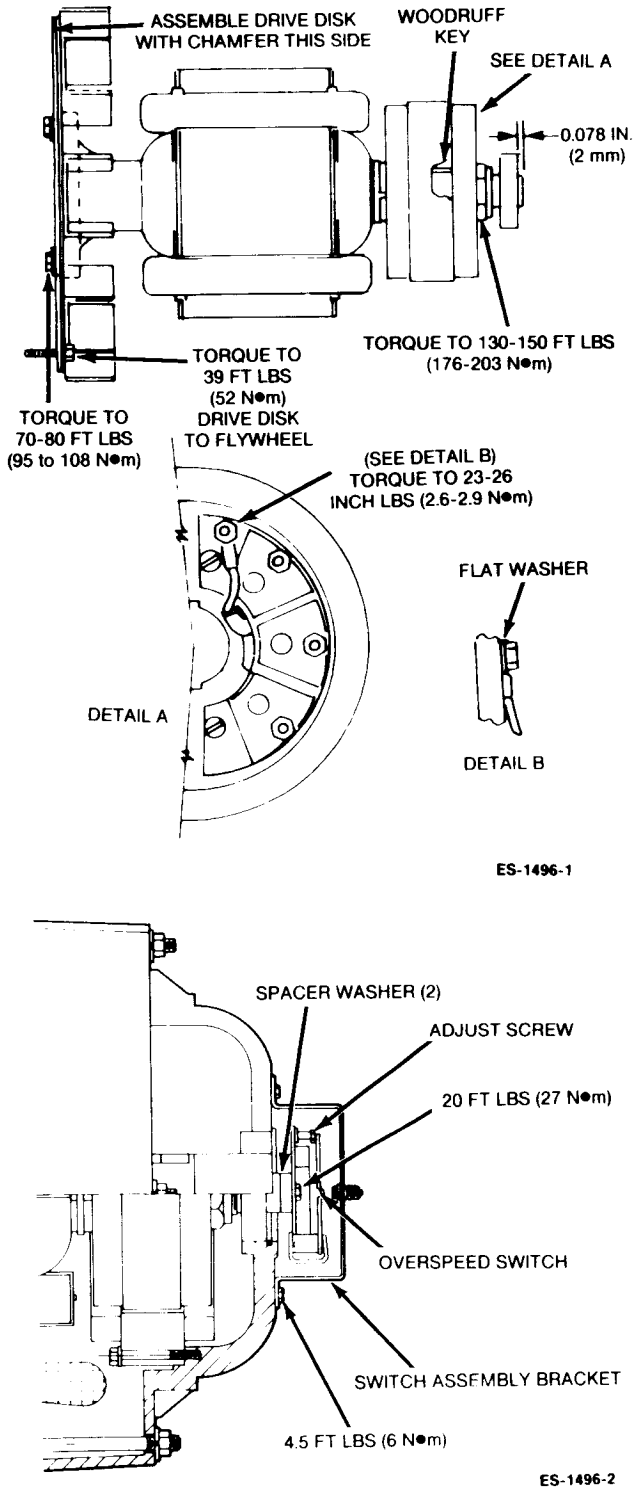


FIGURE 8-3. ROTOR COMPONENT ASSEMBLY/ TORQUE VALUES

9. Connect control leads to the F1+, F2– terminals, and to the overspeed switch.

10. Place the AC output box into position. Slide the engine harness/grommet into the slot opening.

11. Install four (3/8-16) nuts and lockwashers to the end bell studs; then three capscrews and flat washers at the front of the AC box. Torque the end bell nuts to 20 ft-lb (27 N•m).

12. Tighten the output box capscrews. Using a lead hammer, tap the end bell at the horizontal and vertical plane to relieve stress. Retorque the four end bell nuts.

13. Assemble wire conduit to the generator output box. Connect the generator, load, and auxiliary wires to the AC circuit breaker (if used).

14. Set the control box on the output box. Route all control leads through grommet in control box bottom. Secure control box with four screws and lockwashers.

15. Carefully connect all control leads to their marked terminations.

16. Close and secure the control box doors. Do not install the output box back grille until the overspeed switch setting has been checked.

17. Connect the genset starting battery leads (positive [+] lead first) and test generator operation.

18. The r/min at which the overspeed switch shuts down the genset can be changed by the adjust screw. Turning this screw in or out changes the magnetic air gap. When set correctly, the switch closes and shuts down 60 hertz gensets at 2100 ±90 r/min; 50 hertz gensets at 1900 ±100 r/min. On QSA model gensets the overspeed switch is set to shut down 60 hertz gensets at 2400 ±150 r/min; 50 hertz gensets at 2100 ±150 r/min.

    An accurate frequency meter or strobotach is needed to check the overspeed trip point when the engine speed is increased (see the engine service manual). The air gap must not be less than 0.005 inch (0.13 mm).

    ⚠WARNING ***Contact with high voltage wires can cause severe personal injury or death. Some model generator sets can have exposed wire terminals when making this adjustment. Be sure the generator set battery is disconnected (negative [–] lead first) to prevent starting before making an adjustment.***

Section 9. Miscellaneous

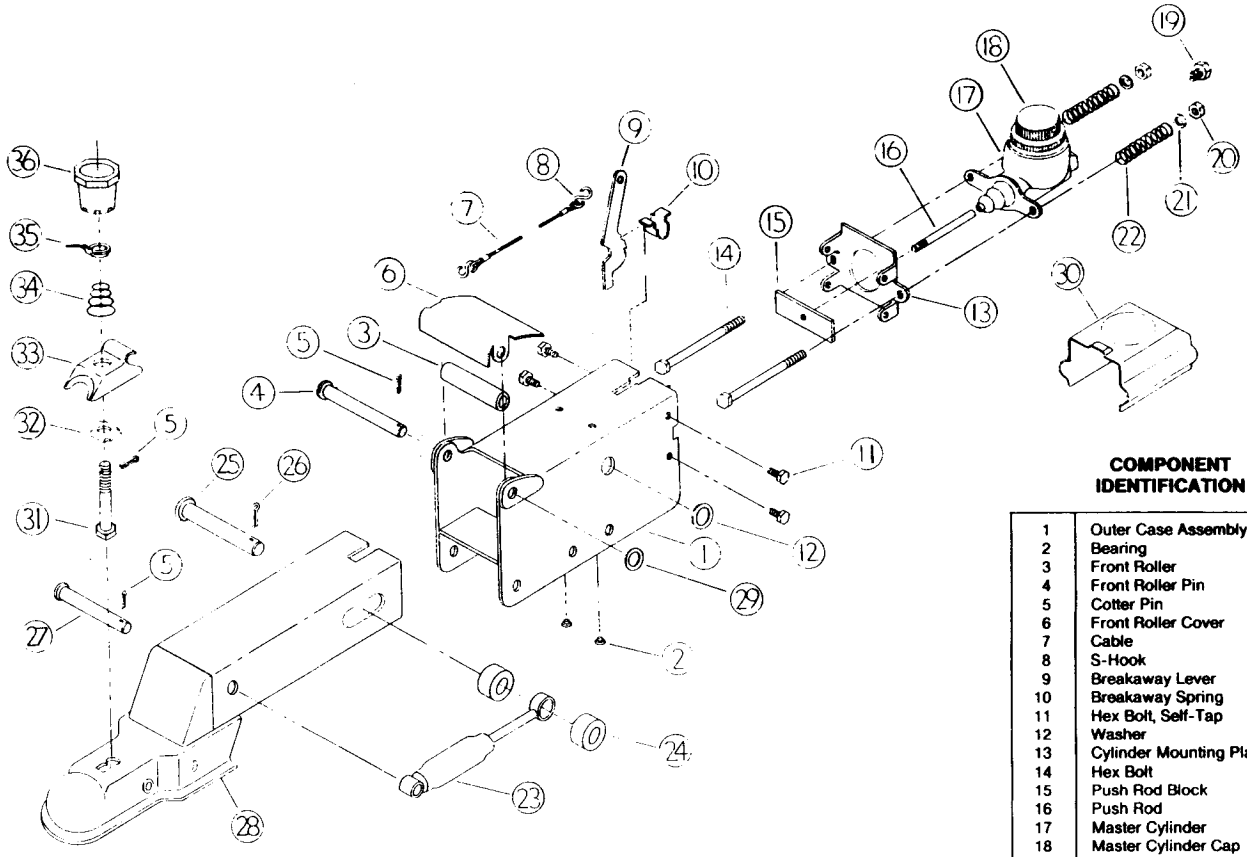
GENERAL

This section contains basic service and maintenance information for miscellaneous components that might not be referenced elsewhere in this manual, or in other Onan literature. The components are mostly "model specific."

TRAILER OPTION (QSA-SERIES)

Trailer Brakes

The trailer uses a system called surge braking. When the tow vehicle brakes are applied, the push of the trailer toward the tow vehicle automatically synchronizes its braking with the tow vehicle. The actuator telescopes together and applies force to the master cylinder that supplies hydraulic pressure to the brakes. See Figure 9-1. A breakaway system applies the trailer brakes should both the coupling and safety chains fail.



COMPONENT IDENTIFICATION

1	Outer Case Assembly
2	Bearing
3	Front Roller
4	Front Roller Pin
5	Cotter Pin
6	Front Roller Cover
7	Cable
8	S-Hook
9	Breakaway Lever
10	Breakaway Spring
11	Hex Bolt, Self-Tap
12	Washer
13	Cylinder Mounting Plate
14	Hex Bolt
15	Push Rod Block
16	Push Rod
17	Master Cylinder
18	Master Cylinder Cap
19	Connector
20	Nut, Hex 3/8
21	Washer, 3/8
22	Spring
23	Damper
24	Rear Roller
25	Master Pin
26	Cotter Pin
27	Damper Pin
28	Inner Slide Assembly
29	Washer
30	Cover
31	Latch Bolt
32	Lock Plate
33	Ball Latch
34	Latch Spring
35	Lock, Hand Wheel
36	Hand Wheel

FIGURE 9-1. TRAILER SURGE BREAKING SYSTEM

Brake Maintenance

1. Before towing, check the brake fluid level in the reservoir. It should be at least half full. If not, add DOT 3 brake fluid. Check for leaks and repair as required.

2. Examine the actuator for bent parts or wear. Replace parts as necessary and make sure mounting bolts are tight and welds not cracked. There are no adjustments on the brake actuator.

   Readjust the brake shoes to reduce actuator stroke length if it exceeds 1 inch (25 mm). The length of the roller path on top of the actuator, when it is fully extended, is the same as stroke length. Brake shoe adjustment is accessible through slots in the back of each drum assembly. Turn the wheel forward while making shoe adjustment. Back off each shoe 10 clicks from the point where wheel cannot be turned by hand.

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

3. Before each towing, wipe the coupler and ball clean and add a film of grease. Doing so will extend their life while eliminating squeaking.

4. ***Bleeding the Brakes:*** Use the following procedure to bleed the brake system.

   A. Fill the system with DOT-3 heavy duty hydraulic fluid using a pressure type brake bleeder. This type bleeder is available at your local automotive jobber. Follow the manufacturer's directions.

   B. Install bleeder hose on first wheel to be bled. Submerge loose end of hose in a glass container of brake fluid to observe bubbling.

   C. Loosen bleeder screw one turn. Bleeding is complete for the wheel when bubbling stops. Be sure to close the bleeder screw securely.

   D. Repeat bleeding operation at other wheel. During the process, replenish brake fluid so the level does not fall below half in the master cylinder reservoir.

   E. After brakes are bled, make sure master cylinder reservoir is filled and the filler cap securely in place.

⚠CAUTION ***Saltwater, granular fertilizer, and other corrosive materials are destructive to metal in the braking system. To prolong the life of the braking system used under corrosive conditions, the actuator should be flushed periodically with a high pressure water hose. Grease bearings and oil all moving parts after the unit has dried. At the end of season when unit is stored, remove the brake drums and clean inside the brakes. Pack the wheel bearings before installing drum.***

Trailer Wiring/Lighting

Check the trailer wiring and operation as follows. Table 9-1 lists the wire color codes and their purpose.

TABLE 9-1. WIRING COLOR CODES

COLOR	PURPOSE
White	Ground
Brown	Tail and Side Marker Lights
Yellow	Left Turn and Stop
Green	Right Turn and Stop

1. Check that the white (ground) wire of the trailer harness is connected to the trailer frame; and that the white (ground) wire of the tow vehicle is connected to its frame or body. Be sure the tie points are free of corrosion and are a good electrical bond. This is very important.

2. If turn signals do not work properly, check the tow vehicle flasher. Many flashers used in automobile applications will not carry the additional load of the trailer turn signals. Install only a heavy duty flasher. Also make sure that the light bulbs are good and have the correct replacement.

3. The trailer tail lights should come on with the headlights; the trailer turn signals should flash simultaneously with the tow vehicle turn signals; the trailer brake lights should come on and go off with each application and release of the brake pedal.

4. If the trailer turn signal lights flash opposite to the towing vehicle, the yellow and green wire connections from the tow vehicle connector have been reversed. Correct problem by reversing the wire connections.

DIESEL FUEL TANK CONTROL SYSTEM (QSA GENSETS)

General

The fuel tank control system consists of a skid-mounted tank, fuel pump, float switches, and the automatic control. The control operates the fuel pump to maintain a reservoir of fuel in the tank, and provides a seven light monitor of the system operation. Figure 9-2 shows an installation on the QSA genset.

The DC control power source can be wired to use either the 24-volt genset battery, or a transformer connected to 120 or 240 VAC. The pump motor can be wired to operate from either 120 or 240 VAC.

⚠WARNING ***Diesel fuel is highly flammable and can cause severe personal injury or death and loss of property if ignited. Faulty component replacement or service can lead to spillage of large quantities of fuel. Installation and service must be performed by qualified persons and in compliance with applicable codes.***

Do not smoke near fuel. Keep flames, sparks and other sources of ignition well away from fuel tanks and piping.

⚠WARNING ***Accidental starting of the generator set, or working on equipment with power connected can cause severe personal injury or death. Be sure all sources of power are disconnected. Disconnect the starting battery cables (negative [-] cable first) from the battery to prevent accidental starting.***

Always disconnect the negative (-) cable first, and reconnect it last to prevent arcing if a tool accidentally touches the frame or other grounded metal parts of the equipment while disconnecting or connecting the positive (+) cable. Arcing can ignite the explosive hydrogen gas given off by the battery and cause severe injury.

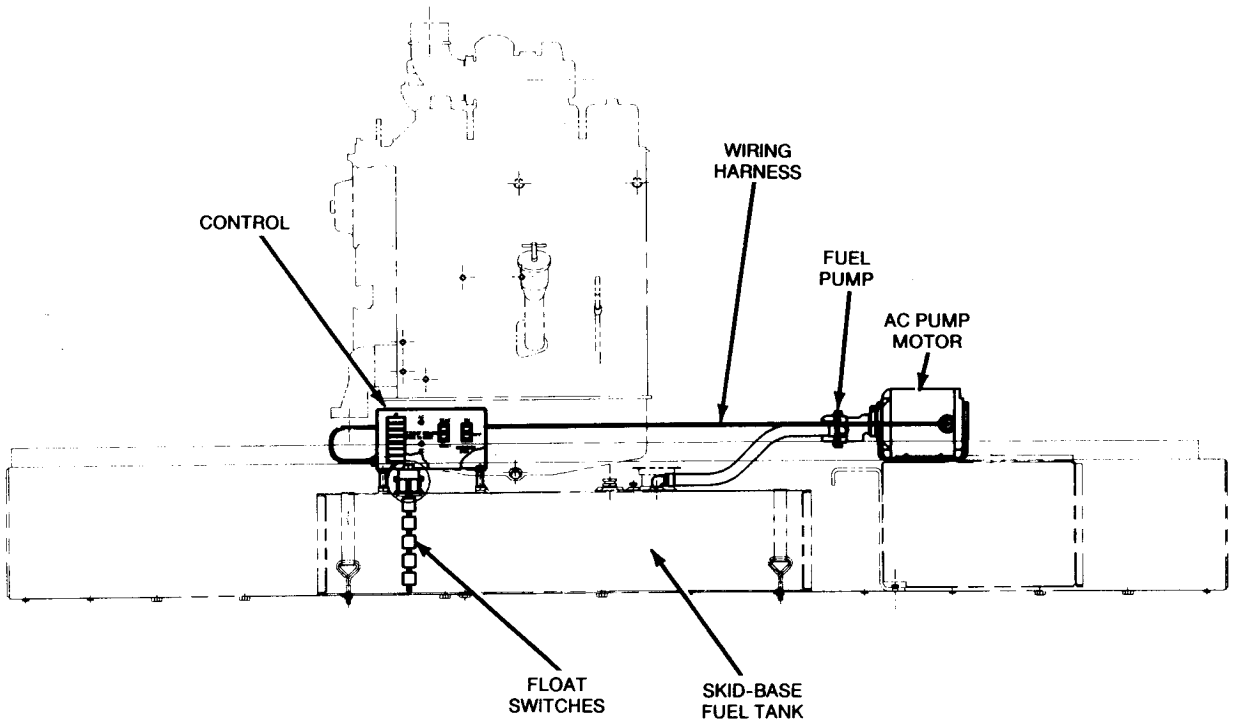


FIGURE 9-2. FUEL TANK CONTROL SYSTEM COMPONENTS, QSA GENSET

Operation

This section explains functions of the control panel lamps, components and operation of the fuel control system. All red color lamps indicate a fault condition. The control front panel is shown in Figure 9-3.

Lamps:

- **READY:** Green lamp comes on if all the following conditions are met:
  - Control switch is in ON position.
  - If AC power is available for pumping.
  - If DC power is available for internal logic circuits (connections to the engine starting battery might be required).

- **HI FUEL:** Red lamp comes on if fuel has reached an abnormally high level. It indicates a possible failure of the "pump-off" float switch (Figure 9-4). The lamp can be turned off with the RESET switch after the fuel level drops to normal. The lamp will come back on again during the next pumping cycle if the fault remains.

⚠WARNING ***Diesel fuel is highly flammable and can cause severe personal injury or death and loss of property if ignited. Continued operation with a HI FUEL fault can lead to spillage of large quantities of fuel if the high fuel float switch fails.***

- **LO FUEL:** Red lamp comes on if fuel level has dropped abnormally low. It indicates possible failure of the "pump-on" float switch, a fuel restriction, low fuel supply, or a defective fuel pump. The lamp can be turned off with the RESET switch after the fuel level rises to normal. The lamp will come back on again during the next pumping cycle if the fault remains.

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

- **LO SHUTDOWN:** Red lamp comes on if fuel level has dropped to near tank bottom. It indicates a possible empty main fuel tank, fuel line restriction, pump failure, or failure of both the "pump-off" and "low fuel" float switches.

  The control should be wired to shut down the genset (optional) as continued operation will allow air to enter the engine injection pump necessitating bleeding to restart the engine. (See Operator's Manual). After restoring the tank fuel level, reset circuit with the RESET switch. This switch also restores engine operation if the tank control has been connected to shut down the engine.

- **BASIN:** Red lamp comes on if fuel has flooded the optional safety basin surrounding the fuel tank. It indicates possible failure of both the "pump-off" and "high fuel" float switches. The basin float switch turns off the fuel pump. The pump cannot function again until the basin is drained of fuel and the circuit reset with the RESET switch.

- **BLANK** - For customer use.

- **PUMP:** Green lamp is on when the pump is running. It will come on and go off as fuel is pumped to maintain tank level. The lamp does not come on when the EMERGENCY RUN switch is used.

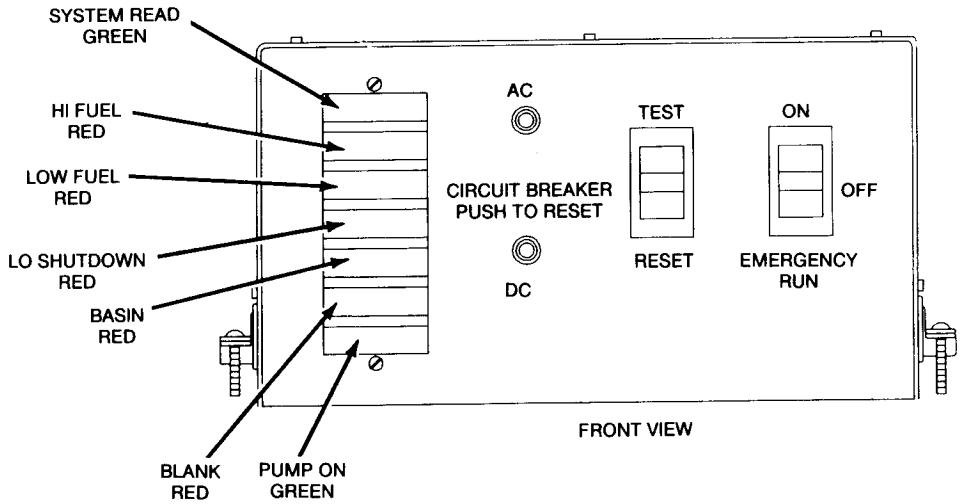


FIGURE 9-3. CONTROL FRONT PANEL

Switches and Circuit Breakers:

Circuit continuity through these control panel components can be checked with an ohmmeter after all power is removed. The following text describes their function.

⚠CAUTION ***Do not test circuits with an ohmmeter when power is applied. Doing so can damage the instrument.***

- **ON/OFF/EMERGENCY RUN:** Switches both AC and DC power supplies. The momentary EMERGENCY RUN position allows pump operation if the control fails to operate the pump automatically.

- **TEST/RESET:** Hold the TEST position to test the indicator lamps and pump operating circuits. Replace any lamps that fail to come on. Pressing the RESET position after correcting a fault condition will restore control operation and turn off the indicator fault lamp. The RESET position also restores engine operation if the fuel control has been connected to shut down the engine.

- **AC and DC CIRCUIT BREAKERS:** Press the breaker reset button to restore control operation if either has tripped.

Float Switch Assembly

This assembly contains five switches, each with a pair of color coded leads coming out the top as identified in Figure 9-4.

Testing: The switches on the float assembly can be tested with an ohmmeter without removing from the fuel tank. However, the tank must be empty of fuel.

Remove the J5 connector from the PC board assembly. Each float switch must show continuity when measured across its corresponding pair of contacts shown in Figure 9-4. If a switch is defective, the entire assembly must be replaced.

Further testing can be done with the float assembly removed from the tank. Connect an ohmmeter across a switch as done in the previous paragraph. Place a 0.125 inch (3 mm) feeler gauge between the float and the C-clip stop above the float. Lifting the float to lightly pinch the feeler gauge should open the switch. Switch should close again when float is moved down. Repeat test on the other float switches.

Control Drawing and Schematic

The following control assembly drawing and overall schematic will be helpfull when troubleshooting. Be sure to read all notes on the schematic. An abbreviated schematic is silkscreened inside the control box cover.

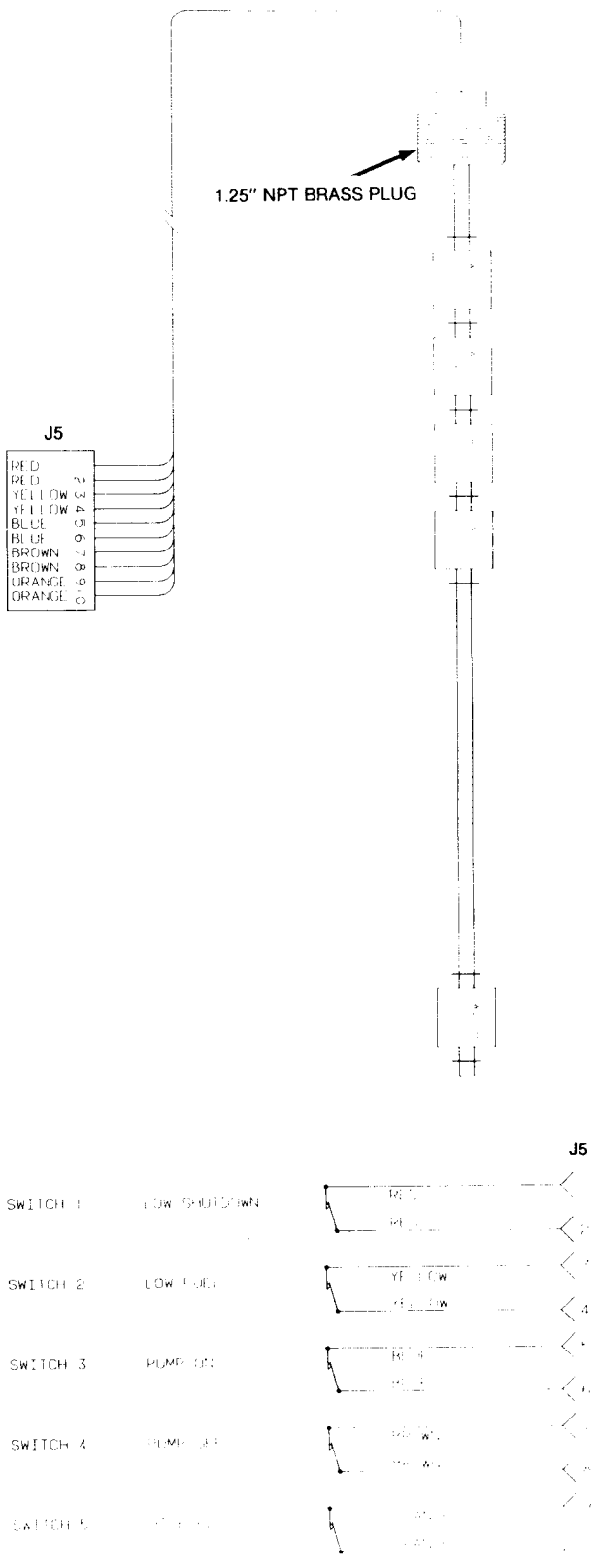
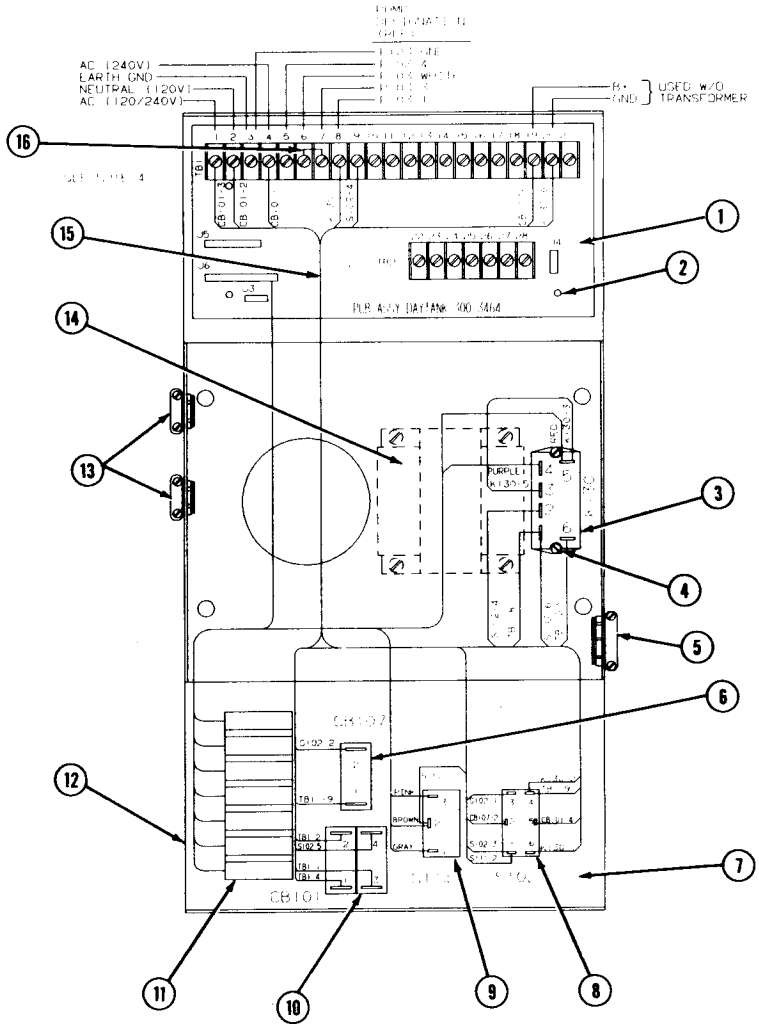


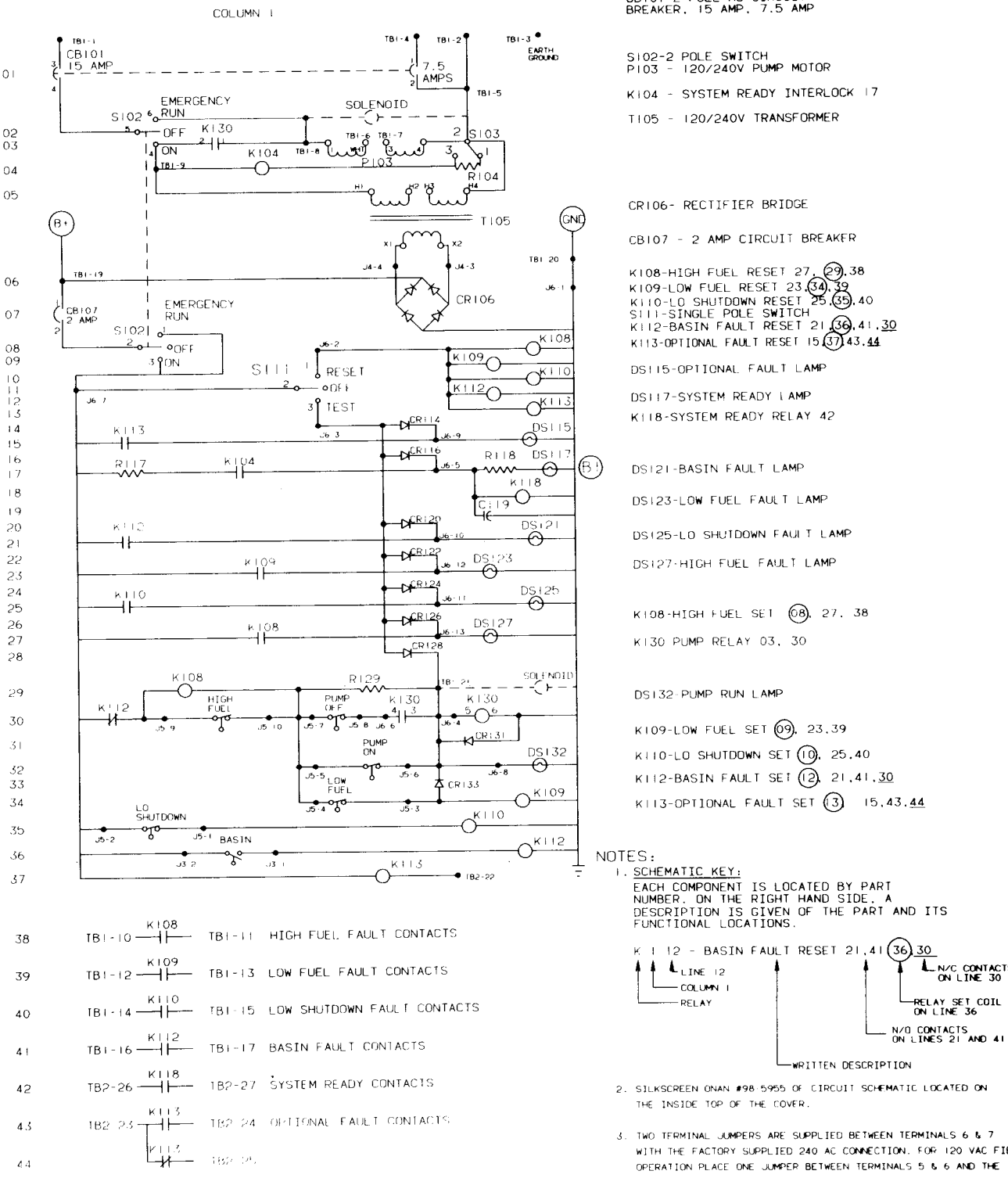
FIGURE 9-4. FLOAT SWITCH ASSEMBLY



COMPONENT IDENTIFICATION

1	CIRCUIT BOARD ASSEMBLY
2	SPACER, PCB
3	RELAY, 2PST
4	SCREW, RELAY MOUNTING
5	CONNECTOR, KNOCKOUT
6	CIRCUIT BREAKER, DC 1-POLE
7	FRONT PANEL, REAR VIEW
8	SWITCH, ON/OFF/EMERGENCY RUN
9	SWITCH, TEST/RESET
10	CIRCUIT BREAKER, AC 2-POLE
11	LAMP ASSY, 7-LIGHT
12	CONTROL BOX
13	CONNECTOR, ROMEX
14	TRANSFORMER, WHEN USED
15	HARNESS, CONTROL
16	JUMPER, TERMINAL

FIGURE 9-5. CONTROL ASSEMBLY DRAWING



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

NOTES:

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

K 1 12 - BASIN FAULT RESET 21, 41 (36), 30

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

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

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

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

FIGURE 9-6. OVERALL SCHEMATIC DIAGRAM

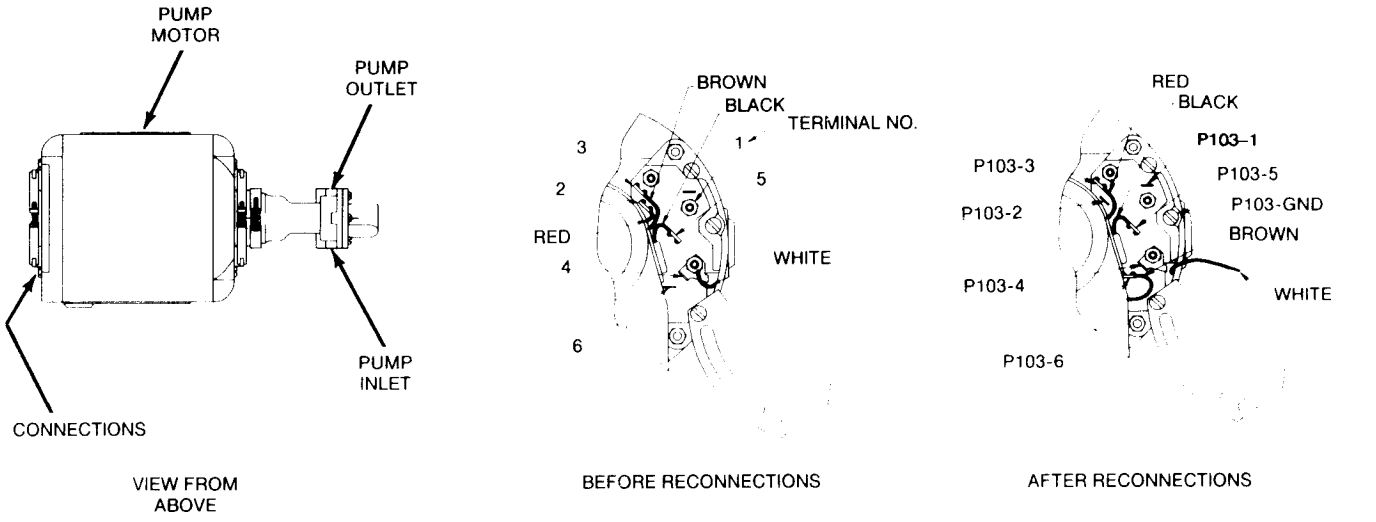


FIGURE 9-7. FUEL PUMP MOTOR RECONNECTIONS

Fuel Pump Motor Wiring Connections

Connect a replacement fuel pump motor as follows to the wiring harness. See Figure 9-7.

1. Remove the end bell cover for access to the motor wiring terminals.
2. Reconnect the brown motor lead from terminal 3 to terminal 6, and the red lead from terminal 2 to terminal 3.
3. Cut the ring terminal connector from the white lead and strip the insulation 1/2 inch (12 mm) for splicing to the wire harness lead marked PLUS-WHITE.
4. Connect the 5 leads of the wiring harness to the appropriate motor terminals or splice. Replace the end bell cover.

Control Wiring Connections

Remove the control cover for access to the wiring terminals. See Figure 9-8.

1. Connect the float switch wiring harness plug to receptacle J5 on the PCB (Printed Circuit Board).
2. Connect the 5 leads of the pump wiring harness to the appropriate terminals on the control PCB.
3. Connect a 120 VAC or 240 VAC power supply to the appropriate control terminals. The control is set up at the factory for connection to 240 VAC. Make sure selector switch S103 on the control PCB is in the down position for 240V. If the power supply is to be 120 VAC, make the following reconnections:

   A. Remove the two jumpers between terminals TB1-6 and TB1-7. Connect one jumper between terminals TB1-5 and TB1-6, and the other between terminals TB1-7 and TB1-8.

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

4. Use the two-lead wire harness to connect terminal TB1-19 to the positive (+) terminal of the starter motor solenoid, and terminal TB-20 to the negative (-) terminal.

5. Connect terminals TB1-14 and TB1-15 to shut down the engine under low fuel conditions.
6. Terminals TB1-10 through TB1-17 and TB2-23 through TB2-27 are available for connections to remote annunciators.
7. Terminal TB2-22 is available for connection of a grounding signal to activate the blank red light.
8. Terminals TB1-8 and TB1-5 are available for connection of a 120 or 240 VAC electric fuel shutoff valve rated not more than 5 amperes. The voltage rating of the valve must correspond with the voltage used for the pump. See proceeding Step 3.

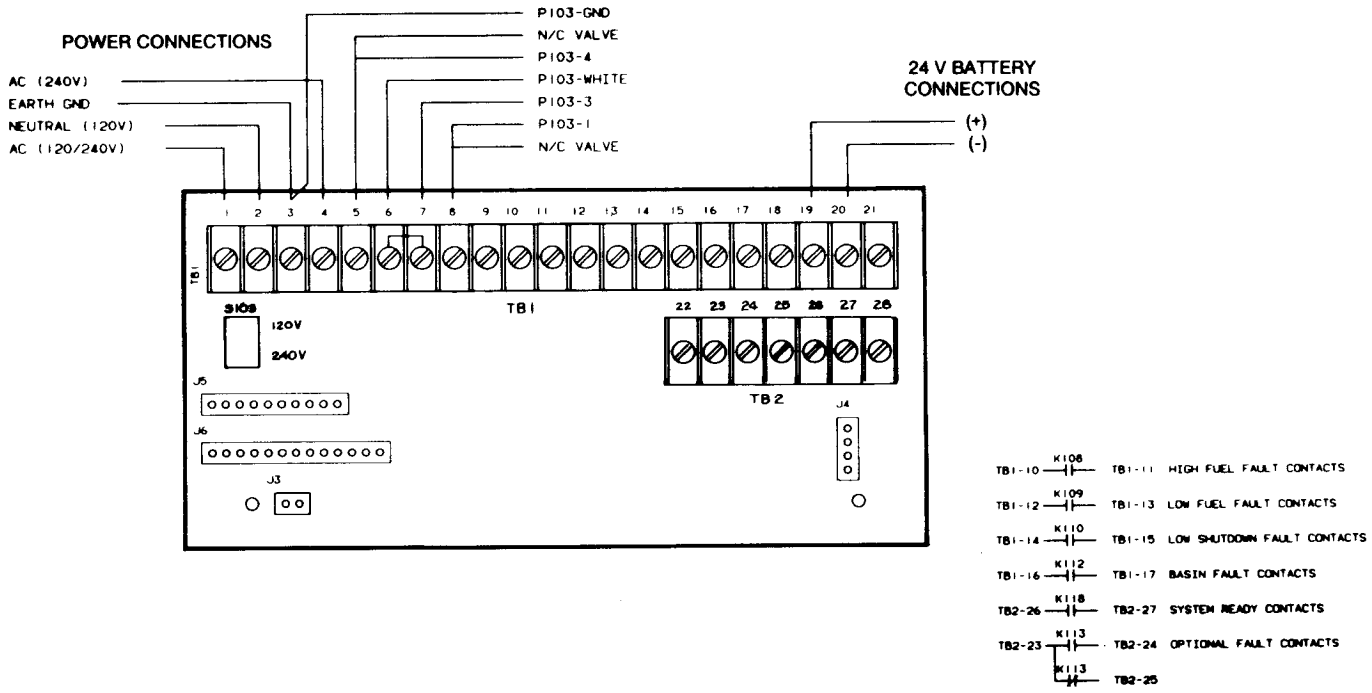


FIGURE 9-8. CONTROL TERMINAL CONNECTIONS

VOLTAGE RECONNECTION PANEL (QSA GENSETS)

This option includes a heavy duty, multi-pole rotary switch, hard-wired output terminals for single- and three-phase voltages, and four convenience receptacles supplying 120 and 240 VAC. The voltage select positions of the switch are shown in Figure 9-9. The switch eliminates rewiring of the generator leads to obtain the required voltage.

A lockable switch cover prevents inadvertent voltage changes. All hard-wired single- and three-phase outputs, and all convenience receptacles are circuit breaker protected.

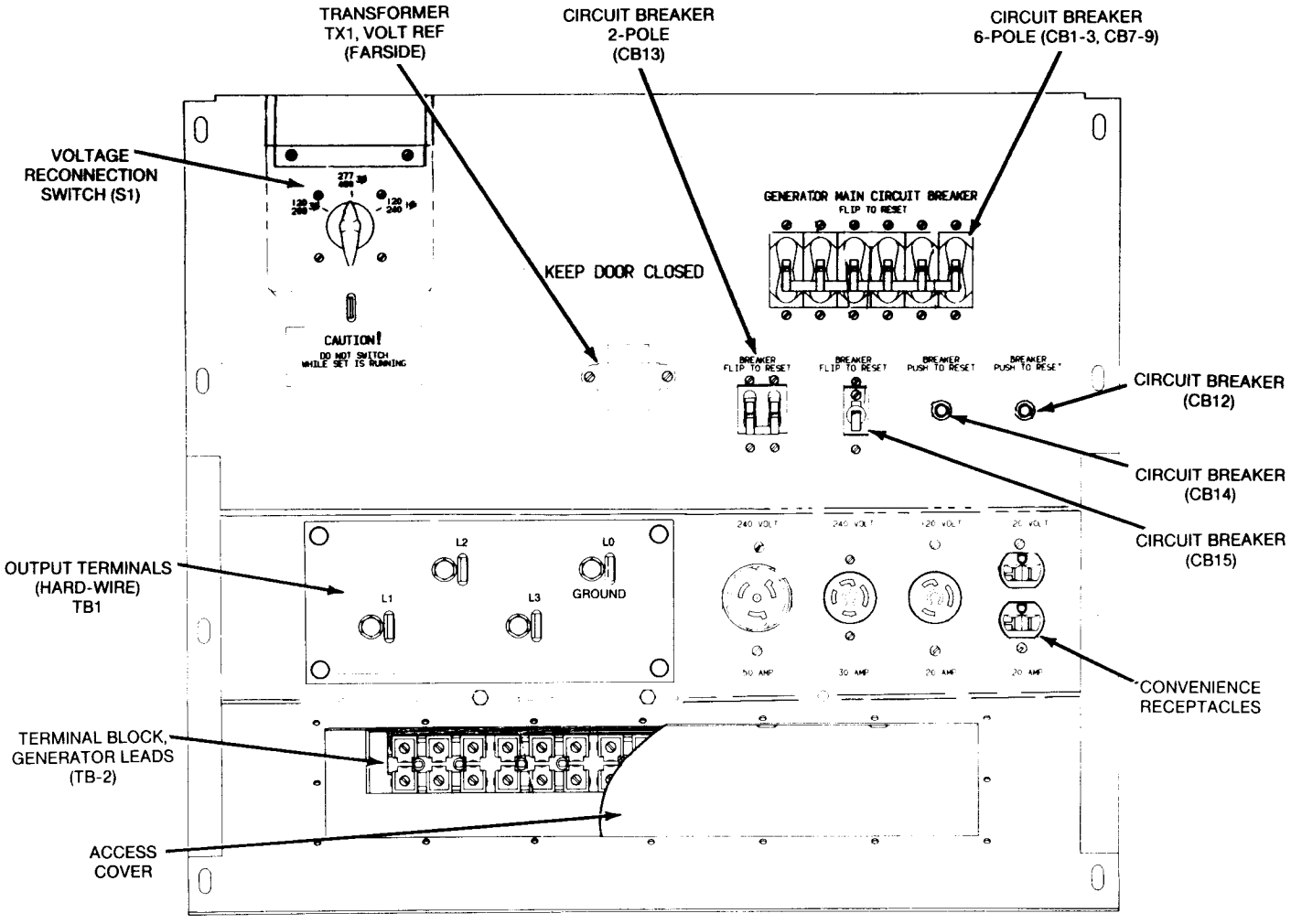
A step-by-step procedure for removal of the voltage reconnection panel is found on page 9-14. Use the following wiring diagrams and drawings when troubleshooting or replacing components on the panel. If terminations stamped on wires are obliterated for any reason, use tape to identify wire termination before removing.

⚠WARNING ***Accidental starting of the generator set can cause severe personal injury or death due to electrocution. Disconnect the starting battery cables (negative (-) cable first) when repairs are made to the voltage reconnection panel.***

⚠WARNING ***Batteries give off explosive gas that can result in severe personal injury if ignited. Do not smoke or allow any arc-producing devices in the battery area.***

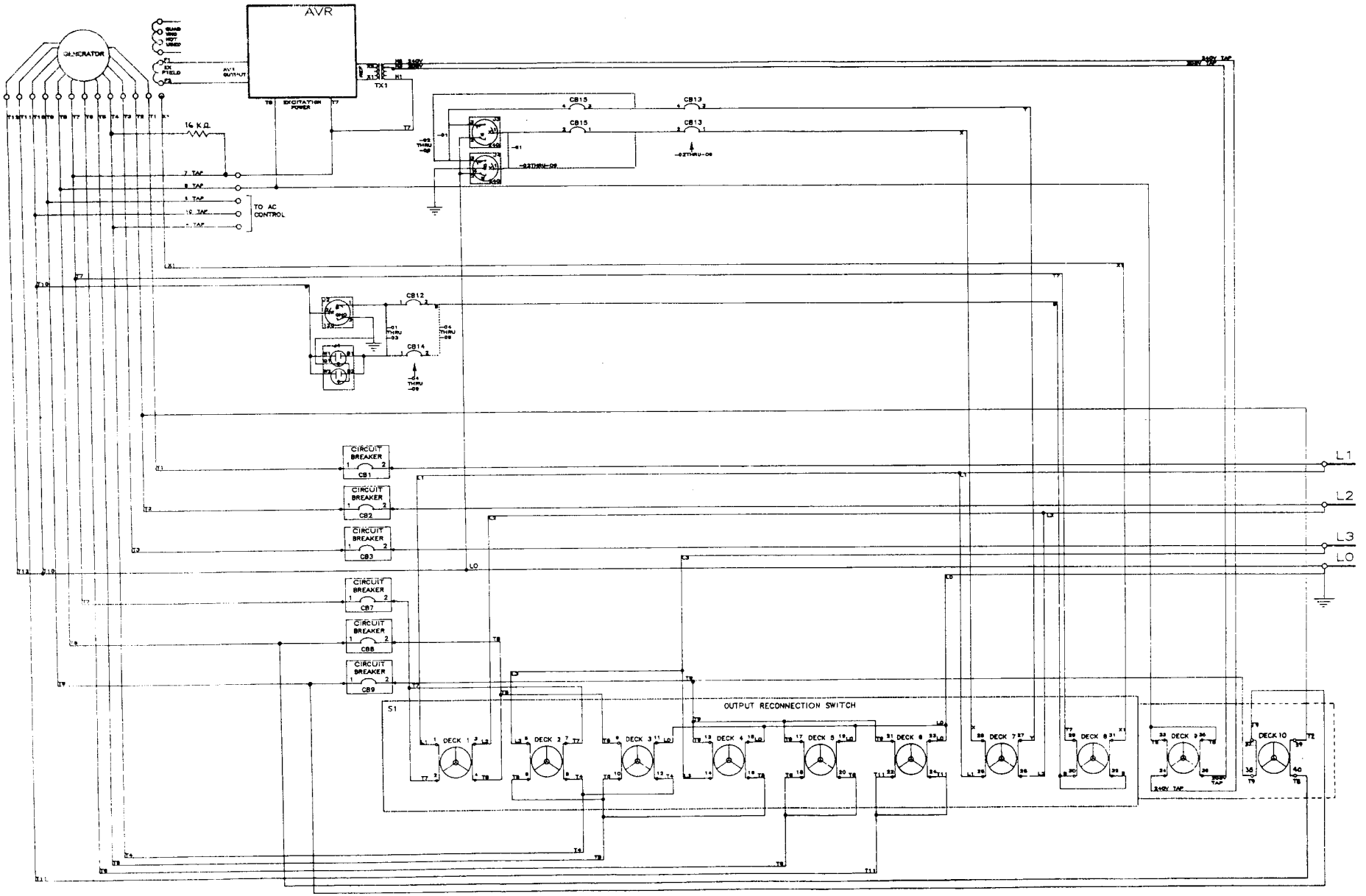
Disconnect the genset starting battery cables (negative (-) cable first) and do not reconnect until repair is completed. The negative (-) cable is disconnected first (and reconnected last) to prevent arcing if a tool accidentally touches the frame or other grounded metal parts of the genset while disconnecting/connecting the positive (+) cable to the battery. Severe injury can result if arcing ignites the explosive hydrogen gas given off by the battery.

⚠DANGER ***Hazardous voltage will cause severe injury or death. Disconnect all electrical supply sources before testing or repairing the voltage reconnection panel.***



ES-1943

FIGURE 9-9. VOLTAGE RECONNECTION PANEL



SWITCH CONTACTS

VOLTAGE	CONNECTION	POSITION	OUTPUT CONNECTION CONTACTS																240V RECPT		120V RECPT		AVR REF			
			1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	21-22	23-24	25-26	27-28	29-30	31-32	33-34	35-36	37-38	39-40
120/208	PAR WYE	1	X					X	X	X		X			X				X			
277/480	SERIES WYE	2				X	X				X			X		X	X	X		X		
120/240	2 IØ 3 WIRE	3	X	X	X			X	X			X	X		X	X	X		X		X	X

REF. DASH #	BREAKER TABULATION RATING	STATOR	CB14	CB13
-01	17.5	STD	NO	NO
-02	17.5	EXT	NO	YES
-03	25.0	EXT	YES	YES
-04	25.0	EXT	YES	YES
-05	30.0	EXT	YES	YES
-06	30.0	STD	YES	YES
-07	40.0	EXT	YES	YES
-08	40.0	STD	YES	YES
-09	70.0	STD	YES	YES

Item	Part No.	Dwg Size	Qty	Description or Material
Name	Date			Onan, Minneapolis, Minnesota 55432
Dr GIBSON	11-28-89			Title SCHEMATIC-SWITCH ASSY
Chk'd HH	12-28-89			
Approved AFL	12-4-89			Dwg No. 625-2293
For interpretation of dimensioning and tolerancing, see ANSI Y14.5M-1982	Model Dist used on RCS			Sheet 1 of 1 Rev D

FIGURE 9-10. VOLTAGE RECONNECTION PANEL SCHEMATIC, QSA-SERIES

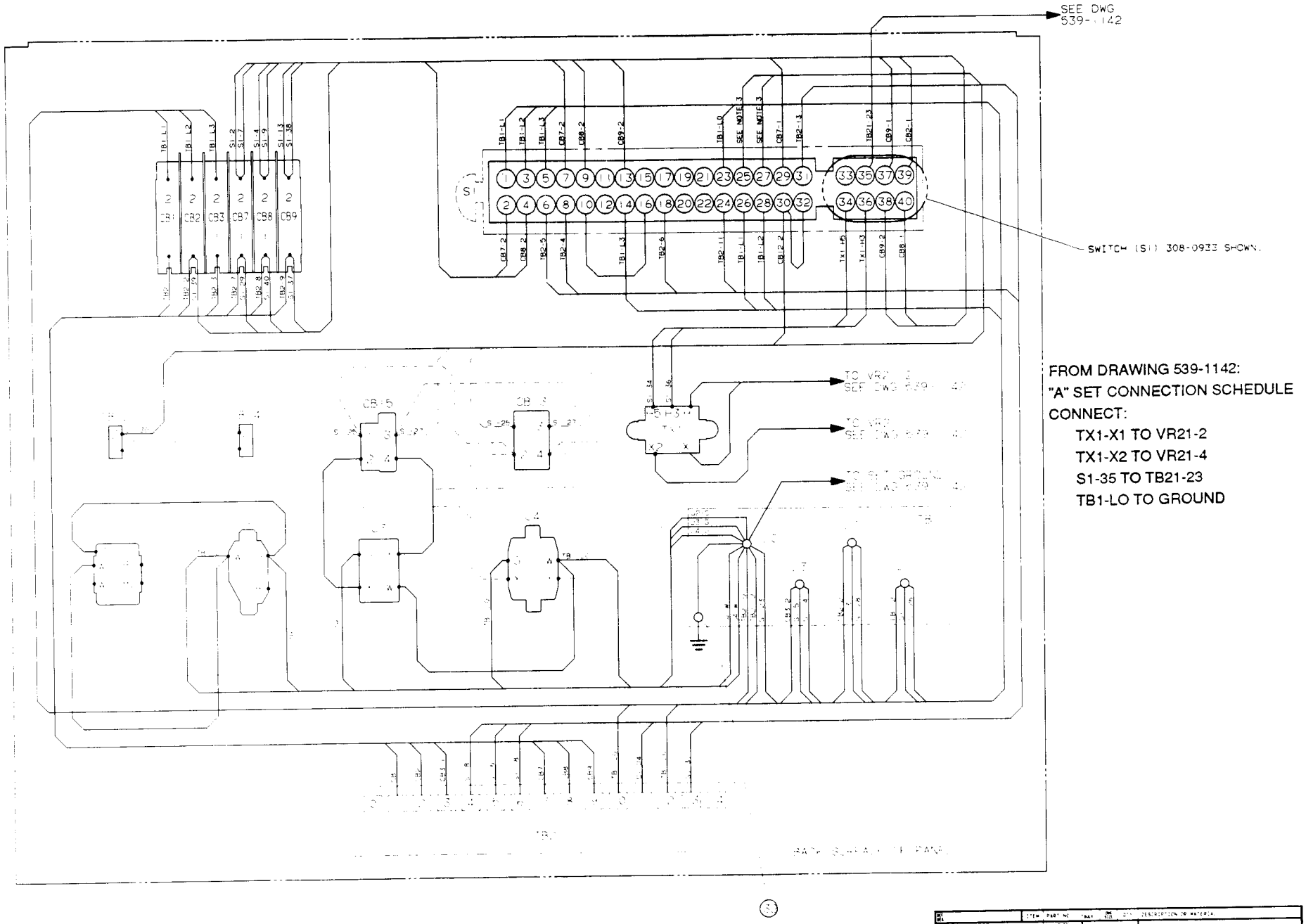
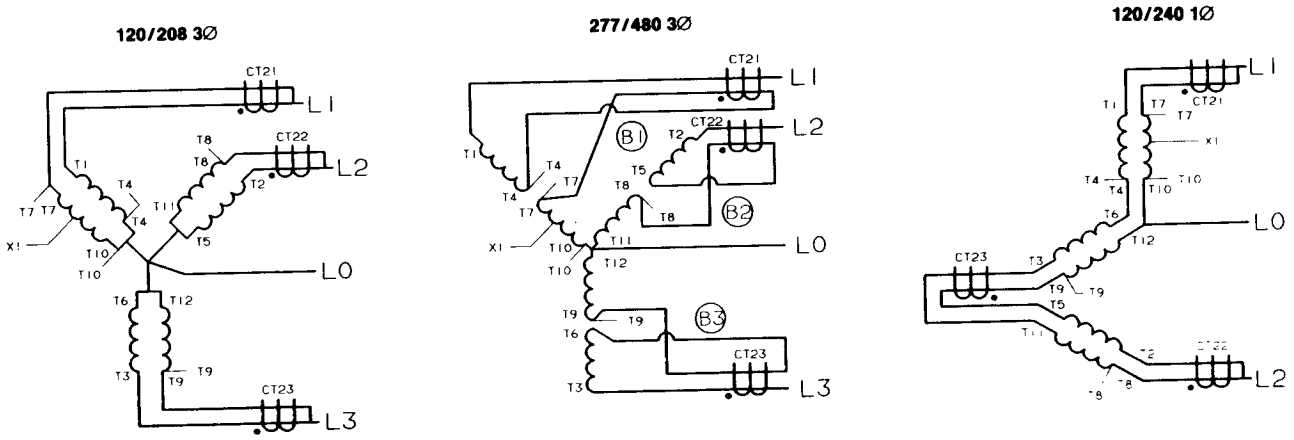


FIGURE 9-11. RECEPTACLE WIRING DIAGRAM. OSA-SERIES

MODEL QS GENERATOR CONNECTIONS WITH GENERATOR SWITCH OPTION



NOTES:

1. **Secondary Current Transformer Conn 1-3 for All Applications**

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

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

FIGURE 9-12. GENERATOR RECONNECTION DIAGRAM, QSA-SERIES SWITCH OPTION

Removing Reconnection Panel Assembly

Use the following procedure to gain access to components for troubleshooting, or to remove the panel assembly from the genset.

1. Disconnect the genset starting battery cables, the negative (-) cable first.
2. Remove the 6 self-lock capscrews securing the control door and hinge at the rear housing panel.
3. Remove the access cover over the TB-2 terminal block (Figure 9-9).
4. Remove 17 hex-head capscrews from the perimeter of the reconnection panel. The panel can now be oriented for troubleshooting; or proceed to Step 5 for complete removal and further service.
5. Remove all generator leads from the bottom connectors of TB-2 terminal block. Make sure all leads are marked for correct re-assembly.
6. Disconnect lead TB1-L0 at the chassis GROUND stud directly below the panel assembly.
7. Disconnect the following 3 leads inside the control box as follows:
   TX1-X1 to VR21-2 (TX1 is transformer on panel.)
   TX1-X2 to VR21-4.
   S1-35 to TB21-23 (S1 is the main rotary switch).
8. Re-assemble in the reverse order of disassembly. Connect all leads before installing the reconnect panel. Connect the generator leads to terminal block TB-2 per the terminal identification sticker on the back of the reconnect panel.

Transformer TX1

This transformer eliminates the need for changing leads at the voltage regulator when different voltages are selected by the voltage reconnection switch (S1). The five transformer lead connections are shown on the voltage reconnection panel schematic Figure 9-10.

Input voltage to the primary winding of TX1 (H1 and H3 or H5) are taken from taps of the stator winding (T7 and T8). The voltage across the stator taps changes from S1 position 1 (208 VAC) and positions 2 and 3 (240 VAC). The primary tap of TX1 is switched by S1 so the voltage regulator input remains unchanged.

The transformer schematic in Figure 9-13 shows lead connection points and resistance readings of the coils. Resistance readings should be within ±10%, and taken at 77°F (25°C). There should be no resistance between windings, and between windings and ground (lamination). Use an insulation resistance meter that applies 500 VDC or more at the test leads for this test.

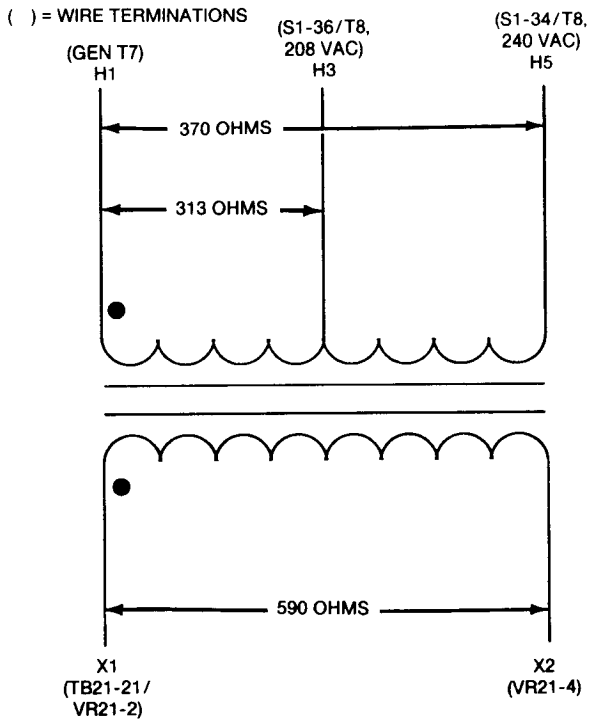


FIGURE 9-13. TRANSFORMER TX1 SCHEMATIC

ELECTRONIC GOVERNOR

General

The governor is used to maintain a constant engine speed during varying generator loads. The mechanical governor (standard) is set at the factory and does not require further adjustment for normal standby service. Refer to the engine service manual for service information.

If the genset has the optional electronic governor shown in Figure 9-14, refer to the following sections for troubleshooting and adjustment/calibration procedures.

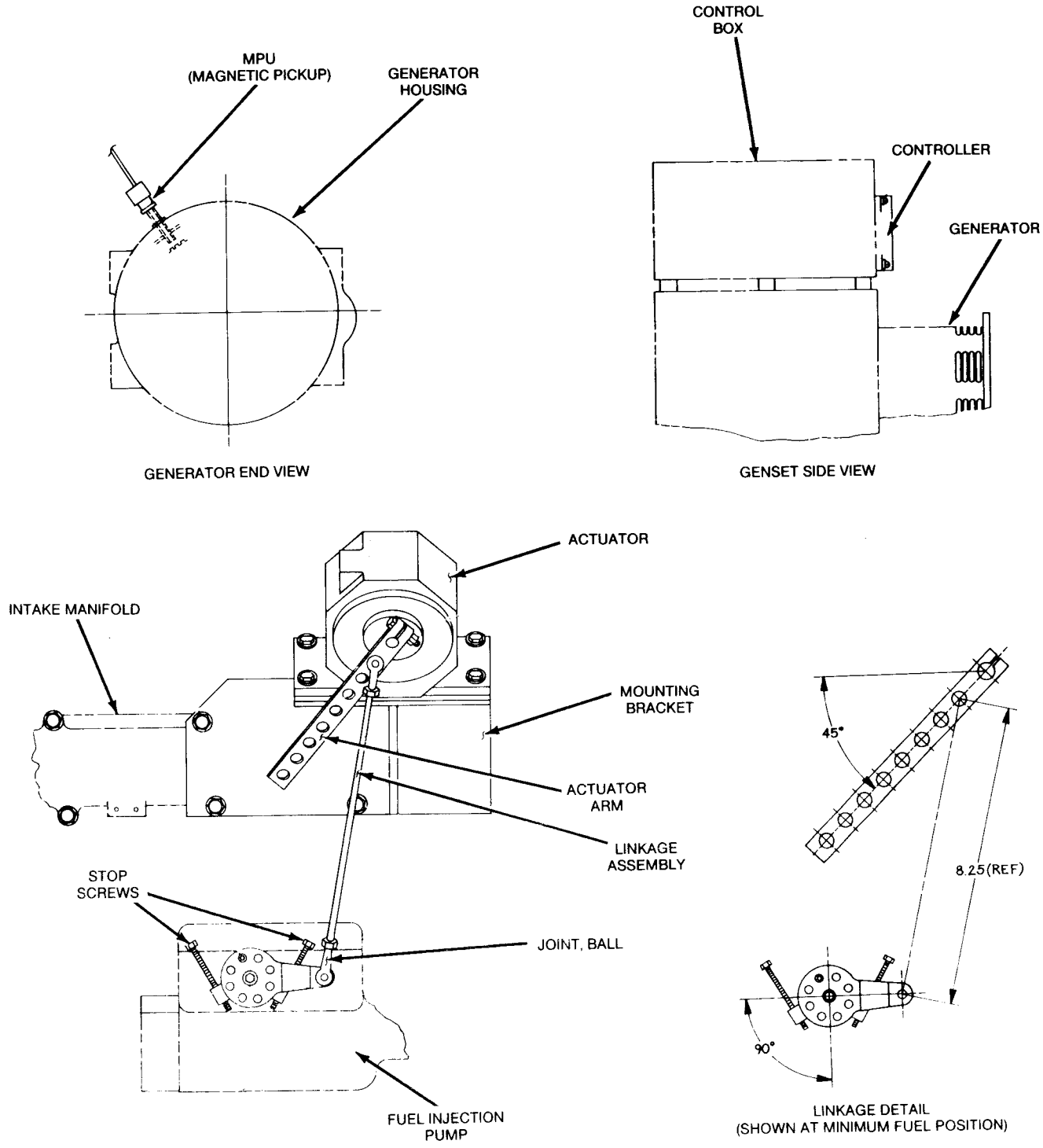


FIGURE 9-14. ELECTRONIC GOVERNOR COMPONENT LOCATION

Troubleshooting

The electronic governor system consists of three major components. These are the MPU (Magnetic Pickup), Controller, and Actuator. The DC power source shown on the drawing is the genset starting battery. The following information provides functional description and checkout information for these components, and is useful to isolate a governor system malfunction. A troubleshooting chart is also included at the end of this section.

The DC voltage readings referenced when troubleshooting are sourced from the starting battery. It is recommended that the cranking motor be disabled when making these tests by disconnecting the starter solenoid B+ lead. This permits application of battery voltage to the governor system (by depressing the Start button) without engine cranking and starting.

⚠CAUTION ***Taking ohmmeter resistance readings with battery voltage connected can cause severe meter damage. Be sure to disengage battery voltage before taking resistance readings of governor components.***

MPU (Magnetic Pickup): The pickup is threaded into the top of the generator flywheel housing and secured with a lock nut. The flywheel teeth moving past the magnetic face of the MPU generates an AC voltage that is coupled to the Controller. Refer to the wiring diagram in Figure 9-18 for component wire terminations. The following checks will establish a functioning unit:

- The DC resistance measured across the MPU leads Controller) (disconnected from terminals 5 and 6 on should be 175 ohms ± 15% at 77°F (25°C). Resistance from the leads to the case (ground) should be infinity.

- At cranking speed the MPU output voltage measured between terminals 5 and 6 on the Controller should be 1.5 VAC RMS or more (the meter AC input impedance must be 5000 ohms/volt or greater). If not, remove the MPU and clean the magnetic pole face. It is important that all magnetic particles be removed.

- ***MPU Adjustment:*** Incorrect adjustment of the MPU can also affect the voltage output. Rotate the engine so a tooth of the ring gear is centered in the MPU mounting hole. Clean the mounting hole with compressed air, then turn the MPU into the threaded hole until it contacts the flywheel tooth positioned directly below. See Figure 9-15. Then turn out from the tooth 1/2 turn and lock in place with the jam nut. Be sure the pickup does not rotate when tightening the jam nut.

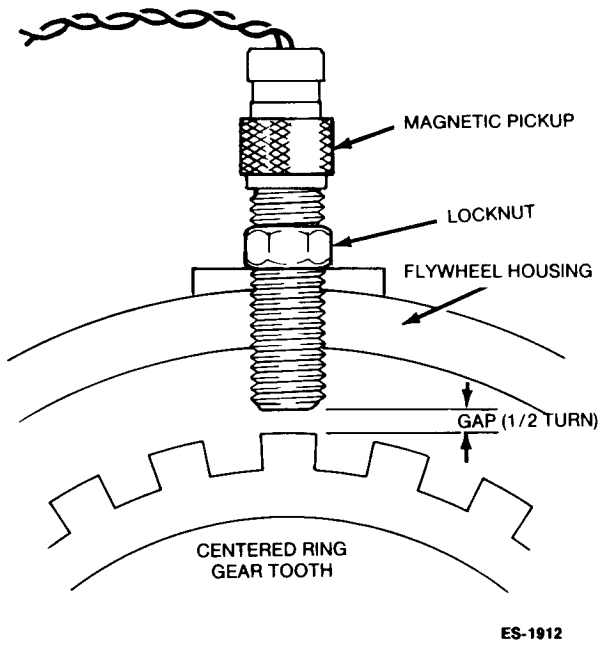


FIGURE 9-15. MAGNETIC PICKUP ADJUSTMENT

Controller: This unit (Figure 9-16) contains the electronics for driving the Actuator. It has two controls (Gain and Speed) that provide governor adjustment. Voltage checks that can be made to the Controller during cranking are as follows:

- Battery voltage should appear between terminals 3 (+) and 4 (-). If not present, check for wiring problems.
- Voltage measured between terminals 8 (+) and 4 (-) should be 3.75 ±1/2 VDC (this is the Controller's internal power supply). Replace Controller if not present, or incorrect.
- Battery voltage should appear between terminals 2 and 4 (-). Replace Controller if not present.

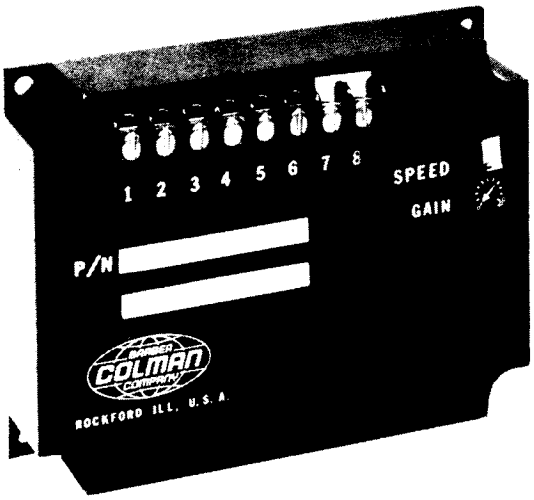


FIGURE 9-16. ELECTRONIC GOVERNOR CONTROLLER

Actuator: The Actuator (Figure 9-17) controls the injection pump throttle lever. It receives input from the Controller, which in turn receives input from the MPU. A few operational checks can establish a functioning unit as follows:

- Wipe the Actuator shaft and linkage if dirty with a clean, dry rag.
- Check the end bearings on the linkage assembly. If worn, replace.
- The Actuator must be securely mounted.
- Check wiring for corroded or loose connections.
- Measure resistance of the Actuator coil with the leads disconnected. Resistance should be 1 ohm ±10% at 77°F (25°C). Resistance to the case should be infinity.
- Disconnect the Actuator leads and apply battery voltage to the Actuator terminals. Be sure to observe correct polarity as shown in Figure 9-18. The Actuator should go full fuel. If not, replace.

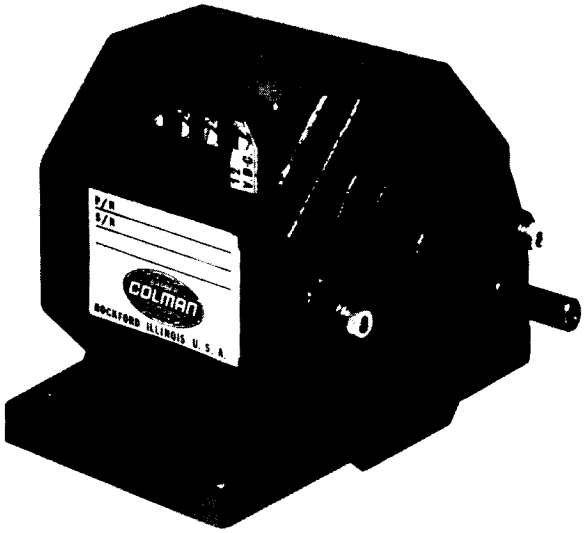


FIGURE 9-17. ELECTRONIC GOVERNOR ACTUATOR

Governor Adjustment/Calibration

This section contains information on adjusting the optional electronic governor. The adjustments covered are to the stop screws on the injection pump mechanical governor (Figure 9-14), and to the GAIN and SPEED screws on the Controller (Figure 9-18).

⚠WARNING ***Contact with rotating machinery can result in severe personal injury or death. Keep hands and fingers clear while performing tests on operating equipment.***

1. Check the governor Actuator linkage to see that it does not bind through its full travel. The linkage should be as shown in Figure 9-14.

   Prior to adjusting the governor controller, be sure that terminals 7 and 8 are jumpered.

2. Attach a tachometer to the engine or a frequency meter to the generator if the control panel does not have one of these meters.

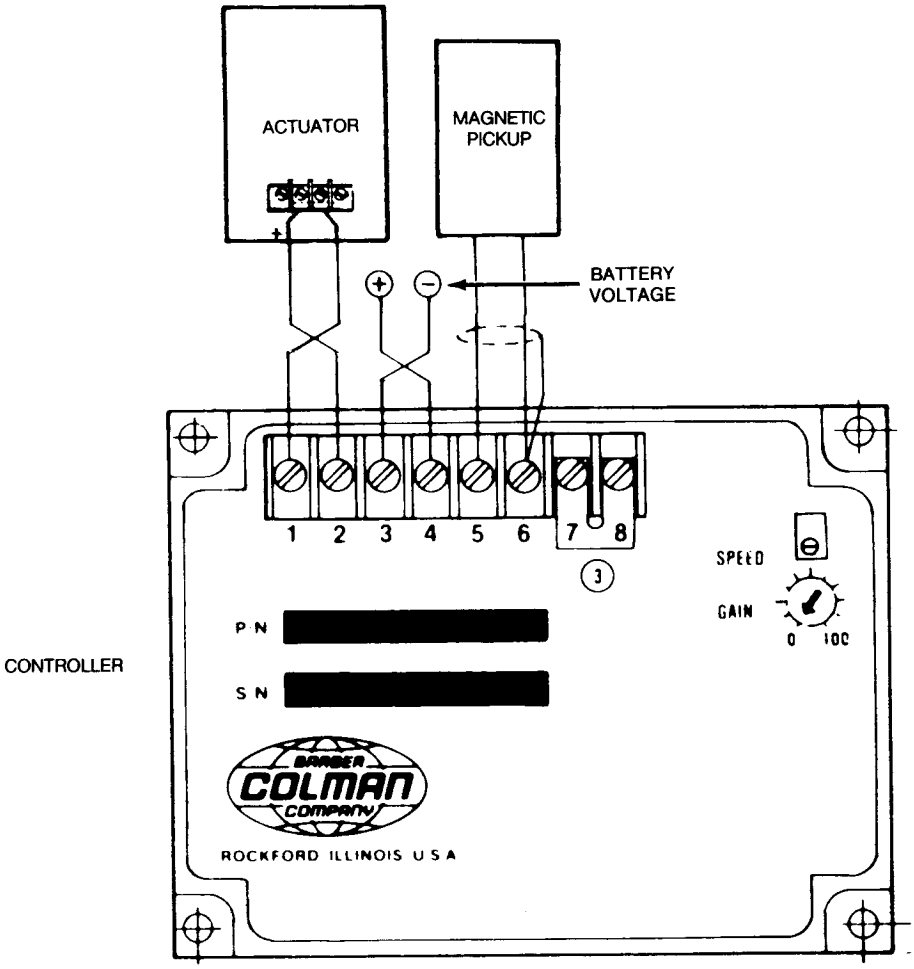


FIGURE 9-18. GOVERNOR COMPONENT WIRING DIAGRAM

When using a frequency meter to determine engine speed, multiply frequency by 30 to calculate engine speed. Example: 30 X 60 = 1800 r/min.

3. Set the Controller GAIN adjustment (Figure 9-18) to the second mark from zero.

4. Disconnect the governor rod from the throttle lever.

5. Place Run/Stop/Remote switch in Run position to start the genset.

6. Adjust the right stop screw on the mechanical governor to obtain a frequency of 72 Hz (2,160 r/min) for 60 Hz gensets (62 Hz [1860 r/min] for 50 Hz gensets). It might be necessary to loosen the left stop screw depending on direction of adjustment.

7. Adjust the left stop screw to just take up the slack, then tighten the locknut. Be careful not to bind the shaft by setting the screw too tightly.

8. Stop the genset and attach the governor rod to the throttle lever. Start the genset and operate without load. Adjust the SPEED screw on the Controller to obtain 60 Hz or 50 Hz as appropriate.

9. Connect full rated load to the genset and observe the frequency meter. If the genset cannot manage the load, stop the genset and shorten the governor rod by one-half turn. Repeat the procedure until the genset is able to manage the load, then tighten the locknuts.

10. Connect 1/4 rated load. Turn the GAIN screw on the Controller clockwise until the Actuator becomes unstable (hunts). It might be necessary to nudge the Actuator lever by hand to cause it to begin hunting. Back off the adjustment until operation is again stable.

11. Stop the genset and wait for 30 seconds to allow the turbo to coast down (if equipped). Restart the genset and check for speed overshoot. If the genset has an overspeed shutdown, check the linkage for binding and make necessary repairs.

12. Restart the genset and check for frequency and stability under various loads. Correct as necessary.

13. Stop the genset and remove tachometer or frequency meter if previously attached. The electronic governor is now calibrated.

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on page ii.***

ELECTRONIC GOVERNOR TROUBLESHOOTING CHART

PROBLEM	DETECTION	CORRECTIVE ACTION
System appears dead. Actuator fails to move to full fuel.	Battery voltage must appear between terminals 3 (+) and 4 (-) during cranking (system activation).	Check wiring/connections between Controller and battery.
	Manually operate the linkage. It must not stick or bind.	Free linkage.
	Weak or no signal from the MPU (magnetic pickup). Measure AC voltage between terminals 5 and 6 of Controller during cranking. Voltage should be 1.5 volts RMS or greater. Meter AC impedance must be 5000 ohms/volt or greater.	Check MPU (magnetic pickup) adjustment; clean pole face of any metallic particles; or replace MPU.
	Check Controller's internal power supply between terminals 8 (+) and 4 (-) with system activated. Reading should be 3.75 ±0.5 VDC.	Replace Controller if voltage reading is incorrect.
	Check Actuator with power to Controller. Battery (B+) voltage should be read at Controller terminals 1 and 2 with respect to terminal 4 (B-). Continue with testing only if battery voltage was not present above. The following Actuator checks are measured from terminal 4 (B-) on the Controller.	Replace Controller if battery voltage is not present.
	1. No battery (B+) voltage at either Actuator terminal.	Broken Actuator lead.
	2. Battery (B+) voltage at both Actuator terminals.	Broken Actuator lead.
	3. Battery (B+) voltage at only one Actuator terminal.	Replace Actuator.
Actuator lever goes to full fuel whenever system power is applied and engine is not running.	Remove Actuator lead from Controller terminal 1. Then apply power to the Controller.	
	1. Actuator goes full fuel.	Check for shorted Actuator lead.
	2. Actuator does not go full fuel. NOTE: Remove power from Controller before reconnecting the Actuator lead.	Replace Controller because it should not cause Actuator lever to go to full fuel with engine not running.
Actuator hunts during operation.	Linkage bearings sticking or binding.	Lubricate or replace.
	Improper governor adjustment.	See Calibration section for adjustment.

⚠WARNING ***Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on page ii.***

ELECTRONIC GOVERNOR TROUBLESHOOTING CHART (Continued)

PROBLEM	DETECTION	CORRECTIVE ACTION
Inadequate power supply voltage to the Controller.	1. Remove Actuator lead at terminal 1 on the Controller. Connect a DC voltmeter between terminals 3 (+) and 4 (-) on the Controller. 2. Apply power to the Controller and momentarily connect the Actuator lead to Terminal 4 (-). Actuator should go to full fuel position, and DC voltage (between terminals 3 (+) and 4 (-) should be greater than 80% of supply. 24 volts X 80% = 19.2 VDC 12 volts X 80% = 9.6 VDC Reconnect Actuator lead to terminal 1 after test.	If Actuator does not get to full fuel, check Actuator leads. If voltage is less than specified, check for loose or poor connections to battery.

Placing The Genset In Service

Place the genset in service (where applicable) by making sure the RUN/STOP/REMOTE switch is in REMOTE position for automatic-standby mode of operation.

FAN BELT REPLACEMENT PROCEDURE QSA-SERIES GENSETS

Series QSA gensets use a centrifugal blower for radiator cooling and ventilation. See Figure 9-19. The blower and fan spacer are mounted by four bolts to the top engine belt pulley. The fan spacer extends through a hole in the blower compartment bulkhead. The blower and spacer have to be removed to slip a new belt over the pulley. Use the following procedure.

⚠WARNING ***Accidental starting of the generator set can cause severe personal injury or death. Disconnect the starting battery cables (negative [-] cable first) from the battery to prevent accidental starting.***

Always disconnect the negative (-) cable first, and reconnect it last to prevent arcing if a tool accidentally touches the frame or other grounded metal parts of the genset while disconnecting or connecting the positive (+) cable. Arcing can ignite the explosive hydrogen gas given off by the battery and cause severe injury.

1. Disable the genset by removing the battery starting cables, the negative (-) cable first.
2. Remove the screws securing the air inlet guard and box from the front of genset.
3. Remove the cone.
4. Remove the four blower hub bolts and lockwashers. Then withdraw the blower, fan spacer, and associated hardware (cap, two rubber isolators, and fan spacer.)
5. At the engine compartment, slip the new belt over the pulley. Make belt adjustments per instructions in the engine service manual.
6. Reassemble the fan spacer, blower and associated hardware as shown in the drawing. Note that there are eight holes drilled in the blower, cap, rubber isolators, and the backing isolator. Align these components so the blower hub bolts go through the four outer circumference holes of each component. See hole locations (typical) on the backing isolator in drawing below.
7. Snug the four hub bolts. Then in opposite progression, torque each bolt once to 9-11 foot pounds (12-15 N•m). The rubber isolators do not permit repeat torque application to the bolts.
8. Reassemble the cone, air inlet guard and air box.
9. Reconnect the starting battery cables, the positive (+) cable first.
10. Start the genset and check operation.

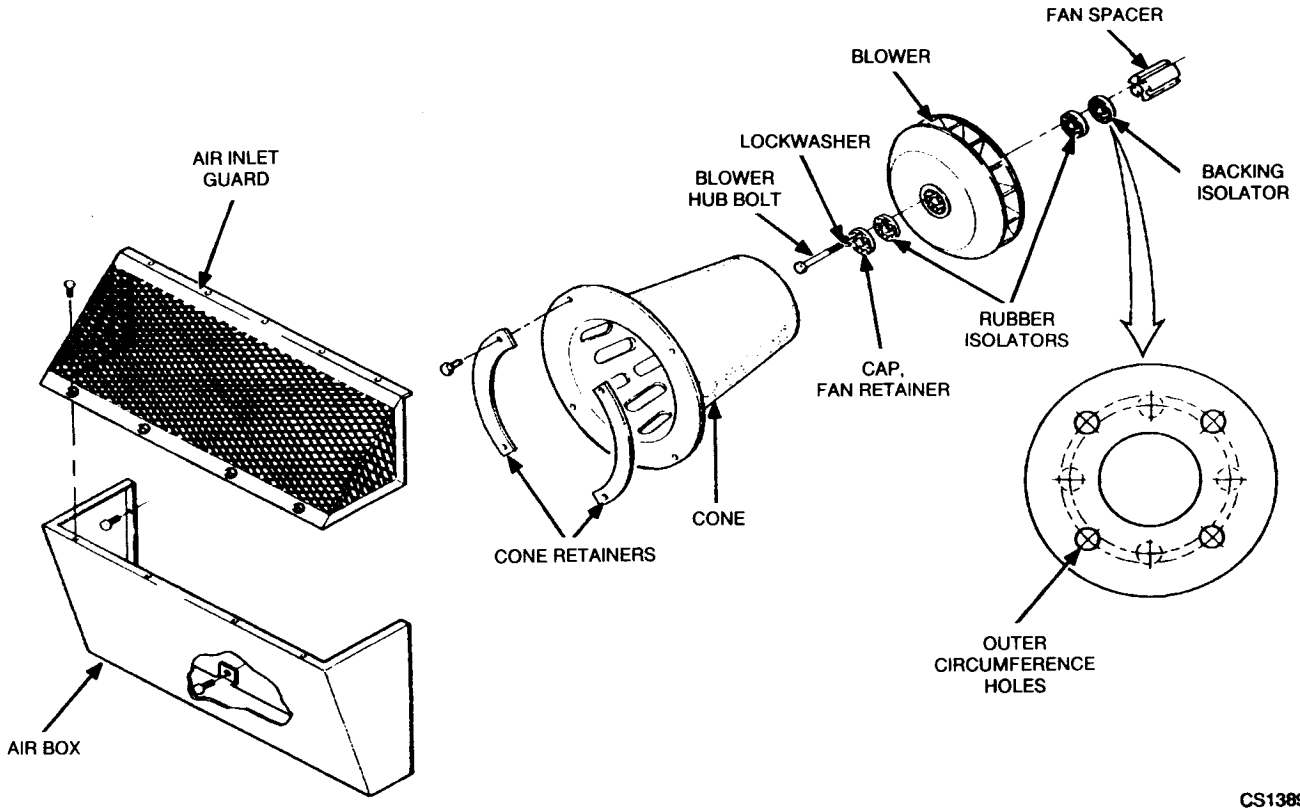


FIGURE 9-19. QSA-SERIES COOLING BLOWER ASSEMBLY

Section 10. Wiring Diagrams

This section consists of the wiring diagrams referenced in the text. It should be noted that they are typical, and that wiring and component specifications are subject to change. Contact your Distributor if you do not have the applicable wiring diagrams.

The following drawings are included:

- AC Control without Meters—Page 10-2
- AC Control with Meters—Page 10-3
- 4-Light DC Control—Pages 10-4 and 10-5
- 10-Light DC Control—Pages 10-6 and 10-7
- 7-Light DC Control—Pages 10-8 and 10-9
- 12-Light DC Control—Pages 10-10 and 10-11
- Voltage Regulator Installation and Generator Reconnections—Page 10-12
- Generator Reconnections (Model QS)—Page 10-13
- Engine Monitor PC Boards—Page 10-14.

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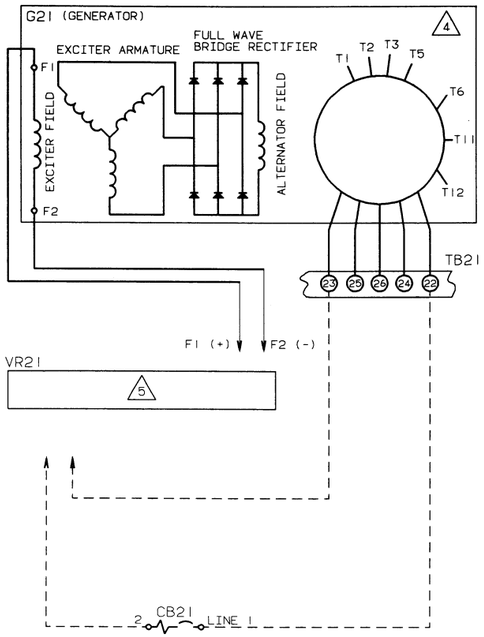
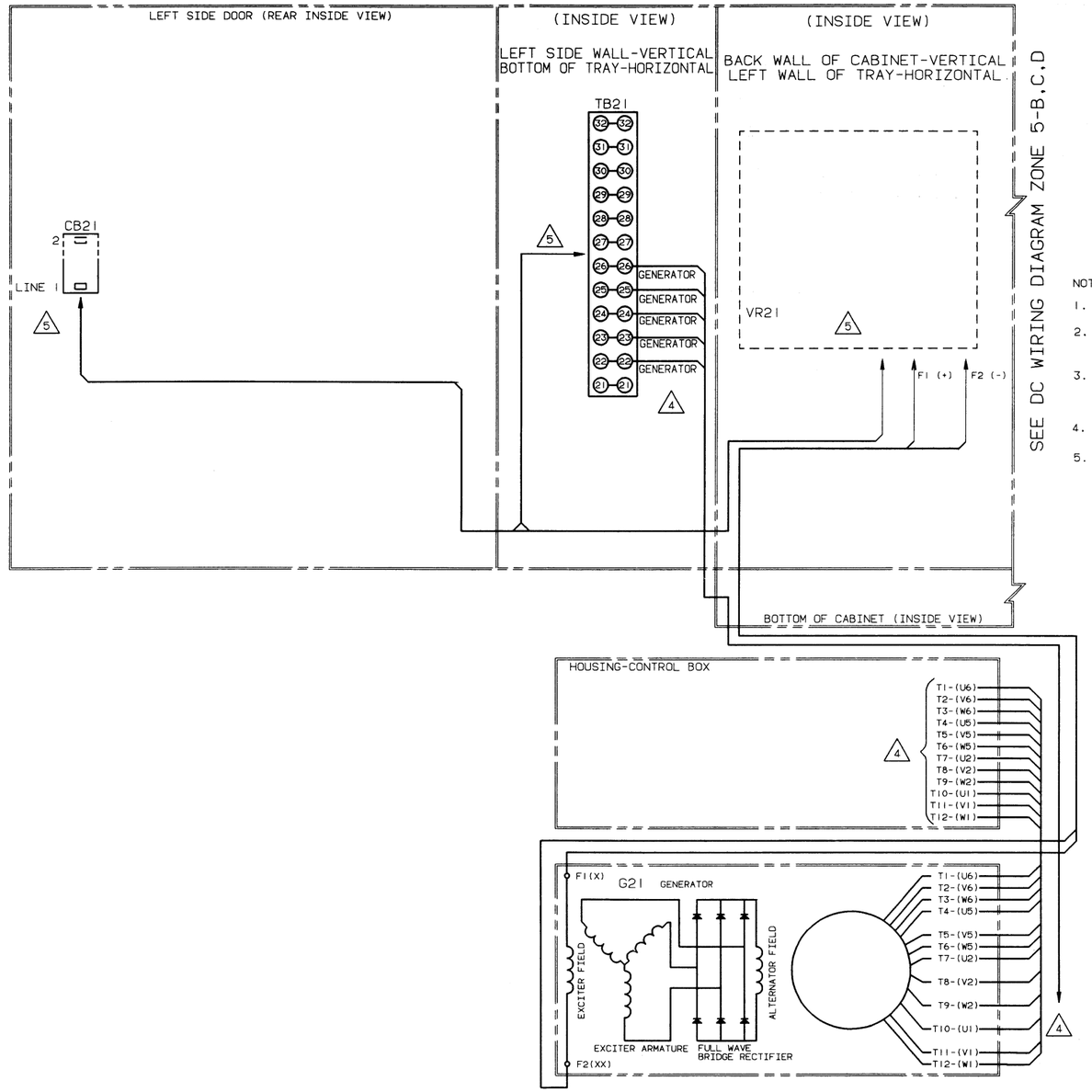
SCHEMATIC DIAGRAM



WIRING DIAGRAM



ER NO	LTR	NO	REVISION	ZONE	DR	CKHR	APPROVED	DATE
29865	A	1	PRODUCTION RELEASE	-	JC	MR	PE	06-25-87
30817	B	1	REVISED PER ER	-	JP	JC	SLS	12-08-87
32870	C	1	REVISED PER ER	-	JC	VB	PE	09-15-88

NOTES:

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

ILLUS NO	REF DES	QTY	DESCRIPTION	DASH #
		2	LABEL-DANGER (3)	-01
	G21	1	GENERATOR	-
43	VR21	1	INSTL-VOLTAGE REGULATOR	-
42		2	SCREW-RHM (#6-32 X 5/8)	ALL
41		1	MARKER STRIP	ALL
29	CB21	1	CIRCUIT BREAKER-MAG (FIELD)	-
25	TB21	1	BLOCK-TERMINAL (12 PL)	ALL
24		1	TRAY ASSY-CONTROL	-02
23		1	SILKSCREEN-PNL REAR (AC,HORIZ)	-02
23		1	SILKSCREEN-PNL REAR (AC,VERT)	-01
22		1	SILKSCREEN-PNL FR (AC,HORIZ)	-02
22		1	SILKSCREEN-PNL FR (AC,VERT)	-01
21		1	DOOR ASSY-CONTROL (LH) HORIZ	-02
21		1	DOOR WELDT-CONTROL (LH) VERT	-01
20		3	SCREW-LKH (#10-32 X 5/16)	-01
17		1	WASHER -EIT LK (5/16)	ALL
16		1	NUT-HEX (5/16-18)	-02
15		1	SCREW-HHC (5/16-18 X 1/2)	-01
14		1	BOND-STRAP	ALL
13		1	WASHER-ET LK (1/4")	ALL
12		1	NUT-HEX (1/4-20)	ALL
11		3	NUT-H W/ET (#10-32)	ALL
10		1	CLIP-WIRE (5/8")	-01
9		2	WASHER-STUD RTNR	-01
8		2	STUD-FASTENER	-01
7		2	RECEPTACLE-FASTENER	-01
6		1	GROMMET (2")	ALL
5		1	GROMMET (3/4")	-01
4		4	WASHER-LK (5/16)	-01
3		4	SCREW-HHC (5/16-18 X 3/8)	-01
2		4	ISOLATOR-VIBRATION	ALL
1		1	COVER ASSY-CONTROL (HORIZ)	-02
1		1	BOX WLDMT-CONTROL (VERT)	-01

WITHOUT METERS

TABULATION	
VERT	-01
HORIZ	-02

CADAM SYSTEM DWG

SIM TO 612-6268 D

	NAME	DATE
DR	J. CASALENDA	6-10-87
CHKR	V. BECKMAN	6-10-87
APPROVED	P. ERICKSON	7-01-87

MODEL FIRST USED ON: DGEA,FA

ONAN CORPORATION
MINNEAPOLIS, MINNESOTA

TITLE: WD-GEN SET AC CONT (BASIC)

DWG NO: 612-6489 SHEET 1 OF 1 REV D

AC CONTROL WIRING DIAGRAM, BASIC WITHOUT METERS

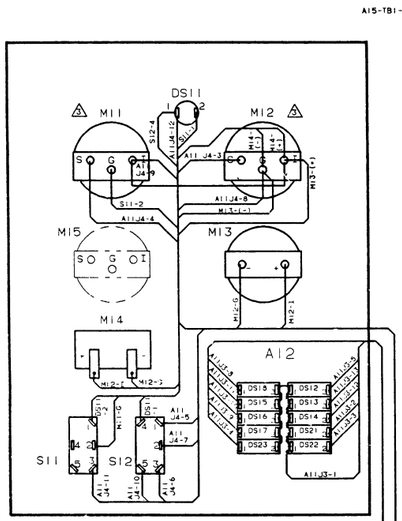
612-6481 D

WIRING DIAGRAM

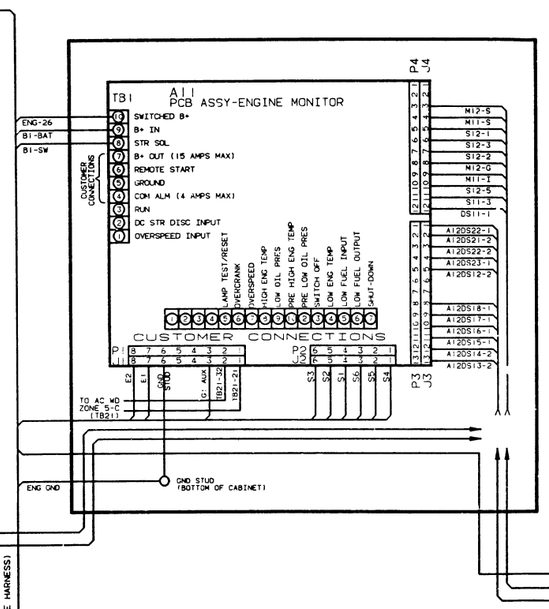
ER NO	LTR	NO	REVISION	ZONE	DR	CKR	APPROVED	DATE
29644	A	1	PRODUCTION RELEASE	-	DC	JC	PE	3-26-87
30817	B	1	REVISED PER ER	-	JP	JC	SLS	7.8.87

(B & C ENGINES)

LEFT SIDE DOOR
(REAR INSIDE VIEW)

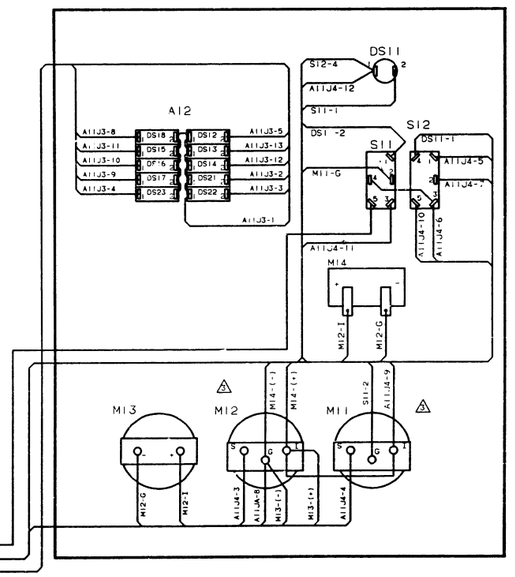


BACK WALL OF CABINET
(INSIDE VIEW)

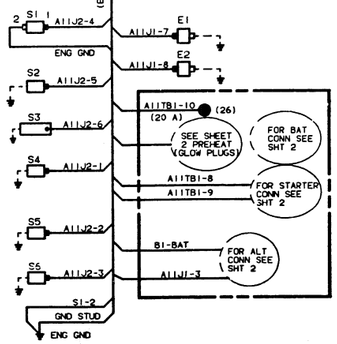


(A ENGINES)

RIGHT SIDE DOOR
(REAR INSIDE VIEW)



(ENGINE HARNESS)



NOTES:

1. ALL COMPONENTS SHOWN IN DE-ENERGIZED POSITION.
2. ILLUSTRATION NUMBERS REFER TO ONAN DWG. NO. 539-0957 B & C (D) ILLUS-STD CONTROL AND 539-0997 A ENG.
3. GAUGE RESISTORS R12,13 (ILLUS #88) ARE USED ON 24V (-02,-04) VERSION ONLY. MOUNT BEFORE ATTACHING HARNESS.
4. TIE ALL UNUSED LEADS INTO HARNESS
5. GROUND BETWEEN M11 & M12 (ILLUS #77,78) IS THROUGH THE FRONT PANEL.
6. DASHED LEADS INDICATE WHEN USED.
7. WHEN USING PRE-HEAT USE SILKSCREEN 98-5901-02

REF DES	PART NO	SPEC NO	QTY	DESCRIPTION
				ENGINE PARTS LIST ABOVE (SHOWN FOR REFERENCE ONLY)
S6				THERMOSTAT (PRE-HET)
S5				SWITCH-PRESS (PRE-LOP)
S4				SWITCH-LOW ENG TEMP
S3				SWITCH-OVERSPEED
S2				THERMOSTAT (HET)
S1				SWITCH-OIL PRESS (LOP)
K4				STARTER SOLENOID
K2				PRE-HEAT SOLENOID (GLOW PLUGS)
K1				FUEL SOLENOID
G1				ALTERNATOR
G2				BATTERY-ALTER. END
BT1				SENDER-OIL PRESSURE
B1				BATTERY-STORAGE
B2				STARTER & SOLENOID

REF DES	PART NO	SPEC NO	QTY	DESCRIPTION	DASH #
96			3	WASHER-FLAT	-03,-04
95			3	LATCH-PANEL	-03,-04
94	S12		1	SWITCH (RUN/STOP/REMOTE)	ALL
89	S11		1	SWITCH-ROCKER (RST/PHT PANEL LAMP)	ALL
88	R12,13		2	RESISTOR (GAUGE,24V)	-02,-04
87			1	PLUG-HOLE	-01,-02
80	M14		1	METER-TIME TOTALIZING	ALL
79	M13		1	VOLTMETER (16-36V)	-02,-04
79	M13		1	VOLTMETER (8-18V)	-01,-03
78	M12		1	GAUGE-WATER TEMP	ALL
77	M11		1	GAUGE-OIL PRESSURE	ALL
71			1	LAMP-PANEL (24V)	-02,-04
71			1	LAMP-PILOT (12V)	-01,-03
70	DS11		1	LIGHT-PANEL	ALL
59	A12		1	LAMP ASSY (10LT,24V)	-02,-04
59	A12		1	LAMP ASSY (10LT,12V)	-01,-03
58	A11		1	PCB ASSY-ENGINE MONITOR (10LT,24V)	-02,-04
58	A11		1	PCB ASSY-ENGINE MONITOR (10LT,12V)	-01,-03
57			1	HARNESS-DC (A ENG)	-03,-04
57			1	HARNESS- (B-C)	-01,-02
56			4	NUT-H W/ET (#6-32)	ALL
55			4	SCREW-RHM (#6-32 X 1/2)(BLK ZINC)	ALL
54			1	BRACKET-DC CONTROL	-01,-02
53			1	SILKSCREEN-PNL REAR (DC) (A ENG)	-03,-04
53			1	SILKSCREEN-PNL REAR (DC) (B-C)	-01,-02
52			1	SILKSCREEN-PNL FR (DC) (A ENG)	-03,-04
52			1	SILKSCREEN-PNL FR (DC) (B-C)	-01,-02
51			1	DOOR ASSY-CONTROL (RH) (A ENG)	-03,-04
51			1	DOOR WLDMT-CONTROL (LH) (B-C)	-01,-02
20			2	SCREW-LK H (#10-32 X 5/16)	-01,-02
18			4	SCREW-RHM XREC W/IT (#6-32 X 1/2)	ALL
11			3	NUT HEX W/ET (#10-32)	ALL
10			1	CLIP-WIRE (5/8")	-01,-02

TABULATION		
DASH NO.	CONTROL	BAT. VOLTS
-01	B & C ENG	12V
-02	B & C ENG	24V
-03	A ENG	12V
-04	A ENG	24V

CADAM SYSTEM DWG

DO NOT SCALE PRINT

TOLERANCES UNLESS OTHERWISE SPECIFIED: MM X ± .X, XX ± .XX, XXX; INCH X ± .X, XX ± .XX, XXX ± .XXX; MACHINED HOLES ± .10 .15 -.10 .08; ANGLES ±1°

SIM TO: FOR USED ON: PROPRIETARY NOTICE

REF DES | ITEM | PART NO | *MULT | SPEC NO | QTY | DESCRIPTION OR MATERIAL

	NAME	DATE
DR	D.CHIZEK	03-24-87
CHKR	J. CASALENDA	03-26-87
APPROVED	P. ERICKSON	03-26-87

ONAN CORPORATION MINNEAPOLIS, MINNESOTA

TITLE: WD-GEN SET DC CONT (10 LT)

FOR INTERPRETATION OF MODEL PORT USED ON IDENTIFICATION AND TOLERANCING SEE ANSI Y14.5M-1982: 40-175 KW

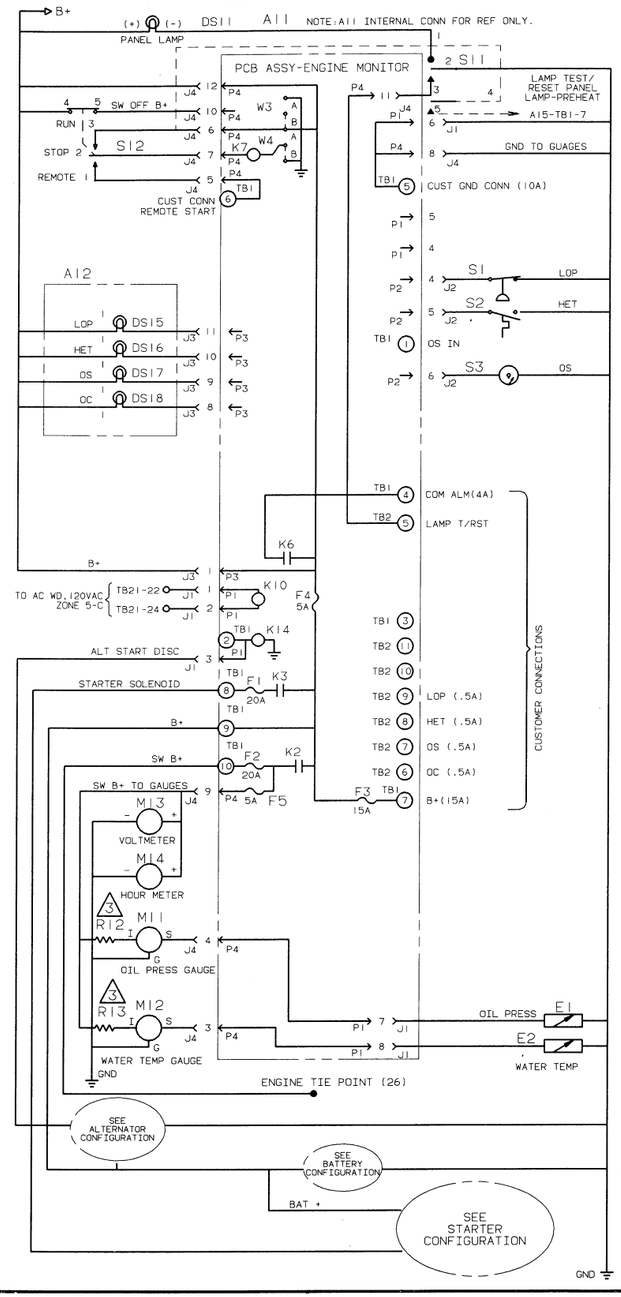
DWG NO 612-6481 SHEET 1 OF 2 REV D

612-6481

DC CONTROL WIRING DIAGRAM. DETECTOR 10, SHEET 1

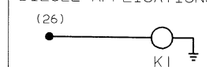
612-6480 **D**

SCHEMATIC DIAGRAM



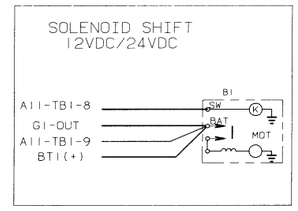
IGNITION SYSTEM

DIESEL APPLICATIONS

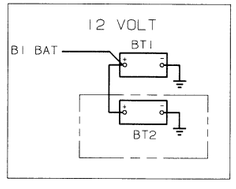


STARTER CONFIGURATION

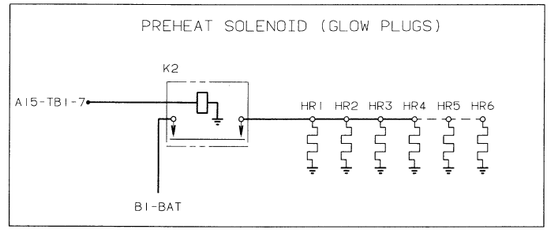
ER NO	LTR	NO	REVISION	ZONE	DR	CKR	APPROVED	DATE
29644	A	1	PRODUCTION RELEASE	-	DC	JC	PE	3-26-87
30817	B	1	REVISED PER ER	-	JP	JC	SLS	11-18-87



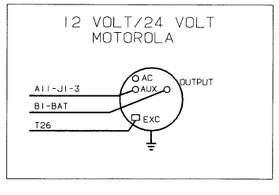
BATTERY CONFIGURATION

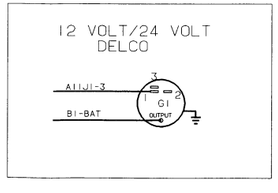


PREHEAT SOLENOID (GLOW PLUGS)



ALTERNATOR CONFIGURATIONS





CADAM SYSTEM DWG

DO NOT SCALE PRINT

TOLERANCES UNLESS OTHERWISE SPECIFIED: MM: X ± / X.X ± / XX.X ± — INCH: X ± / XX.X ± / XXX.X ± — MACHINED HOLES ≤ .5 IN (13MM): +0.15 -0.05 / +.006 -.002 — ANGLES ± — DRAWN TO SCALE OF

SIM TO — COPIED FROM — THIRD ANGLE PROJECTION

612-6480

REF DES	ITEM	PART NO	*BULK	ENG RTE	QTY	DESCRIPTION OR MATERIAL

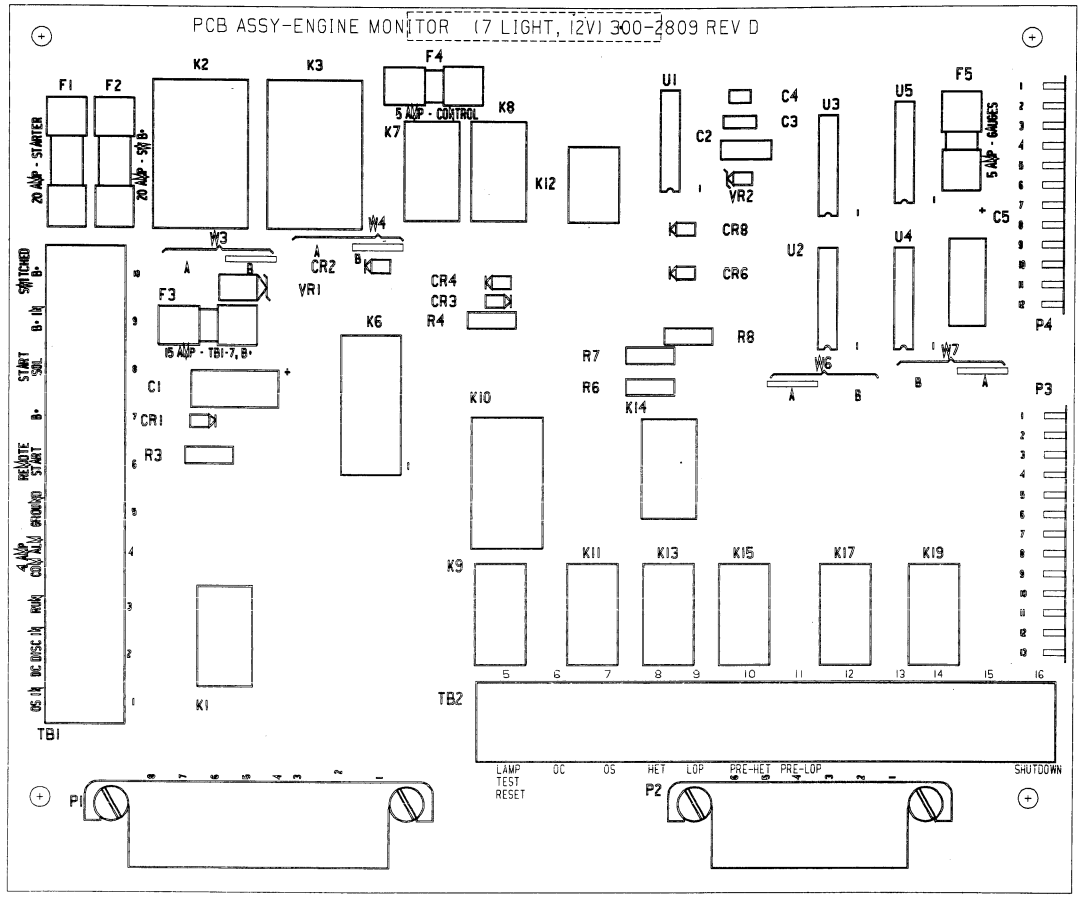
	NAME	DATE
DR	D.CHIZEK	03-23-87
CHKR	J. CASALENDA	03-31-87
APPROVED	P. ERICKSON	03-26-87

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ANSI Y14.5M-1982 — MODEL FIRST USED ON: 40-175 (DS)

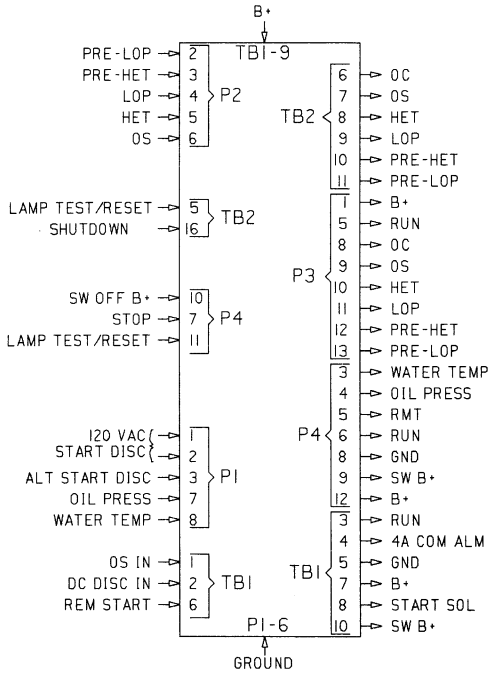
ONAN CORPORATION MINNEAPOLIS, MINNESOTA

TITLE: WD-GEN SET DC CONT 4 LT

DWG NO: 612-6480 — SHEET 2 OF 2 — REV D



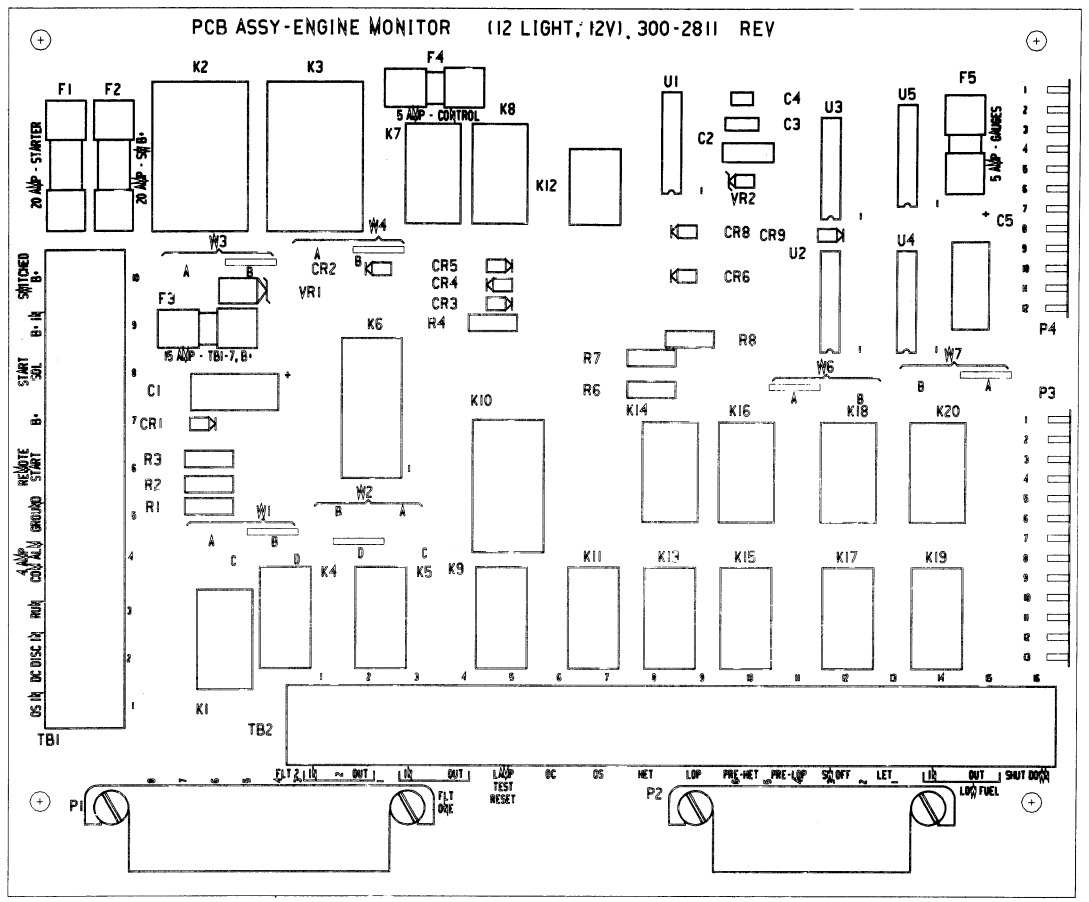
BLOCK DIAGRAM



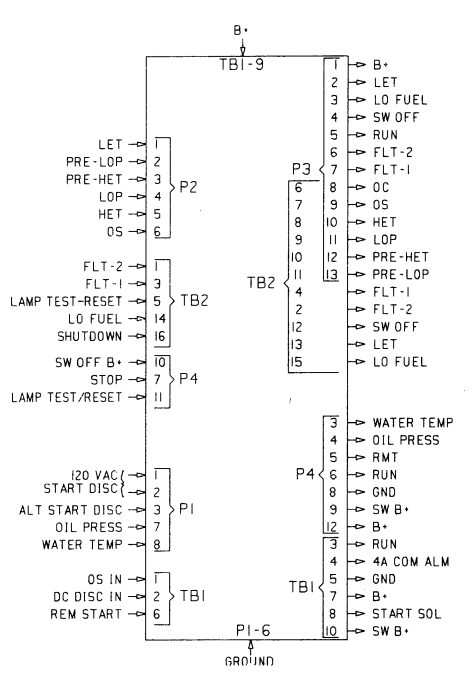
MAJOR COMPONENT IDENTIFICATION

Item	Description
F1,F2	Fuse, Cartridge, 20 Amp.
F3	Fuse, Cartridge, 15 Amp.
F4, F5	Fuse, Cartridge, 5 Amp.
K1—K19	Relay
P1—P4	Connector, PCB
TB1, TB2	Terminal Block
W1—W7	Jumper, PCB

SEVEN LIGHT ENGINE MONITOR PCB ASSEMBLY



BLOCK DIAGRAM



MAJOR COMPONENT IDENTIFICATION

Item	Description
F1,F2	Fuse, Cartridge, 20 Amp.
F3	Fuse, Cartridge, 15 Amp.
F4, F5	Fuse, Cartridge, 5 Amp.
K1—K20	Relay
P1—P4	Connector, PCB
TB1, TB2	Terminal Block
W1—W7	Jumper, PCB

TWELVE LIGHT ENGINE MONITOR PCB ASSEMBLY

625-2251 D

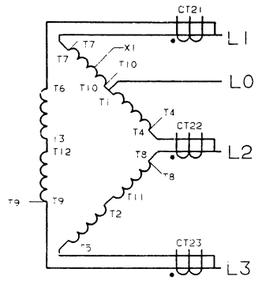
YD & UC GENERATORS FOR QS MODELS

ER NO	LTR	NO	REVISION	ZONE	DR	CHKR	APPROVED	DATE
35,436	A	1	PRODUCTION RELEASE	-	JK	JFK		05-05-89

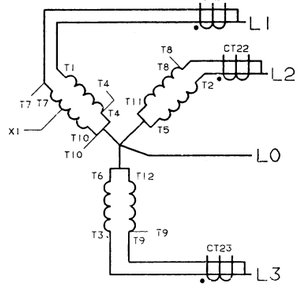
18 518 L Z — 3 PHASE RECONNECTABLE

SECONDARY CURRENT TRANSFORMER CONN. 1-3

110/220V, 50HZ
115/230V, 50HZ
120/240V, 60HZ

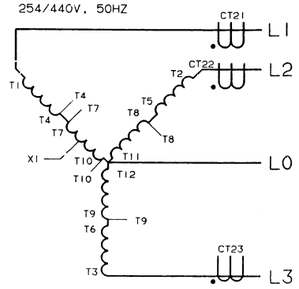


110/190V, 50HZ 120/208V, 60HZ
115/220V, 50HZ 127/220V, 60HZ
120/208V, 50HZ 139/240V, 60HZ
127/220V, 50HZ



SECONDARY CURRENT TRANSFORMER CONN. 1-2

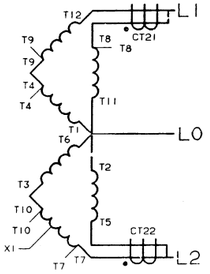
220/380V, 50HZ 240/416V, 60HZ
230/400V, 50HZ 254/440V, 60HZ
240/416V, 50HZ 277/480V, 60HZ
254/440V, 50HZ



18 518 L Z — 1 PHASE RECONNECTABLE

SECONDARY CURRENT TRANSFORMER CONN. 1-3

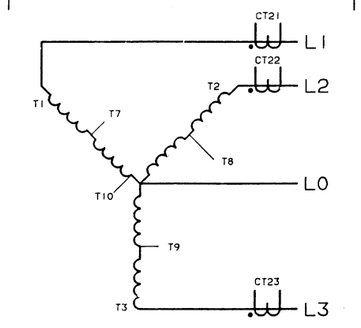
110/220V, 50HZ
115/230V, 50HZ
120/240V, 60HZ



7/F: 270/380V 60HZ

9X/H: 347/600V 60HZ

SECONDARY CURRENT TRANSFORMER CONN. 1-2



VOLTAGE CODE			
CONT INPUT TB21	18 518 L Z	7 F	9 H
22	T7	T7	T7
23	T8	T8	T8
24	T4	-	-
25	T9	T9	T9
26	T10	T10	T10
JUMPER	-	22-24	22-24

NOTES:

1. CURRENT TRANSFORMER SECONDARY MUST BE MANUALLY SELECTED. HIGH VOLTAGE (ABOVE 300 VOLTS) TERMINALS 1&2, LOW VOLTAGE BELOW 300 VOLTS USE TERMINALS 1&3. TERMINAL #1 IS COMMON
2. GENERATORS 7/F AND 9X ARE NOT RECONNECTABLE AND ARE WOUND FOR A SPECIFIC VOLTAGE
3. THESE CONNECTIONS ARE FOR SPEC E "L" WITH THE STANDARDIZED CONTROL
4. TIE OFF UNUSED WIRES (X1 IF APPLICABLE)

CADAM DWG — DO NOT SCALE PRINT

ADD TO 625-2108 D

DR JEFF KRAGE 09-05-89
CHKR 09-07-89
APPROVED 9-11-89

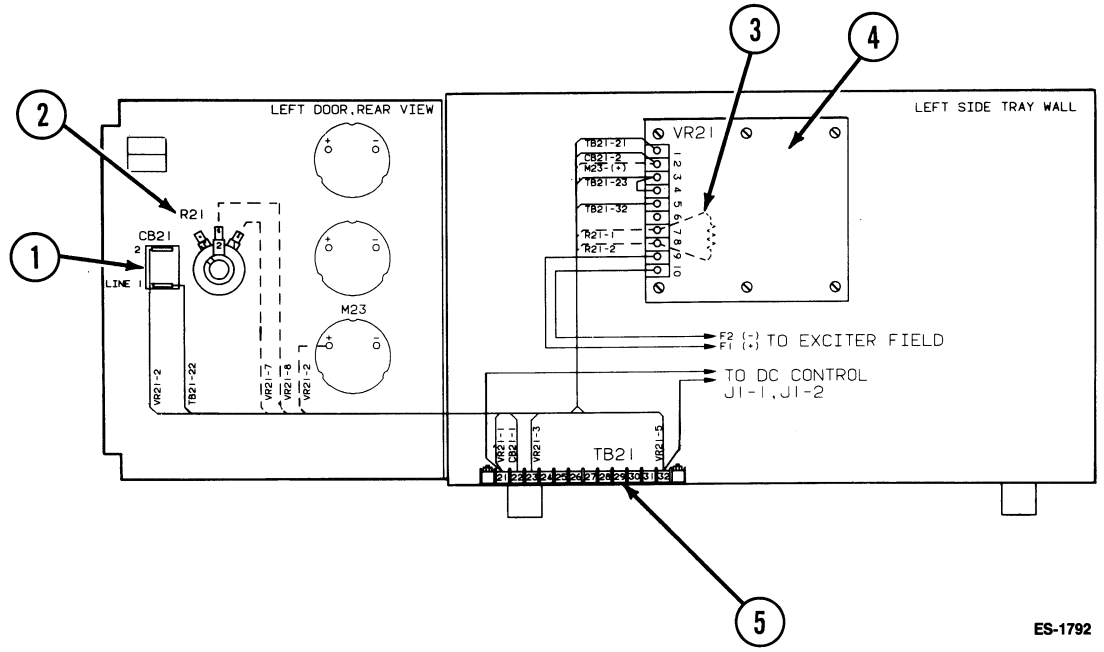
QS

Onan

TITLE WD-GEN RECONNECT

DWG NO 625-2251 SHT 1-1 REV D

GENERATOR RECONNECTION DIAGRAM, (WITHOUT SWITCH OPTION)

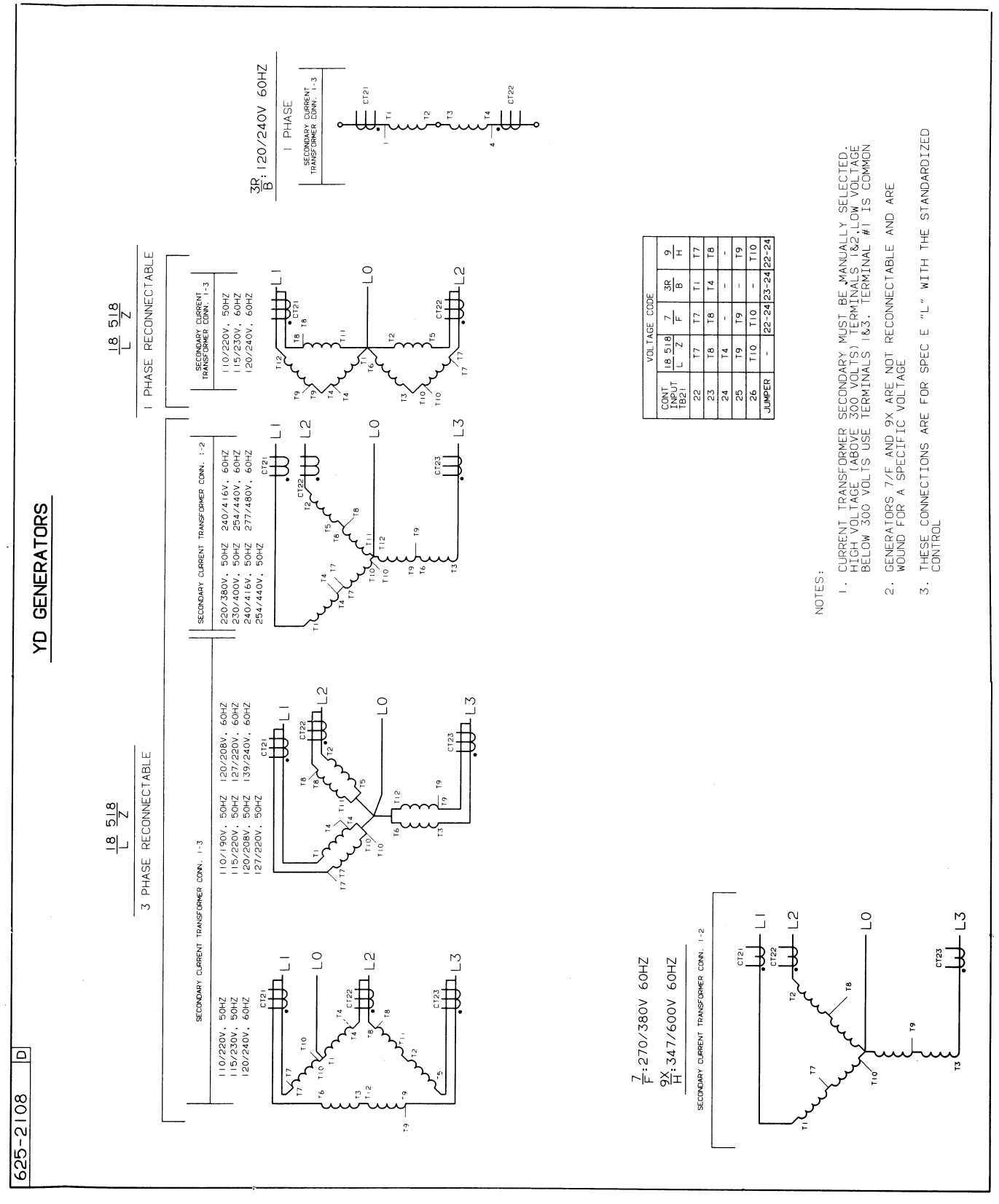


ES-1792

COMPONENT IDENTIFICATION

ITEM	REF.	DESCRIPTION
1	CB21	Field Circuit Breaker
2	R21	Voltage Adjust Potentiometer
3	—	Resistor (Used W/O R21)
4	VR21	Voltage Regulator, VRAS-2
5	TB21	Terminal Block

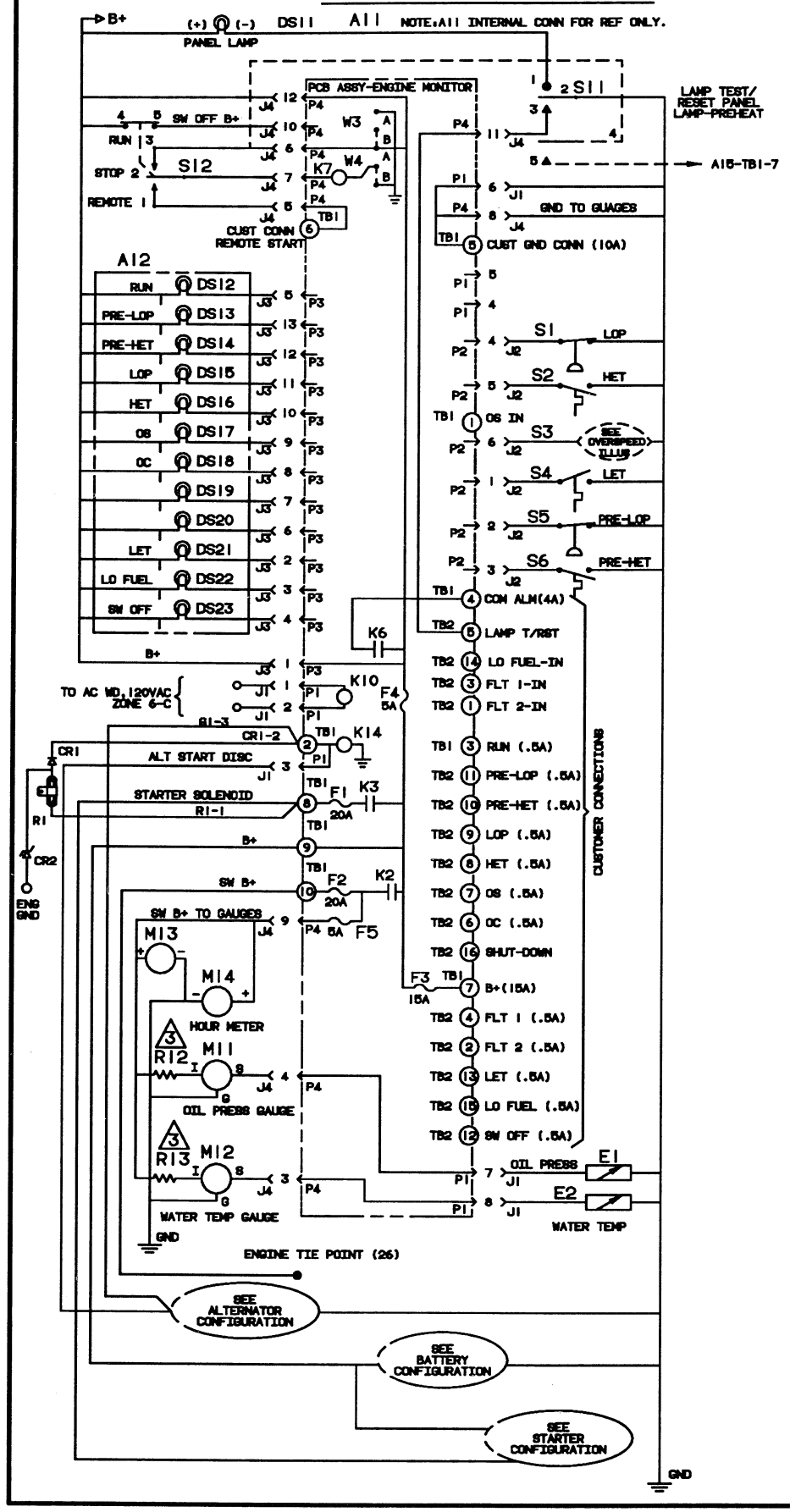
VOLTAGE REGULATOR INSTALLATION WIRING DIAGRAM 300-3303



GENERATOR RECONNECTION WIRING DIAGRAM 625-2108

612-6488 D

SCHEMATIC DIAGRAM



IGNITION SYSTEMS

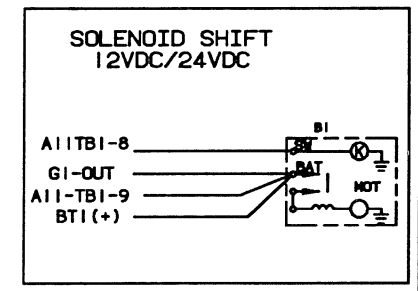
DIESEL APPLICATIONS

(26) — K1

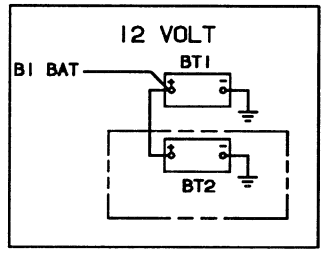
STARTER CONFIGURATIONS

ER NO	LTR	NO	REVISION	ENGR	DR	CHK/APPR/APPR	DATE
25865	A	1	PRODUCTION RELEASE	-	JC	VB PE	07-01-87
30817	B	1	REVISED PER ER	-	JP	JC SLS	12-08-87
32870	D	2	REVISED PER ER	-	JC	VB PE	09-15-88
33249	E	2	REVISED PER ER	-	MJ	VB BAH	11-18-88
37302	H	1	REVISED ALARM CONFIGURATION	-	JC		02-13-91
		2	ADDED OVERSPEED CONFIGURATION	-	JC		02-13-91

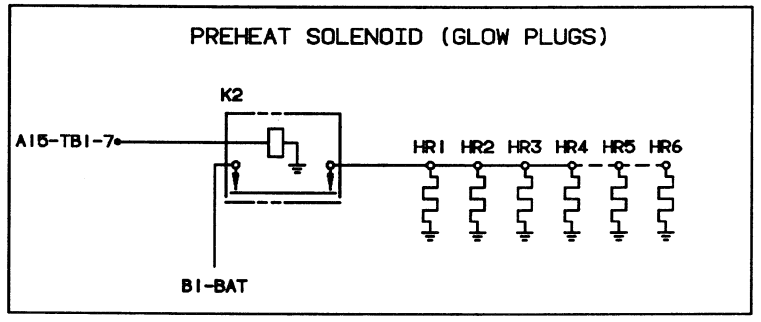
SOLENOID SHIFT
12VDC/24VDC



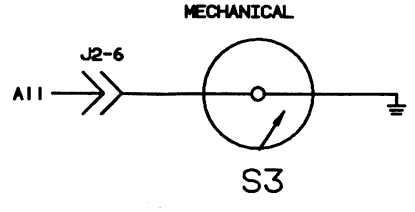
BATTERY CONFIGURATIONS



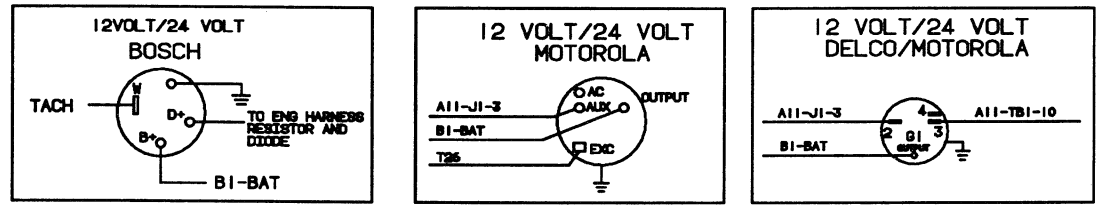
PREHEAT SOLENOID (GLOW PLUGS)



(H2) OVERSPEED CONFIGURATION



(H1) ALTERNATOR CONFIGURATIONS



CADAM SYSTEM DMS

DO NOT SCALE PRINT

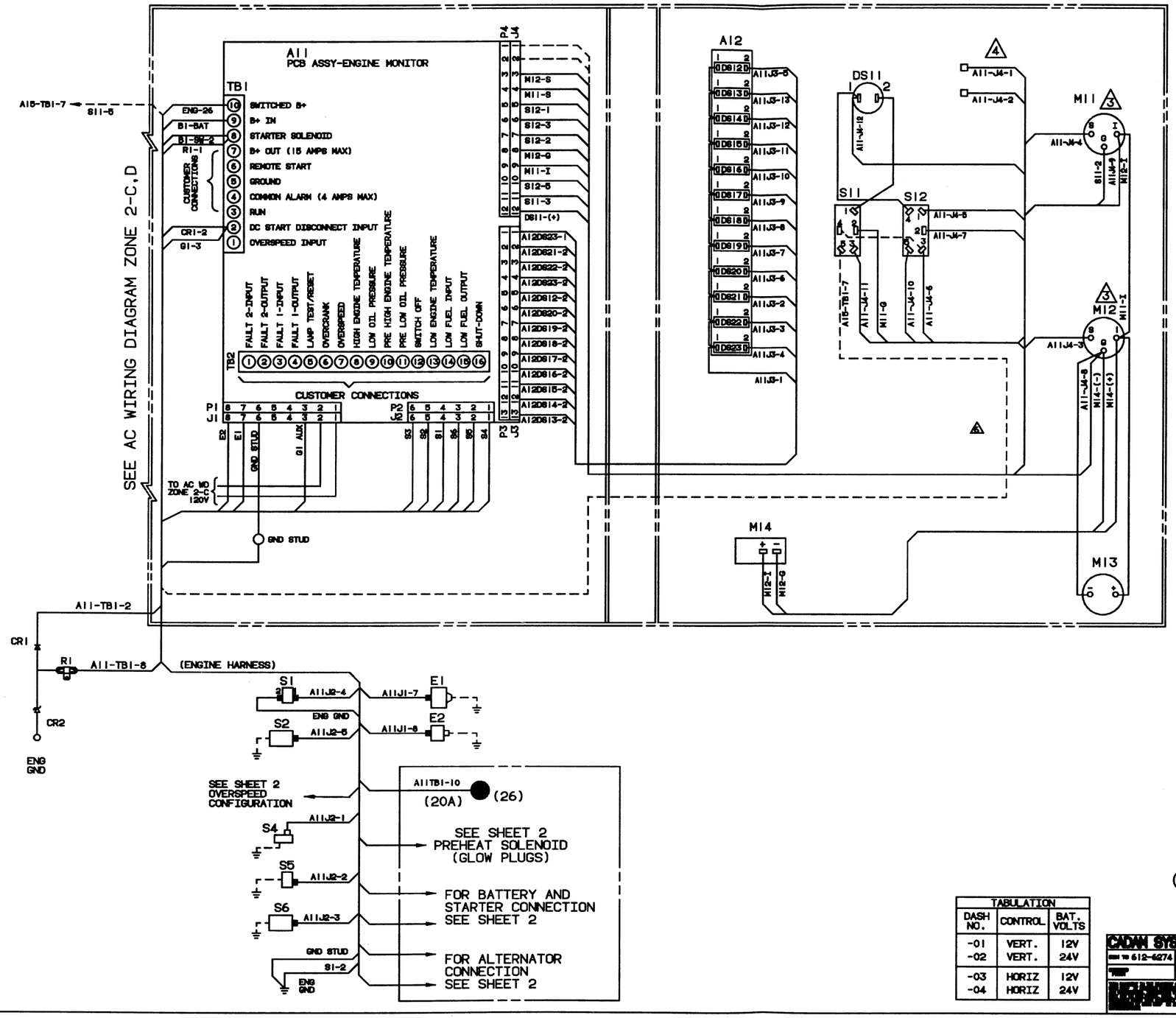
612-6488 D

ITEM	PART NO	*VOLT	QTY	DESCRIPTION OR MATERIAL

J. CASALENDA	06-26-87	Onan ONAN CORPORATION MINNEAPOLIS, MINNESOTA
M. REED	07-01-87	WD-GEN SET DC CONT 12 LT
P. ERICKSON	07-01-87	
DGEA, FA		612-6488 2 OF 2 D

12-LIGHT DC CONTROL WIRING DIAGRAM, SHEET 2

612-6488 D



TABULATION		
DASH NO.	CONTROL	BAT. VOLTS
-01	VERT.	12V
-02	VERT.	24V
-03	HORIZ	12V
-04	HORIZ	24V

ER NO	LTR	RD	REVISION	BY	CH	APPROVED	DATE
29665	A	1	PRODUCTION RELEASE	-	JC	MR	PE	06-26-87
30617	B	1	REVISED PER ER	-	JP	JC	SLS	12-8-87
31830	C	1	ADD ITEM 54 PER ER	-	JC	VB	GH	04-01-88
32870	D	1	REVISED PER ER	-	JC	VB	PE	09-15-88
		2	SEE SHEET 2	-	JC	VB	PE	09-15-88
		3	WAS 98-5719	-	JC	VB	PE	09-15-88
33259	E	1	REVISED PER ER	-	MT	VB	BAH	11-18-88
		2	SEE SHEET 2	-	MT	VB	BAH	11-18-88
35906	F	1	ADD CR2 - REVISED PER ER	-	JC	VB	BAH	11-18-88
36432	G	1	MMV NOTE 7	2-C	BR	MR	PE	08-29-89
		2	ITEM 52 98-5698-02 WAS 98-5698-01	1-A	BR	MR	PE	08-29-89
37302	H	1	SEE SHEET 2	-	JC			08-13-91
		2	SEE SHEET 2	-	JC			08-13-91

NOTES:

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

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

ENGINE PARTS LIST ABOVE (SHOWN FOR REFERENCE ONLY)

REF DES	PART NO.	QTY.	DESCRIPTION	DASH #
		3	WASHER-FLAT	-03,-04
		3	LATCH-PANEL	-03,-04
S12		1	SWITCH (RUN/STOP/REMOTE)	ALL
S11		1	SWITCH-ROCKER (RET/PHT PANEL LAMP)	ALL
R12,13		2	RESISTOR (GAUGE,24V)	-02,-04
R1			RESISTOR WIREWOUND	ALL
		1	PLUG-HOLE	-01,-02
M14		1	METER-TIME TOTALIZING	ALL
M13		1	VOLTMETER (16-36V)	-02,-04
M13		1	VOLTMETER (8-18V)	-01,-03
M12		1	GAUGE-WATER TEMP	ALL
M11		1	GAUGE-OIL PRESSURE	ALL
		1	LAMP-PANEL (24V)	-02,-04
		1	LAMP-PILOT (12V)	-01,-03
DS11		1	LIGHT-PANEL	ALL
CR2		1	RECTIFIER	ALL
CR1		1	RECTIFIER	ALL
A12		1	LAMP ASSY (12LT,24V)	-02,-04
A12		1	LAMP ASSY (12LT,12V)	-01,-03
A11		1	PCB ASSY-ENGINE MONITOR (12LT,24V)	-02,-04
A11		1	PCB ASSY-ENGINE MONITOR (12LT,12V)	-01,-03
		1	HARNESS-DC (HORIZ)	-03,-04
		1	HARNESS-DC (VERT)	-01,-02
		4	NUT-H W/ET (#6-32)	ALL
		4	SCREW-RHN (#6-32 X 1/2)(BLK ZINC)	ALL
		1	BRACKET-DC CONTROL	-01,-02
		1	SILKSCREEN-PNL REAR (DC) (HORIZ)	-03,-04
		1	SILKSCREEN-PNL REAR (DC) (VERT)	-01,-02
		1	SILKSCREEN-PNL FR (DC) (HORIZ)	-03,-04
		1	SILKSCREEN-PNL FR (DC) (VERT)	-01,-02
		1	DOOR ASSY-CONTROL (RH) (HORIZ)	-03,-04
		1	DOOR W.DMT-CONTROL (RH) (VERT)	-01,-02
		5	SCREW-LK H (#10-32 X 5/16)	-01,-02
		4	SCREW-RHN XREC W/IT (#6-32 X 1/2)	ALL
		3	NUT HEX W/ET (#10-32)	ALL
		1	CLIP-WIRE (5/8")	-01,-02

(F1) (C1) (G2) (D3)

CADAM SYSTEM DWG = 612-6274 D

DRAWN	J CASALENDA	6-25-87
CHECKED	M. REED	7-21-87
APPROVED	P. ERICKSON	7-01-87

DGEA,FA

Onan — ONAN CORPORATION MINNEAPOLIS, MINNESOTA

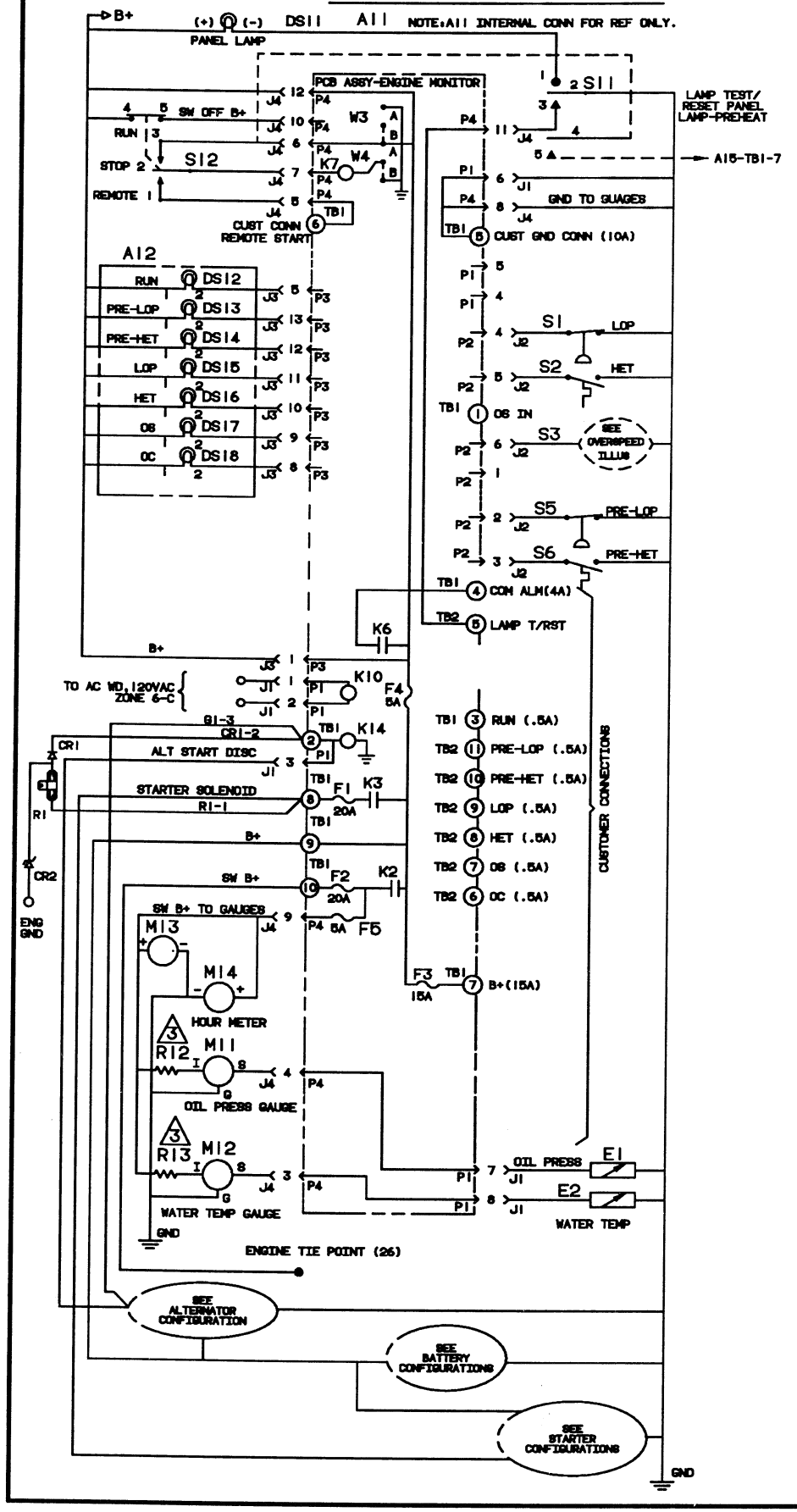
WD-GEN SET DC CONT(12LT)

612-6488 — SHEET 1 of 2 — REV D

12–LIGHT DC CONTROL WIRING DIAGRAM, SHEET 1

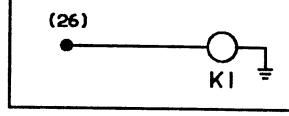
612-6487 D

SCHEMATIC DIAGRAM



IGNITION SYSTEMS

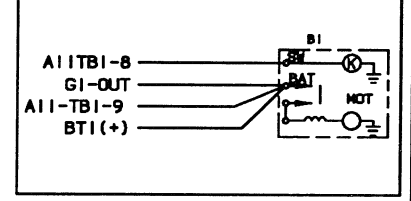
DIESEL APPLICATIONS



STARTER CONFIGURATIONS

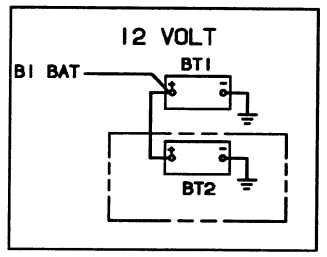
ER NO	LTR	NO	REVISION	SHEET	DR	DES	APPROVED	DATE
29656	A	1	PRODUCTION RELEASE	-	JC	VB	PE	07-01-87
30817	B	1	REVISED PER ER	-	JC	VB	PE	11-17-87
32870	D	2	REVISED PER ER	-	JC	VB	PE	06-16-88
33209	E	2	REVISED PER ER	-	MT	VB	BAH	11-16-88
37302	H	1	REVISED ALTERNATOR CONFIGURATION	2-1	JC			02-19-91
		2	ADDED OVERSPEED CONFIGURATION	1-1	JC			02-19-91

SOLENOID SHIFT
12VDC/24VDC

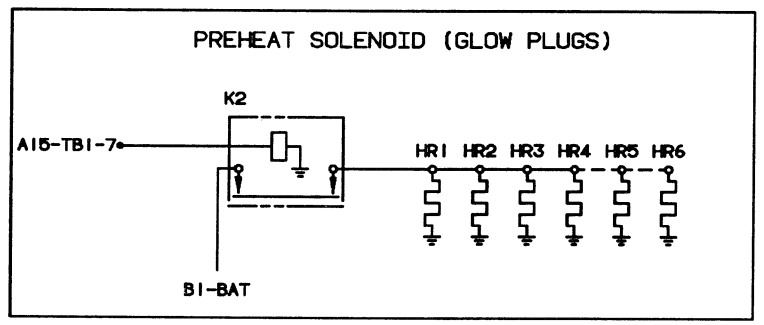


BATTERY CONFIGURATIONS

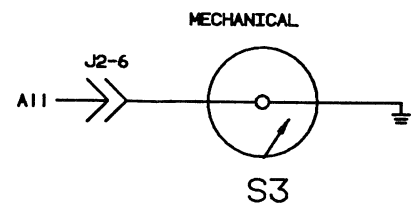
12 VOLT



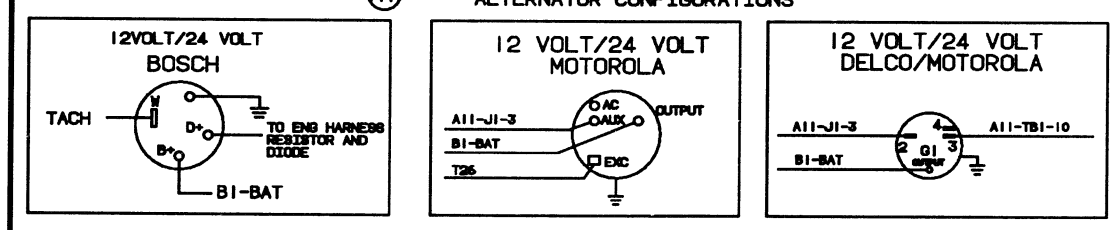
PREHEAT SOLENOID (GLOW PLUGS)



(H2) OVERSPEED CONFIGURATION



(H1) ALTERNATOR CONFIGURATIONS

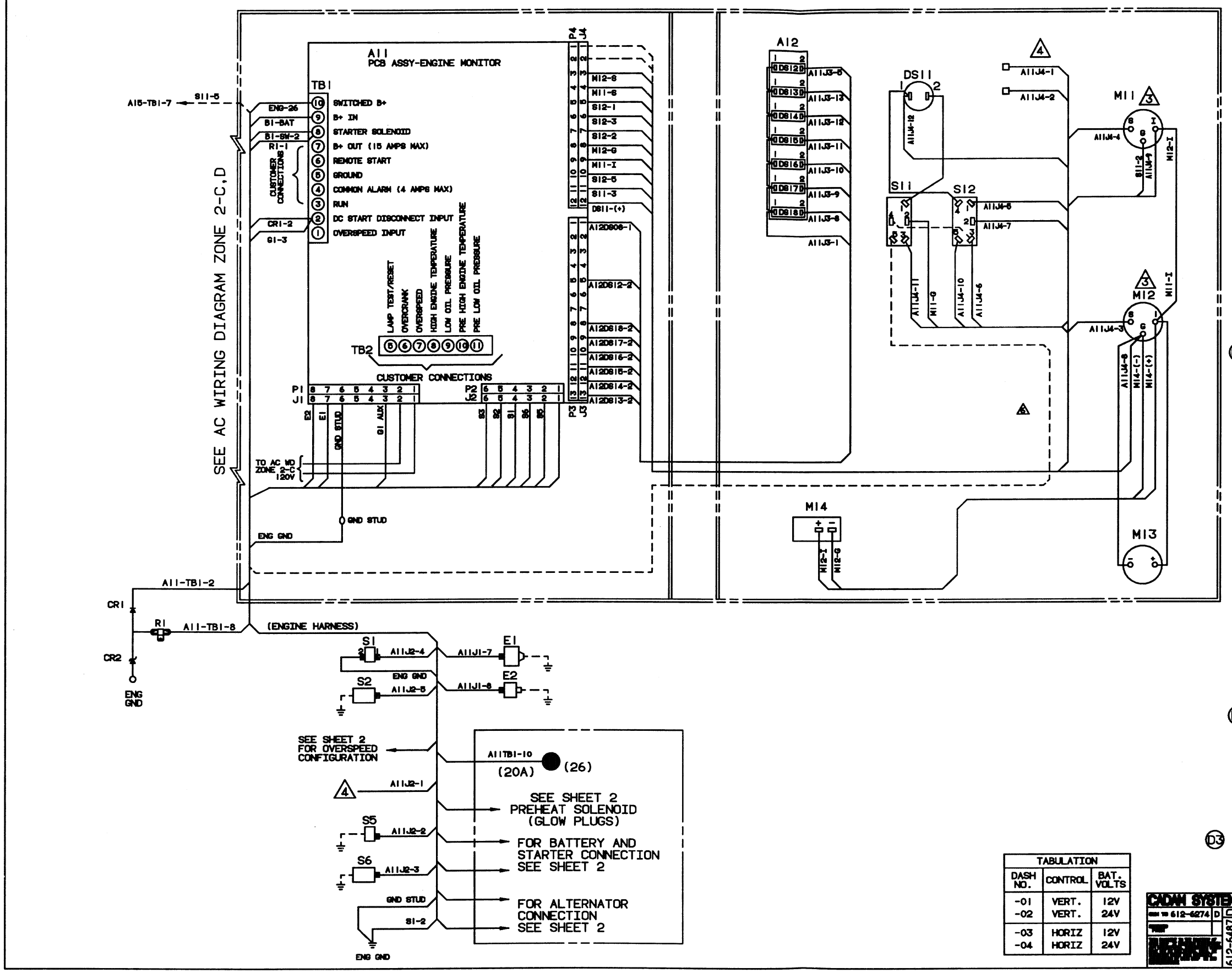


CADAM SYSTEM DMG

DO NOT SCALE PRINT	612-6487 D	J.CASALENDA	06-26-87	Onan CUMMINS ONAN CORPORATION MINNEAPOLIS, MINNESOTA
		M. REED	07-02-87	WD-GEN SET DC CONT (7LT)
		P. ERICKSON	07-01-87	612-6487 SHEET 2 OF 2 D
		DGEA.FA		

7-LIGHT DC CONTROL WIRING DIAGRAM, SHEET 2

612-6487 D



ER NO	LTR	NO	REVISION	DRN	CK	ENGR APPROVED	DATE
29845	A	1	PRODUCTION RELEASE	-	JC	MR PE	06-26-87
30617	B	1	REVISED PER ER	-	JP	JC SLS	12-08-87
31830	C	1	ADD ITEM 54 PER ER	-	JC	VB GH	04-01-88
32670	D	1	REVISED PER ER	-	JC	VB PE	09-15-88
		2	SEE SHEET 2	-	JC	VB PE	09-15-88
		3	WAS 96-5719	-	JC	VB PE	09-15-88
33209	E	1	REVISED PER ER	-	KG	VB BAH	11-15-88
		2	SEE SHEET 2	-	KG	VB BAH	11-15-88
35906	F	1	ADD CB2 PER ER	-	JC	VB BAH	11-15-89
36432	G	1	RMV NOTE 7	2-CBR	MR	PE	05-29-90
		2	ITEM 54- 96-5696-02 WAS 96-5696-01	1-ABR	MR	PE	05-29-90
37302	H	1	SEE SHEET 2	-	JC		09-19-91
		2	SEE SHEET 2	-	JC		09-19-91

NOTES:

1. ALL COMPONENTS SHOWN IN DE-ENERGIZED POSITION
2. ILLUSTRATION NUMBERS REFER TO DWG. NO. 539-0741 VERT. (D) ILLUS-STD CONTROL AND 539-0997 HORIZ.
3. GAUGE RESISTORS R12,13 (ILLUS #88) ARE USED ON 24V (-02,-04) VERSION ONLY. MOUNT BEFORE ATTACHING HARNESS.
4. TIE ALL UNUSED LEADS INTO HARNESS
5. GROUND BETWEEN MII & MI2 (ILLUS #77,78) IS THROUGH THE FRONT PANEL.
6. DASHED LEADS INDICATE WHEN USED.

(G1)

8. ITEMS CR1, CR2, R1, AND LEAD G1-3 TO A11-TB1-2 ARE USED ONLY ON THE CUMMINS B & C BLOCK ENGINES USING THE DELCO/MOTOROLA ALTERNATOR.

S6				THERMOSTAT (PRE-HET)
S5				SWITCH-PRESS (PRE-LOP)
S3				SWITCH-OVERSPEED
S2				THERMOSTAT (HET)
S1				SWITCH-OIL PRESS (LOP)
K4				STARTER PILOT SOLENOID
K2				PREHEAT SOLENOID (GLOW PLUGS)
K1				FUEL SOLENOID
G1				ALTERNATOR
E2				SENDER-WATER TEMP
E1				SENDER-OIL PRESSURE
BT1				BATTERY-STORAGE
B1				STARTER & SOLENOID

REF DES	PART NO	REF	QTY.	DESCRIPTION
ENGINE PARTS LIST ABOVE (SHOWN FOR REFERENCE ONLY)				

96				3	WASHER-FLAT	-03,-04
95				3	LATCH-PANEL	-03,-04
90	S12			1	SWITCH (RUN/STOP/REMOTE)	ALL
89	S11			1	SWITCH-ROCKER (RST/PHT/PANEL LAMP)	ALL
88	R12,13			2	RESISTOR (GAUGE,24V)	-02,-04
	R1				RESISTOR WIREWOUND	ALL
87				1	PLUG-HOLE	-01,-02
80	MI4			1	METER-TIME TOTALIZING	ALL
79	MI3			1	VOLTMETER (16-36V)	-02,-04
79	MI3			1	VOLTMETER (8-18V)	-01,-03
78	MI2			1	GAUGE-WATER TEMP	ALL
77	MII			1	GAUGE-OIL PRESSURE	ALL
71				1	LAMP-PANEL (24V)	-02,-04
71				1	LAMP-PILOT (12V)	-01,-03
70	DS11			1	LIGHT-PANEL	ALL
	CR2			1	RECTIFIER	ALL
(F1)	CR1			1	RECTIFIER	ALL
59	A12			1	LAMP ASSY (7LT,24V)	-02,-04
59	A12			1	LAMP ASSY (7LT,12V)	-01,-03
58	A11			1	PCB ASSY-ENGINE MONITOR (7LT,24V)	-02,-04
58	A11			1	PCB ASSY-ENGINE MONITOR (7LT,12V)	-01,-03
57				1	HARNESS-DC (HORIZ)	-03,-04
57				1	HARNESS-DC (VERT)	-01,-02
56				4	NUT-H W/ET (#6-32)	ALL
55				4	SCREW-RHM (#6-32 X 1/2)(BLK ZINC)	ALL
(C1) 54				1	BRACKET-DC CONTROL	-01,-02
53				1	SILKSCREEN-PNL REAR (DC) (HORIZ)	-03,-04
53				1	SILKSCREEN-PNL REAR (DC) (VERT)	-01,-02
(G2) 52				1	SILKSCREEN-PNL FR (DC) (HORIZ)	-03,-04
52				1	SILKSCREEN-PNL FR (DC) (VERT)	-01,-02
(D3) 51				1	DOOR ASSY-CONTROL (RH) (HORIZ)	-03,-04
51				1	DOOR WLDMT-CONTROL (RH) (VERT)	-01,-02
20				5	SCREW-LK H (#10-32 X 5/16)	-01,-02
18				4	SCREW-RHM XREC W/IT (#6-32 X 1/2)	ALL
11				3	NUT HEX W/ET (#10-32)	ALL
10				1	CLIP-WIRE (5/8")	-01,-02
	REF DES	PART NO.	REF	QTY	DESCRIPTION	DASH #

TABULATION		
DASH NO.	CONTROL	BAT. VOLTS
-01	VERT.	12V
-02	VERT.	24V
-03	HORIZ	12V
-04	HORIZ	24V

CADAM SYSTEM DWG 612-6274 D

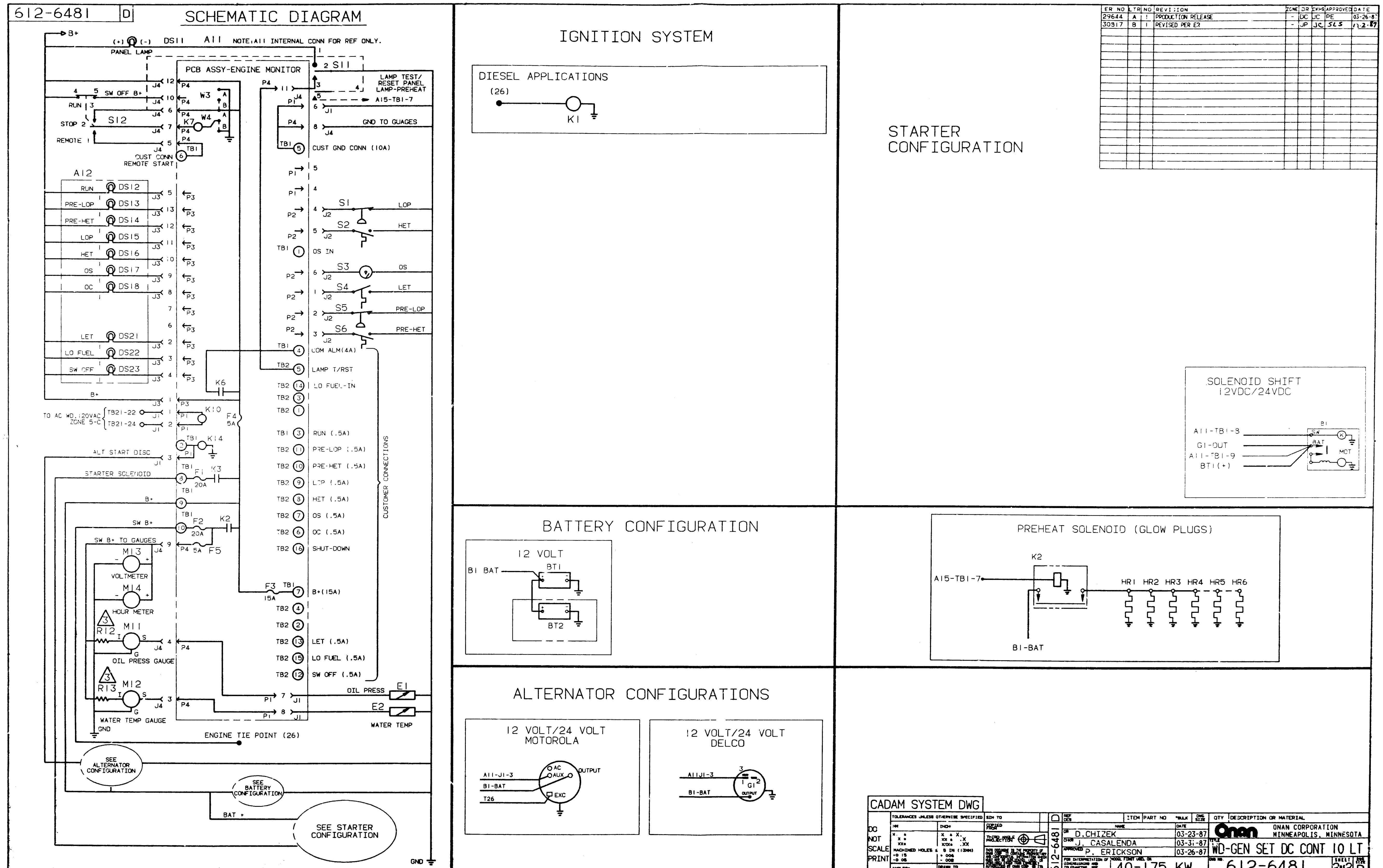
DRAWN	J CASALENDA	6-25-87
CHECKED	M. REED	7-21-87
ENGINEER	P. ERICKSON	7-01-87

Onan — ONAN CORPORATION MINNEAPOLIS, MINNESOTA

WD-GEN SET DC CONT (7 LT)

DGEA,FA | 612-6487 | SHEET 1 of 2 | REV D

7-LIGHT DC CONTROL WIRING DIAGRAM, SHEET 1



DC CONTROL WIRING DIAGRAM, DETECTOR 10, SHEET 2

612-6480 D

WIRING DIAGRAM

ER NO	LTR	NO	REVISION	ZONE	DR	CKR	APPROVED	DATE
29644	A	1	PRODUCTION RELEASE	-	JP	JC	PE	3-26-87
30817	B	1	REVISED PER ER	-	JP	JC	SLS	12-08-87
35819	C	1	CHANGE P3 TO J4 PER ER	4-D	JC	VB	PE	10-31-89

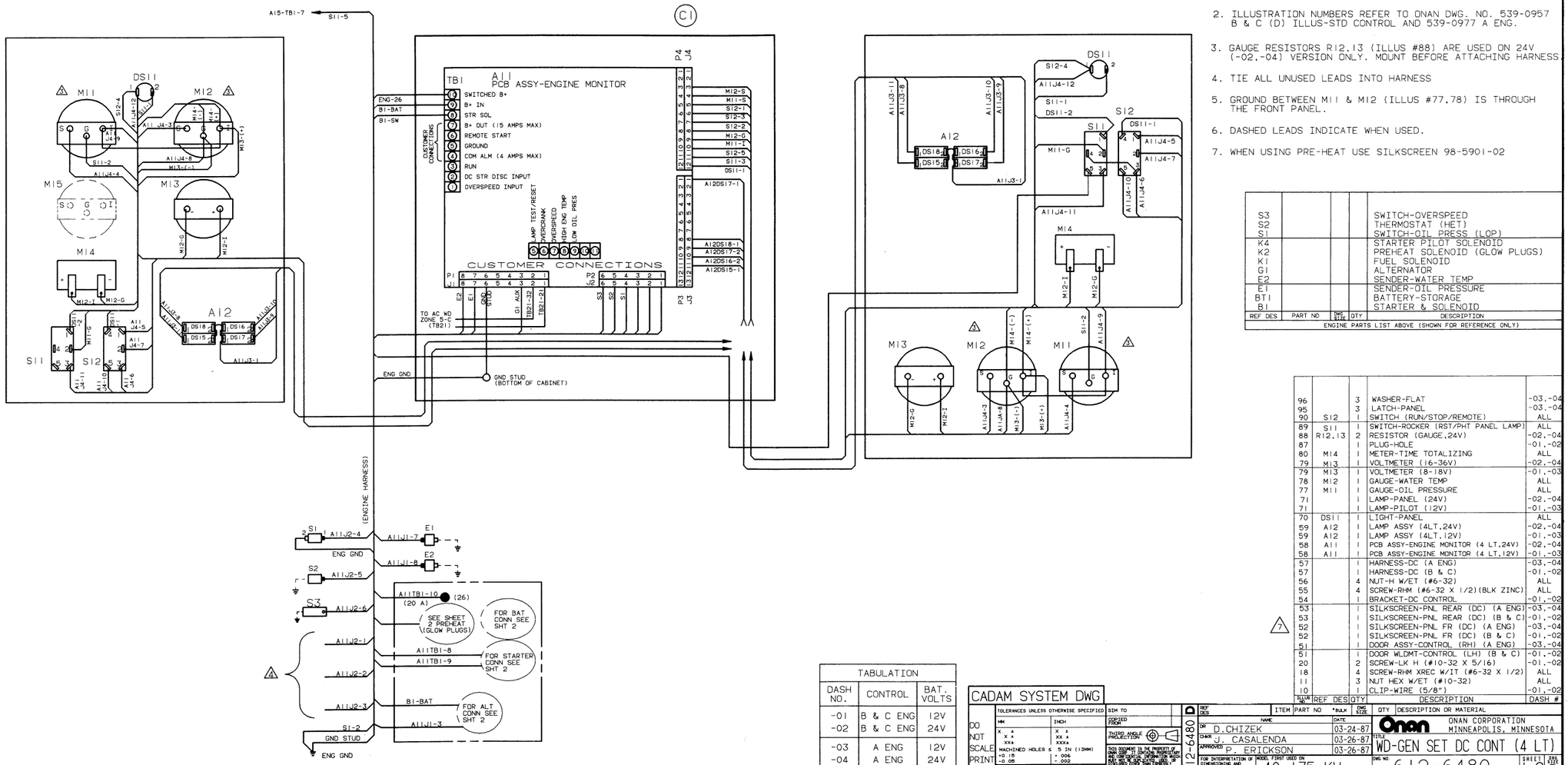
(B & C ENGINES)

LEFT SIDE DOOR
(REAR INSIDE VIEW)

BACK WALL OF CABINET
(INSIDE VIEW)

(A ENGINES)

RIGHT SIDE DOOR
(REAR INSIDE VIEW)



NOTES:

1. ALL COMPONENTS SHOWN IN DE-ENERGIZED POSITION.
2. ILLUSTRATION NUMBERS REFER TO ONAN DWG. NO. 539-0957 B & C (D) ILLUS-STD CONTROL AND 539-0977 A ENG.
3. GAUGE RESISTORS R12,13 (ILLUS #88) ARE USED ON 24V (-02,-04) VERSION ONLY. MOUNT BEFORE ATTACHING HARNESS.
4. TIE ALL UNUSED LEADS INTO HARNESS
5. GROUND BETWEEN M11 & M12 (ILLUS #77,78) IS THROUGH THE FRONT PANEL.
6. DASHED LEADS INDICATE WHEN USED.
7. WHEN USING PRE-HEAT USE SILKSCREEN 98-5901-02

S3				SWITCH-OVERSPEED
S2				THERMOSTAT (HET)
S1				SWITCH-OIL PRESS (LOP)
K4				STARTER PILOT SOLENOID
K2				PREHEAT SOLENOID (GLOW PLUGS)
K1				FUEL SOLENOID
G1				ALTERNATOR
E2				SENDER-WATER TEMP
E1				SENDER-OIL PRESSURE
BT1				BATTERY-STORAGE
B1				STARTER & SOLENOID

REF DES	PART NO	SPEC USE	QTY	DESCRIPTION
ENGINE PARTS LIST ABOVE (SHOWN FOR REFERENCE ONLY)				

TABULATION		
DASH NO.	CONTROL	BAT. VOLTS
-01	B & C ENG	12V
-02	B & C ENG	24V
-03	A ENG	12V
-04	A ENG	24V

REF DES	QTY	DESCRIPTION	DASH #
96	3	WASHER-FLAT	-03,-04
95	3	LATCH-PANEL	-03,-04
90	S12	SWITCH (RUN/STOP/REMOTE)	ALL
89	S11	SWITCH-ROCKER (RST/PHT PANEL LAMP)	ALL
88	R12,13	RESISTOR (GAUGE,24V)	-02,-04
87	1	PLUG-HOLE	-01,-02
80	M14	METER-TIME TOTALIZING	ALL
79	M13	VOLTMETER (16-36V)	-02,-04
79	M13	VOLTMETER (8-18V)	-01,-03
78	M12	GAUGE-WATER TEMP	ALL
77	M11	GAUGE-OIL PRESSURE	ALL
71	1	LAMP-PANEL (24V)	-02,-04
71	1	LAMP-PILOT (12V)	-01,-03
70	DS11	LIGHT-PANEL	ALL
59	A12	LAMP ASSY (4LT,24V)	-02,-04
59	A12	LAMP ASSY (4LT,12V)	-01,-03
58	A11	PCB ASSY-ENGINE MONITOR (4 LT,24V)	-02,-04
58	A11	PCB ASSY-ENGINE MONITOR (4 LT,12V)	-01,-03
57	1	HARNESS-DC (A ENG)	-03,-04
57	1	HARNESS-DC (B & C)	-01,-02
56	4	NUT-H W/ET (#6-32)	ALL
55	4	SCREW-RHM (#6-32 X 1/2)(BLK ZINC)	ALL
54	1	BRACKET-DC CONTROL	-01,-02
53	1	SILKSCREEN-PNL REAR (DC) (A ENG)	-03,-04
53	1	SILKSCREEN-PNL REAR (DC) (B & C)	-01,-02
52	1	SILKSCREEN-PNL FR (DC) (A ENG)	-03,-04
52	1	SILKSCREEN-PNL FR (DC) (B & C)	-01,-02
51	1	DOOR ASSY-CONTROL (RH) (A ENG)	-03,-04
51	1	DOOR WLDMT-CONTROL (LH) (B & C)	-01,-02
20	2	SCREW-LK H (#10-32 X 5/16)	-01,-02
18	4	SCREW-RHM XREC W/IT (#6-32 X 1/2)	ALL
11	3	NUT HEX W/ET (#10-32)	ALL
10	1	CLIP-WIRE (5/8")	-01,-02

7

CADAM SYSTEM DWG

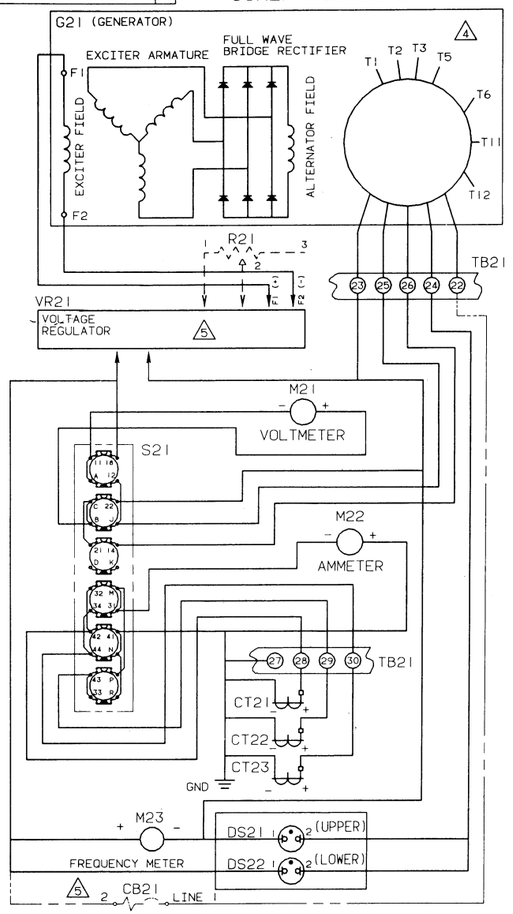
D	REF DES		ITEM	PART NO	*BULK	DWG SIZE	QTY	DESCRIPTION OR MATERIAL
612-6480	DR	D.CHIZEK				03-24-87		ONAN CORPORATION MINNEAPOLIS, MINNESOTA
	CHKR	J. CASALENDA				03-26-87		
	APPROVED	P. ERICKSON				03-26-87		TITLE WD-GEN SET DC CONT (4 LT)
	FOR INTERPRETATION OF MODEL FIRST USED ON		40-175 KW			DWG NO	612-6480	SHEET 1 OF 2 SIZE D

TOLERANCES UNLESS OTHERWISE SPECIFIED: MM: X ± .5, XX ± .25, XXX ± .127; INCH: X ± .5, XX ± .01, XXX ± .005; MACHINED HOLES ≤ .5 IN (13MM): +.10 -.05 / +.006 -.002; ANGLES ± 1/2°. SIM TO. COPIED FROM. THIRD ANGLE PROJECTION. DRAWN TO SCALE OF SCALE IS 1/2. DO NOT SCALE PRINT.

DC CONTROL WIRING DIAGRAM, DETECTOR 4, SHEET 1

612-6490 D

SCHEMATIC DIAGRAM



S21

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

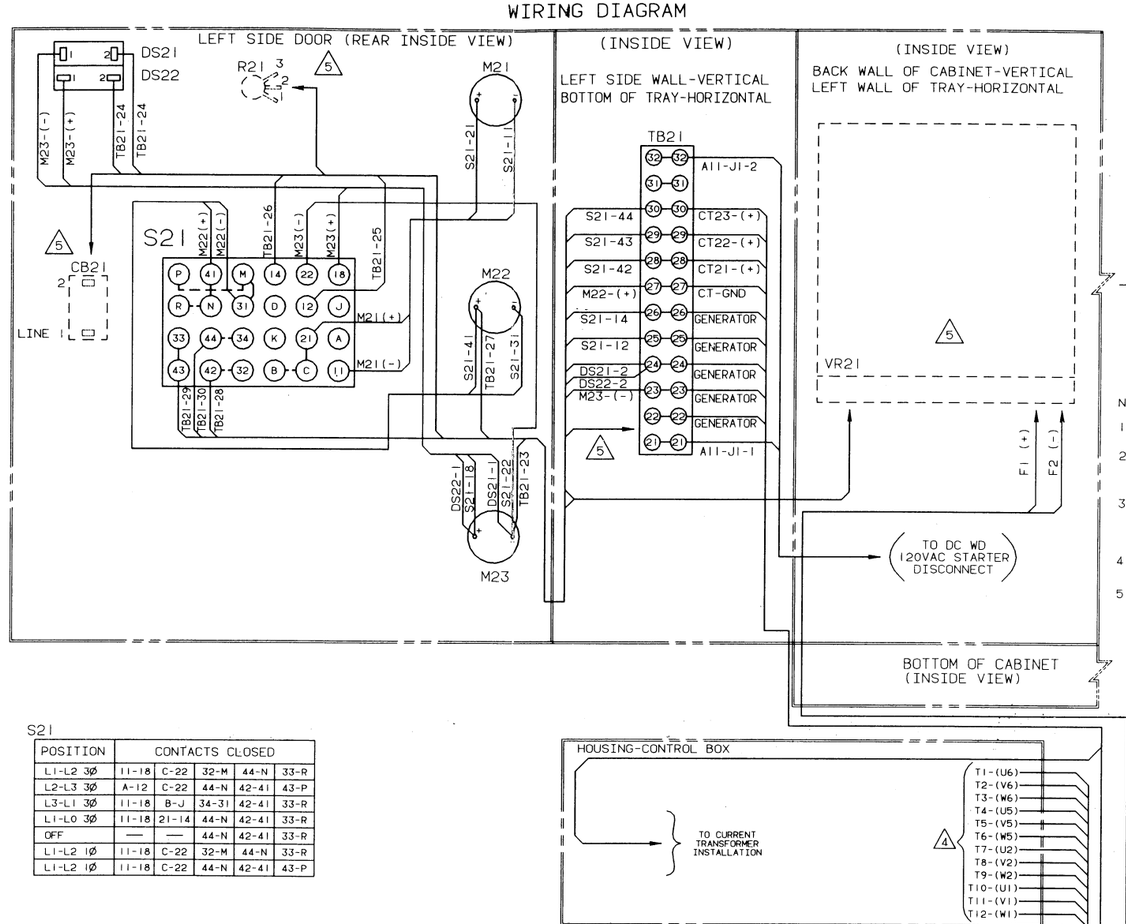
TABULATION

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

TABULATION

<500V	VERTICAL	-10	-11	-12	-13	-14	-15	-16	-17	-18
600V	VERTICAL	-35	-36	-37	-38	-39	-40	-41	-42	-43
<500V	HORIZONTAL	-60	-61	-62	-63	-64	-65	-66	-67	-68
600V	HORIZONTAL	-85	-86	87	-88	-89	-90	-91	-92	-93
ITEM 32 (M22)		302-1727	302-1728	302-1729	302-1798	302-1799	302-1800	302-1908		
AMMETER SCALE (M22)		(0-500,0-1000)	(0-600,0-1200)	(0-750,0-1500)	(0-1000,0-2000)	(0-1500,0-3000)	(0-2000,0-4000)	(0-3000,0-6000)		
CURRENT TRANSFORMER SECONDARY CONNECTION		0-500 (1-2) 0-1000 (1-3)	0-600 (1-2) 0-1200 (1-3)	0-750 (1-2) 0-1500 (1-3)	0-1000 (1-2) 0-2000 (1-3)	0-1500 (1-2) 0-3000 (1-3)	0-2000 (1-2) 0-4000 (1-3)	0-3000 (1-2) 0-6000 (1-3)		

WIRING DIAGRAM



SEE DC WIRING DIAGRAM ZONE 5-B,C,D

NOTES

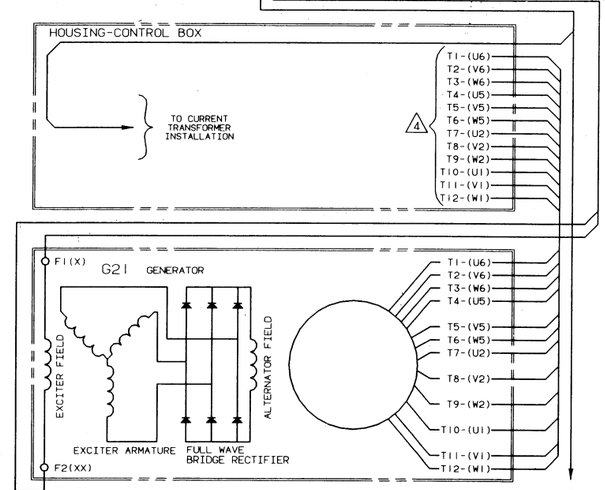
1 ALL COMPONENTS SHOWN IN DE-ENERGIZED POSITION

2 ILLUSTRATION NUMBERS REFER TO DWG NO 539-0741 VERT (D) ILLUS-STD CONTROL AND 539-0997 (D) HORIZ

3 LOCATE ONE (1) DANGER LABEL ON EXTERIOR AND ONE (1) ON INTERIOR OF LEFT SIDE DOOR IN ANY READILY VISIBLE AREA AVAILABLE.

4 SEE GENERATOR CONNECTION DIAGRAM FOR INPUT CONNECTIONS

5 SEE VOLTAGE REGULATOR INSTALLATION FOR CONNECTIONS TO VR21,CB21,R21 AND TB21



WITH METERS

ER NO	LTR	NO	REVISION	ZONE	DR	CKHR	APPROVED	DATE
29865	A	1	PRODUCTION RELEASE	-	JP	MR	PE	11-5-87
30817	B	1	REDRAWN W/CHNG PER ER	-	JP	JC	SLS	12-08-87
32870	C	1	REVISED PER ER	—	JC	VB	PE	09-15-88
34657	D	1	ADD 302-1908 AMMETER TO TAB	4-A	JC	VB	PE	5-15-89

	CT21-23	-	TRANSFORMER ASSY-CUR	-
	G21	-	GENERATOR △3	-
		2	LABEL-DANGER	ALL
43	VR21	-	INSTL-VOLTAGE REGULATOR	-
42		2	SCREW-RHM (#6-32 X 5/8)	ALL
41		1	MARKER STRIP	ALL
40	S21	1	SWITCH-ROTARY (VOLT & AMMETER)	ALL
39		1	KNOB-RHEOSTAT (SWITCH-ROTARY)	ALL
38	R21	-	POTENTIOMETER (VOLTS ADJUST)	-
33	M23	1	METER-FREQUENCY (45-65 HZ)	ALL
32	M22	1	AMMETER-AC (SEE TAB)	ALL
31	M21	1	VOLTMETER-AC (0-750)	1-50
31	M21	1	VOLTMETER-AC (0-300,0-600)	51-99
30	DS21-22	1	LAMP ASSY (UPPER/LOWER SCALE)	ALL
29	CB21	-	CIRCUIT BREAKER-MAG.(FIELD)	-
25		1	HARNESS-AC (HORIZ)	51-99
25		1	HARNESS-AC.(VERT)	1-50
25	TB21	-	PART OF AC HARNESS	-
24		1	TRAY ASSY-CONTROL	51-99
23		1	SILKSCREEN-PNL REAR (AC,HORIZ)	51-99
23		1	SILKSCREEN-PNL REAR (AC,VERT)	1-50
22		1	SILKSCREEN-PNL FR (AC,HORIZ)	51-99
22		1	SILKSCREEN-PNL FR (AC,VERT)	1-50
21		1	DOOR ASSY-CONTROL (LH) HORIZ	51-99
21		1	DOOR WLDMT-CONTROL (LH) VERT	1-50
20		3	SCREW-LKH (#10-32 X 5/16)	1-50
17		1	WASHER -EIT LK (5/16)	ALL
16		1	NUT-HEX (5/16-18)	51-99
15		1	SCREW-HHC (5/16-18 X 1/2)	1-50
14		1	BOND-STRAP	ALL
13		1	WASHER-ET LK (1/4")	ALL
12		1	NUT-HEX (1/4-20)	ALL
11		3	NUT-H W/ET (#10-32)	ALL
10		1	CLIP-WIRE (5/8")	1-50
9		2	WASHER-STUD RTNR	1-50
8		2	STUD-FASTENER	1-50
7		2	RECEPTACLE-FASTENER	1-50
6		1	GROMMET (2")	ALL
5		1	GROMMET (3/4")	1-50
4		4	WASHER-LK (5/16)	1-50
3		4	SCREW-HHC (5/16-18 X 3/8)	1-50
2		4	ISOLATOR-VIBRATION	ALL
1		1	COVER ASSY-CONTROL (HORIZ)	51-99
1		1	BOX WLDMT-CONTROL (VERT)	1-50
ITEM NO	REF DES	QTY	DESCRIPTION	DASH #

CADAM SYSTEM DWG

SIM TO 612-6269 D

612-6490 D1

	NAME	DATE
DR	JOHN PREESE	6-25-87
CHKR	M REED	7-21-87
APPROVED	P ERICKSON	7-01-87

ONAN CORPORATION MINNEAPOLIS, MINNESOTA

TITLE: WD-GEN SET AC CONT (METER)

DWG NO 612-6490 SHEET 1 OF 1 SIZE D

MODEL FIRST USED ON DGEA,FA

Onan

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