

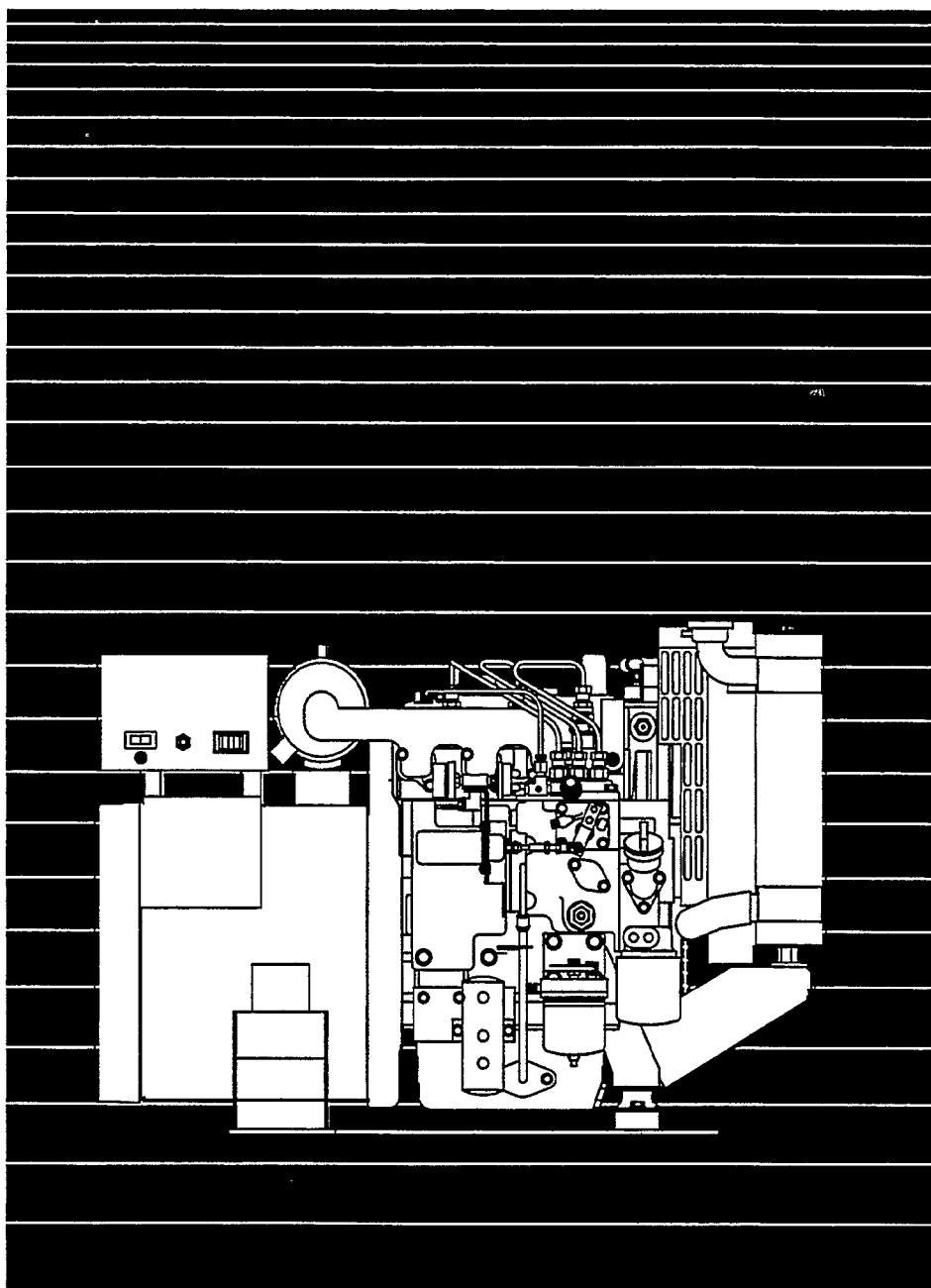
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**Onan**

**GenSet**

# Service Manual

**DKC, DKD  
MDKC, MDKD**



# Safety Precautions

Before operating the generator set, read this manual and become familiar with it and the equipment. **Safe and efficient operation can be achieved only if the unit 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.*

Read and observe each of the following safety precautions.

## FUEL AND FUMES ARE FLAMMABLE

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

- Do not smoke or allow an open flame or spark-producing equipment near the generator set or fuel tank.
- Inspect the fuel lines and connections daily for leaks per the maintenance schedule.

## EXHAUST GASES ARE DEADLY

- Never sleep in the vehicle with the generator set running unless vehicle is equipped with an operating carbon monoxide detector.
- Inspect exhaust system daily for leaks per the maintenance schedule. Do not use engine cooling air to heat a compartment.
- Never operate the generator set inside a building or in an area where exhaust gases could accumulate, such as near a wall or snow bank, or in high grass. When parking, make sure the exhaust outlet is not obstructed. Make sure the generator set is well ventilated.

## ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Disconnect the negative (-) cable at the starting battery before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms on the ground or over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surfaces to be damp when handling electrical equipment.
- Use extreme caution when working on electrical components. High voltages can cause injury or death.
- Tag remote or open switches to avoid accidental closure or starting.

- 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 device and after building main switch is open. Consult an electrician in regard to emergency power use.

## MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Before starting work on the generator set, disconnect negative (-) cable at the battery. This will prevent accidental arcing or starting.
- Keep your hands away from moving parts.
- Make sure that fasteners on the generator set are secure. Tighten supports and clamps, keep guards in position over fans, etc.
- Do not wear loose clothing or jewelry while working on generator sets, because they 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.

## GENERAL SAFETY PRECAUTIONS

- Wear safety glasses and protective clothing when servicing batteries. DO NOT SMOKE while servicing batteries. Lead-acid batteries emit a highly explosive hydrogen gas that can be ignited by electrical arcing or by smoking.
- Have a fire extinguisher rated ABC nearby. Maintain extinguisher properly and become familiar with its use.
- 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.
- Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and engine damage, which presents a potential fire hazard.
- Do not store anything in the generator set compartment such as oil or gas cans, oily rags, chains, wooden blocks, portable propane cylinders, etc. A fire could result or the generator set operation (cooling, noise and vibration) may be adversely affected. Keep the compartment 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

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## ABOUT THIS MANUAL

For servicing purposes, the generator set can be divided into three basic parts: the engine, the generator, and the control. This manual contains troubleshooting and repair information for the generator and the control. Refer to the Engine Service Manual (981-0501) when servicing the engine.

Study this manual carefully and observe all the warnings and cautions throughout the manual. Knowing the generator set, using it properly, and following a regular maintenance schedule can result in longer unit life, better performance and safer operation.

Information for printed circuit board repair is limited because it is more efficient to replace the boards in the field and repair them at the factory. Application of meters or hot soldering irons to printed circuit boards by other than qualified service personnel can cause unnecessary and expensive damage.

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

## HOW TO OBTAIN ASSISTANCE

Always give the complete model number and serial number as shown on the Onan nameplate when seeking additional service information or replacement parts.

## TEST EQUIPMENT

Most of the test procedures in this manual can be performed with a multimeter such as the Simpson Model 260 VOM or with a digital VOM. Additional instruments used to service generator sets that should be available are:

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

## **▲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.*

## SAFETY CONSIDERATIONS

Always consider the safety aspects of any service procedure. Generator sets present several safety hazards that the service person must be aware of to safely complete the job. Read through the safety precautions listed on the inside cover and familiarize yourself with the hazards shown in Table 1-1. Once the hazards are known, approach the job with a safety conscious attitude. Being safety conscious is the most effective way to avoid injury to yourself or others. Reduce the chance that an accident will occur by adopting the following safeguards.

### Safeguards to Avoid Hazards

- **Use personal protection** - Protect your body by wearing the appropriate safety equipment. Protective clothing includes safety shoes, gloves, safety glasses, and hard hats. Leave rings and jewelry off and do not wear loose clothing that might get caught on equipment.
- **Work to Reduce the Hazard** - The workshop area and all pieces of equipment used can contribute to reducing the hazard potential. Keep guards and shields in place on machinery and maintain equipment in good working order. Store flammable liquids in approved containers away from open flame, spark, pilot light, cigarette, or other ignition source. Keep the workshop clean and well-lighted, and provide adequate ventilation. Keep fire extinguisher and safety equipment nearby and be prepared to respond to an emergency.
- **Develop Safe Work Habits** - Unsafe actions are identified as the source of most accidents involving the use of tools and machines. Be familiar with the equipment and know how to use it safely. Use the correct tool for the job and check its condition before starting. Observe the warnings and cautions in this manual and take special precautions when working around electrical equipment. Do not work alone if possible and do not take risks.

**TABLE 1-1. HAZARDS AND THEIR SOURCE**

<ul style="list-style-type: none"><li>● Fire and Explosions<ul style="list-style-type: none"><li>—Leaking or spilled fuel</li><li>—Hydrogen gas from battery</li><li>—Oily rags improperly stored</li><li>—Flammable liquids improperly stored</li></ul></li><li>● Burns<ul style="list-style-type: none"><li>—Hot exhaust pipes</li><li>—Hot engine and generator surfaces</li><li>—Electrical short in DC wiring system</li></ul></li><li>● Poisonous Gases<ul style="list-style-type: none"><li>—Carbon monoxide from faulty exhaust pipes, joints or hangers</li><li>—Operating generator set where exhaust gases can accumulate</li></ul></li></ul>	<ul style="list-style-type: none"><li>● Electrical Shock (AC)<ul style="list-style-type: none"><li>—Improper generator set load connections</li><li>—Faulty load circuit</li><li>—Faulty electrical appliance</li><li>—Faulty generator set wiring</li><li>—Working in damp conditions</li><li>—Jewelry touching electrical components</li></ul></li><li>● Rotating Machinery<ul style="list-style-type: none"><li>—Jewelry or loose clothing catching in moving parts</li></ul></li><li>● Slippery Surfaces<ul style="list-style-type: none"><li>—Leaking or spilled oil</li></ul></li><li>● Heavy Objects<ul style="list-style-type: none"><li>—Removing generator set from RV</li><li>—Removing heavy components</li></ul></li></ul>
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Be prepared if an accident does occur. Numerous agencies such as the Red Cross and local police and fire departments offer basic courses in first aid, CPR, and fire control. Take advantage of these offerings so you are ready to respond when an accident occurs. Learn to be safety conscious and make safe practices a part of your work routine. Do not work when tired or after consuming any alcohol or drug that makes the operation of equipment unsafe.

### SET REMOVAL

Some service procedures will require removing the generator set from a vehicle or boat. Because of the wide variety of generator set installations, it is not possible to specify the exact removal procedures for each generator set. If, after examining the installation, a satisfactory method for removing the set cannot be determined, contact the vehicle or boat manufacturer or the generator set installer to obtain their recommendations.

**▲WARNING** *Generator sets are heavy and they can cause severe personal injury or death if dropped during removal. Use adequate lifting devices to provide sufficient support for the set. Keep hands and feet clear while lifting the generator set.*

#### Disconnecting Generator Set Systems

Some installations may require partial removal of the set to gain access to the battery cable, fuel line, and other connections. Read this entire section before starting set removal. The following steps are a general guideline for set removal.

**▲WARNING** *Leakage of fuel in or around the generator set compartment presents the hazard of fire or explosion that can cause severe personal injury or death. Do not disconnect or connect battery cables if fuel vapors are present. Ventilate the compartment thoroughly, use bilge blowers or power exhausters in boats, and park vehicles outdoors in a well ventilated area.*

1. Disconnect the generator set negative (-) battery cable at the battery terminal.
2. Disconnect the generator set positive (+) battery cable from the wire harness.
3. Disconnect the remote control plug wire from the generator set, if applicable.
4. Disconnect the generator load wires and tag for identification when reconnecting.
5. Disconnect the exhaust system and support brackets or hangers to allow set removal.
6. Disconnect the fuel line at the generator set housing. Securely plug the end of the fuel line to prevent fuel leakage or an accumulation of explosive gas-line vapor.
7. Verify that the generator set is adequately supported before loosening any of the mounting bolts or support members.

**▲WARNING**

***Leakage of fuel presents the hazard of fire or explosion that can cause severe personal injury or death. Make certain all fuel line openings are plugged to prevent gasoline vapor from accumulating. Before disconnecting the fuel line, be certain there are no ignition sources such as flame, spark, pilot light, cigarette, etc., near the generator set. Keep an ABC type fire extinguisher nearby.***

When reinstalling the generator set, be sure all mounting hardware, and electrical, exhaust, and fuel system components are connected exactly as they were before removal. Refer to the appropriate installation manual during reinstallation for important safety precautions.

Check for oil and fuel leaks. Check exhaust system audibly and visually with the generator set running. Repair any leaks immediately. Replace worn, damaged, or corroded exhaust and fuel line components before leaks occur.





# Section 2. Marine Engine Control

## GENERAL

The marine engine control system includes all the functions that relate to the operation of the engine. This includes starting and stopping, instrumentation, monitoring for fault conditions, and battery charging. This section covers a description of the controls and shows where they are located, describes how the control operates, and provides basic troubleshooting procedures.

## CONTROL DESCRIPTION

### Gauges/Meters and Switches

**Oil Pressure Gauge (Optional):** Shows engine lubricating oil pressure. The gauge has a range of 0 to 100 psi (0 to 700 kPa) and is connected to an engine sensor. See Figure 2-1.

**Coolant Temperature Gauge (Optional):** The water temperature should be in the range of 165°F to 195°F (74°C to 91°C) depending on the load and the ambient temperature.

**DC Voltmeter (Optional):** Normal battery B+ voltage during operation should be 13.5 to 15 volts on a 12-volt system; 27 to 30 volts on a 24-volt system.

**Start/Stop Switch S11:** Starts and stops the unit locally. Unit may be operated from an optional remote switch wired to the control panel. Preheat added to stop position on later production sets.

**Preheat Switch S12:** Activates heater relay K13 to connect battery B+ to the engine glow plugs prior to starting the engine. S12 is not used on later production sets.

**Fault Reset:** A manual reset breaker that shuts down the engine for low oil pressure, high coolant temperature, high exhaust temperature, and overspeed (option).

**Emergency Stop DC Control Breaker:** A 15-ampere breaker providing protection to the control box wiring and remote wiring from short circuits or overload. Also serves as an emergency stop switch.

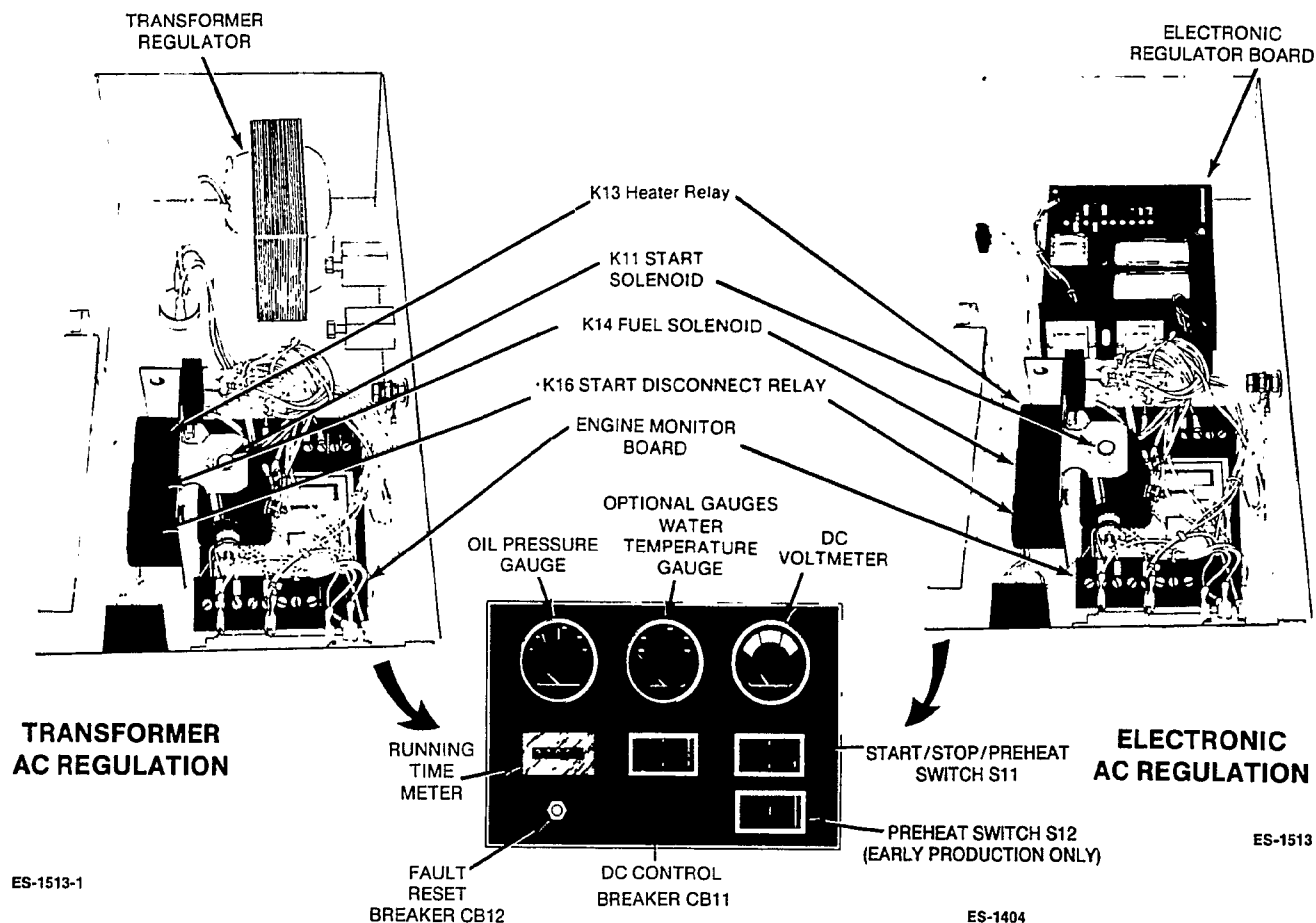


FIGURE 2-1. MDKC/MDKC CONTROL BOX

## Control Components

The following describes the basic engine control components and how they function.

**Engine Monitor Circuit Board:** A printed circuit board that monitors engine control system functions. This includes starting, stopping, and fault system operation. A terminal board is included for making remote connections. See Figure 2-1.

Two relays are soldered to the circuit board that are not serviceable. Power Relay K12 connects and maintains battery B+ to the control meters and fuel solenoid during operation. Starter Protection Relay K15 is an AC operated relay. When the start switch is actuated, B+ is connected to the K11 start solenoid through K15 NC contacts until the generator output reaches 90 volts AC. K15 activates and disconnects the starter.

**F1 In-Line Fuse:** A 30-ampere fuse is located in a fuse-holder connected to the B+ terminal of the starter. This fuse connects B+ to the control and it will open if a short or overload should occur.

**K1 Fuel Solenoid:** Opens the fuel control valve when the start/stop switch is placed in the Start position.

**K11 Start Solenoid:** Located over the engine monitor circuit board. It connects the battery B+ to the starter solenoid B1 during cranking.

**K13 Heater Relay:** Located on the relay mounting tray. It connects the battery B+ to the engine glow plugs prior to and during cranking. It is energized by the Preheat Switch (S12 early production/S11 late production) and the start switch S11 during start sequence.

**K14 Fuel Solenoid Relay:** Located on the relay mounting tray. It is energized only during cranking and connects B+ to the fuel solenoid K1, fuel pump E5, and fault breaker CB12 circuits.

**K16 Start Disconnect Relay:** Located on the relay mounting tray. It is connected through CR11 to the 12-volt battery charging alternator. The relay actuates at 5.5 to 7.5 volts DC. The K16 relay and CR11 diode are not used on later production sets and were disconnected on some sets (refer to Product Support Bulletin 450).

## Engine Sensors

The following briefly describes the engine mounted sensors and switches, and how they protect the engine from adverse operating conditions.

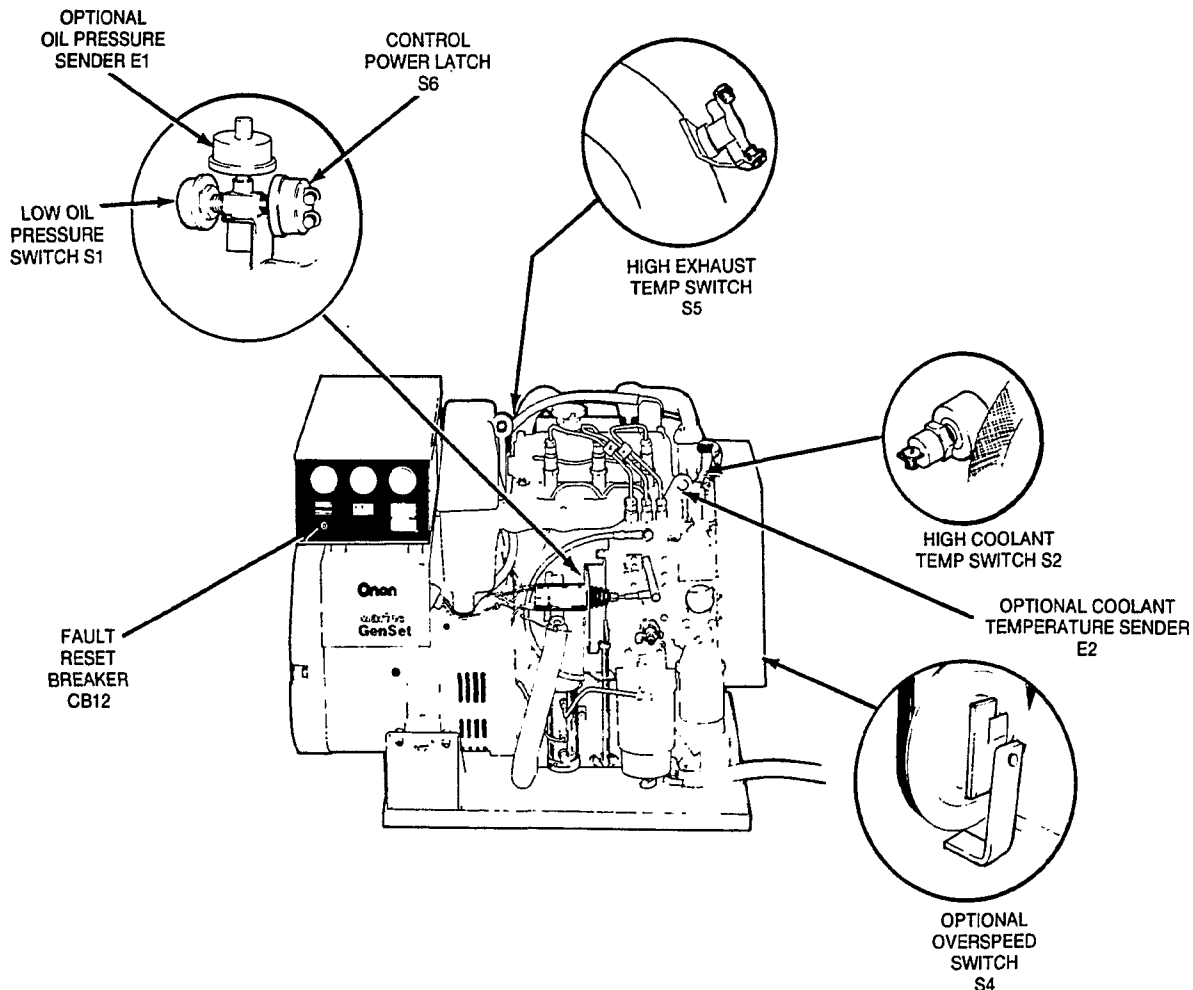


FIGURE 2-2. MDKC/MDKD FAULT SENSOR LOCATION

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All safety sensors (switches) close to ground if abnormal operating conditions exist and trip the fault breaker CB12 to stop the engine. See Figure 2-2.

Resistance units and switches in the monitoring and shutdown systems are sealed units and are not repairable. When replacing a sensor, do not use a substitute item since resistance units are matched to the gauge they supply. Cutoff switches are close tolerance parts made for a specific application.

### Oil Pressure Monitors

Refer to Figure 2-2 for the location of the oil pressure sensors.

**Oil Pressure Sender E1 (Optional):** The sender resistance changes with oil pressure and results in a reading on the oil pressure meter. The meter range is 0 to 100 psi (0 to 700 kPa).

**Low Oil Pressure Switch S1:** This switch closes if oil pressure drops to 9 psi (62 kPa), activating the fault breaker and stopping the engine.

**Control Power Latch S6:** This oil pressure switch closes at 5 psi (34 kPa) and provides a latch function for the control circuits. When closed, the switch supplies a ground path for relay K12 on the engine monitor board.

### Overspeed Switch (Optional)

The mechanical overspeed switch is mounted on the front of the engine crankshaft as shown in Figure 2-3. It is factory adjusted to close and shut down 60 hertz units at 2200 r/min +/- 90 r/min; 50 hertz units at 1900 r/min +/- 90 r/min. An overspeed condition grounds the shutdown circuit on the Engine Monitor Board and trips the fault breaker. After the problem is corrected, starting will not occur until the breaker is reset.

If necessary, the speed trip point can be corrected by turning the adjusting screw, to adjust the magnetic air gap (see Figure 2-3). An accurate tachometer or stroboscope is needed to check the overspeed trip point after adjustment is made. The air gap must not be less than 0.005 inch (0.13 mm).

### Engine Temperature Monitors

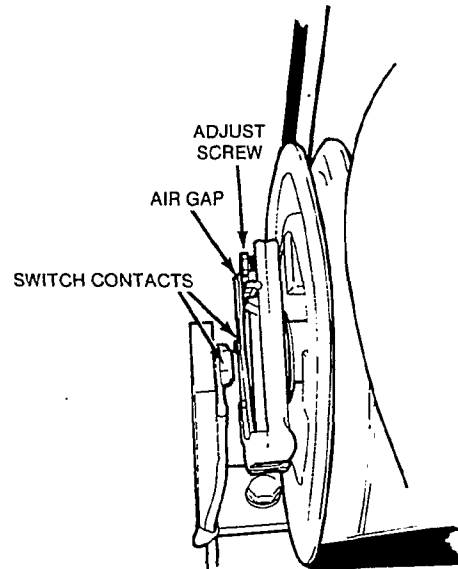
Refer to Figure 2-2 for the location of the engine temperature sensors.

**Coolant Temperature Sender E2 (Optional):** The resistance of the sender unit changes with the engine coolant temperature and causes a reading of the Water Temp Meter. The meter range is 100°F to 250°F (40°C to 121°C).

**High Coolant Temperature Switch S2:** This switch closes if the coolant temperature rises to 222°F (106°C), activating the fault breaker and stopping the engine.

**High Exhaust Temperature Switch S5:** This switch is mounted on the exhaust elbow and it closes on temperature rise above 230°F (110°C), activating the fault breaker and stopping the engine. It will open again when the temperature reaches about 190°F (88°C).

High exhaust elbow temperature is caused by insufficient or lack of sea water flow. Sea water flow at the exhaust outlet should be about 3 gal/min (11 litre/min).



ES-1514

FIGURE 2-3. OPTIONAL OVERSPEED SWITCH

### CONTROL OPERATION

Trouble-free operation of the control system should be the major concern of generator set service personnel. Service personnel must thoroughly understand how the controls operate, know how to make the proper adjustments, replacements, or repairs in a reasonable amount of time.

The following section covers the control operation. The schematic diagram shown in Figure 2-4 can be used to help follow the circuit description. Always refer to the specific wiring diagram that corresponds to the model and specification number of the generator set when troubleshooting. Relay contact references normally open (NO) and normally closed (NC) refer to the position of the contacts with the unit at rest (not energized).

Prior to starting the generator set, Check the fuel supply, engine oil level, and battery connections for loose or broken wires. Check the entire exhaust system for worn or corroded parts. Replace defective parts before leaks occur.

Figure 2-4 shows a typical schematic for the circuits described in the following Starting, Start-Disconnect, and Stopping sequences. Relay contact references normally open (NO) and normally closed (NC) refer to position of contacts with the unit at rest (not energized).

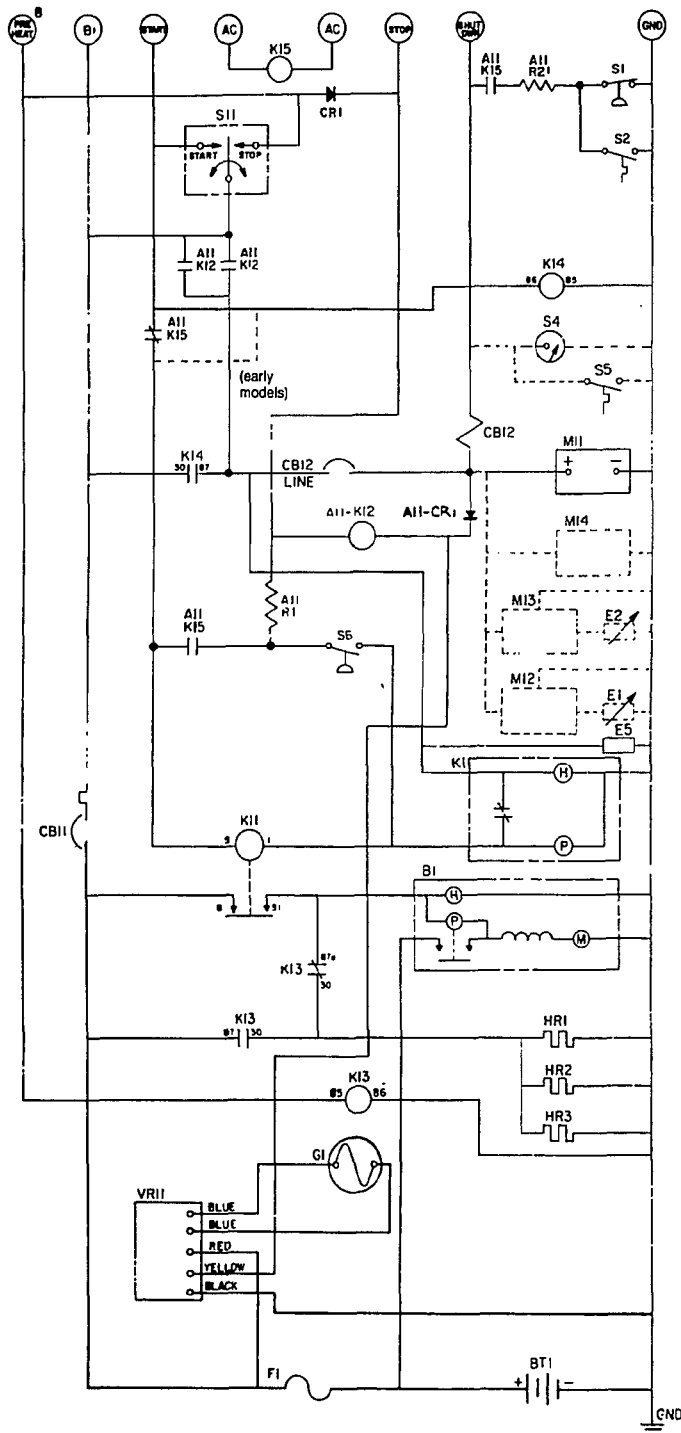


FIGURE 2-4. MDKC/MDKD CONTROL SCHEMATIC

**Starting Sequence:** The engine Preheat switch is held for 10 to 30 seconds (depending upon temperature). This energizes the Heater Solenoid K13 and closes a set of NO contacts to connect B+ to the glow plugs. After the preheat time, the start sequence is initiated by pressing the Start button S11.

Switch S11 connects B+ to the coil of K14 and (through the A11-K15 contacts and K16 [early production only] NC contacts) to the Start Solenoid K11. The coil of K11 is grounded through the pull coil of K1 after K1 is completely pulled in and the pull coil is disconnected from B+. K1 must pull in completely before the engine will crank.

The closing of the K11 contacts connects B+ to the glow plugs and to the starter solenoid B1. K14 connects B+ to the fuel solenoid K1, fuel pump E5, CB21 fault breaker and engine monitor circuits only during starting.

**Start-Disconnect Sequence:** As the engine starts, latch switch S6 closes and completes the ground circuit through resistor A11-R1 for the K12 power relay. The closing of K12 dual contacts completes the B+ running circuit to CB12 fault circuit breaker. This was accomplished by K14 during cranking.

The start-disconnect circuit provides starter protection. As the generator gains speed and output voltage, the K15 starter protection relay energizes at about 90 volts AC. The A11-K15 NC contacts open and de-energize the K11 start solenoid; the A11-K15 NO contacts close and provide another ground path for K12 through K11 coil similar to S6.

A backup start-disconnect circuit is initiated by the battery charging alternator G1. When DC output at CR11 reaches approximately 6 volts, K16 energizes and opens B+ to the K11 start solenoid. De-energizing K11 disconnects B+ from the starter solenoid to stop cranking and eliminate glow plug heating. The K16 relay and CR11 diode are not used in later production generator sets.

**Stopping Sequence:** Placing S11 in the Stop position puts B+ on the ground side of K12 power relay. This causes K12 to de-energize and disconnect B+ from CB12, fuel pump E5, and the K1 fuel solenoid. De-energizing K1 shuts off the fuel flow and stops the engine.

**Emergency Shutdown:** Fault breaker CB12 opens to stop the engine any time a fault sensor closes the circuit to ground. The fault sensors, shown in Figure 2-4, are:

- S1 low oil pressure
- S2 high coolant temperature
- S4 overspeed (option)
- S5 high exhaust temperature

CB21 should not be reset for starting until fault is located and corrected.

## CONTROL TROUBLESHOOTING

The information in this section is divided into three flow charts. Determine the problem and then refer to the appropriate flow chart (A, B, or C) for the troubleshooting procedures.

- A. Engine does not crank.
- B. Engine cranks but does not start.
- C. Engine starts but stops after running several seconds.

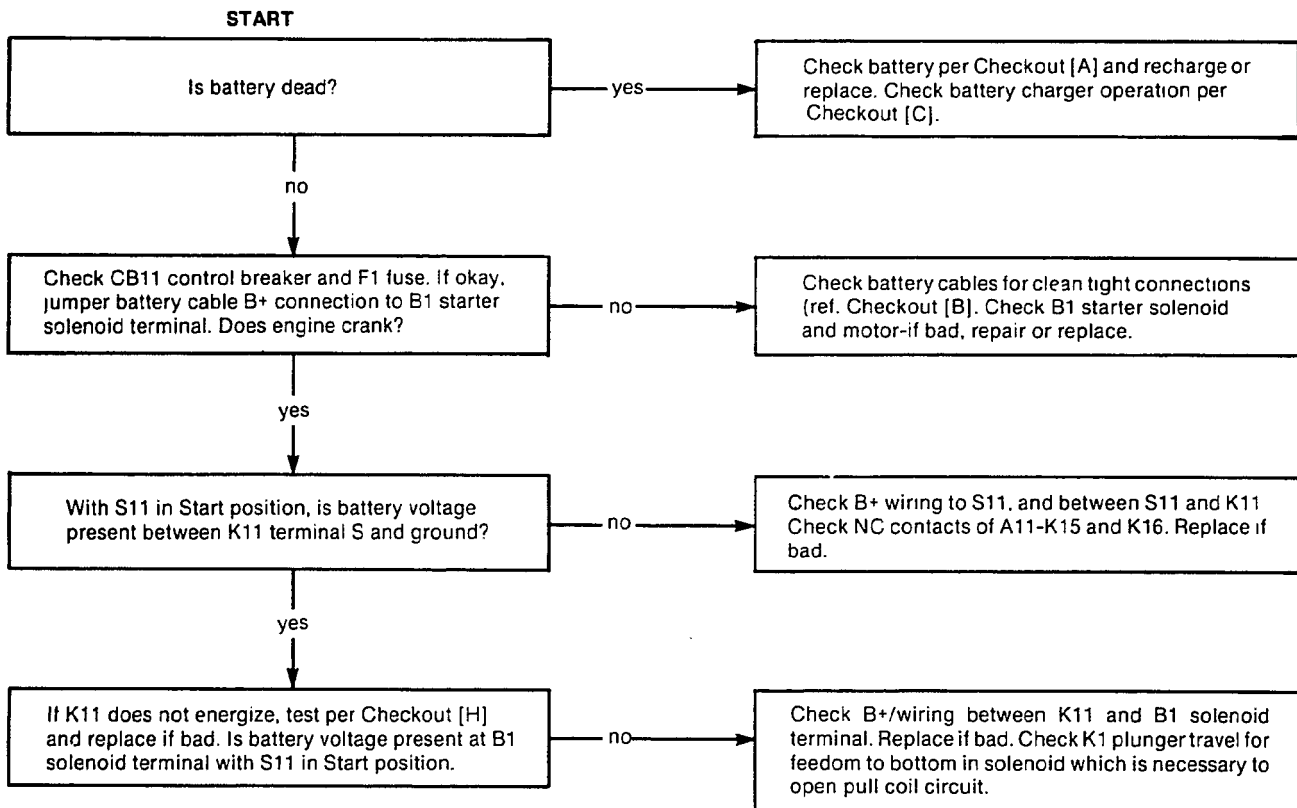
Before starting a troubleshooting procedure, make a few simple checks that could expose the problem and cut down on troubleshooting time.

- Check all modifications, repairs, and replacements that have been performed since the last satisfactory operation of the set. A loose wire connection could cause problems. An incorrect connection, an opened switch or circuit breaker, or a loose plug-in 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.

To troubleshoot a problem, start at the upper left corner of the chart and answer all questions either YES or NO. Follow the chart until the problem is found, performing referenced adjustment or test procedures. Refer to Figures 2-1 through 2-4 to locate control components.

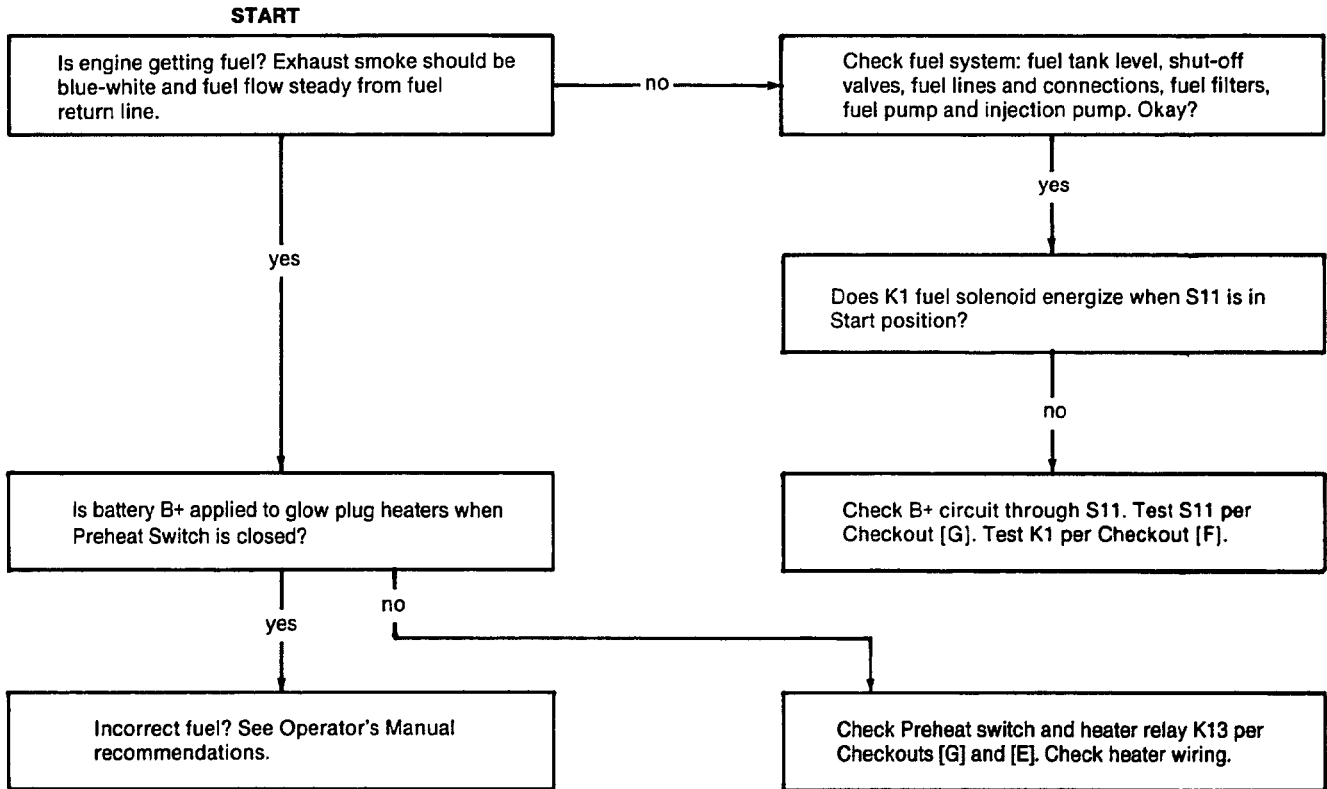
### FLOW CHART A. ENGINE DOES NOT CRANK

**⚠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 inside cover page.*



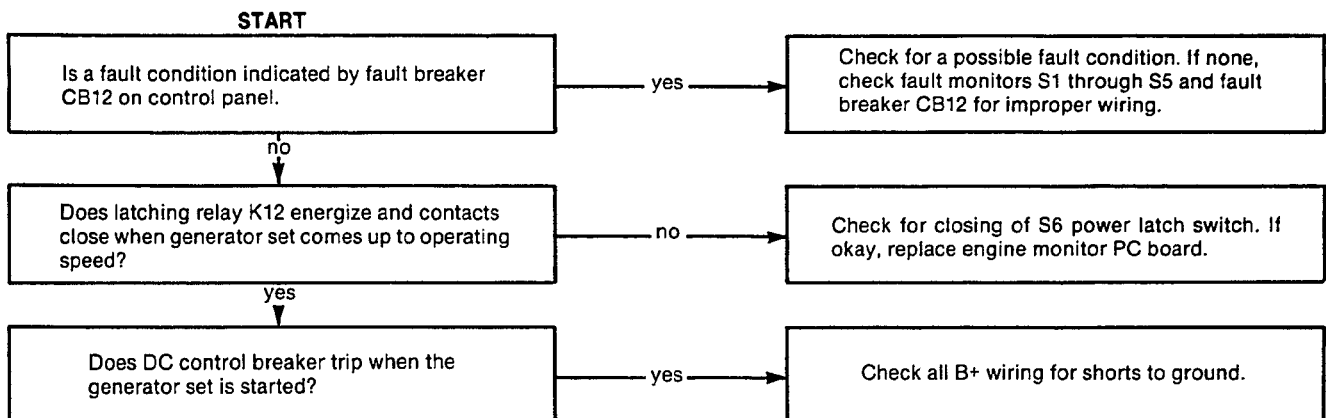
## FLOW CHART B. ENGINE CRANKS BUT DOES NOT START

**⚠ 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 inside cover page.



## FLOW CHART C. ENGINE STARTS BUT STOPS AFTER RUNNING SEVERAL SECONDS

**⚠ 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 inside cover page.



# Section 3. Standby Engine Controls

## GENERAL

This section contains control information for standby generator sets. Two starting controls are available that differ primarily in the method of starting. An Electric Start Control is used for electric starting and stopping at the generator set only. A Remote Start Control is used for electric starting and stopping with provision for remote operation with optional accessory equipment. Each of the start controls will be covered in a separate section.

## ELECTRIC START CONTROL

This control has a key switch for Preheat, Start and Stop on the front panel and cannot be connected for remote operation. Component references are found on separate wiring/schematic diagrams in the Wiring Diagrams section of this manual.

## Gauges/Meters and Switches

**DC Voltmeter (Optional):** Normal battery B+ voltage during operation should be 13.5 to 15 volts on a 12-volt system; 27 to 30 volts on a 24-volt system. See Figure 3-1.

**Coolant Temperature Gauge (Optional):** Shows engine coolant temperature. The gauge is wired to a sensor on the engine and has a range of 100°F to 250°F (40°C to 121°C).

**Oil Pressure Gauge (Optional):** Shows engine lubricating oil pressure. The gauge has a range of 0 to 100 psi (0 to 700 kPa) and is connected to an engine sensor.

**Preheat/Stop/Run/Start Switch S11:** This is a key switch that preheats, starts and stops the generator set locally.

**Fault Reset Breaker CB12:** A manual reset breaker that shuts down the engine for low oil pressure, high coolant temperature, and overspeed.

**K1 Fuel Solenoid:** It opens the fuel control valve when the start/stop switch is placed in the Start position.

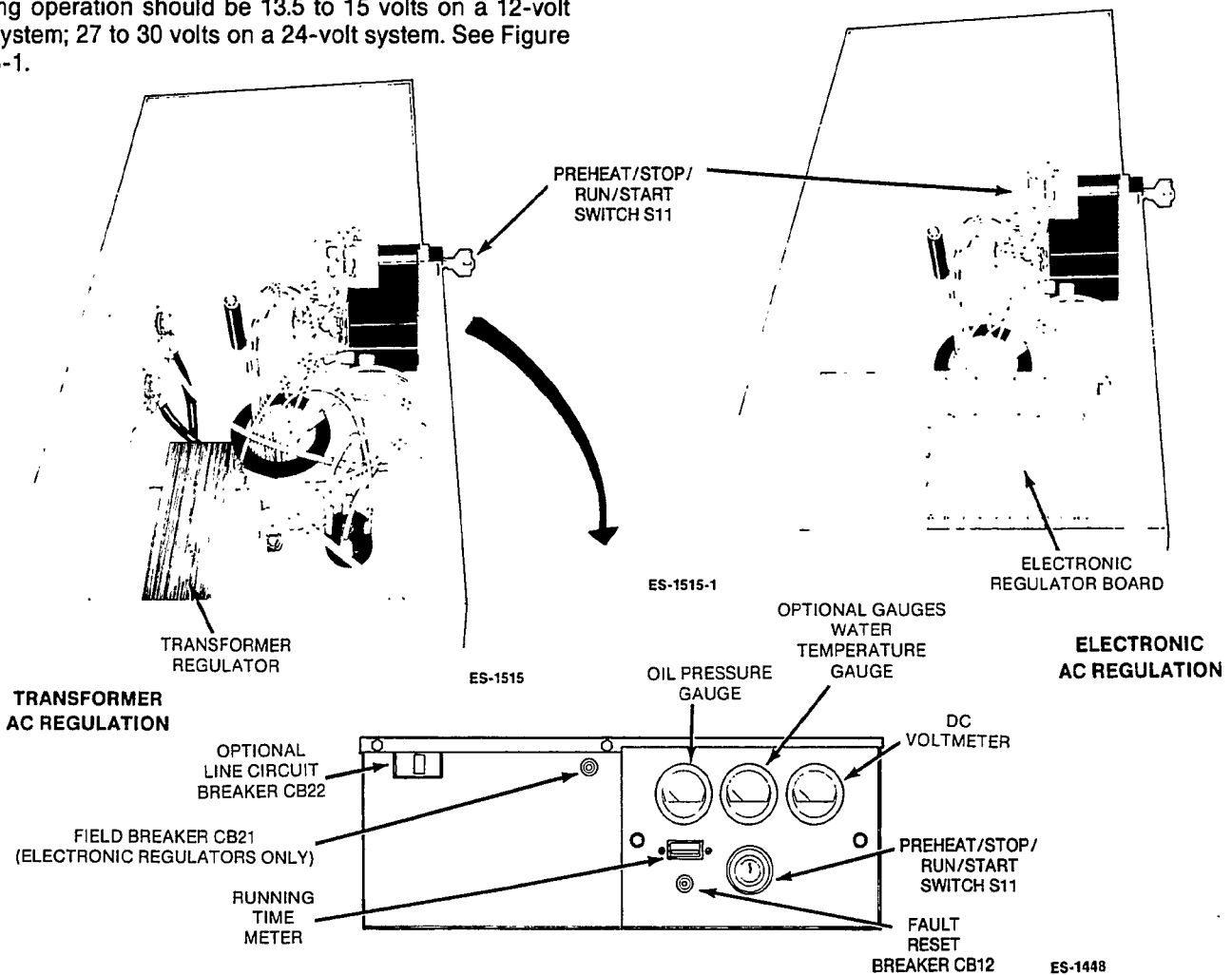


FIGURE 3-1. DKC/DKD ELECTRIC START AND LAND SET CONTROL BOX



**F1 In-Line Fuse:** A 30-ampere fuse is located in a fuse holder connected to the B+ terminal of the starter. This fuse connects B+ to the control and opens if a short or overload should occur.

Resistance units and switches in the monitoring and shutdown systems are sealed units and are not repairable. When replacing a sensor, do not use a substitute item since resistance units are matched to the gauge they supply. Cutoff switches are close tolerance parts made for a specific application.

### Oil Pressure Monitors

Refer to Figure 3-2 for the location of the oil pressure sensors.

**Oil Pressure Sender E1 (Optional):** The sender resistance changes with oil pressure and results in a reading on the oil pressure meter. The meter range is 0 to 100 psi (0 to 700 kPa).

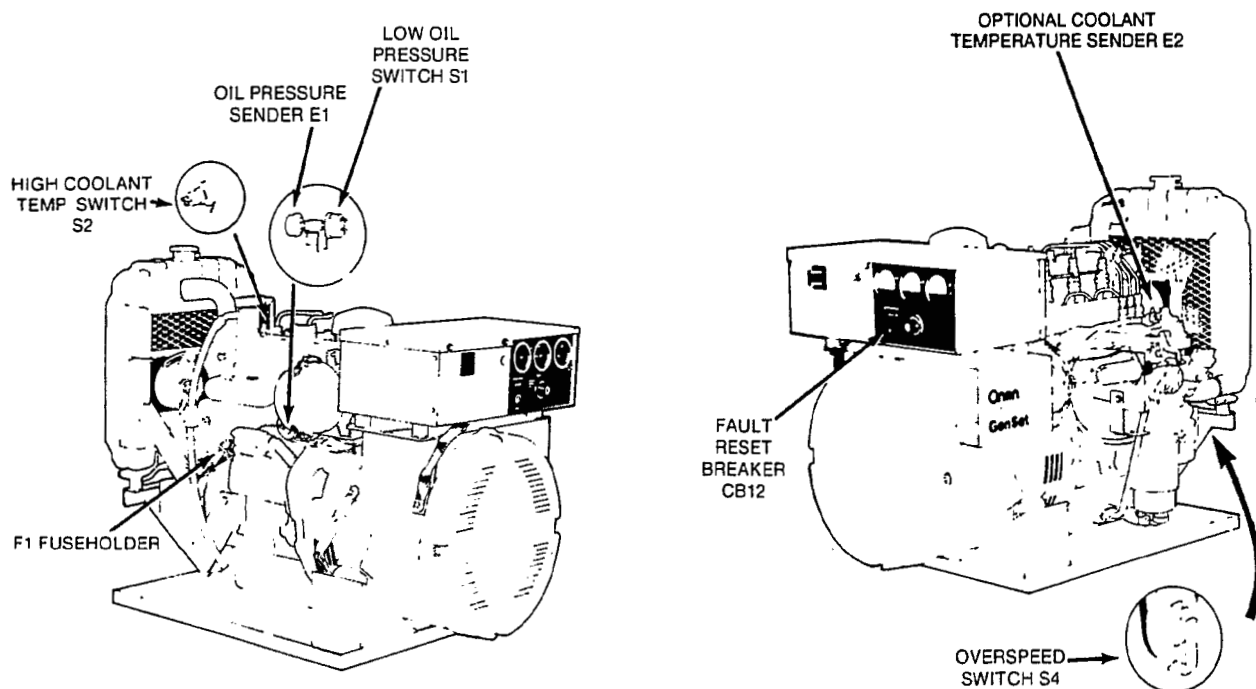
**Low Oil Pressure Switch S1:** This switch closes if oil pressure drops to 9 psi (62 kPa), activating the fault breaker and stopping the engine.

### Engine Temperature Monitors

Refer to Figure 3-2 for the location of the engine temperature sensors.

**Coolant Temperature Sender E2 (Optional):** The resistance of the sender unit changes with the engine coolant temperature and causes a reading on the Water Temp meter. The meter range is 100° to 250°F (40° to 121°C).

**High Coolant Temperature Switch S2:** This switch closes if the coolant temperature rises to 250°F (121°C), activating the fault breaker CB12 and stopping the engine.

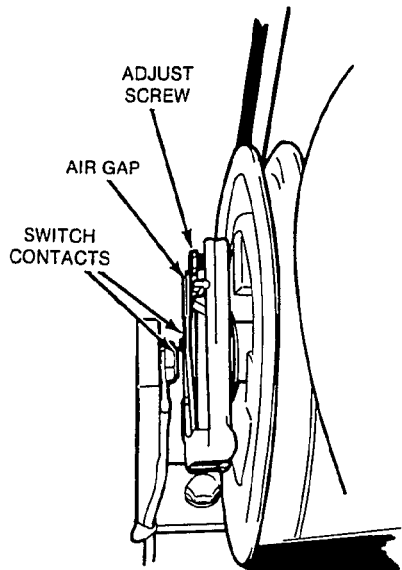


ES-1449

FIGURE 3-2. DKC/DKD ELECTRIC START FAULT SENSOR LOCATION

### Overspeed Switch (Optional)

The mechanical overspeed switch is mounted on the front of the engine crankshaft as shown in Figure 3-3. It is factory adjusted to close and shut down 60 hertz units at 2200 +/- 90 r/min; 50 hertz units at 1900 r/min +/- 90 r/min. An overspeed condition grounds the shutdown circuit on the Engine Monitor Board and trips the fault breaker. After the problem is corrected, starting will not occur until the fault breaker is reset.



ES-1514

FIGURE 3-3. OPTIONAL OVERSPEED SWITCH

If necessary, the speed range can be corrected by turning the adjusting screw, thereby changing the magnetic air gap. An accurate tachometer or strobotach is needed to check the overspeed trip point after adjustment is made. The air gap must not be less than 0.005 inch (0.13 mm).

### Control Operation

Trouble-free operation of the control system should be the major concern of generator set service personnel. Service personnel must thoroughly understand how the controls operate, know how to make the proper adjustments, replacements, or repairs in a reasonable amount of time.

Prior to starting the generator set, check the fuel supply, engine oil level, and all battery connections for loose or broken wires.

Figure 3-4 shows a schematic diagram for the circuits described in the following Starting, Start-Disconnect and Stopping sequences. Relay contact references normally open (NO) and normally closed (NC) refer to position of contacts with the unit at rest (not energized).

**Starting Sequence:** When the control key switch S11 is in the Preheat position, contacts 1-2 connects B+ to the glow plug heaters. See Figure 3-4.

In the Start position, S11 contacts 1-2, 3-4 and 5-6 close. Contacts 1-2 energize the glow plugs during cranking; contacts 3-4 connect B+ to CB12 Fault breaker, K1 fuel solenoid, S4 overspeed switch and VR11 battery charging voltage regulator; contacts 5-6 connect B+ to the starter solenoid B1.

In the Run position, S11 contacts 3-4 and 7-8 close. Contacts 3-4 remain closed and maintain B+ to CB12, K1, S4 and VR11. Contacts 7-8 connect B+ to the engine fault sensors S1 and S2. Contacts 1-2 open the glow plug heater circuit, and contacts 5-6 open the starter solenoid circuit.

**Start-Disconnect Sequence:** This function is completed manually when key switch S11 is released from the Start position opening S11 contacts 5-6 for the starter solenoid B1.

**Stopping Sequence:** This function is completed manually when key switch S11 is turned to the Stop position. This opens all switch contacts and removes B+ from the fuel solenoid K1. De-energizing K1 shuts off the fuel flow and stops the engine.

**Emergency Shutdown:** Fault breaker CB12 opens and disconnects B+ from the fuel solenoid K1 anytime a fault sensor closes the circuit to ground. The fault sensors are:

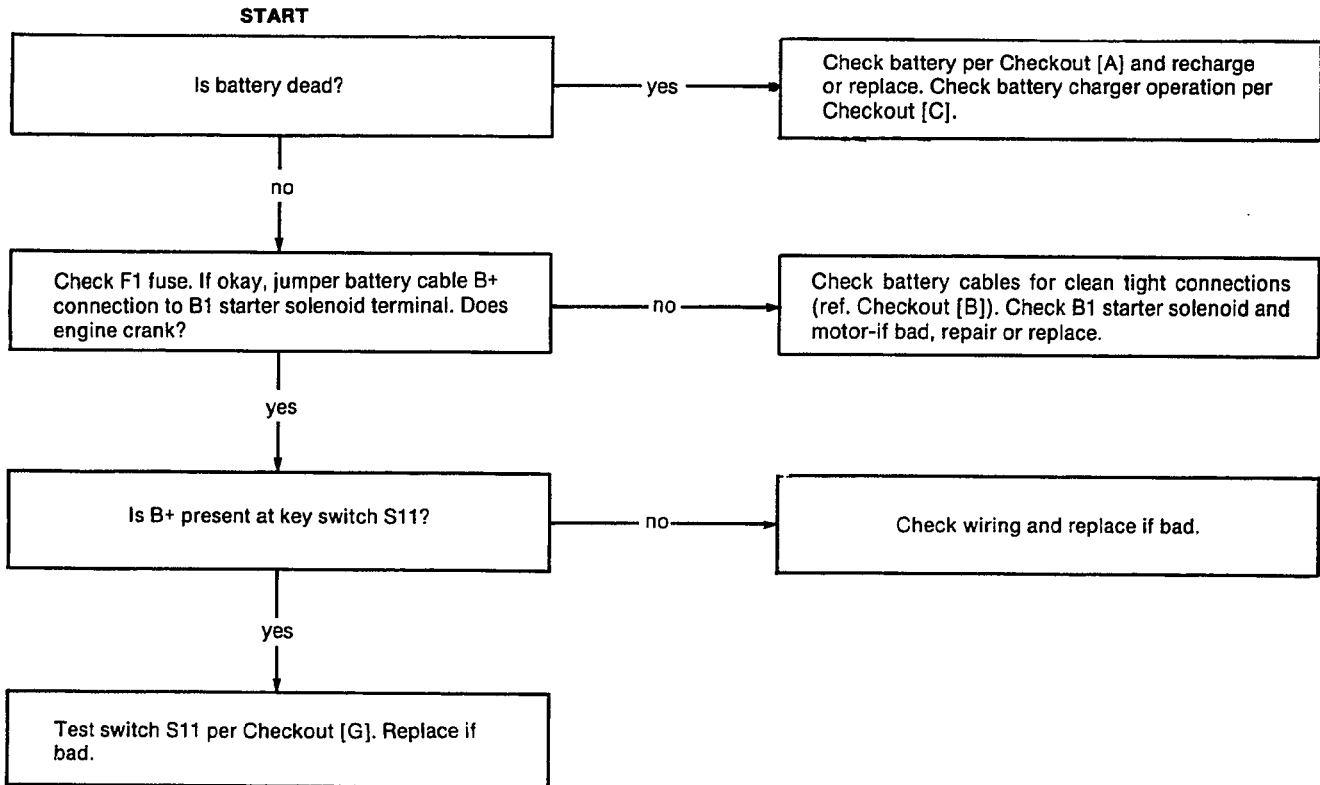
- S1 low oil pressure
- S2 high engine temperature
- S4 overspeed

CB12 should not be reset for starting until fault is located and corrected.



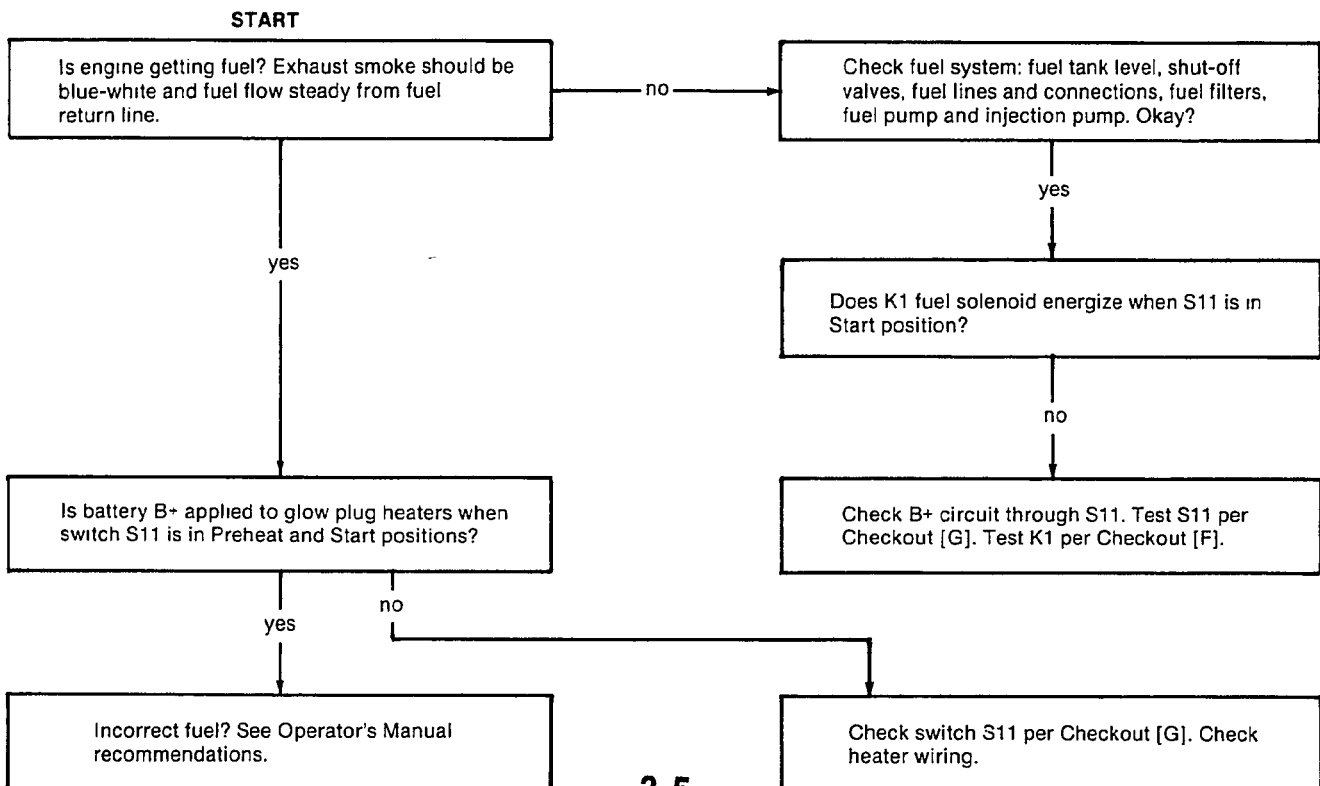
## FLOW CHART A. ENGINE DOES NOT CRANK

**⚠ 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 inside cover page.



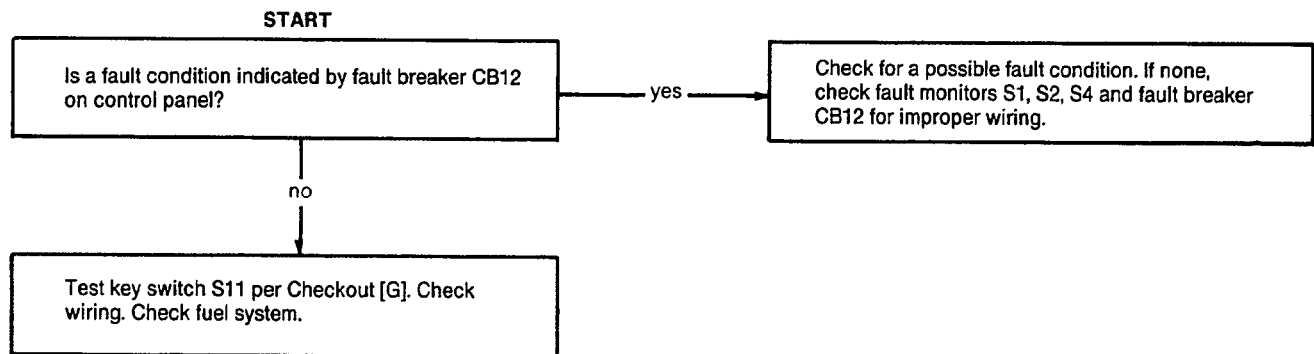
## FLOW CHART B. ENGINE CRANKS BUT DOES NOT START

**⚠ 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 inside cover page.



## FLOW CHART C. ENGINE STARTS BUT STOPS AFTER RUNNING SEVERAL SECONDS

**▲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 inside cover page.*



## REMOTE START CONTROL

This control can provide starting and stopping from remote locations when connected to optional accessory equipment. The following text explains control components function, control operation and troubleshooting.

**Oil Pressure Gauge (Optional):** Shows engine lubricating oil pressure. The gauge has a range of 0 to 100 psi (0 to 700 kPa) and is connected to an engine sensor. See Figures 3-5 and 3-6.

**Coolant Temperature Gauge (Optional):** The water temperature should be in the range of 165°F to 195°F (74°C to 91°C) depending on the load and ambient temperature.

**DC Voltmeter (Optional):** Normal battery B+ voltage during operation should be 13.5 to 15 volts on a 12-volt system; 27 to 30 volts on a 24-volt system.

**Preheat Switch S12:** Activates heater relay K13 to connect battery B+ to the engine glow plugs prior to starting the engine.

**Start-Stop Switch:** Starts and stops the unit locally. When released, unit may be operated from a remote switch wired to the control panel.

**DC Control Breaker CB11:** A 15 ampere breaker providing protection to the control box wiring and remote wiring from short circuits or overload. Also serves as an emergency stop switch.

**Fault Reset Breaker CB12:** A manual reset breaker that shuts down the engine for low oil pressure, high coolant temperature, high exhaust temperature and overspeed.

**Battery Charge Breaker CB13 (RV Generator sets):** A 15-ampere breaker protecting the DC voltage regulator, alternator and wiring from short circuits or overload.

**In-Line Fuse F1 (Land Generator sets):** A 30 ampere fuse is located in a fuseholder connected to the B+ terminal of the starter. This fuse connects B+ to the control and opens if a short or overload should occur.

**Engine Monitor Circuit Board:** A printed circuit board that monitors engine control system functions. This includes starting, stopping, and fault system operations. A terminal board is included for making remote connections. See Figure 3-5.

Two relays are soldered to the circuit board and are not serviceable. Power relay K12 connects and maintains battery B+ to the control meters and fuel solenoid during operation. Starter protection relay, K15 energizes at about 90 volts AC. The A11-K15 NC contacts open and de-energize the K11 start solenoid; the A11-K15 NO contacts close and provide another ground path for K12 through K11 coil similar to S6.

**K1 Fuel Solenoid:** Opens the fuel control valve when the start/stop switch is placed in the Start position.

**K11 Start Solenoid:** Located over the engine monitor circuit board. It connects battery B+ to the starter solenoid B1 during cranking.

**K13 Heater Relay:** Located on the relay mounting tray. It connects battery B+ to the engine glow plugs prior to cranking. It is energized by S12 preheat switch.

**K14 Fuel Solenoid Relay:** Located on the relay mounting tray. It is energized only during cranking and connects B+ to the fuel solenoid K1, fuel pump E5 and fault breaker CB12 circuits.

**K16 Start Disconnect Relay:** Located on the relay mounting tray. It is connected through CR11 to the 12-volt battery charging alternator. The relay actuates at about 6 volts DC. The K16 and CR11 diode are not used on later production sets and were disconnected on some sets (refer to Product Support Bulletin 450).

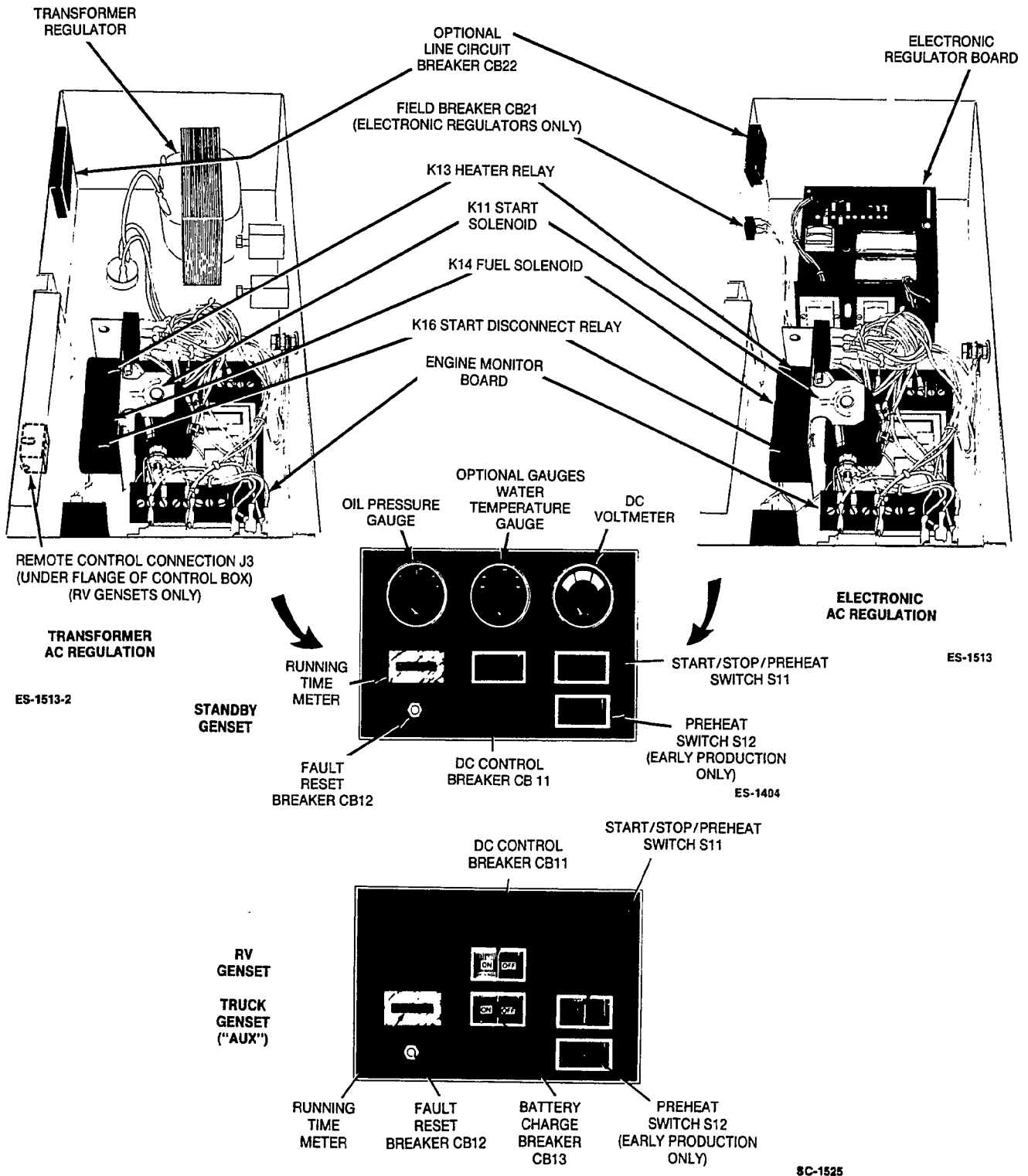


FIGURE 3-5. DKD RV CONTROL BOX COMPONENTS

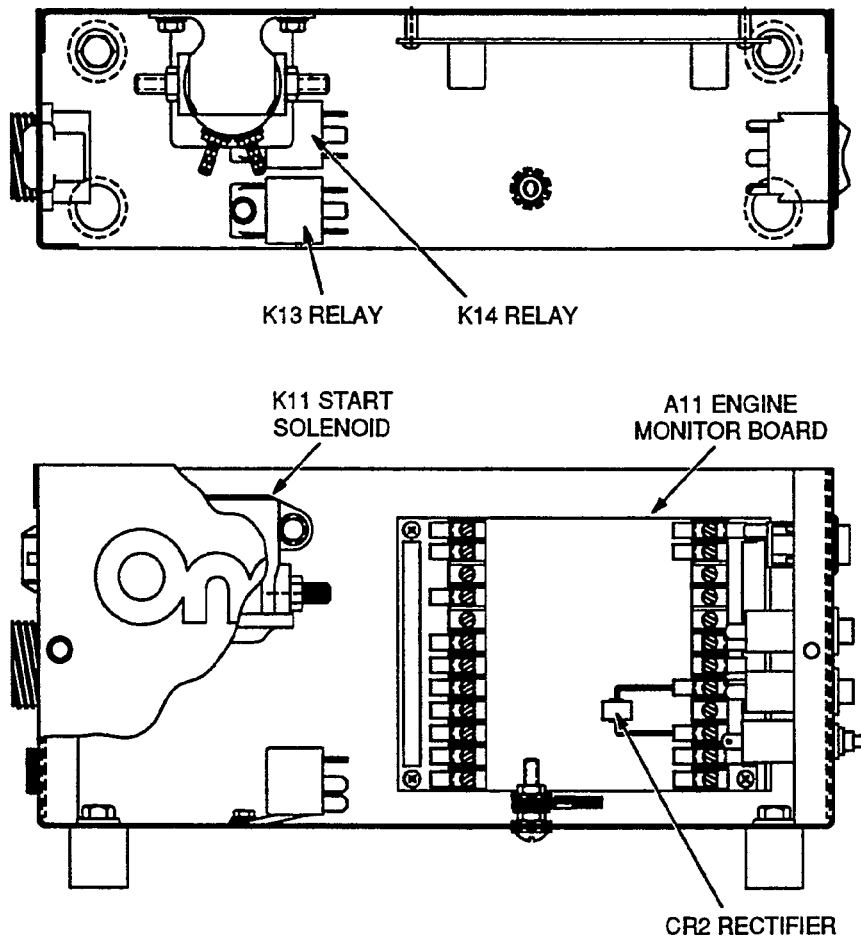
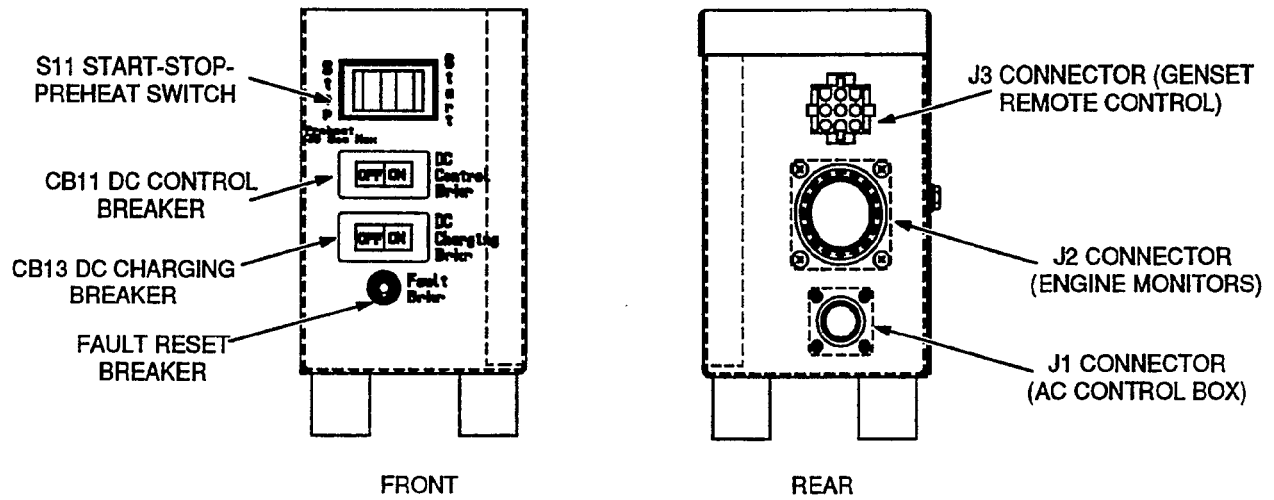


FIGURE 3-5a. DKD DC CONTROL BOX



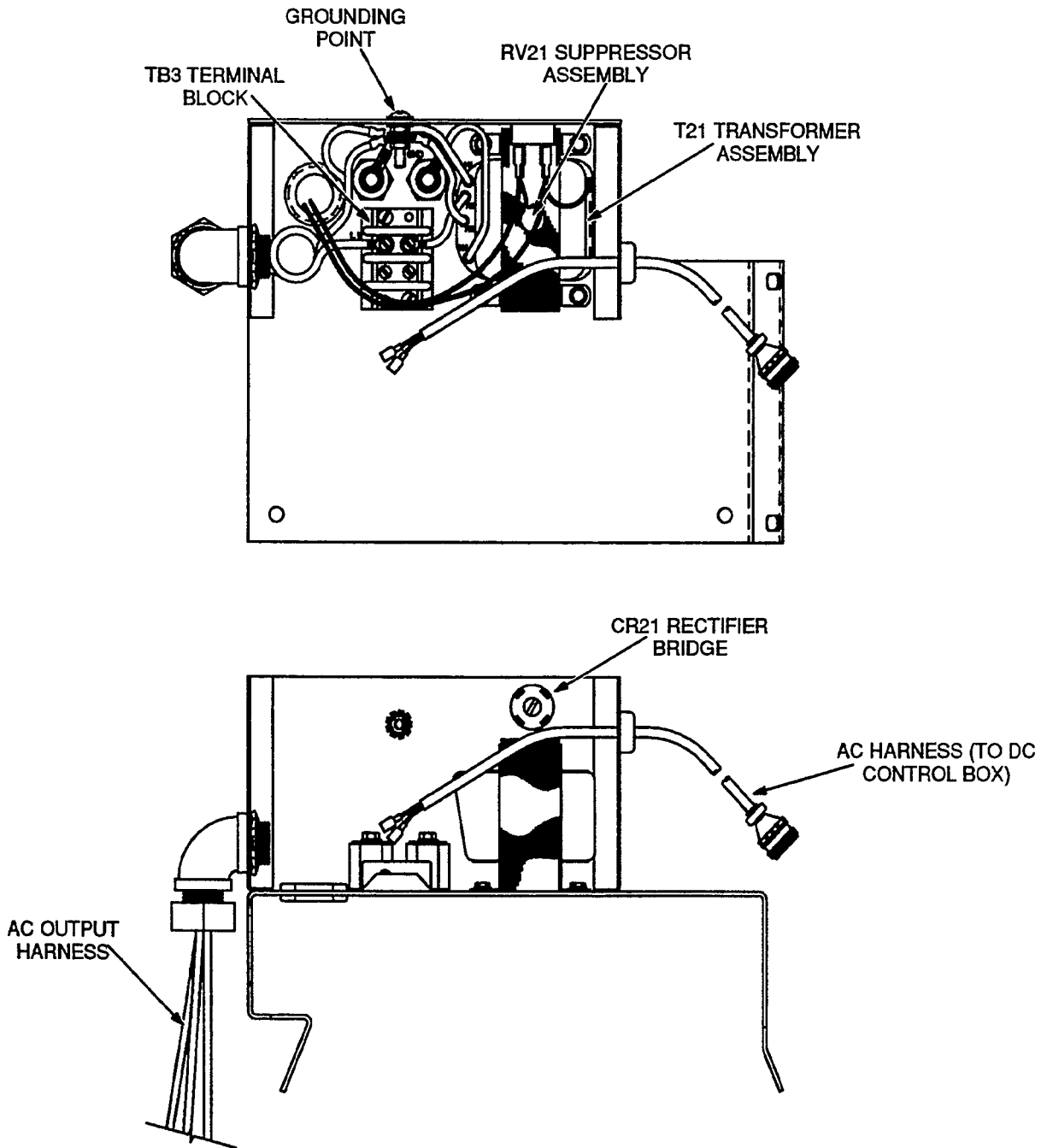


FIGURE 3-5b. DKD AC CONTROL ASSEMBLY

### Engine Sensors

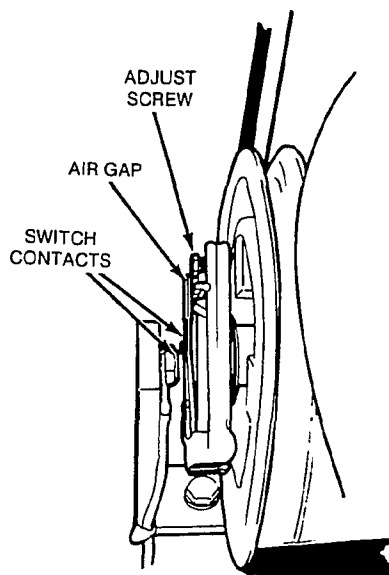
The following briefly describes the engine mounted sensors and switches, and how they protect the engine from adverse operating conditions. All safety sensors (switches) close to ground if abnormal operating conditions exist and trip the fault breaker CB12 to stop the engine. See Figure 3-6. Resistance units and switches in the monitoring and shutdown systems are sealed units and are not repairable. When replacing a sensor, do not use a substitute item since resistance units are matched to the gauge they supply. Cutoff switches are close tolerance parts made for a specific application.

**Oil Pressure Sender E1 (Optional):** The sender resistance changes with oil pressure and results in a reading on the oil pressure meter. The meter range is 0 to 100 psi (0 to 700 kPa).

**Low Oil Pressure Switch S1:** This switch closes if oil pressure drops to 9 psi (62 kPa). Some early generator sets had switches closing at 14 psi (97 kPa). This activates the fault breaker and stops the engine.

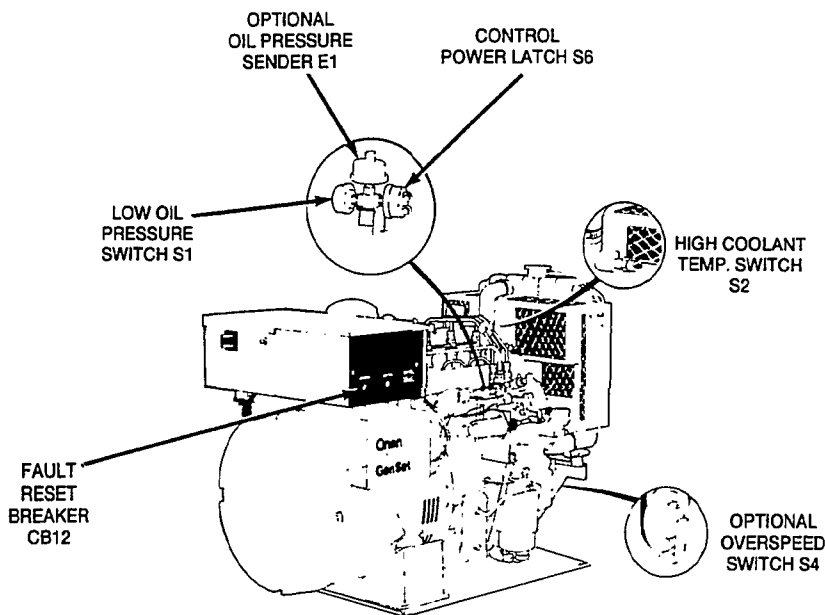
**Control Power Latch (S6):** This oil pressure switch closes at 5 psi (34 kPa) and provides a latch function for the control circuits. When closed, the switch supplies a ground path for relay K12 on the engine monitor board.

**Overspeed Switch (Optional):** The mechanical overspeed switch is mounted on the front of the engine crankshaft as shown in Figure 3-7. It is factory adjusted to close and shut down 60 hertz units at 2200 r/min +/- 90 r/min; 50 hertz units at 1900 r/min +/- 90 r/min. An overspeed condition grounds the shutdown circuit on the Engine Monitor Board and trips the fault breaker. After the problem is corrected, starting will not occur until the fault breaker is reset.



ES-1514

FIGURE 3-7. OPTIONAL OVERSPEED SWITCH



ES-1551-1

FIGURE 3-6. ENGINE SENSOR LOCATIONS

If necessary, the speed trip point can be corrected by turning the adjusting screw, thereby changing the magnetic air gap. An accurate tachometer or strobosch is needed to check the overspeed trip point after adjustment is made. The air gap must not be less than 0.005 inch (0.13 mm).

**Coolant Temperature Sender E2 (Optional):** The resistance of the sender unit changes with the engine coolant temperature and causes a reading on the Water Temp meter. The meter range is 100° to 250°F (40° to 121°C).

**High Coolant Temperature Switch S2:** This switch closes if the coolant temperature rises to 222°F (106°C), activating the fault breaker and stopping the engine.

### Control Operation

Trouble free operation of the control system should be the major concern of generator set service personnel. Service personnel must thoroughly understand how the controls operate, know how to check for troubles, and know how to make the proper adjustments, replacements, or repairs in a reasonable amount of time.

Figure 3-8 shows a typical schematic for the circuits described in the following Starting, Start-Disconnect and Stopping sequences. Relay contact references normally open (NO) and normally closed (NC) refer to position of contacts with the unit at rest (not energized).

**Starting Sequence:** The engine Preheat switch S12 is held for 10 to 30 seconds (depending upon temperature). This energizes the K13 heater solenoid which closes a NO set of contacts to connect B+ to the glow plugs. After preheat time, the start sequence is initiated by pressing the Start button S11.

Switch S11 contacts B+ to the coil of K14 and (through the A11-K15 contacts and K16 NC contacts) to the Start Solenoid K11. The coil of K11 is grounded through the pull coil of K1 after K1 is completely pulled in and the pull coil is disconnected from B+. K1 must pull in completely or the engine will not crank.

The closing of K11 contacts connects B+ to the glow plugs and B1 starter solenoid. K14 connects B+ to K1 fuel solenoid, K5 fuel pump, CB12 fault breaker and engine monitor circuits only during starting.

**Start-Disconnect Sequence:** As the engine starts, latch relay S6 closes and completes the ground circuit through resistor A11-R1 for the K12 power relay. The closing of K12 dual contacts completes the B+ running circuit to CB12 fault circuit breaker.

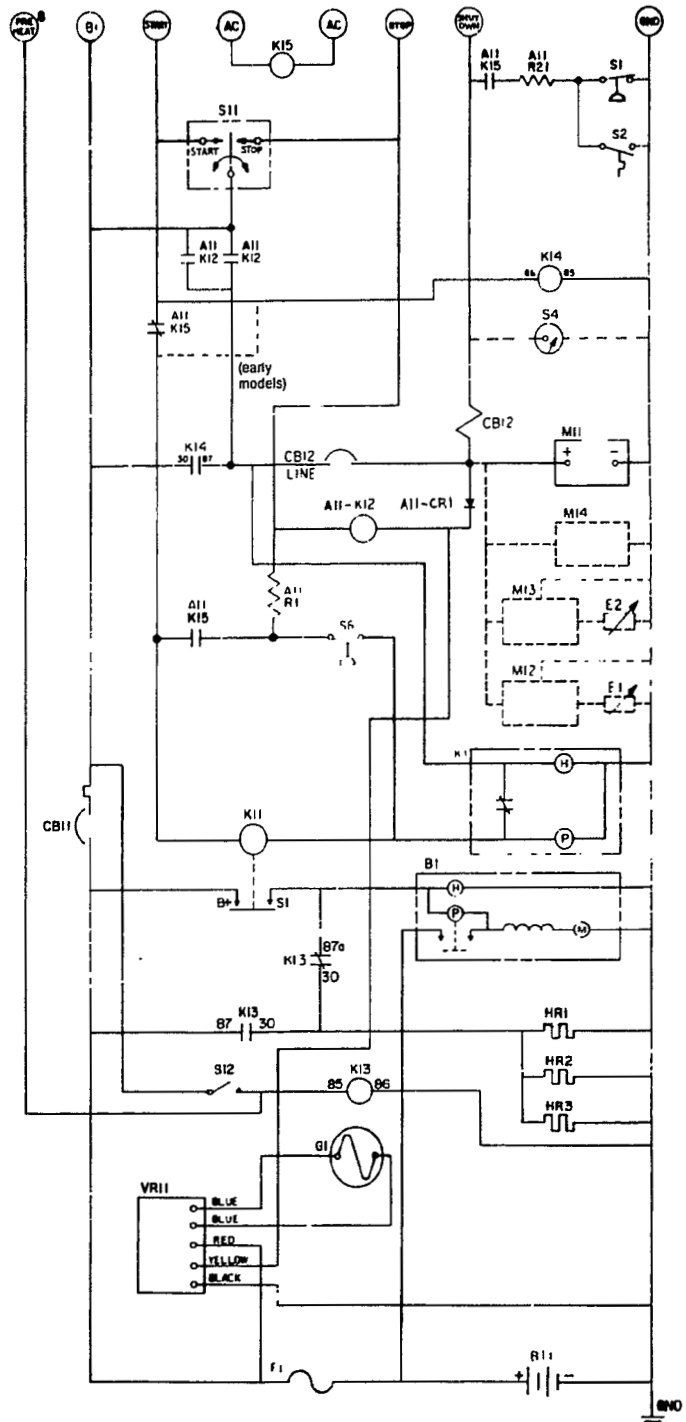


FIGURE 3-8. TYPICAL CONTROL SCHEMATIC

The start-disconnect circuit provides starter protection. As the generator gains speed and output voltage, the K15 starter protection relay energizes at about 90 volts AC. The A11-K15 NC contacts open and de-energize the K11 start solenoid; the A11-K15 NO contacts close and provide another ground path for K12 through K11 coil similar to S6.

A backup start-disconnect circuit is initiated by the battery charging alternator G1. When DC output at CR11 reaches approximately 6 volts, K16 energizes and opens B+ to the K11 start solenoid. De-energizing K11 disconnects B+ from the starter solenoid to stop cranking and eliminate glow plug heating. The K16 relay and CR11 diode are not used in later production generator sets.

**Stopping Sequence:** Placing S11 in the Stop position puts B+ on the ground side of K12 power relay. This causes K12 to de-energize and disconnect B+ from CB12, fuel pump E5 and the K1 fuel solenoid. De-energizing K1 shuts off the fuel flow and stops the engine.

**Emergency Shutdown:** Fault breaker CB12 opens to stop the engine anytime a fault sensor closes the circuit to ground. The fault sensors as shown in Figure 3-8 are:

- S1 low oil pressure
- S2 high coolant temperature
- S4 overspeed

CB12 should not be reset for starting until fault is located and corrected.

### Control Troubleshooting

The information in this section is divided into three flow charts. Determine the problem and then refer to the appropriate flow chart (A, B, or C) for the troubleshooting procedures.

- A. Engine does not crank.
- B. Engine cranks but does not start.
- C. Engine starts but stops after running several seconds.

Before starting a troubleshooting procedure, make a few simple checks that may expose the problem and cut down on troubleshooting time.

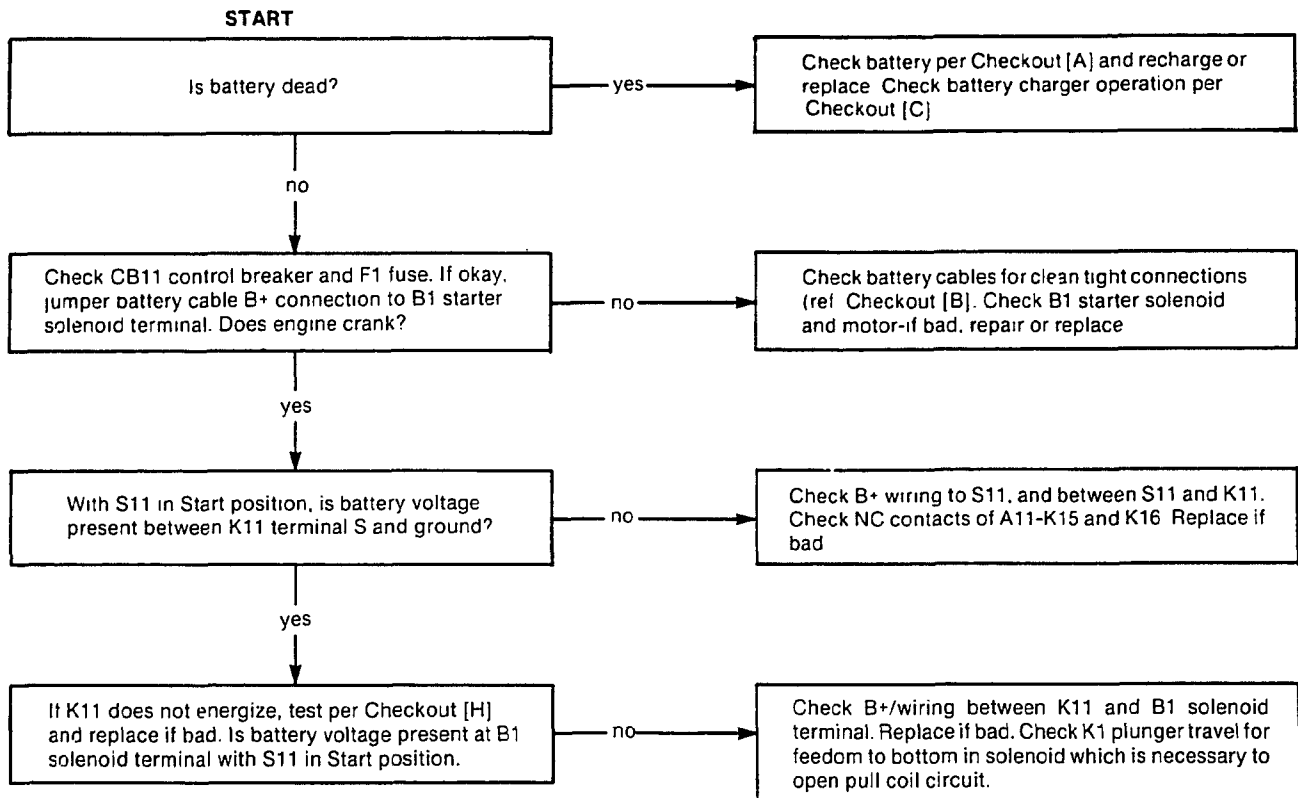
- Check all modifications, repairs, and replacements performed since the last satisfactory operation of set. A loose wire connection could cause problems. An incorrect connection, an opened switch or circuit breaker, or a loose plug-in are all potential problems that can be eliminated by a visual check.

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

To troubleshoot a problem, start at the upper-left corner of chart and answer all questions either YES or NO. Follow the chart until the problem is found, performing reference adjustment or test procedures. Refer to Figures 3-5 through 3-8 for locating control components, leads, terminals and other check points.

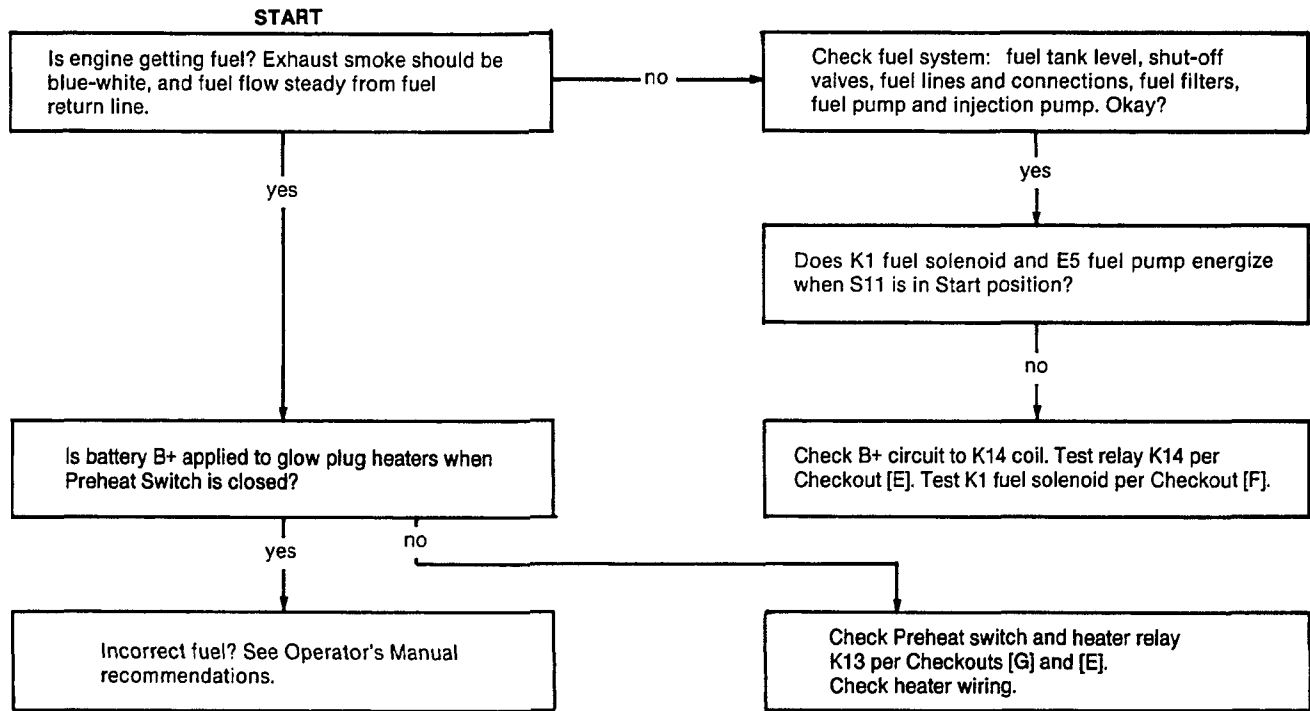
### FLOW CHART A. ENGINE DOES NOT CRANK

**⚠ 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 inside cover page.



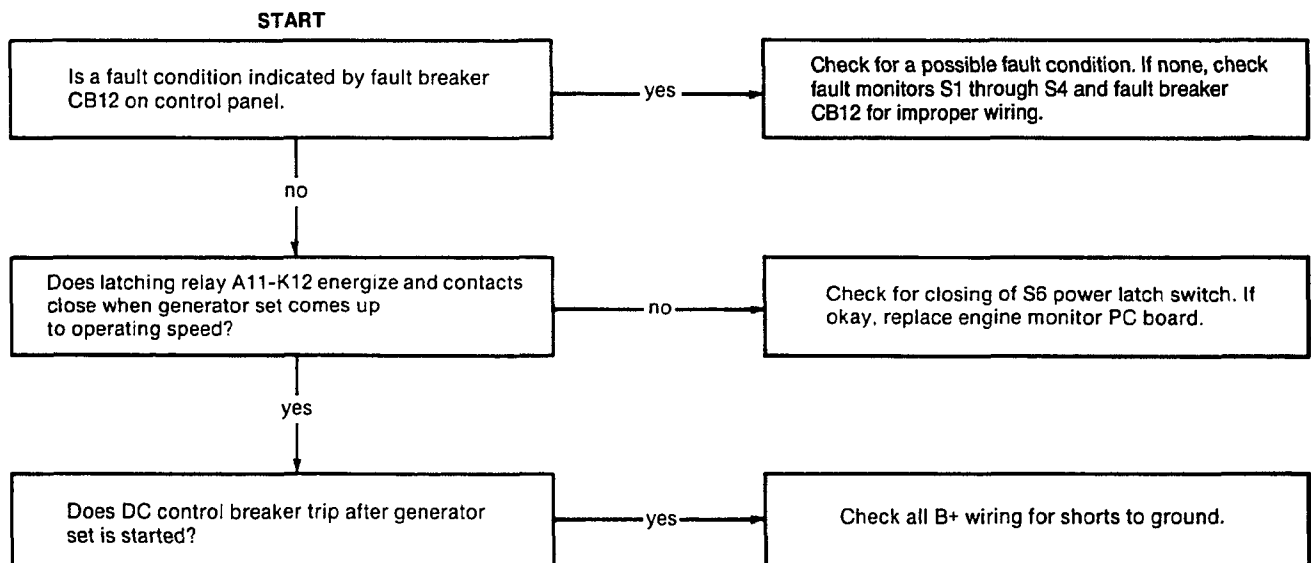
## FLOW CHART B. ENGINE CRANKS BUT DOES NOT START

**⚠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 inside cover page.



## FLOW CHART C. ENGINE STARTS BUT STOPS AFTER RUNNING SEVERAL SECONDS.

**⚠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 inside cover page.



# Section 4. Engine Control Service

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## GENERAL

The following component checks are referenced in the Control Troubleshooting flow charts. They are an aid to isolating circuit problems caused by faulty engine control components. Disconnect leads before testing components.

**▲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 inside cover page.*

## [A]

### BATTERY CHECK

**▲WARNING** *Battery electrolyte can cause severe eye damage and burns to the skin. Wear goggles, rubber gloves and a protective apron when working with batteries.*

Check charge condition of the battery with a hydrometer. 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, replace it.

If battery loses excess water, the charge rate may be too high. If battery state of charge is not maintained, the charge rate may be too low.

## [B]

### BATTERY CABLE CHECK

With the starter motor operating, check the voltage drops (1) from the battery negative post (not the cable clamp) to the cylinder block, (2) from the battery positive post to the battery terminal stud on the solenoid. Normally, each of these should be less than 0.3 volts. If extra long battery cables are used, slightly higher voltage drops may result. Thoroughly clean all connections in any part of the circuit showing excessive voltage drop.

## [C]

### BATTERY CHARGING CHECK

With the engine running, check the DC voltmeter (control option). A 12-volt system should be 13.5 to 15 volts; a 24-volt system should be 27 to 30 volts.

The power source is a belt driven alternator. The charge rate/voltage is determined by voltage regulator VR11. On marine sets VR11 is located on the bottom of the control box saddle and it is located inside the control box on land sets.

Improper output may be caused by a loose drive belt, poor terminal connections, broken wires, bad regulator or alternator. Checkout procedures for the regulator and alternator are found in Section 5 of the engine service manual. The charge circuit on RV series generator sets is protected by a circuit breaker CB13.

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. With remote start Kubota powered sets, exhibiting overcharging symptoms, refer to Product Support Bulletin 450.

## [D]

### SOLENOID CHECK

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

## [E]

### RELAY CHECK

1. Connect relay coil voltage across relay coil terminals. Relay should activate if coil is okay.
2. Connect voltage source to one side of relay contacts.
3. Connect a voltmeter to other side of relay contact and voltage source. If voltage appears when relay energizes, contact is okay. The voltage reading appears in reverse order when checking normally closed (NC) contacts.

## [F]

### FUEL SOLENOID CHECK

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

To check solenoid operation, watch for solenoid actuation when B+ is applied (start switch in start or run position). If there is no actuation when B+ is applied, the fuel solenoid must be replaced. When B+ is removed, the solenoid must de-activate.

## [G]

### SWITCH CHECK

1. Remove battery B+ cable.
2. Place ohmmeter leads across switch.
3. Open and close switch while observing the ohmmeter. A normally open (NO) switch should indicate infinite resistance when open and continuity when closed. A normally closed (NC) switch should indicate continuity when closed and infinite resistance when open.
4. Replace switch if defective.

## [H]

### SOLENOID CHECK

1. Apply battery positive (B+) to the terminal marked S.
2. Connect a ground wire to the terminal marked I. Solenoid should activate.
3. Continuity should be read across the two large terminals while solenoid is activated.

# Section 5. Generator/Voltage Regulator

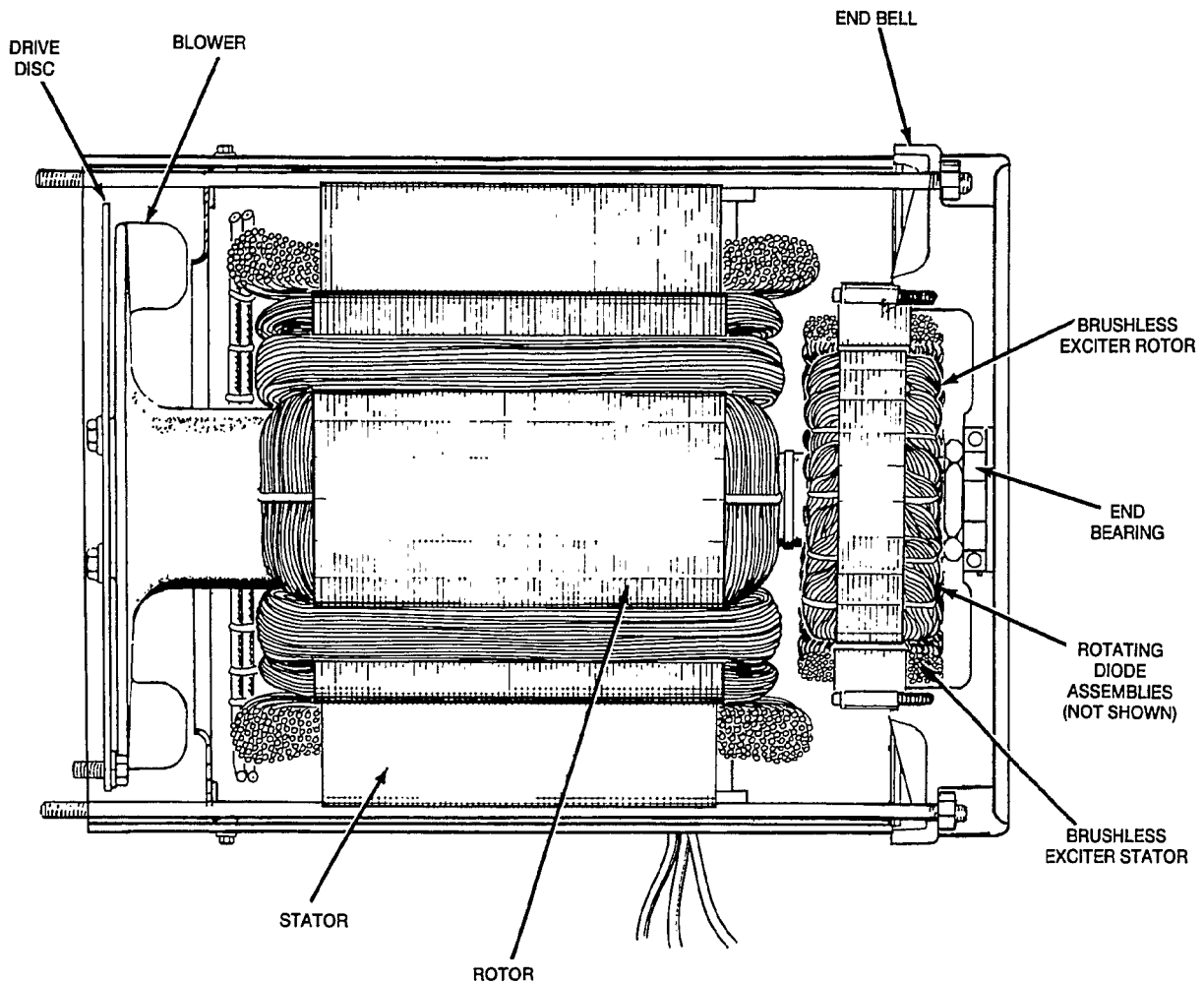
## GENERAL DESCRIPTION

The YD generator (Figure 5-1) is a four-pole, revolving field, brushless exciter design with drip-proof construction. Single and three phase generators are available for both 50 and 60 hertz models.

The generator rotor is directly coupled to the engine flywheel with a flexible drive disc (engine speed determines generator output voltage and frequency). A centrifugal blower on the drive disc circulates generator cooling air which is drawn in through the end bell and discharged through an outlet in the blower end.

A ball bearing in the end bell supports the outer end of the rotor shaft. The end bell is attached with four studs that thread into the generator adapter casting. The brushless exciter stator mounts in the end bell while the exciter rotor and its rotating diode assemblies mount on the generator rotor shaft. Leads F1 (+) and F2 (-) from the exciter stator winding are connected to the output terminals of the voltage regulator.

The composite illustration in Figure 5-2 shows the generator output and control/meter leads for the various voltage options. Voltage reconnection diagrams appear in Section 7, *Generator/Regulator Tests*, and in Section 8, *Wiring Diagrams*.



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FIGURE 5-1. TYPICAL YD SERIES GENERATOR

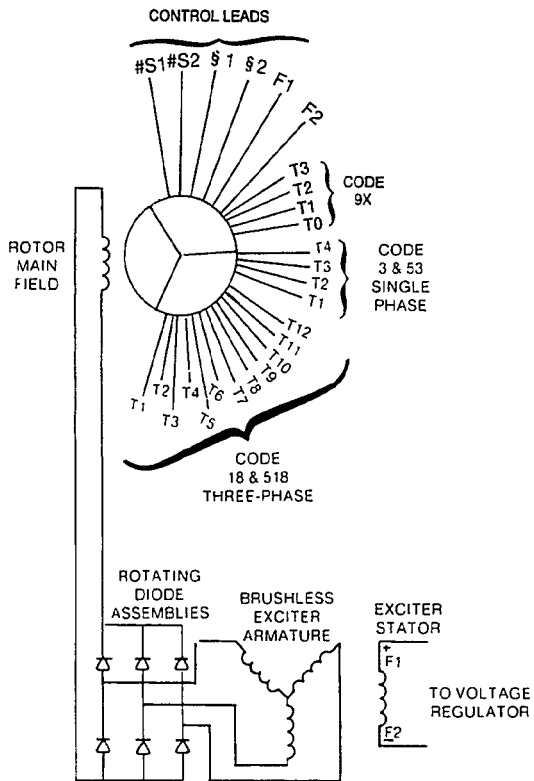


## GENERATOR OPERATION

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 generator set 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.

Generator sets without control panel AC meters are shipped from the factory with the AC output leads separated in the control box. Generator sets with AC meters have the AC output leads wired as specified on the customer's purchase order to deliver the voltage specified.



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- # - NOT USED ON 1 Ø GENSETS WITH ELECTRONIC REGULATION
- § - NOT USED ON 1 Ø GENSETS WITH TRANSFORMER REGULATION

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

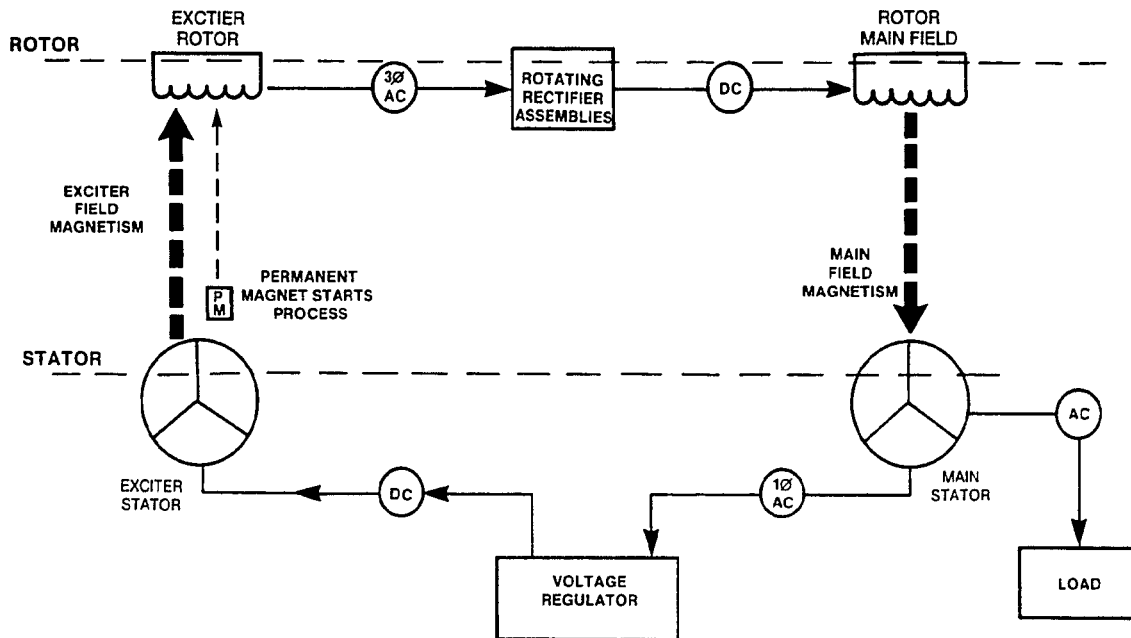


FIGURE 5-3. EXCITATION BLOCK DIAGRAM

ES-1322-2

## VOLTAGE REGULATOR

The voltage regulator controls the output of the generator so that a constant voltage is maintained under varying load conditions. There are two types of voltage regulators used on these sets: transformer and electronic (solid state). The description and operation of each type is covered separately.

### Transformer Voltage Regulator

The transformer voltage regulator is standard equipment on all single-phase generator sets. It is located inside the generator set control box. A typical transformer and a schematic showing circuit application is shown in Figure 5-4. The transformer provides a feedback loop from the output of the generator to the exciter stator.

The number of primary windings and secondary taps will change for 50 hertz and different model applications. See individual model wiring diagrams in the back of this manual.

The transformer primary is connected in series with the generator output leads making it a current boost winding for the secondary. Separate coils in the primary allows the generator to be reconnected for other voltages without causing an output voltage unbalance.

The transformer secondary is in the exciter circuit and is connected through a diode bridge. The diode bridge converts AC to DC for the exciter. Thus the exciter DC boost current is dependent upon the primary/load current.

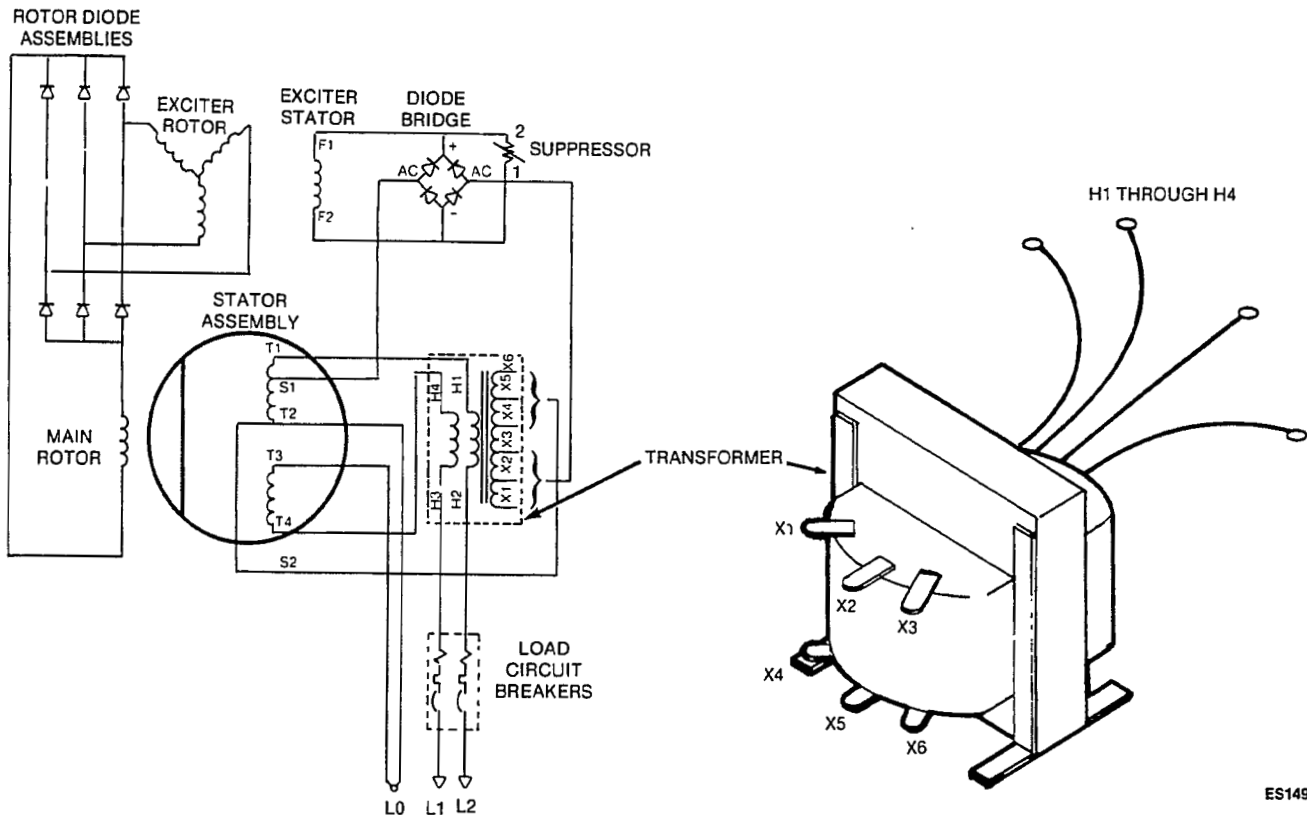


FIGURE 5-4. TYPICAL TRANSFORMER AND CIRCUIT APPLICATION

## Electronic Voltage Regulator

Electronic Voltage Regulator is standard equipment on all three phase generator sets, and is optional for single phase sets. Basic components consist of the following items shown in Figure 5-5.

- Regulator Board Assembly
- Voltage Reference Transformer T21
- Commutating Reactor CMR21
- Terminal Board TB21

The electronic regulator provides better voltage regulation than the transformer type. It is recommended when powering non-linear SCR loads (usually associated with solid-state equipment).

Only the basic functions of the regulator are described. Current from one of the generator stator windings is supplied to the primary side (H1 and H2) of voltage reference transformer T21. See Figure 5-6 wiring diagram. AC in the secondary winding (X1 and X2) is supplied as a reference voltage to the regulator circuit board.

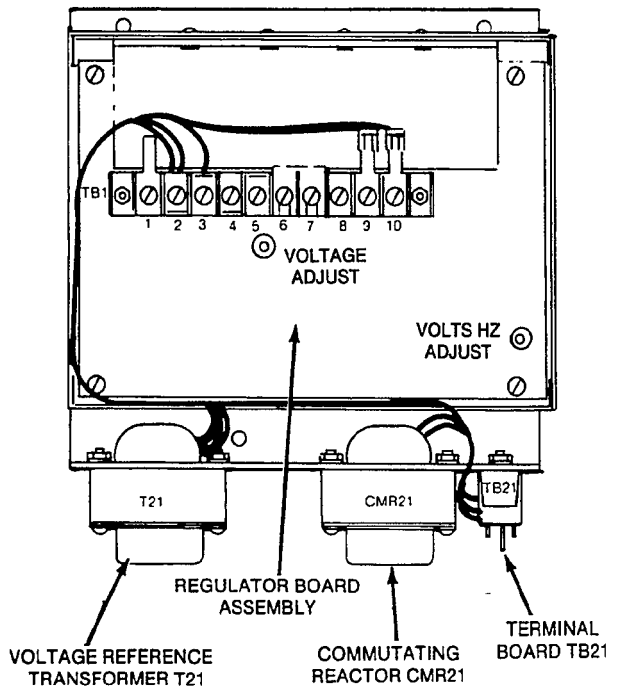
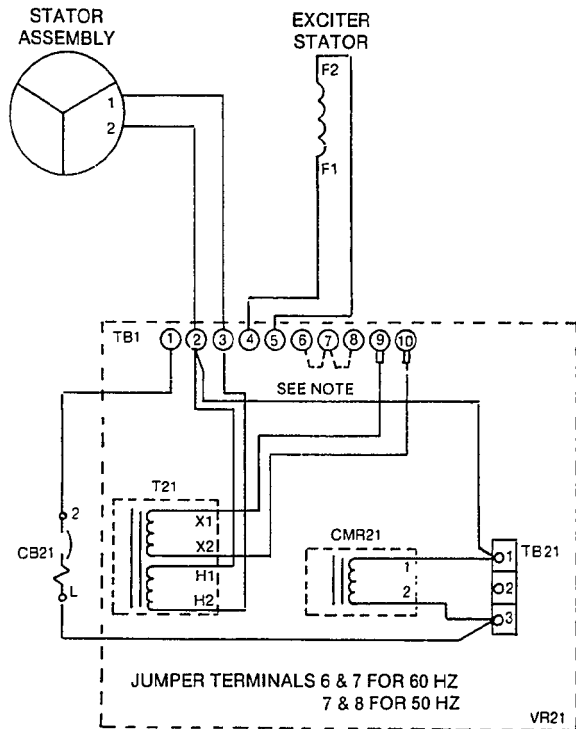


FIGURE 5-5. ELECTRONIC REGULATOR BASIC COMPONENTS

A rise or fall in the generator stator output voltage produces a corresponding change in the transformer secondary.

The generator stator is also connected to the commutating reactor CMR21. Reactor L21 is a choke used to produce a uniform AC wave to the circuit board AC input terminal TB1-1.

During operation, the regulator circuit board responds to changes in the reference voltage supplied by transformer T21. These changes raise or lower the DC output voltage produced for field excitation which results in a stable output for the load.



ES1493

FIGURE 5-6. ELECTRONIC REGULATOR WIRING DIAGRAM

## GENERATOR SERVICE

The following sections describe the disassembly and reassembly procedures for the generator.

**▲WARNING** *Generator components are heavy and can cause severe personal injury if dropped during service. Be careful, keep hands and feet clear during service, and use the recommended service procedures.*

### Disassembly

1. Disconnect the negative (-) battery cable from the battery to prevent accidental starting of the generator set while servicing.

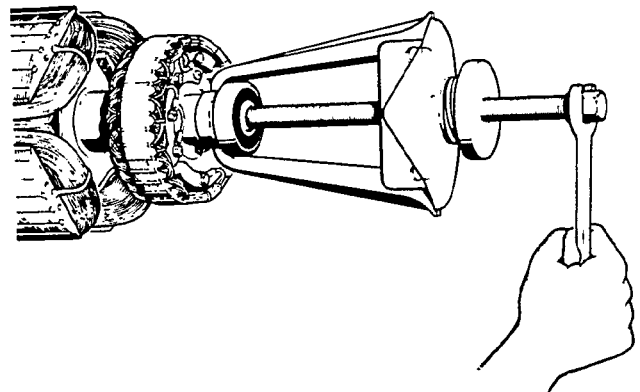
**▲WARNING** *Accidental starting of the set can cause severe personal injury or death. Disconnect the battery cables, negative (-) lead first, when repairs are made to the engine, controls or generator.*

2. Remove cover from the control box and disconnect all stator leads. If control has load circuit breakers, disconnect leads at breaker. If lead markings do not clearly identify reconnection, mark leads with tape.
3. Remove end bell cover and remove field leads F1 and F2.
4. Remove load wires and flexible conduit from control box.
5. Remove leads from the plug of the DC voltage regulator mounted on the bottom of saddle.
6. Remove capscrews securing the control box mounting saddle to the stator. The control box and saddle are removed as an assembly.
7. Pull stator leads through opening in bottom of control box and saddle as they are lifted free from stator. Do not disconnect any engine DC control wires in the control box.
8. Set control box and saddle on top of engine.
9. Remove the end bell stud nuts and slide off the end bell and exciter stator. It may be necessary to pry or jar the assembly loose from the main stator assembly.

10. Use a hoist and safe lifting device (stator handling tongs, nylon lifting strap or chain and lift hooks) to support the stator assembly. A support must be placed under the engine before removing stator from the vibration mounts.
11. Remove stator assembly being careful not to touch or drag it on the rotor. Place stator on its side in the horizontal position.
12. Using a hoist and sling to support the rotor, carefully remove the capscrews that attach the drive disc to the engine flywheel (Figure 5-8).
13. Remove the rotor assembly and place upon wood block in the horizontal position. The drive disc and fan should not be resting on anything or distortion may occur.
14. Remove bolts that hold the drive disc and fan to the rotor shaft. Remove bolts holding drive disc to the fan.
15. Use a gear puller to remove the end bearing from the rotor shaft (Figure 5-7).

**▲CAUTION** *The end bearing will be damaged if pulled on the outer race. If reused, the bearing must be pulled on the inner race.*

16. Clamp the rotor in a fixed position and remove the exciter rotor lock nut.
17. Remove the generator field leads from the exciter rotor and slide the exciter off the rotor shaft.



ES1495

FIGURE 5-7. END BEARING REMOVAL

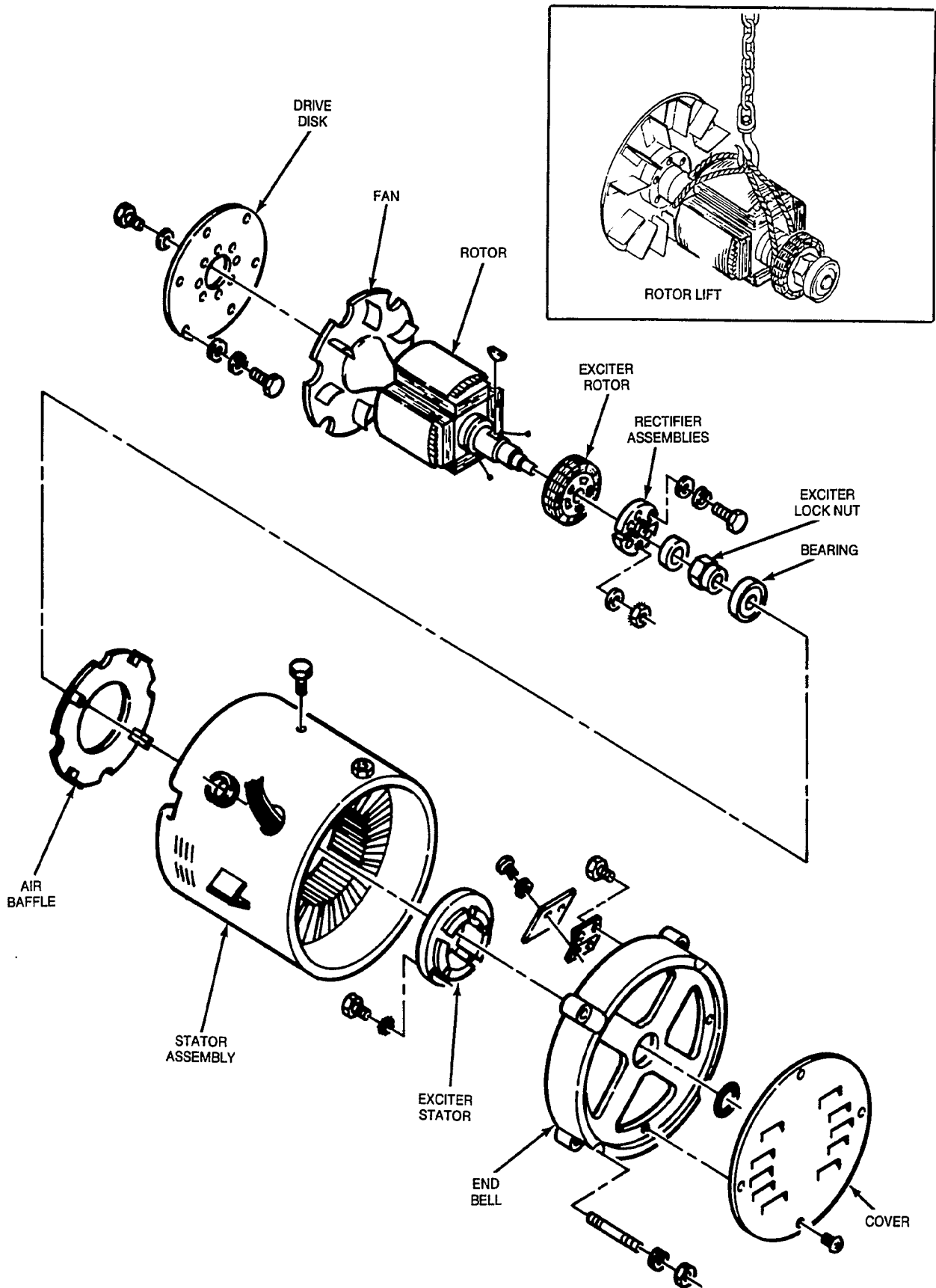
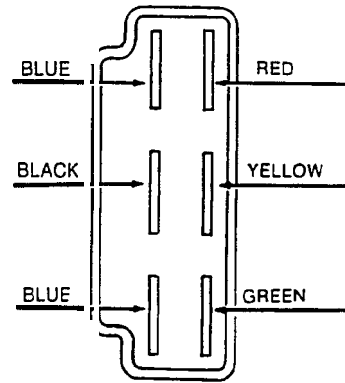


FIGURE 5-8. GENERATOR ASSEMBLY

G-1158-2

## Reassembly

- Slide the exciter rotor over the generator shaft and woodruff key. Install the exciter nut and apply torque values shown in Figure 5-9.
- Connect generator field leads to F1+ and F2- terminals on exciter assembly. Torque to values shown.
- Press the end bearing onto the rotor shaft.
- Assemble rotor fan and drive disc to the engine flywheel. Use a hoist and sling to support rotor. Be sure the drive disc is assembled with the chamfer on the flywheel side. Apply torque values shown in Figure 5-9.
- Install air baffle.
- Using a hoist and safe lifting device, carefully move the stator into position over the rotor. The leads should be in the top position. Apply a thin film of Molykote grease to mating surfaces of end bearing and hole in the end bell.
- Install the end bell stud bolts through the stator and into the generator adapter.
- Install end bell assembly on the stator with the generator lead opening at top position.
- Torque end bell stud nuts to 20 ft lbs (27 N•m).
- Using a lead hammer tap the end bell at the horizontal and vertical to relieve stress. Torque end bell stud nuts.
- Feed stator and control leads through opening in control box and saddle and secure saddle to the generator.
- Connect all applicable control leads (F1, F2, battery charging, etc.) and verify that all connections are secure.
- Connect leads to the plug of the DC voltage regulator mounted on the bottom of saddle. Figure 5-10.
- Install the end bell cover.
- Connect the stator wires to the load wires.
- Connect the negative (-) battery cable and test generator operation.



ES1497

FIGURE 5-10. DC REGULATOR PLUG CONNECTIONS

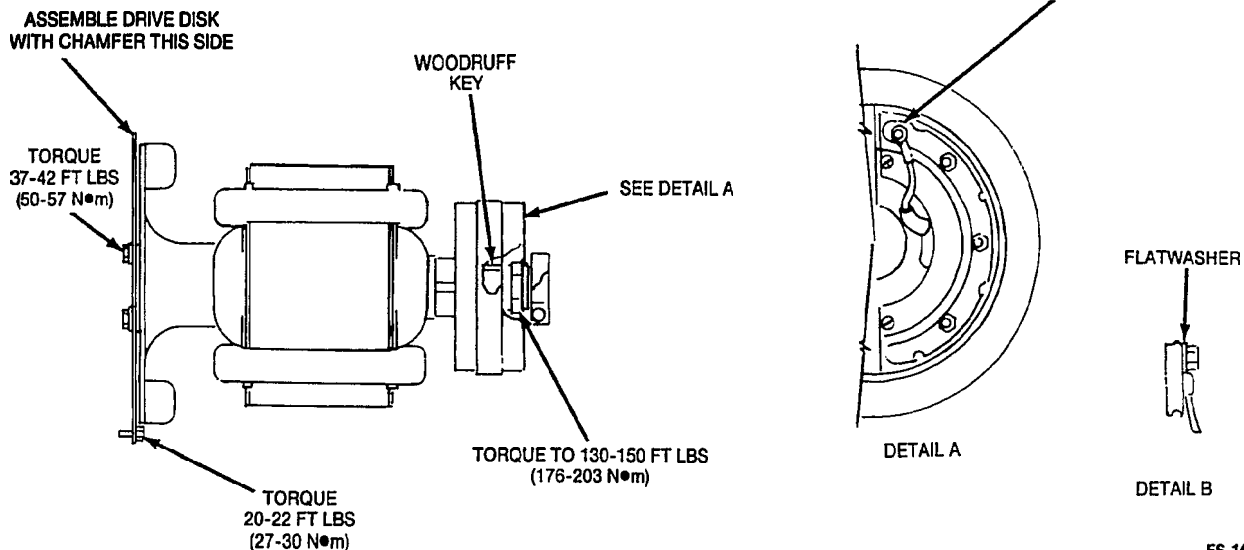


FIGURE 5-9. ROTOR ASSEMBLY AND TORQUE VALUES

ES-1496-3

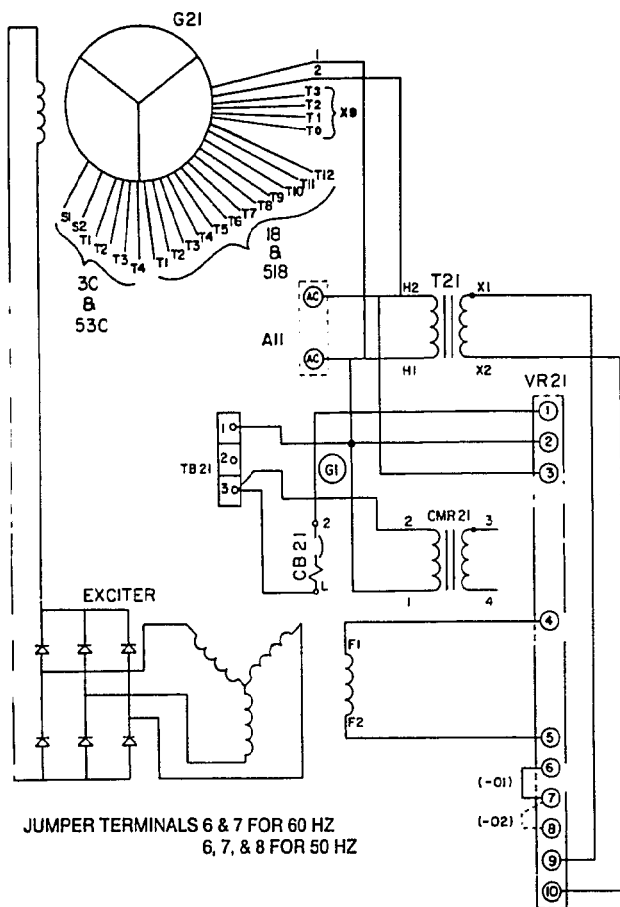


# Section 6. Generator/Regulator Troubleshooting

## GENERAL

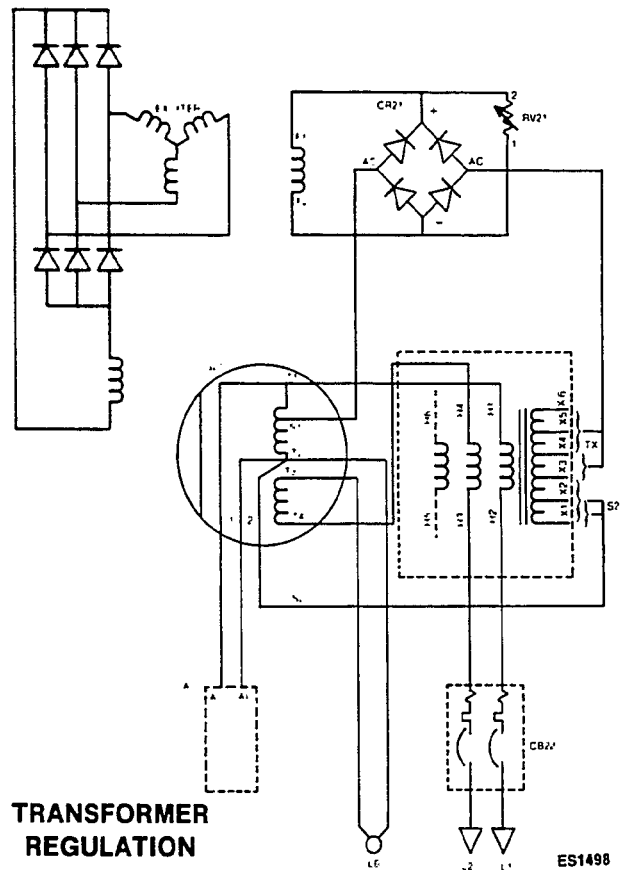
This section contains service information for single and three phase generator sets with transformer or electronic voltage regulators. Make the following visual checks prior to starting the troubleshooting procedures.

- Check any modification or repair that has been performed since the last satisfactory operation of the set to see that they are installed properly.
- Check to see that generator leads are connected correctly. Also check the circuit board connectors. A loose, contaminated, or misplaced wire connection will cause problems that can be detected by close inspection.
- Check for an open circuit breaker. If the breaker is open, check for an overloaded circuit and correct load problems before resetting circuit breaker.



### ELECTRONIC REGULATION

ES-1499-1



### TRANSFORMER REGULATION

ES1498

FIGURE 6-1. ELECTRONIC AND TRANSFORMER REGULATION (TYPICAL SCHEMATICS)



## **TROUBLESHOOTING PROCEDURES**

Determine the type of problem and then refer to the corresponding flow chart (A, B, C, D, E, F, or G) for troubleshooting procedures.

- A. NO AC OUTPUT VOLTAGE AT RATED ENGINE RPM (ELECTRONIC VOLTAGE REGULATOR)
- B. NO AC OUTPUT VOLTAGE AT RATED ENGINE RPM (TRANSFORMER VOLTAGE REGULATOR)
- C. UNSTABLE OUTPUT VOLTAGE, ENGINE SPEED STABLE (ELECTRONIC VOLTAGE REGULATOR)
- D. OUTPUT VOLTAGE TOO HIGH OR TOO LOW (ELECTRONIC VOLTAGE REGULATOR)
- E. OUTPUT VOLTAGE TOO HIGH, TOO LOW, OR UNSTABLE (TRANSFORMER VOLTAGE REGULATOR)

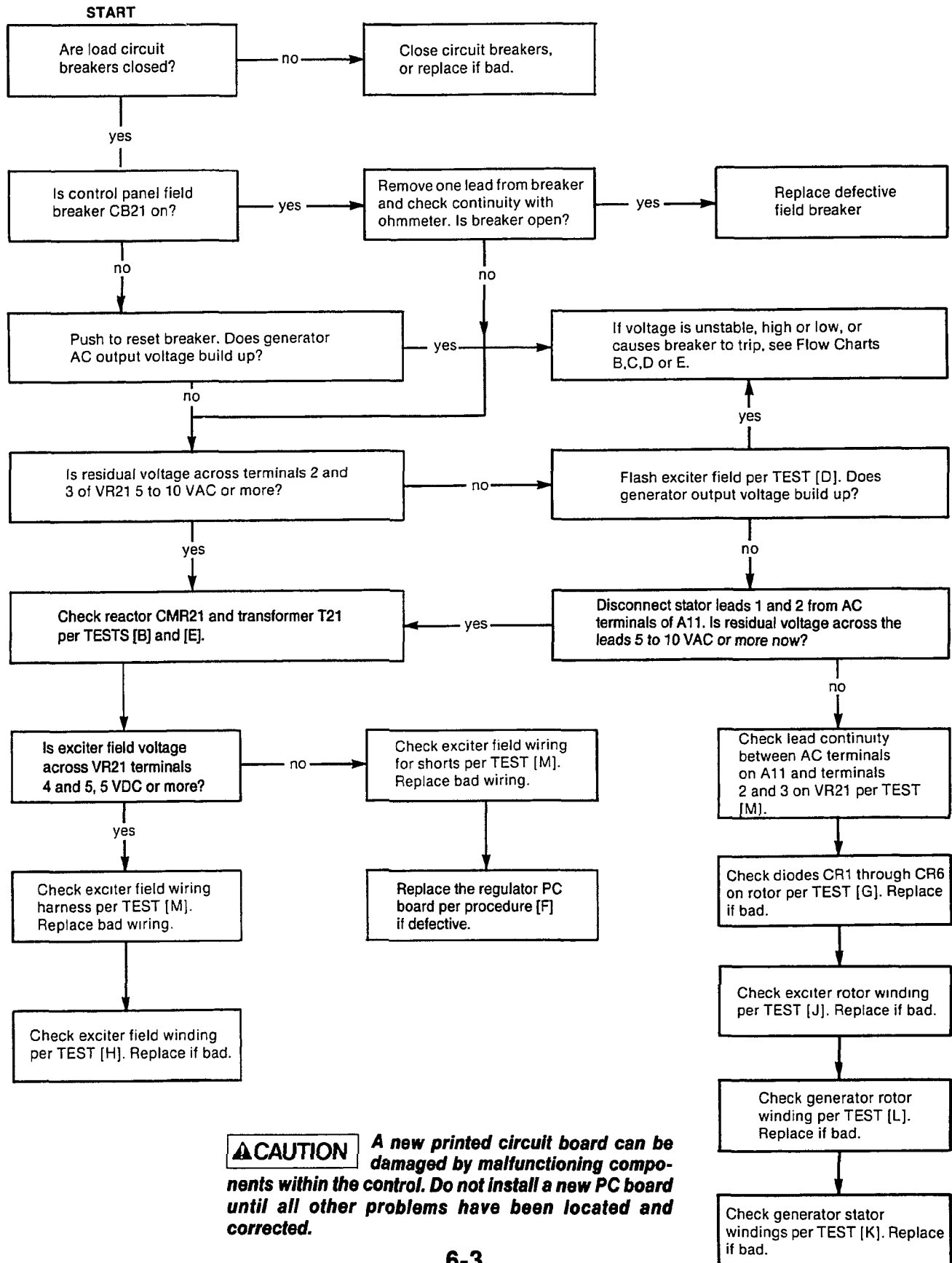
- F. FIELD BREAKER (CB21) TRIPS (ELECTRONIC VOLTAGE REGULATOR)
- G. UNBALANCED OUTPUT VOLTAGE (TRANSFORMER OR ELECTRONIC VOLTAGE REGULATOR)

To troubleshoot a problem, start at the upper-left corner of the chart that corresponds to the problem, and answer all questions either YES or NO. Follow the chart until the problem is found. Perform the referenced test or adjustment procedures in the Generator/Regulator Tests section.

Referenced components in the flow charts and test and adjustment procedures can be found on the electrical schematics (Figure 6-1) and on the wiring diagrams.

## FLOW CHART A. NO AC OUTPUT VOLTAGE AT RATED ENGINE RPM (ELECTRONIC VOLTAGE REGULATOR)

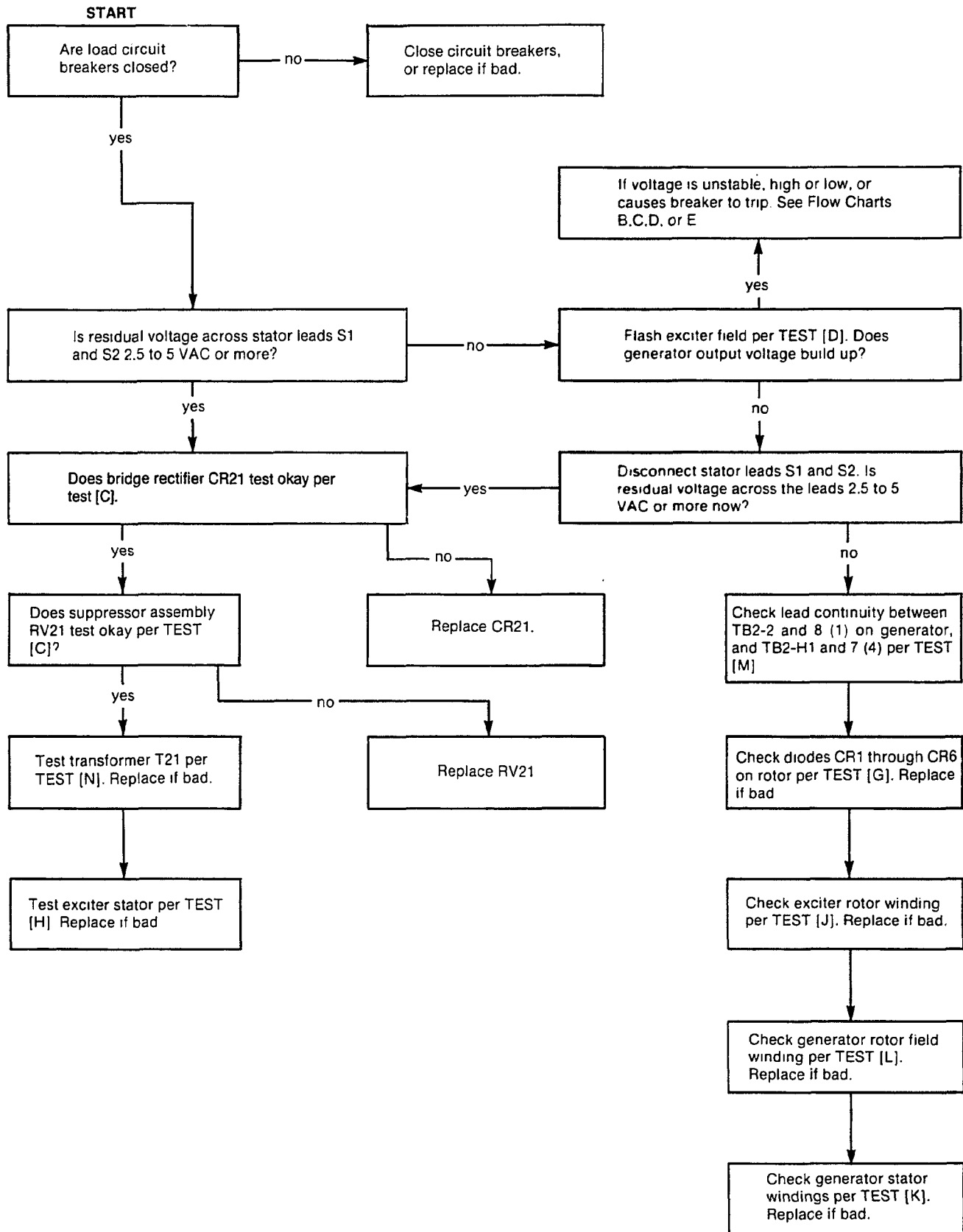
**⚠WARNING** *Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on inside cover page.*



**⚠CAUTION** *A new printed circuit board can be damaged by malfunctioning components within the control. Do not install a new PC board until all other problems have been located and corrected.*

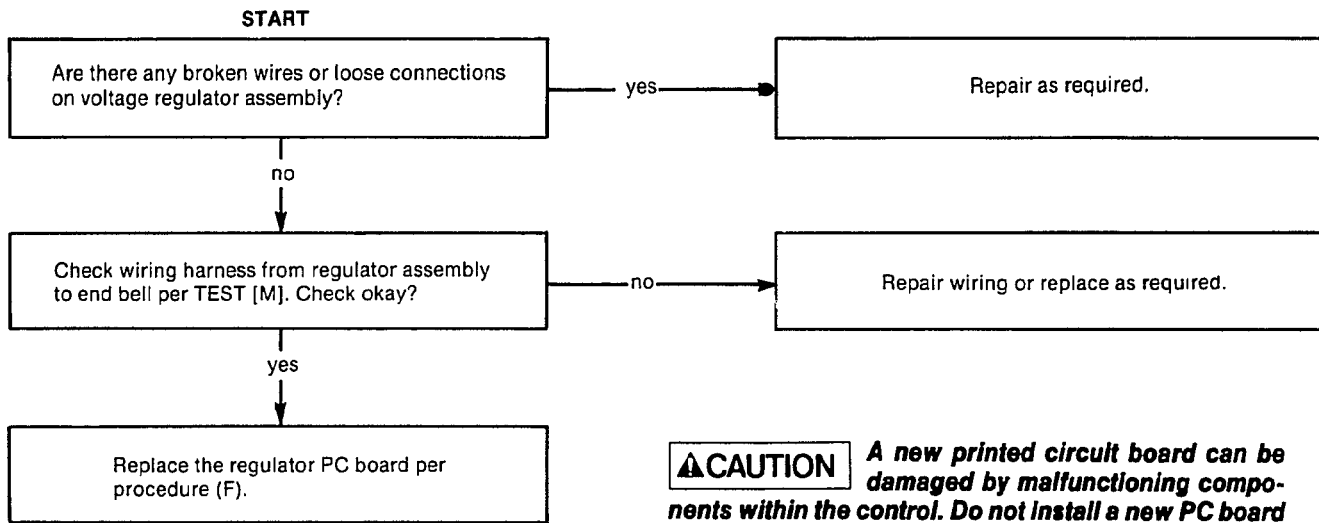
## FLOW CHART B. NO AC OUTPUT VOLTAGE AT RATED ENGINE RPM (TRANSFORMER VOLTAGE REGULATOR)

**⚠ 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 inside cover page.



## FLOW CHART C. UNSTABLE VOLTAGE, ENGINE SPEED STABLE (ELECTRONIC VOLTAGE REGULATOR)

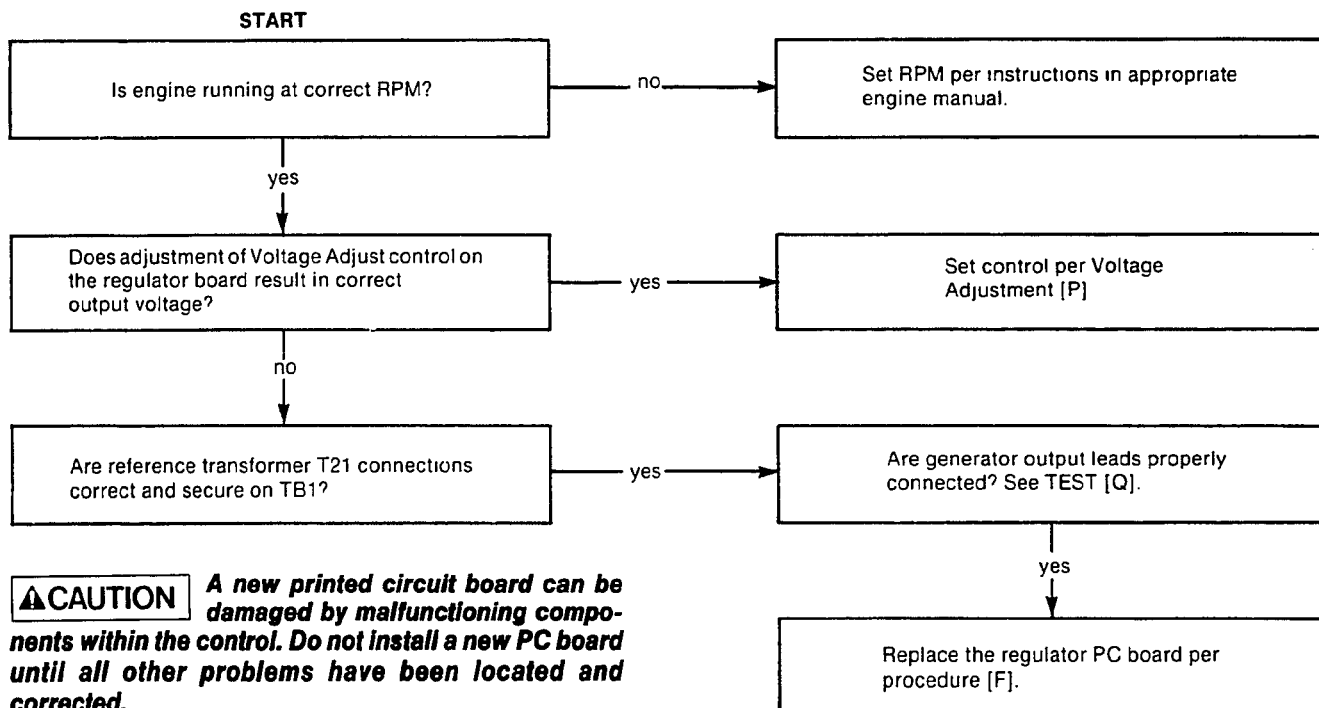
**⚠WARNING** *Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on inside cover page.*



**⚠CAUTION** *A new printed circuit board can be damaged by malfunctioning components within the control. Do not install a new PC board until all other problems have been located and corrected.*

## FLOW CHART D. OUTPUT VOLTAGE TOO HIGH OR TOO LOW (ELECTRONIC VOLTAGE REGULATOR)

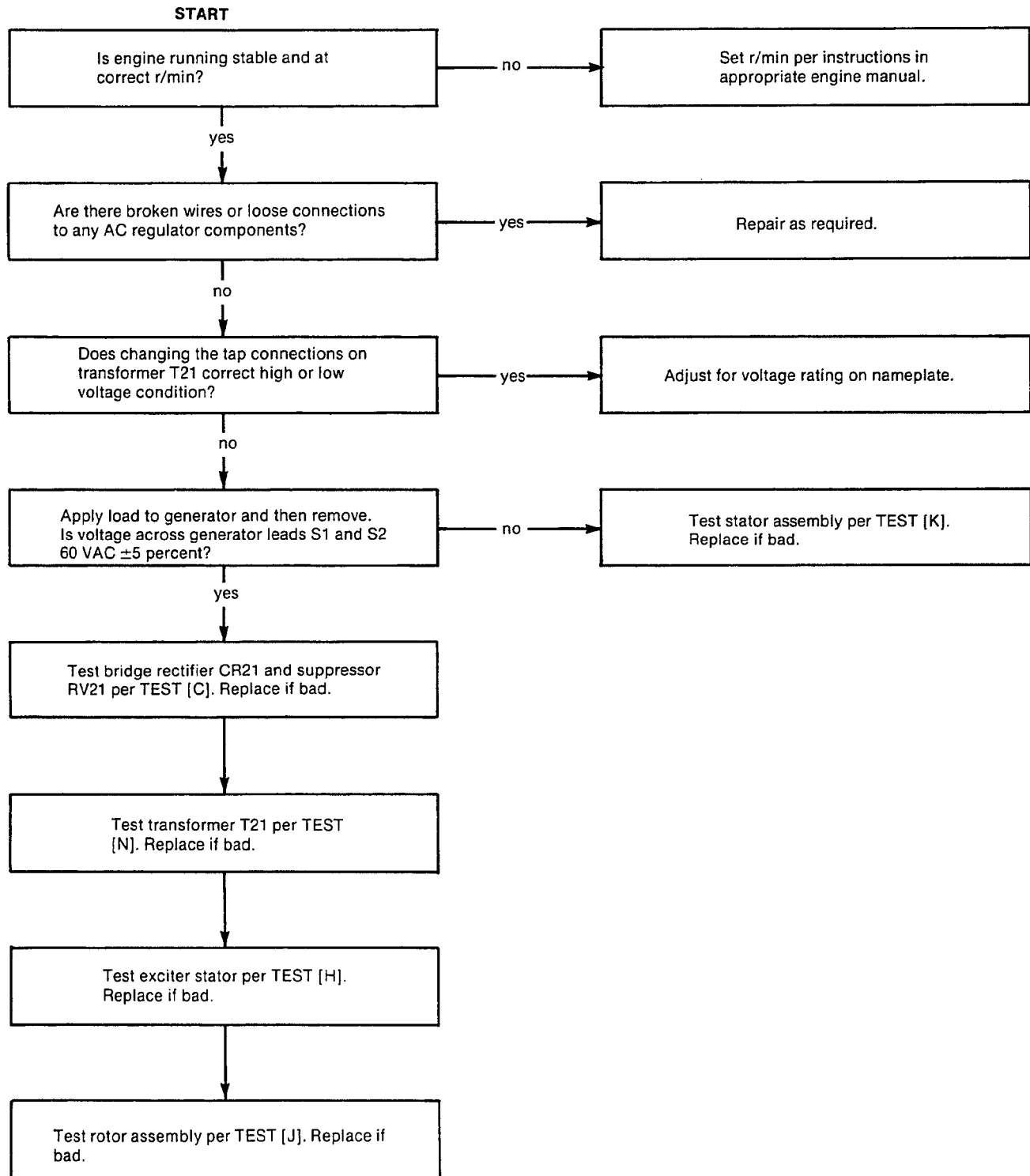
**⚠WARNING** *Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on inside cover page.*



**⚠CAUTION** *A new printed circuit board can be damaged by malfunctioning components within the control. Do not install a new PC board until all other problems have been located and corrected.*

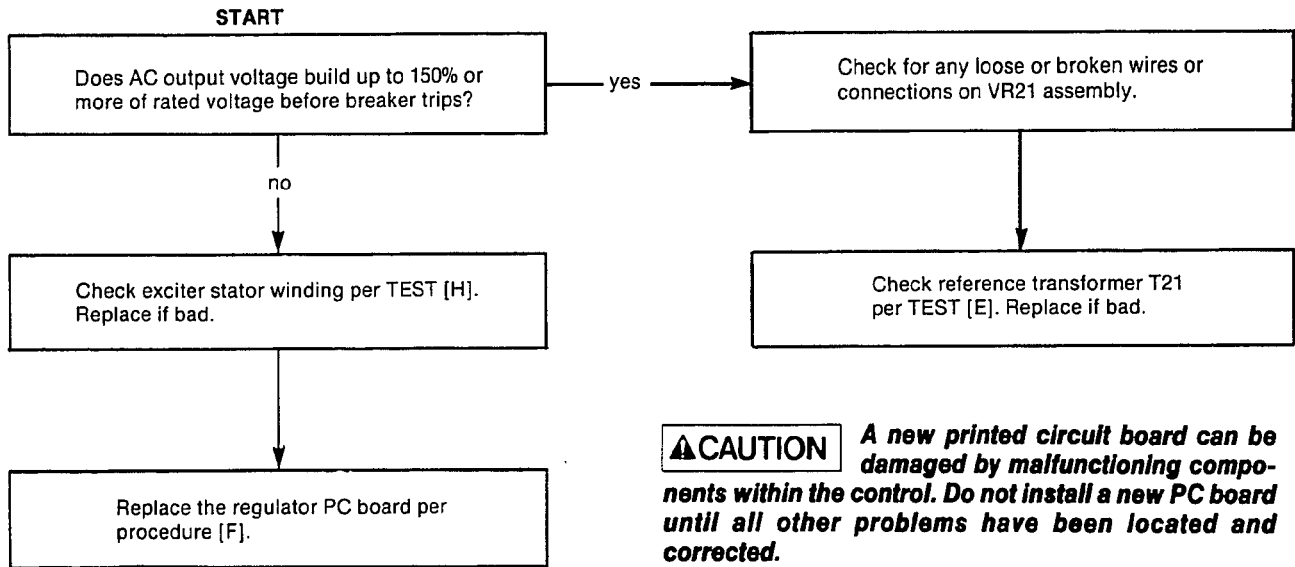
## FLOW CHART E. OUTPUT VOLTAGE TOO HIGH, TOO LOW, OR UNSTABLE (TRANSFORMER VOLTAGE REGULATOR)

**⚠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 inside cover page.



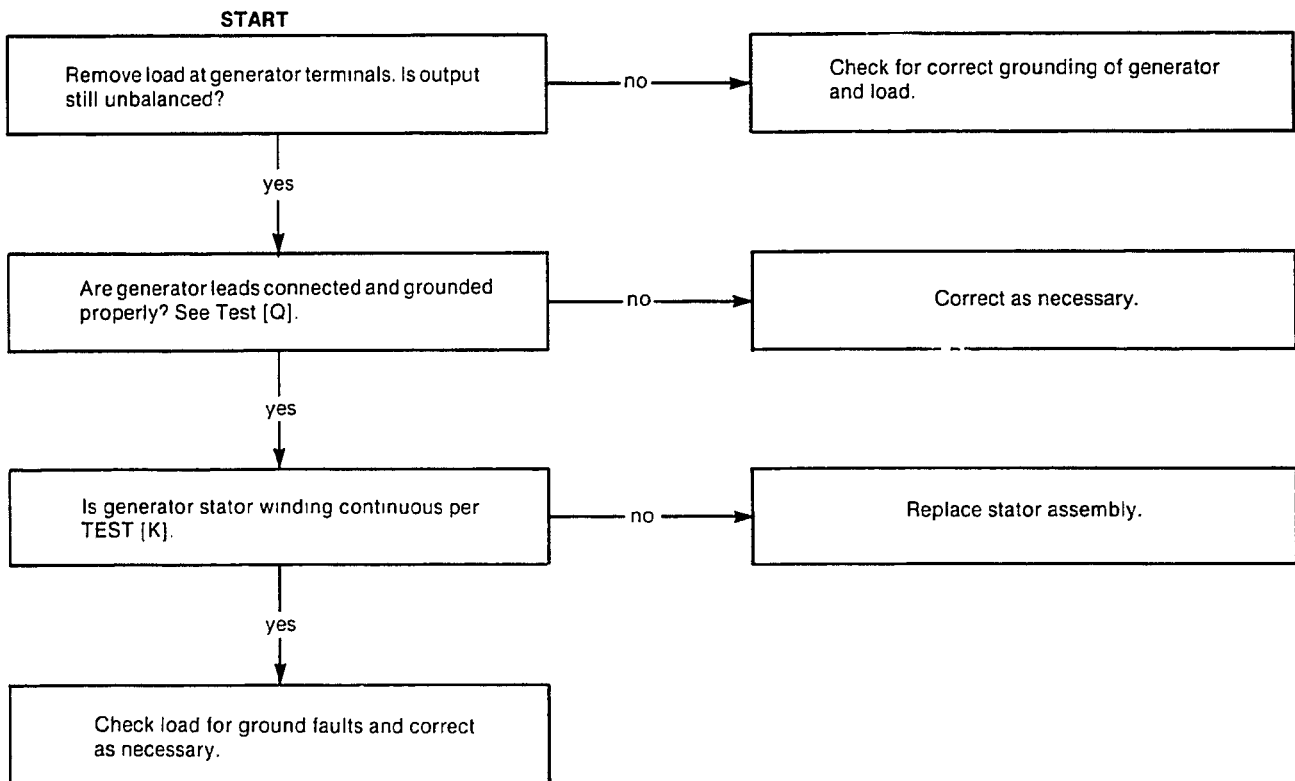
## FLOW CHART F. FIELD BREAKER TRIPS (ELECTRONIC VOLTAGE REGULATOR)

**⚠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 inside cover page.*



## FLOW CHART G. UNBALANCED GENERATOR OUTPUT VOLTAGE (TRANSFORMER OR ELECTRONIC VOLTAGE REGULATOR)

**⚠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 inside cover page.*





# Section 7. Generator/Regulator Tests

## GENERAL

The following tests and adjustments can be performed without disassembly of the generator. These procedures should be used for testing the generator components and the regulator in conjunction with the Troubleshooting Flow Charts in the Generator/Regulator Troubleshooting section.

**⚠ 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 inside cover page.*

## [A]

### TESTING AC RESIDUAL VOLTAGE

Test for residual AC voltage if there is no AC power output from the generator. Check between generator leads 1 and 2 (electronic regulation controls); between S1 and S2 (transformer regulation controls). See Figure 6-1. Residual voltage should be as follows:

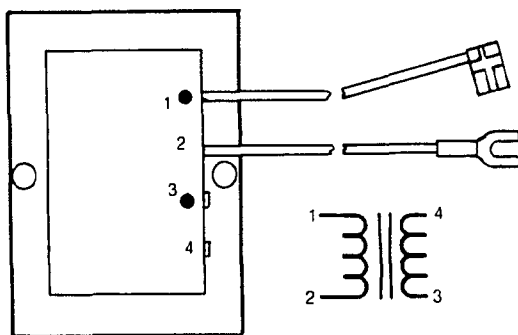
Electronic Regulation 5 to 10 VAC minimum. Transformer Regulation 2.5 to 5 VAC minimum.

## [B]

### TESTING COMMUTATING REACTOR

The commutating reactor is shown in Figure 7-1. It is referenced CMR21 on schematics. Only one winding of the reactor (leads 1 and 2) is used. Remove reactor leads from terminal board for testing.

Resistance across 1 and 2 should be 330 to 390 milliohms at 77°F (25°C). Resistance between winding and the reactor frame should be infinity.



ES1500

FIGURE 7-1. COMMUTATING REACTOR

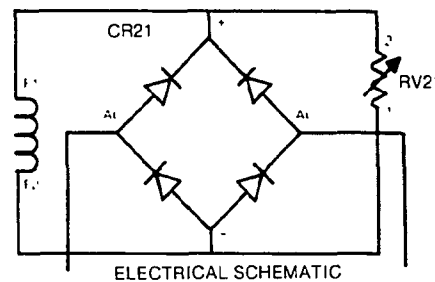
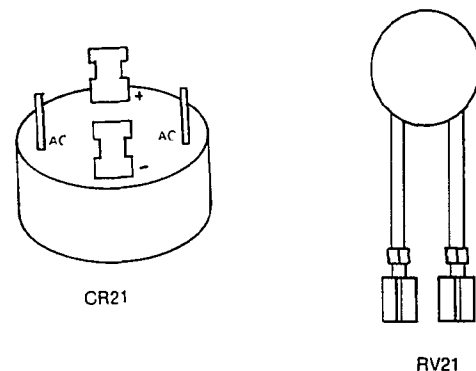
## [C]

### TESTING RECTIFIER BRIDGE CR21 AND SUPPRESSOR RV21

The rectifier bridge and suppressor are located within the control box of transformer regulated sets. The bridge contains four diodes as shown in Figure 7-2. They are encapsulated within a hermetically sealed block, and failure of any diode requires replacement of the entire bridge.

Disconnect wires from the bridge prior to testing. Check forward resistance with an ohmmeter on the R x 1 scale; reverse resistance on the R x 10K scale. Forward resistance should be 6 to 50 ohms, and reverse resistance infinity.

If CR21 is defective, the suppressor RV21 should also be replaced. RV21 should have infinite ohmmeter readings in both directions.



ES1501

FIGURE 7-2. RECTIFIER BRIDGE, SUPPRESSOR ASSEMBLY



## [D]

### FLASHING THE FIELD

If output voltage does not build up it may be necessary to restore residual magnetism by flashing the field. This requires a 12-volt storage battery, 10-amp fuse, momentary-on switch, and diode assembled as shown in Figure 7-3.

**CAUTION** *Incorrect flashing procedure can damage the voltage regulator. Do not keep excitation circuitry connected longer than 5 seconds.*

Start the generator set and operate at normal speed. Connect the positive lead to the F1 (+) exciter stator lead, and the negative lead to the F2 (-) exciter lead. Close the switch just long enough for the generator output voltage to build up, but not longer than 5 seconds.

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

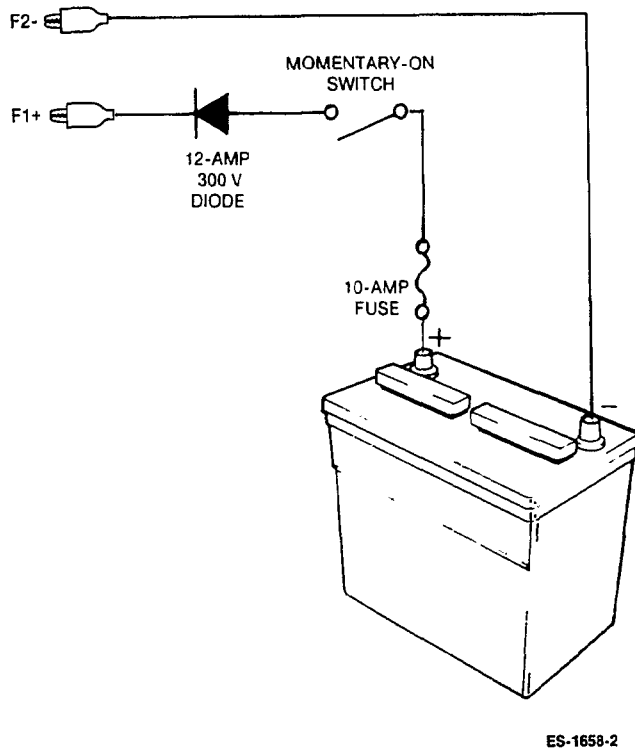
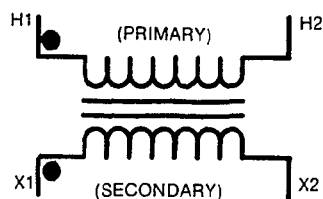
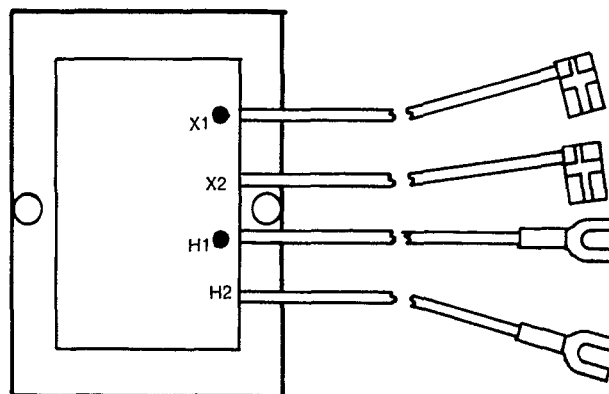


FIGURE 7-3 FIELD FLASHING CIRCUIT

## [E]

### TESTING REFERENCE TRANSFORMER

The reference transformer has four leads; two primary marked H1 and H2 and two secondary leads marked X1 and X2. See Figure 7-4. Resistance readings are made with leads disconnected. The resistance of either coil should be 110 ohms +/- 10% at 77°F (25°C). Resistance between leads and transformer frame should be infinity.



WINDING SCHEMATIC

ES1502

FIGURE 7-4. REFERENCE TRANSFORMER

## [F]

### VOLTAGE REGULATOR VR21 REPLACEMENT

Use the following procedure for replacing the voltage regulator PC board or VR chassis.

1. Stop the generator set and disconnect the starting battery leads, negative (-) lead first.
2. Disconnect (and label if necessary) the wires from voltage regulator. 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. Set voltage as outlined in test [P] Voltage Adjustment.

## [G]

### TESTING ROTATING RECTIFIERS

Two different rectifier assemblies make up the rotating rectifier bridge assembly (Figure 7-5). Using an ohmmeter, test each CR rectifier using negative (-) and positive (+) polarities. Use the following procedure.

1. Disconnect all leads from assembly to be tested.
2. Connect one ohmmeter test lead to F1+ stud and connect the other lead to CR1, CR2 and CR3 in turn; record resistance value of each rectifier.
3. Connect one lead to F2- stud and connect other lead to CR4, CR5, and CR6 in turn; record resistance value of each rectifier.
4. Reverse ohmmeter leads from steps 2 and 3 and record resistance value of each rectifier F1+ to CR1, CR2 and CR3 and F2- to CR4, CR5 and CR6.
5. All the 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.
6. Replace defective rectifier assembly with new identical part.

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

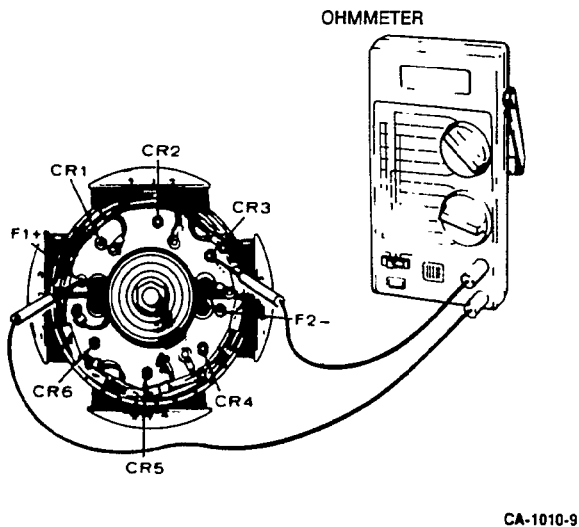


FIGURE 7-5. TESTING ROTATING RECTIFIERS

## [H]

### TESTING EXCITER STATOR

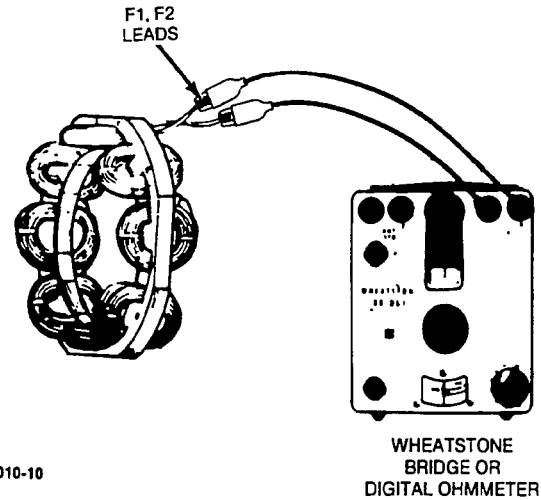
Test the exciter stator (Figure 7-6) for open or shorted windings and grounds as follows:

#### Testing for Open or Shorted Windings

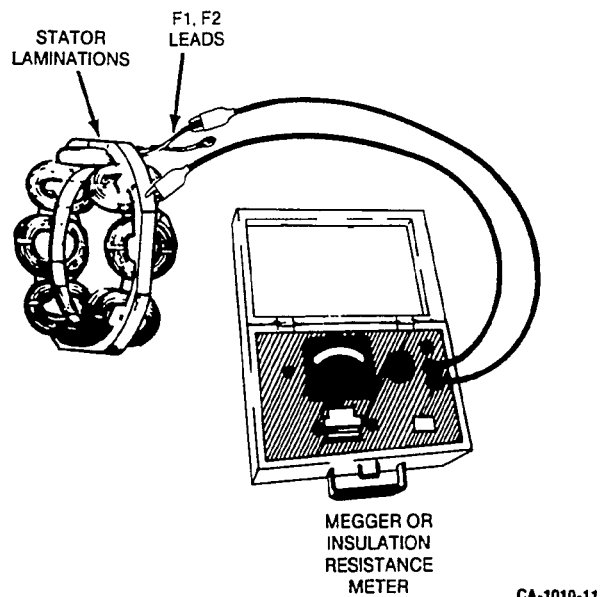
Use a Wheatstone Bridge or digital ohmmeter for this test. Disconnect F1+ and F2- exciter field leads from terminal block in generator end bell. The resistance between field leads should be 11.16 to 13.64 ohms at 77°F (25°C).

#### Testing for Grounds

Connect a megger or insulation resistance meter that applies 500 VDC or more between either field lead and the exciter stator lamination. Be sure both exciter leads are disconnected from the terminal block. Reading should be 1,000,000 ohms or greater. If not, the exciter stator is questionable and may require removal for oven drying and retest. A shorted stator must be replaced.



#### TESTING FOR OPEN OR SHORTED WINDING



#### TESTING FOR GROUND TO LAMINATION

FIGURE 7-6. TESTING EXCITER STATOR

# [J]

## TESTING EXCITER ROTOR

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

### Testing for Open or Shorted Windings

Use a Wheatstone Bridge or digital ohmmeter for this test. Disconnect main rotor field leads that connect to rotating rectifier assemblies at F1+ and F2-. Disconnect lead wires from diodes CR1, CR2, CR3, CR4, CR5, and CR6. Test between exciter lead pairs T1-T2, T2-T3 and T1-T3. Resistance at 77°F (25°C) should be 486 to 594 milliohms.

### 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 1,000,000 ohms or higher. If not, the exciter rotor is questionable and may 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.

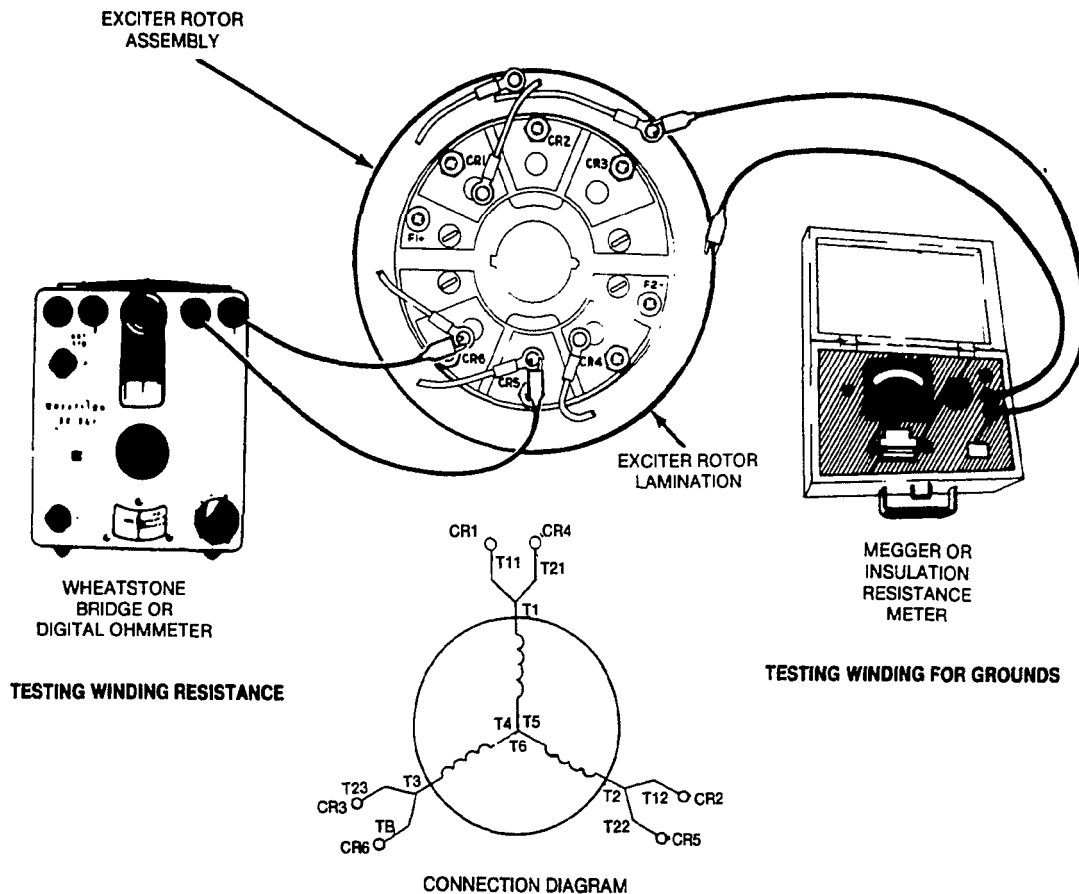


FIGURE 7-7. TESTING EXCITER ROTOR

ES-1794

[K]

## TESTING GENERATOR STATOR

Using proper test equipment, check the stator for grounds, opens, and shorts in the windings.

### Testing for Grounds

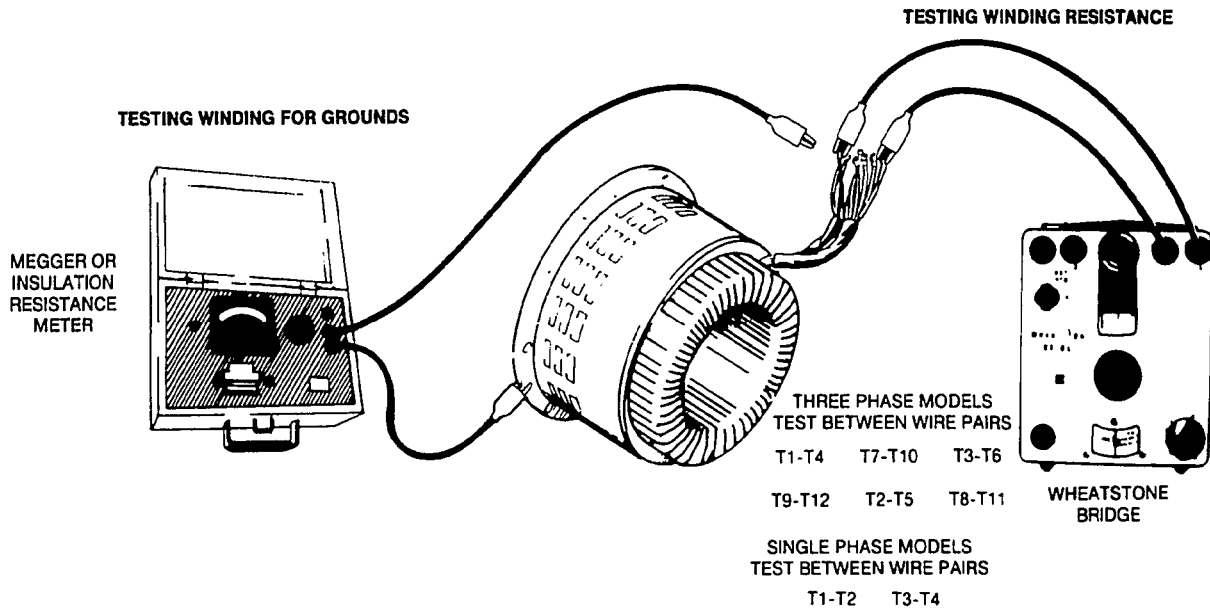
Some generators have ground connections to the frame. Check wiring diagram. All stator leads must be isolated for testing.

Use a megger or insulation resistance meter which applies 500 VDC or more to the test leads (Figure 7-9). Test each stator winding for short to laminations. A reading less than 1,000,000 ohms indicates a questionable stator. Oven dry the stator and retest.

### Testing for Open or Shorted Windings

Test for continuity between coil leads shown in Figure 7-8; all pairs should have equal resistance. Use an accurate instrument for this test such as a Wheatstone Bridge. Resistance values at 77°F (25°C) are given in Table 7-1.

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



ES-1795

FIGURE 7-8. TESTING STATOR WINDINGS

TABLE 7-1. STATOR RESISTANCE VALUES IN MILLIOHMS\*

kW RATING AND MODEL		60 HZ	50 Hz	60 HZ	50 HZ
50 Hertz	60 Hertz	3∅	3∅	1∅	1∅
3.5 DKC/MDKC	4.0MDKC/MDKC	920	1010	290	380
6.0 DKD	7.5 DKD	460	498	190	260
6.5 MDKD	8.0 MDKD	460	498	190	260

\*Resistance in ohms @ 77°F (25°C) ±10%

# [L]

## TESTING GENERATOR ROTOR

For these tests, use a megger or insulation resistance meter which applies 500 VDC or more to the test leads.

### Testing for Grounds

Check for grounds between each rotor lead and the rotor shaft, Figure 7-9. 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.
2. Connect test leads between F1+ and rotor shaft, then between F2- and rotor shaft. Meter should register 1,000,000 ohms or greater.
3. If less than 1,000,000 ohms, rotor is questionable. Oven dry the rotor and retest.
4. Replace a grounded rotor with a new identical part.

### Testing for Open or Shorted Windings

Perform this test with an accurate meter such as a digital ohmmeter.

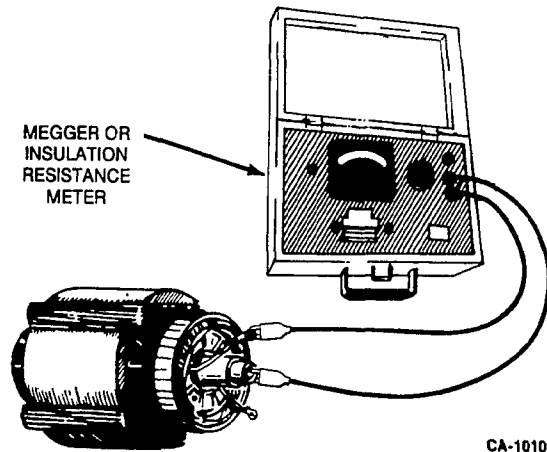
1. Remove rotor leads F1+ and F2- from rotating rectifier assemblies.
2. Using ohmmeter, check resistance between F1 and F2 leads, Figure 7-10.

The resistance values at 77°F (25°C) should be as shown in Table 7-2. If not, replace defective rotor with new, identical part.

**TABLE 7-2. ROTOR RESISTANCE VALUES**

Model	Ohms Resistance*
DKC/MDKC	2.50
DKD/MDKD	2.82

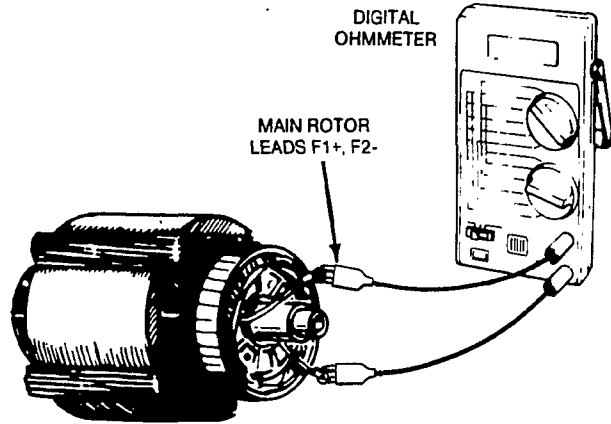
\*Resistance in ohms @ 77°F (25°C) ±10%



CA-1010-12

TESTING WINDING FOR GROUNDS

FIGURE 7-9. TESTING ROTOR FOR GROUNDS



CA-1010-8

TESTING WINDING RESISTANCE

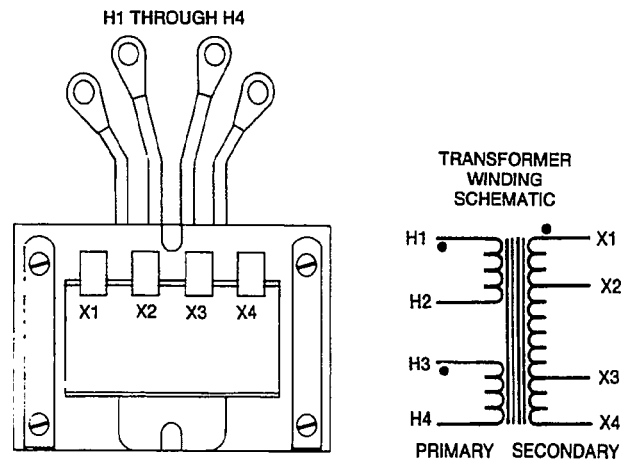
FIGURE 7-10. TESTING ROTOR FOR AN OPEN CIRCUIT

# [M]

## WIRING HARNESS CHECK

Carefully check wiring harness 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 with 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 according to applicable wiring diagram.



ES-1510

FIGURE 7-11. TYPICAL REGULATING TRANSFORMER

# [N]

## TESTING REGULATING TRANSFORMER T21

Regulating transformer T21 is used only on single phase generators. It consists of a multi-coil primary and a multi-tapped secondary. Figure 7-11 shows a typical transformer. Some transformers may have up to three coils in the primary and six taps on the secondary.

DC resistance of windings at 77°F (25°C) are shown in Table 7-3. Resistance between primary and secondary and the transformer frame should be over 100,000 ohms when measured with a megger or insulation meter.

TABLE 7-3. TRANSFORMER RESISTANCE VALUES IN OHMS

WINDING	TRANSFORMER PART NUMBER			
	315-0571	315-0572	315-0582	315-0583
Primary H1-H2	.007 ± .0005	.003 ± .0005	.007 ± .0005	.004 ± .0005
H3-H4	.007 ± .0005	.003 ± .0005	.007 ± .0005	.004 ± .0005
H5-H6	N.A.	N.A.	.003 ± .0005	.002 ± .0005
Secondary X1-X6	N.A.	N.A.	1.44 ± .1	1.37 ± .1
X1-X5	N.A.	N.A.	1.33 ± .1	1.35 ± .1
X1-X4	1.29 ± .01	1.15 ± .01	1.21 ± .1	1.24 ± .1
X1-X3	1.24 ± .01	1.11 ± .01	.04 ± .01	.04 ± .01
X1-X2	.019 ± .01	.019 ± .01	.02 ± .01	.02 ± .01

N.A. (Not applicable)

## [P]

### VOLTAGE ADJUSTMENT

This section supplies information for adjusting the transformer and electronic regulators. When checking output voltage, be sure the generator set has stabilized and is running at the correct speed (frequency). Adjusting the transformer regulator is done with the set stopped. The electronic regulator is adjusted with the set running.

**⚠ WARNING** *Accidental starting of the set can cause severe personal injury or death. Disconnect both battery cables, negative (-) cable first, when repairs are made to the engine, controls, or generator.*

#### Transformer Voltage Regulator

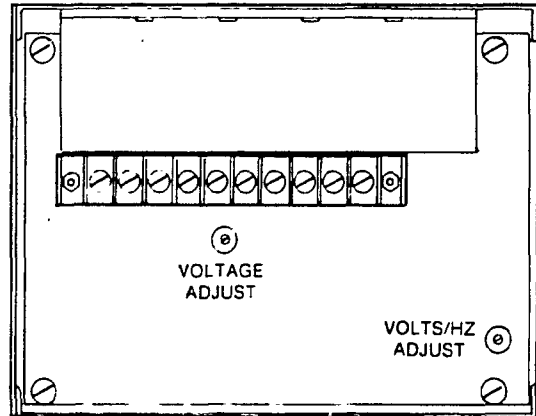
The transformer regulator circuit supplies a feedback voltage (dependent on load) to the exciter stator. Voltage adjustment is made by changing tap connections on the transformer. When replacement is necessary, install leads to the same terminals on the new transformer. To change voltage, refer to the model wiring diagram or the generator reconnection diagrams in Test [Q].

#### Electronic Voltage Regulator

**⚠ 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.*

With the generator set running, set the Voltage Adjust potentiometer on the regulator board assembly for correct voltage. See Figure 7-12.

**⚠ CAUTION** *Do not adjust the other potentiometer (Volts/Hz Adjust) as it can be impossible to reset for proper operation. It is factory set using special calibration equipment.*



ES-1388

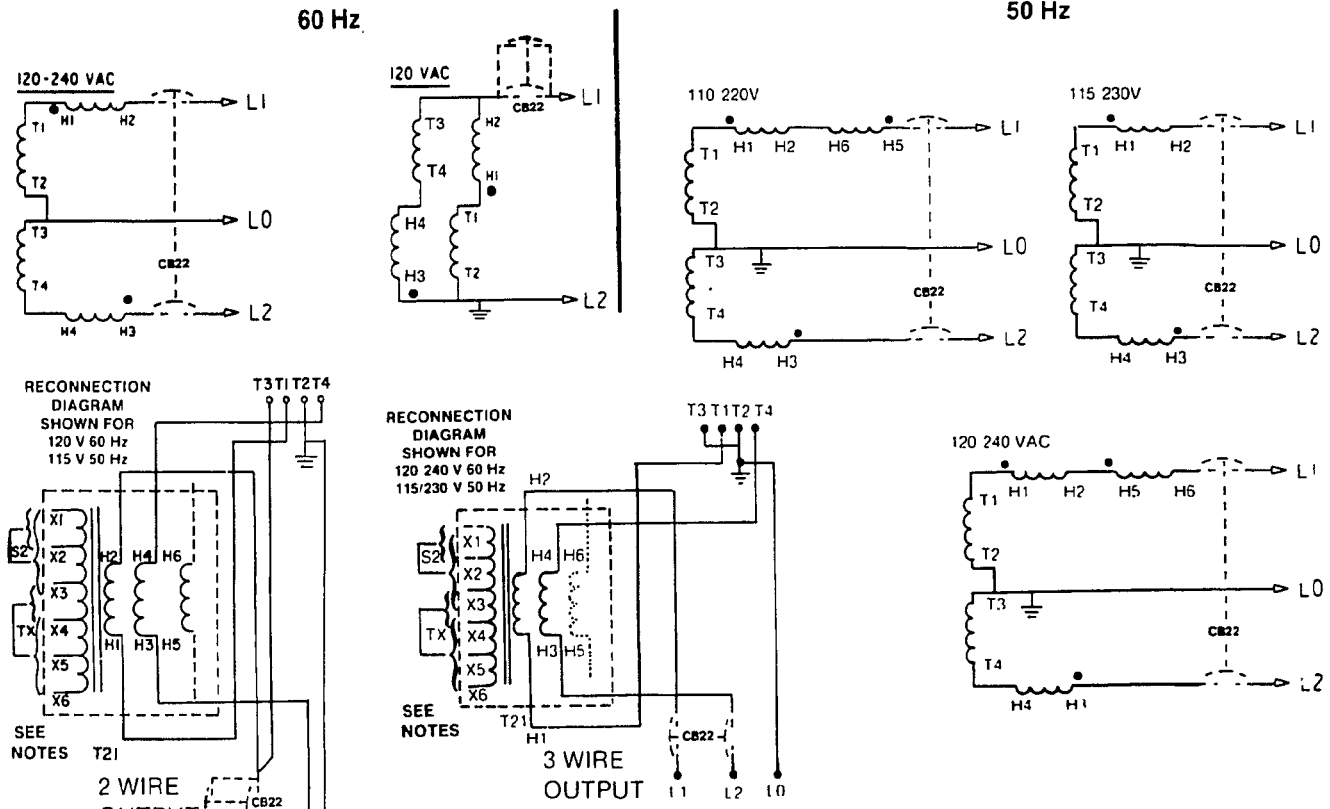
FIGURE 7-12. ELECTRONIC REGULATOR BOARD

## [Q]

### RECONNECTION

Generator reconnection is dependent upon the nameplate code. Figure 7-13 shows reconnection possibilities. Information is also found on the individual model wiring diagrams in Section 8 of this manual.

# Transformer Regulation



To Adjust Output Voltage, Move Taps on T21 According to Following Charts

OUTPUT VOLTAGE ADJUSTMENT	60 Hz (-01)				50 Hz (-02)			
	120, 120/240V TAP POSITION		110, 110/220V TAP POSITION		115, 115/230V TAP POSITION		120, 120/240V TAP POSITION	
	S2	TX	S2	TX	S2	TX	S2	TX
INCREASE	X2	X3	X3	X6	X3	X5	X3	X4
ST'D	X1	X3	X2	X6	X2	X5	X2	X4
DECREASE	X2	X4	X1	X6	X1	X5	X1	X4
	X1	X4						

OUTPUT VOLTAGE ADJUSTMENT	60 Hz (-03)				50 Hz (-04)			
	120, 120/240V TAP POSITION		110, 110/220V TAP POSITION		115, 115/230V TAP POSITION		120, 120/240V TAP POSITION	
	S2	TX	S2	TX	S2	TX	S2	TX
INCREASE	X2	X3	X3	X6	X3	X5	X3	X4
ST'D	X1	X3	X2	X6	X2	X5	X2	X4
DECREASE	X2	X4	X1	X6	X1	X5	X1	X4
	X1	X4						

**NOTES**

- 1 IN ALL VOLTAGE CONNECTIONS (50 AND 60 Hz) LEAVE T1 AND T4 CONNECTED TO H1 AND H4 RESPECTIVELY
- 2 FOR 60 Hz USE S2 LEAD (FROM GEN) ON TAPS X1-2 (4 TAPS) USE TX LEAD ON TAPS X3-4
- 3 FOR 50 Hz USE S2 LEAD (FROM GEN) ON TAPS X1-3 (6 TAPS) USE TX LEAD ON TAPS X4-6
- a FOR 110/220V AND 110V CONNECT H2 TO H6. FOR 110V CONNECT H5 TO T3 (L1) AND H3 TO T2 (L2) FOR 110/220V USE H5 FOR L1 AND H3 FOR L2 (T2 AND T3 ARE GND)

- b FOR 115/230V AND 115V INSULATE H5 AND H6 (NOT USED)
- c FOR 120/240V AND 120V CONNECT H2 TO H5 FOR 120V CONNECT H6 TO T3 (L1) AND H3 TO T2 (L2) FOR 120/240V USE H6 FOR L1 AND H3 FOR L2 (T2 AND T3 ARE GND)
- 4 DASHED LINES INDICATE WHEN USED
- 5 H5 AND H6 LEADS ARE USED ONLY ON 50 Hz 110V, 110/220V AND 50 Hz 120V, 120/240V CONNECTIONS

## Electronic Regulation

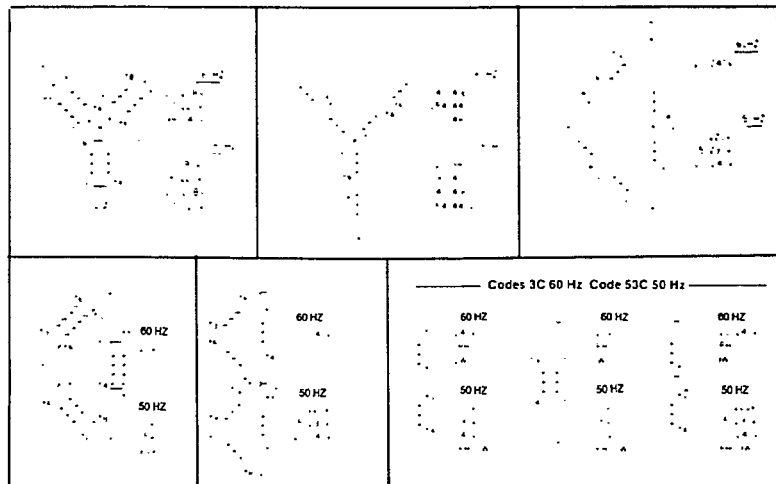


FIGURE 7-13. GENERATOR RECONNECTION DIAGRAMS





# Section 8. Wiring Diagrams

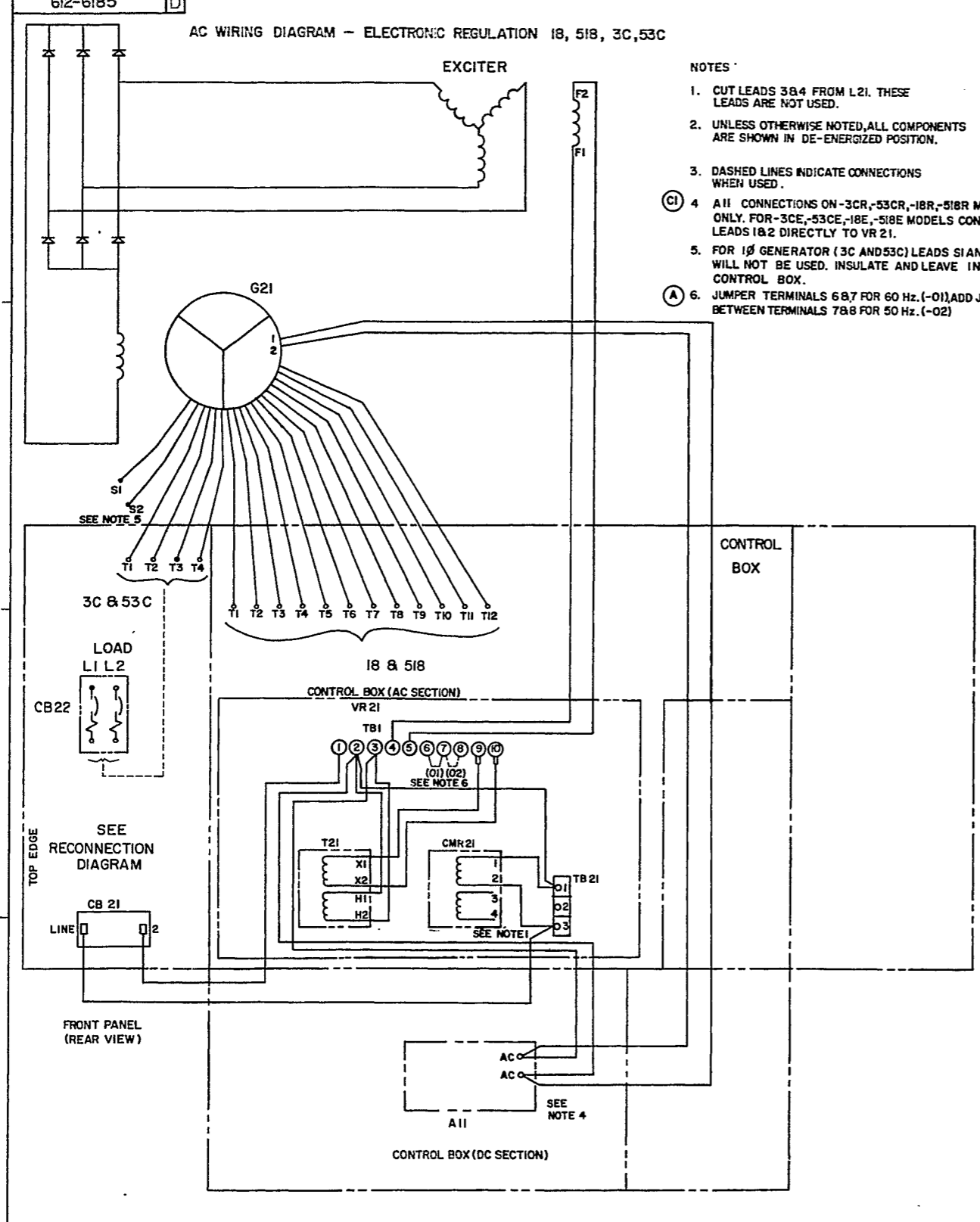
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## Notes

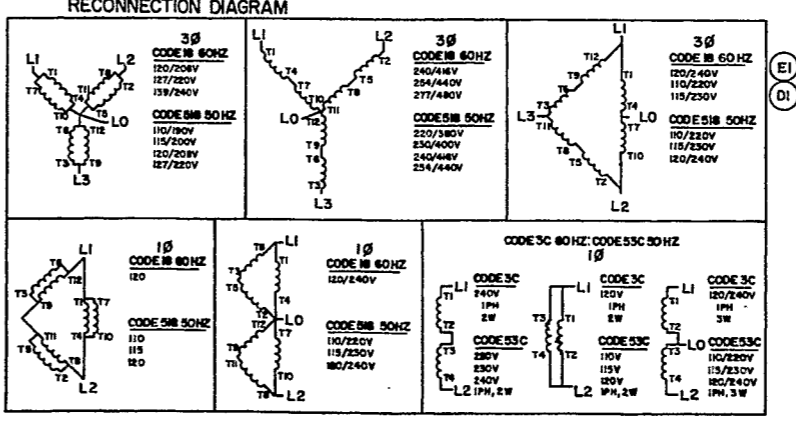
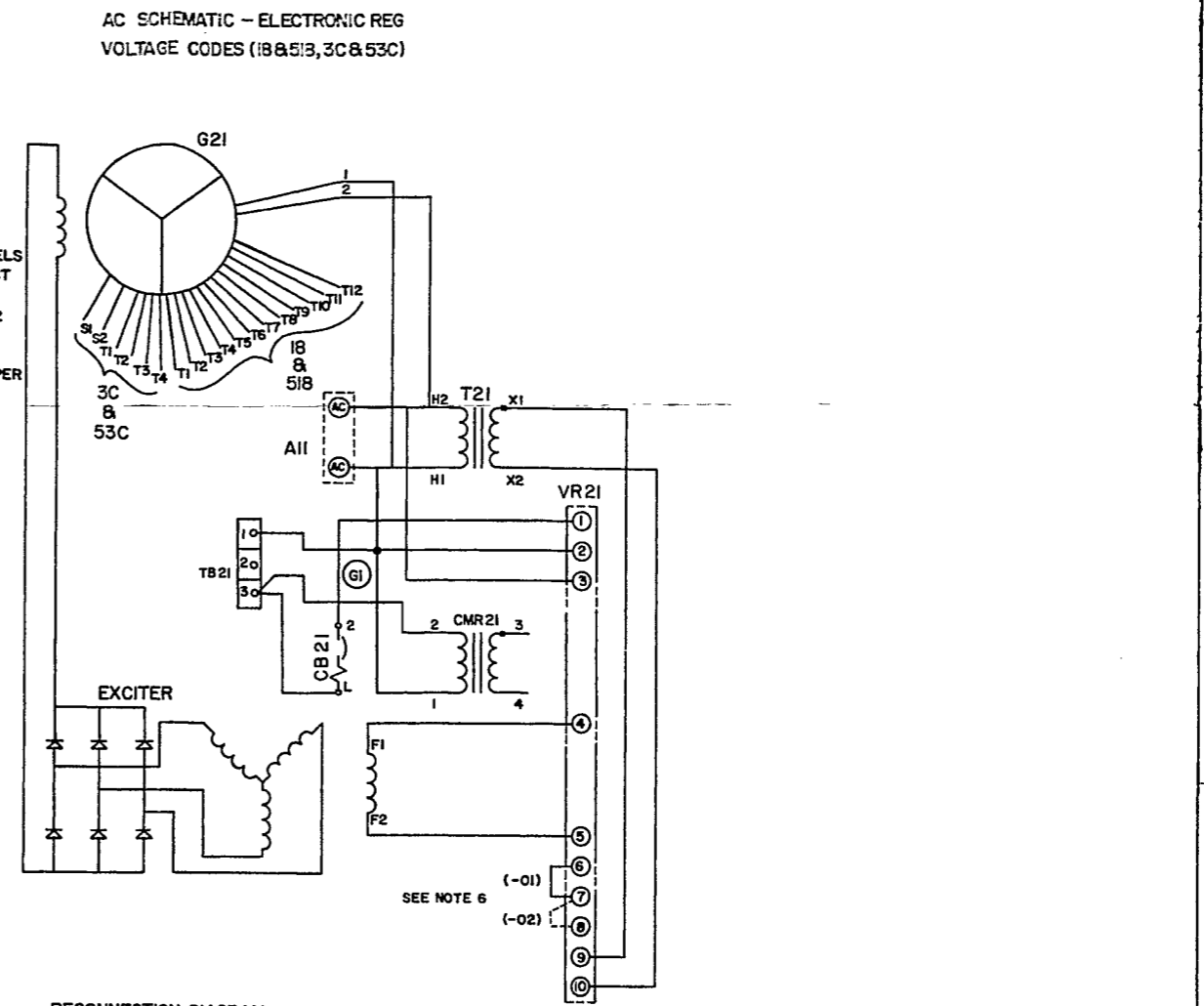
The electrical schematics and wiring diagrams that apply to the generator sets covered in this manual are listed below:

<b>WIRING DIAGRAM</b>	<b>DRAWING NO.</b>	<b>PAGE</b>
Single Phase AC Control .....	612-6184	8-2
Single and Three Phase AC Control .....	612-6185	8-3
MDKC/MDKD DC Control .....	612-6187	8-4
DKC/DKD 3-Wire Start Control ("R" Remote Start) .....	612-6262	8-5
RV and "AUX" Generator Set Control 3-Wire Start .....	612-6353	8-6
DKC/DKD Control ("E" Electric Start Standby Generator sets) .....	612-6186	8-7
Electronic AC Voltage Regulator Assembly .....	305-0691	8-8
6.5/7.5 DKD DC Control (Spec F RV Gensets) .....	612-6624	8-9
Single-phase AC Genset Control (Spec F RV Gensets) .....	612-6442	8-10
6.5/7.5 DKD Control Schematic (Extended Oil Fill Version) .....	612-6631	8-11

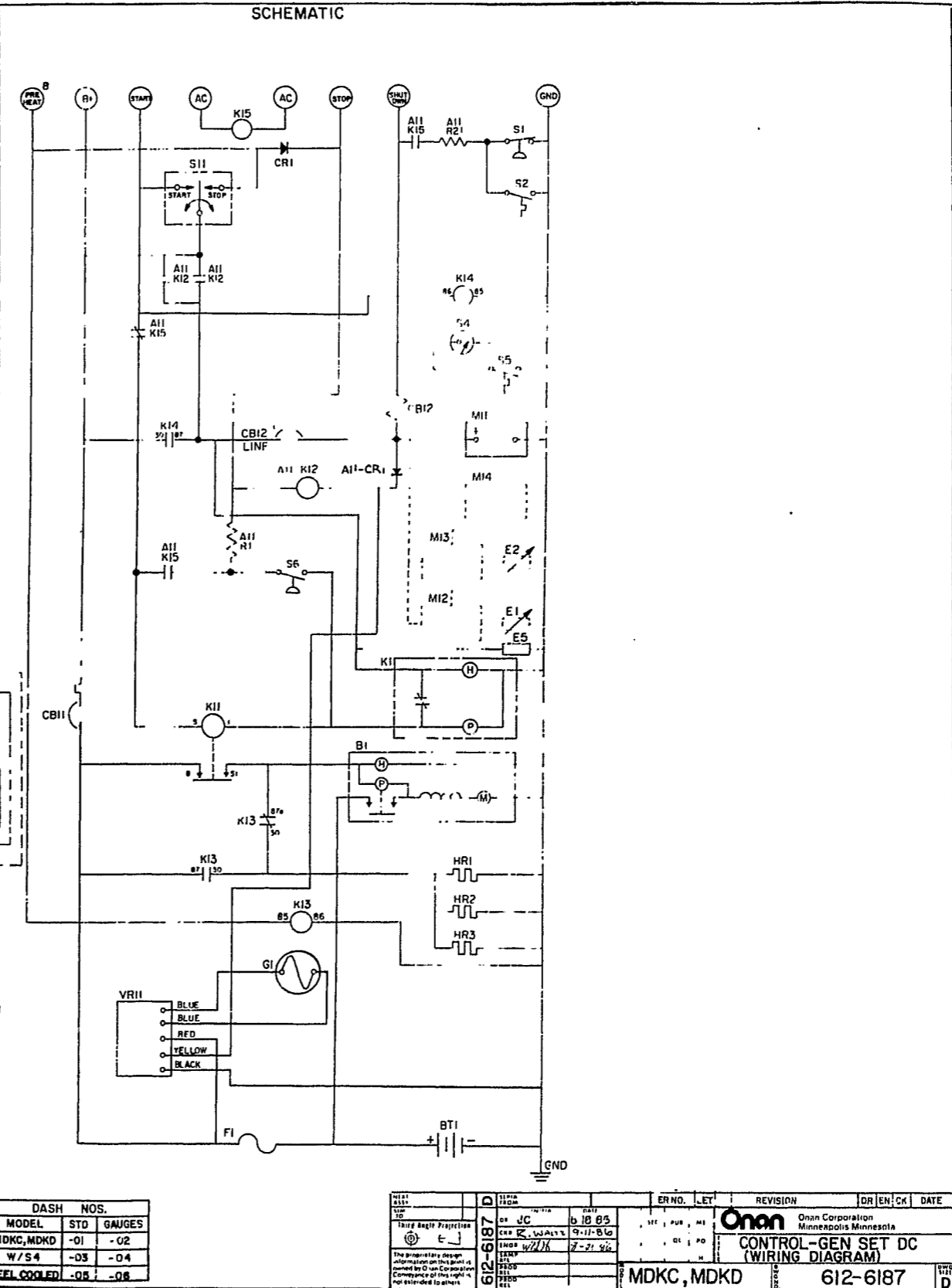
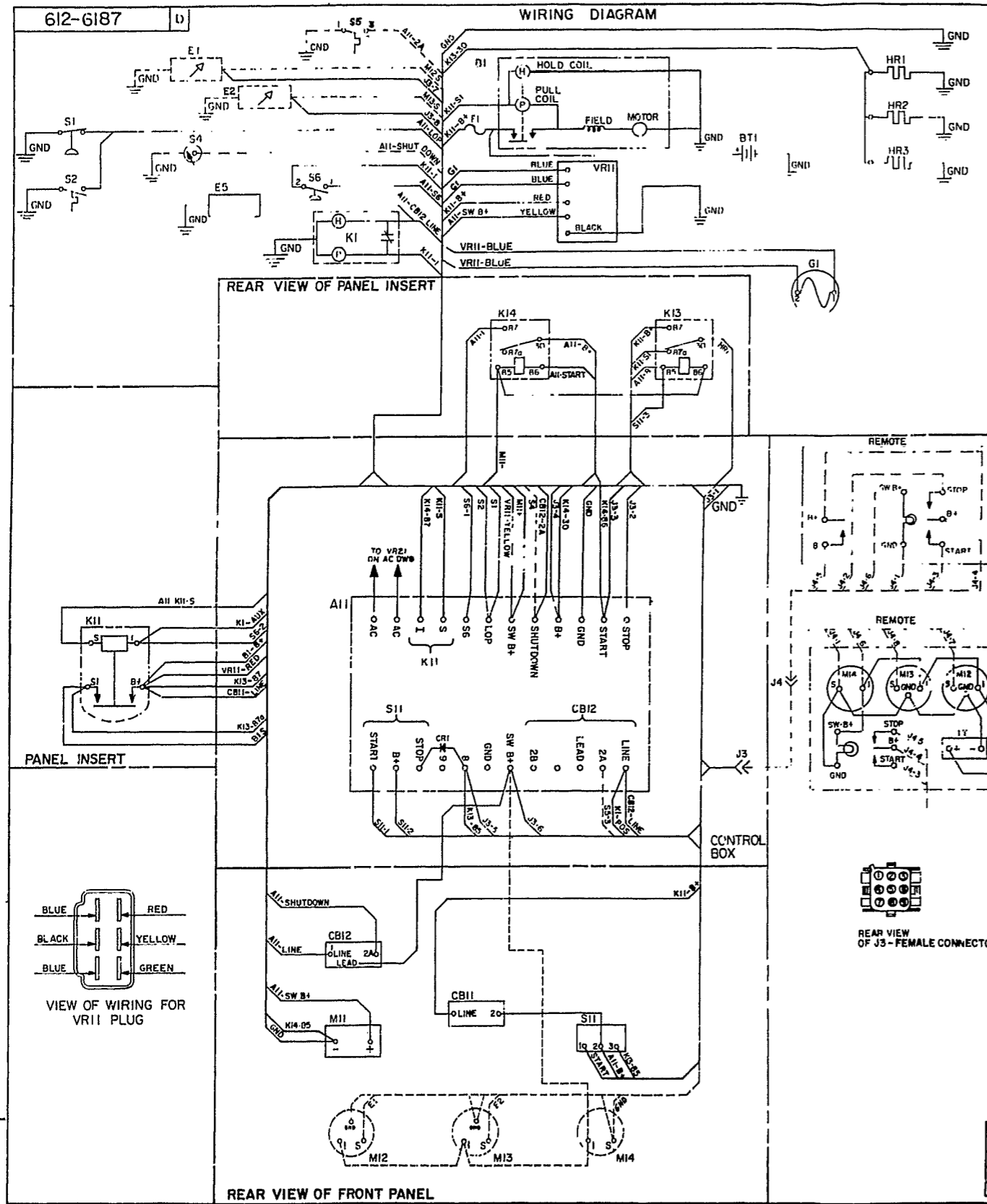




- NOTES**
1. CUT LEADS 3&4 FROM L21. THESE LEADS ARE NOT USED.
  2. UNLESS OTHERWISE NOTED, ALL COMPONENTS ARE SHOWN IN DE-ENERGIZED POSITION.
  3. DASHED LINES INDICATE CONNECTIONS WHEN USED.
  4. ALL CONNECTIONS ON -3CR-, -53CR-, -18R-, -518R MODELS ONLY. FOR -3CE-, -53CE-, -18E-, -518E MODELS CONNECT LEADS 1&2 DIRECTLY TO VR 21.
  5. FOR 1Ø GENERATOR (3C AND 53C) LEADS S1 AND S2 WILL NOT BE USED. INSULATE AND LEAVE IN CONTROL BOX.
  6. JUMPER TERMINALS 6&7 FOR 60 Hz. (-01), ADD JUMPER BETWEEN TERMINALS 7&8 FOR 50 Hz. (-02)



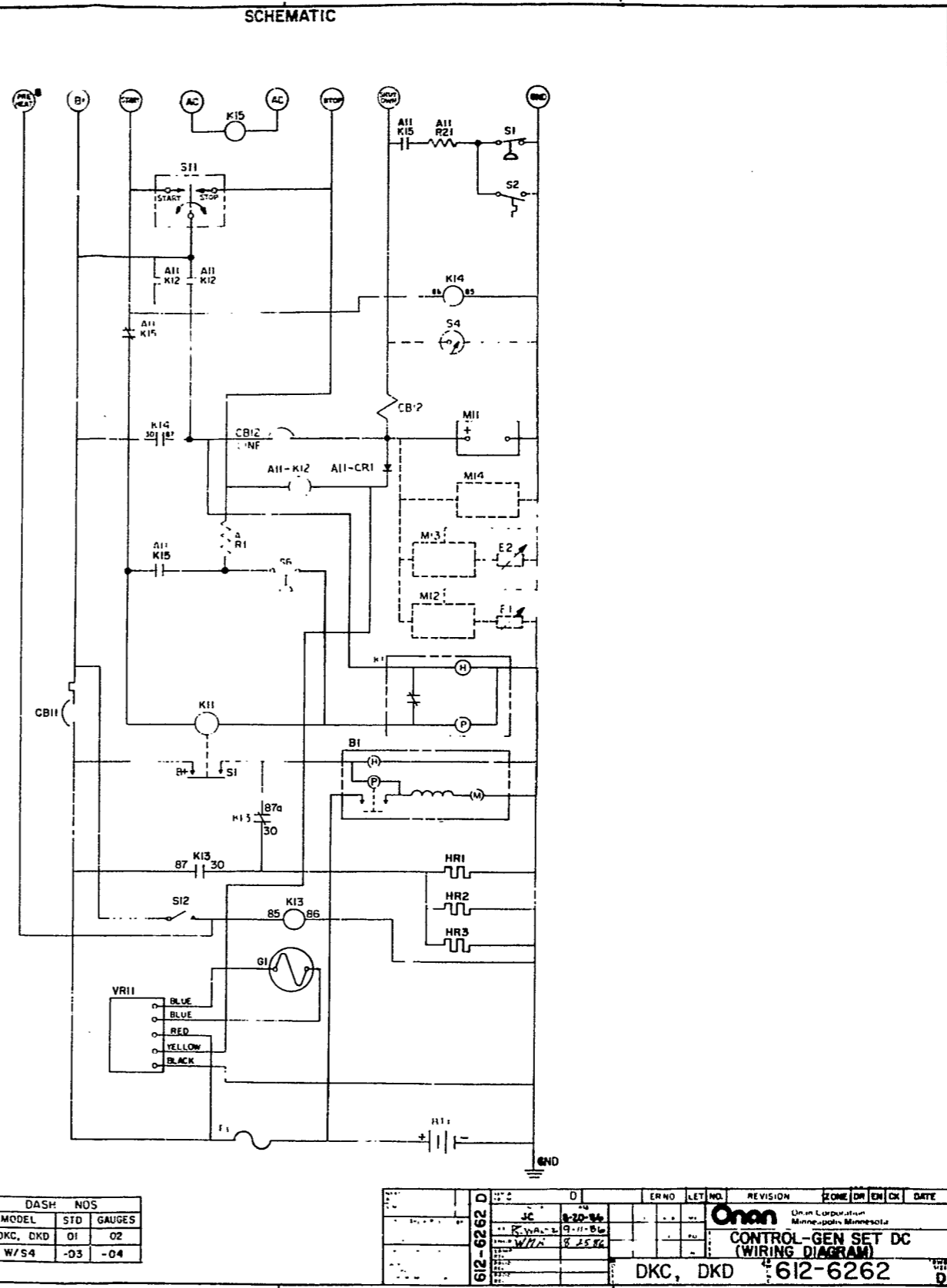
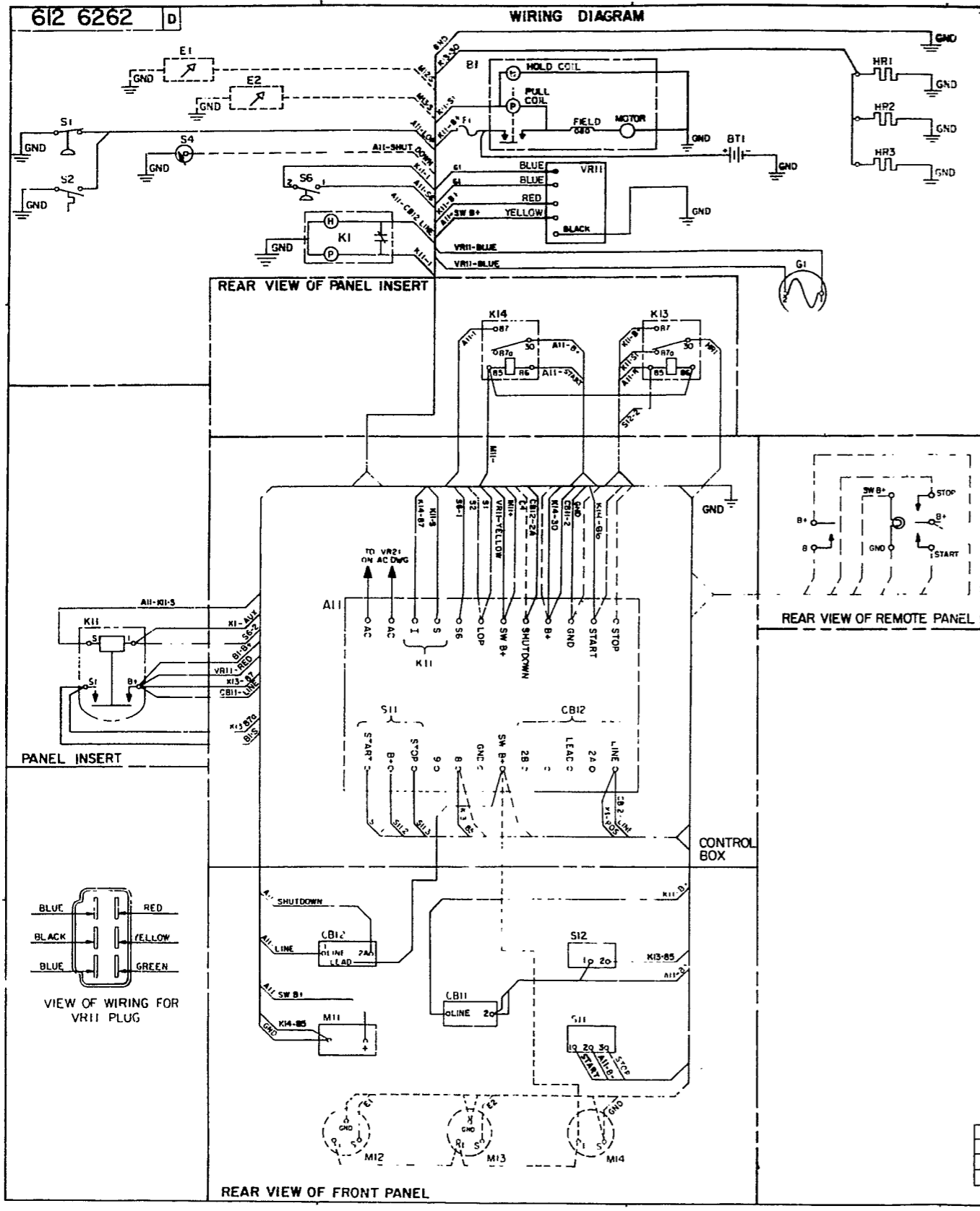
ADCSWITCHER	-01	60 Hz	
8AUG 63	-02	50 Hz	
			CONTROL-GEN SET AC (1Ø3PH)
			612-6185
			DKC,DKD,MDKC,MDKD



DASH NOS.	
MODEL	STD GAUGES
MDKC,MDKD	-01 -02
W/S4	-03 -04
KEEL COOLED	-05 -08

REV	BY	CHK	DATE	REV	BY	CHK	DATE
1	JC		10-18-65	1			
2				2			
3				3			
4				4			

**Onan** Onan Corporation  
 Minneapolis, Minnesota  
**CONTROL-GEN SET DC**  
**(WIRING DIAGRAM)**  
**MDKC, MDKD 612-6187**



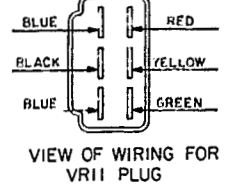
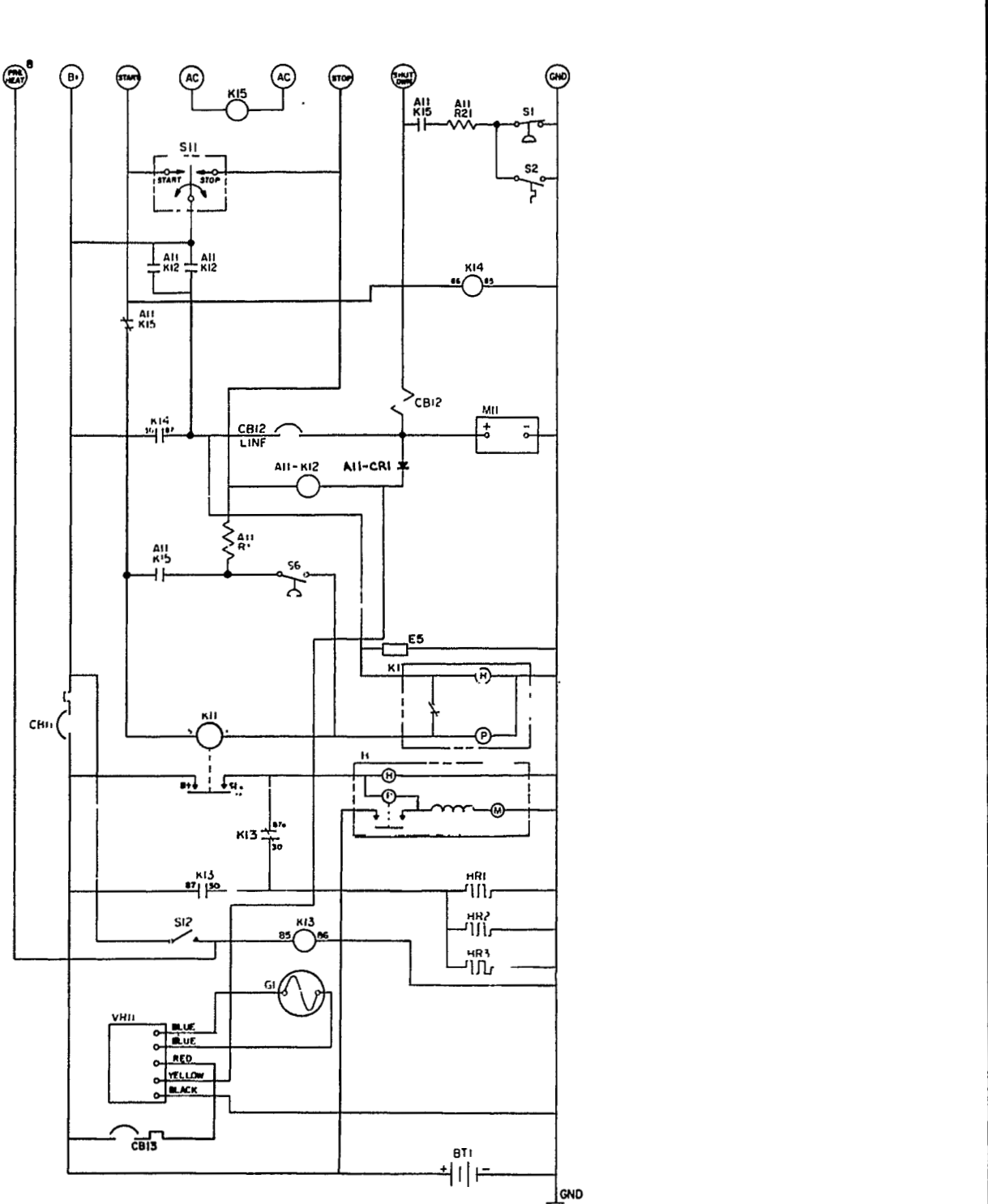
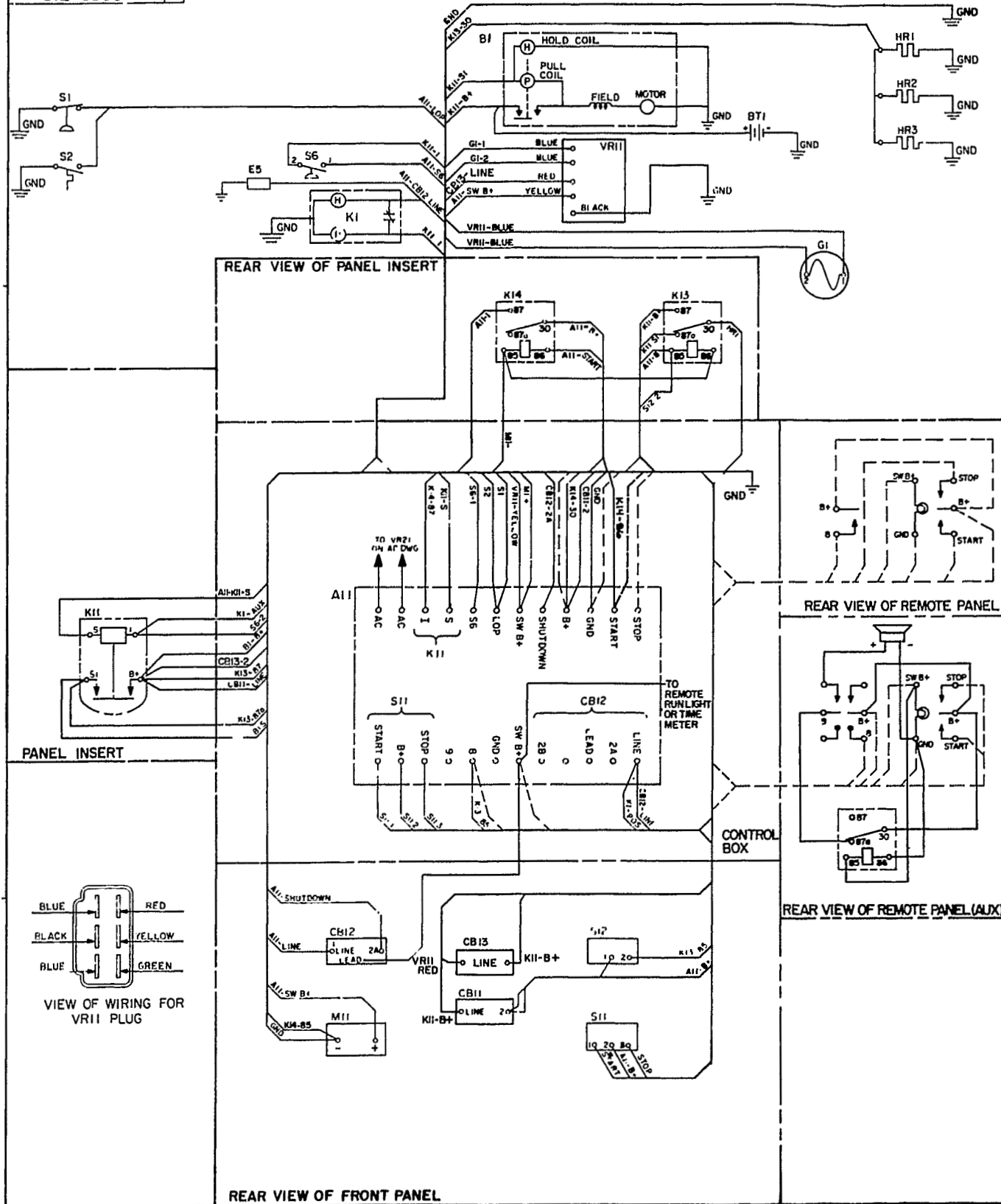
DKC/DKD 3-WIRE START CONTROL ("R" REMOTE START)

612-6353

D

### WIRING DIAGRAM

### SCHEMATIC



REV	NO.	DATE	BY	CHKD	ERNO	LET NO.	REVISION	ZONE	DR	EN	CK	DATE
1	1	6 20 88	JC									
2	2	9-11-88	WALTY									
3	3	8-25-91	MLK									

Onan Corporation  
Minneapolis, Minnesota

CONTROL-GEN SET DC  
(WIRING DIAGRAM)

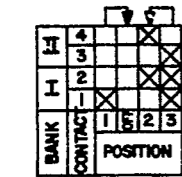
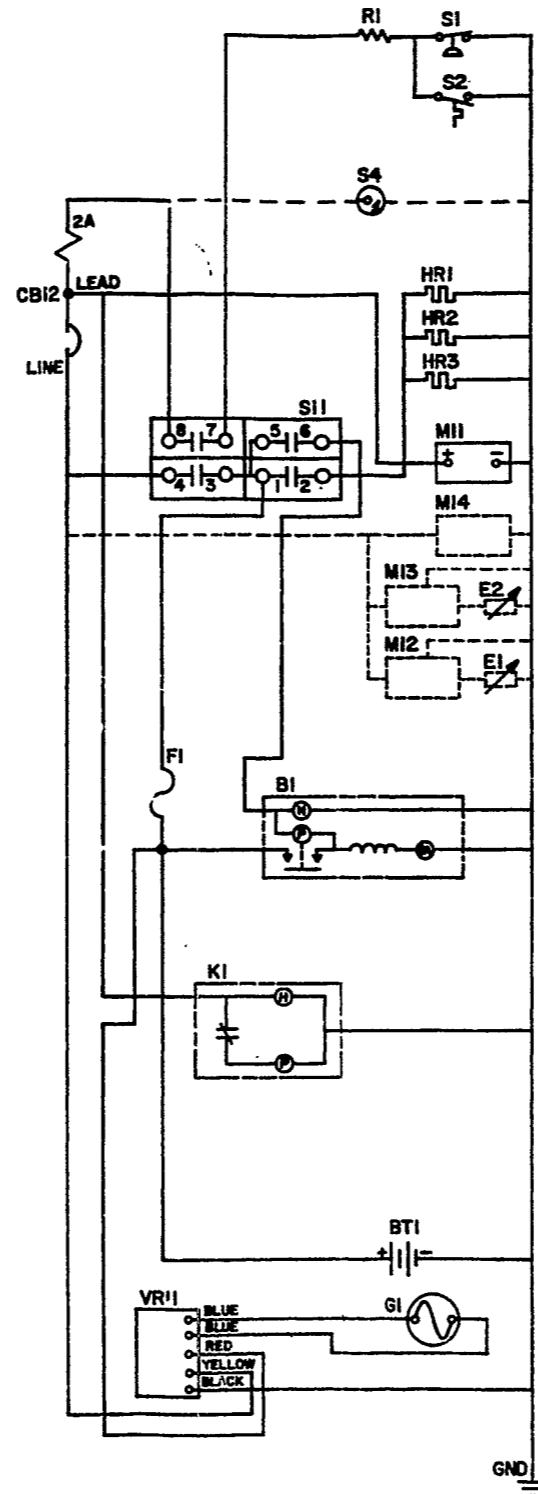
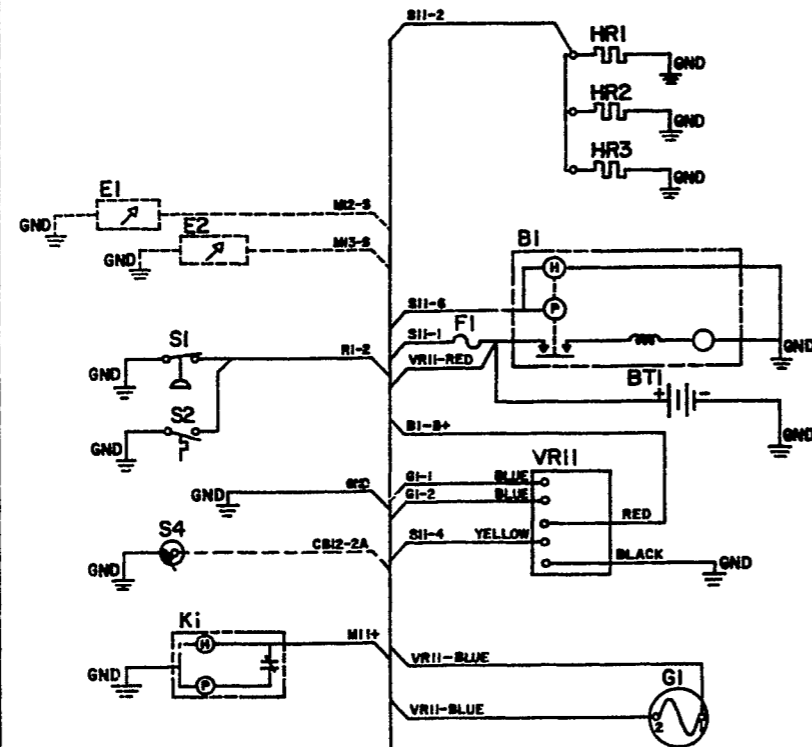
DKC, DKD 612-6353

612-6186

C

WIRING DIAGRAM

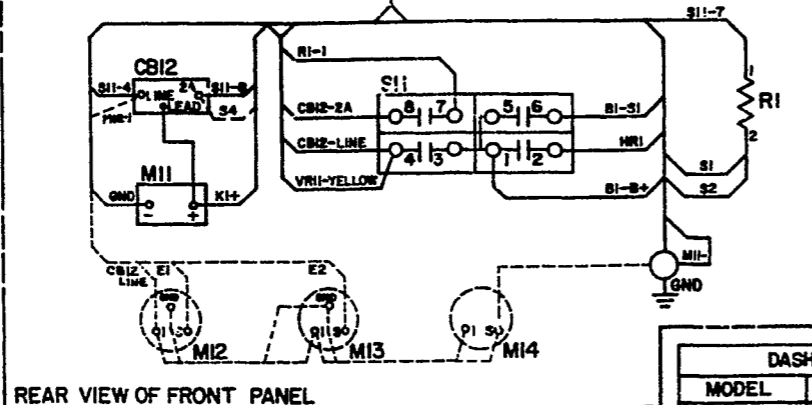
SCHEMATIC



S11 SWITCH DETAIL



VIEW OF WIRING FOR VR11 PLUG



REAR VIEW OF FRONT PANEL

DASH NOS.		
MODEL	STD	GAUGES
DKC.DKD	-01	-02
W/S4	-03	-04

REV	BY	CHKD	DATE	ER NO.	LET	REVISION	DR	ENG	CKR	DATE
1	DKC	DKD	7-28-83							
2	DKC	DKD	8-8-83							
3	DKC	DKD	8-8-83							
4	DKC	DKD	6 AUG 83							

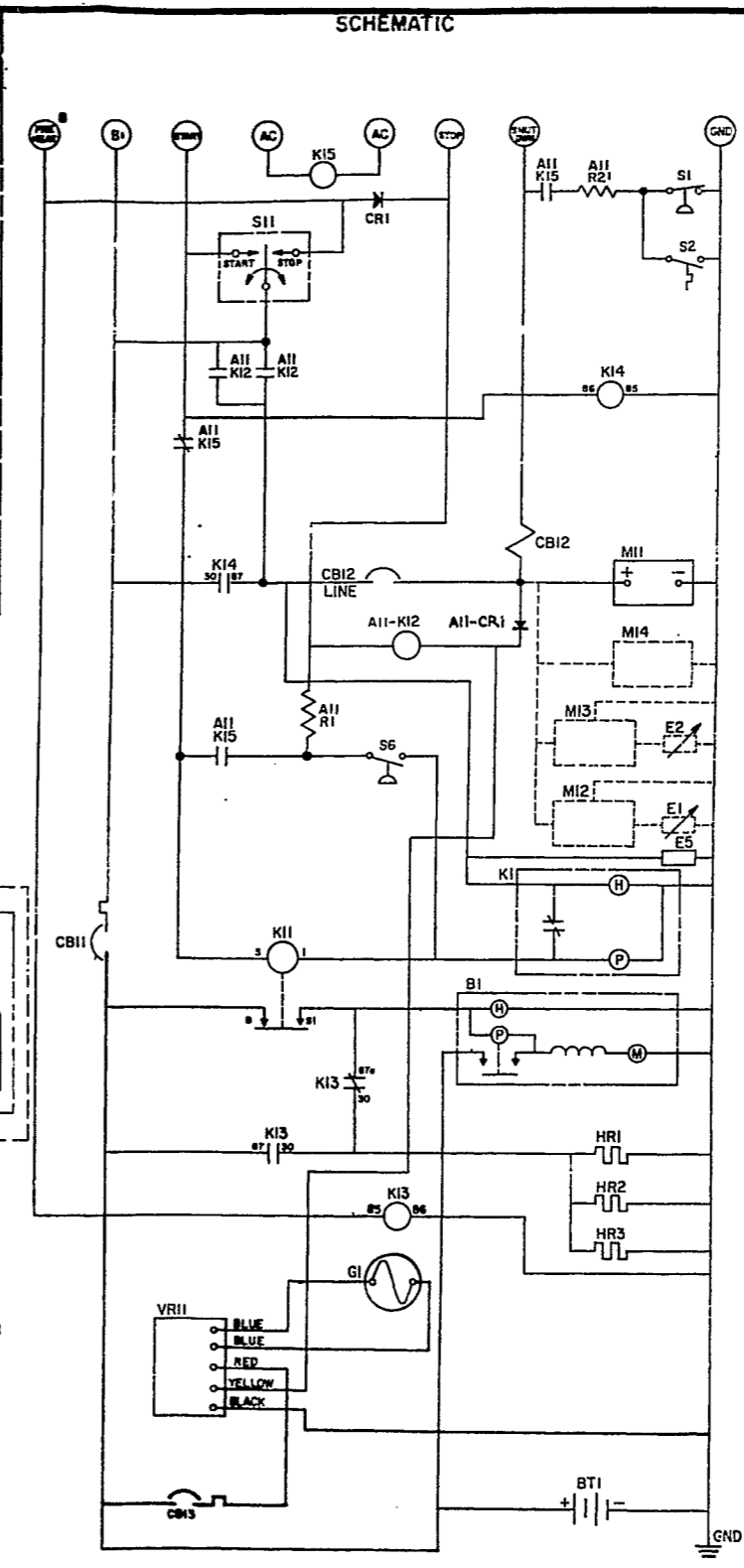
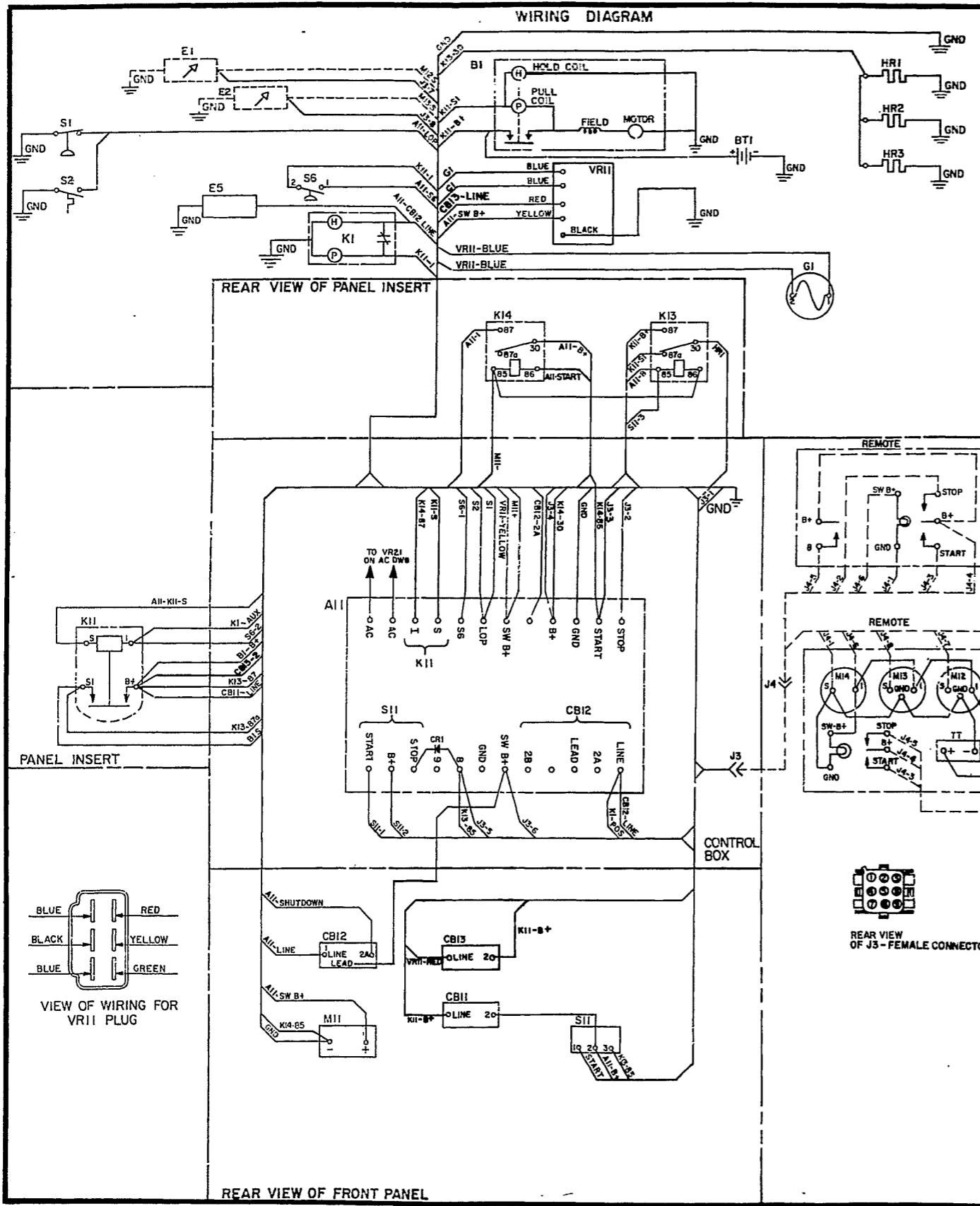
CONTROL-GEN SET DC (WIRING DIAGRAM)

DKC,DKD

612-6186



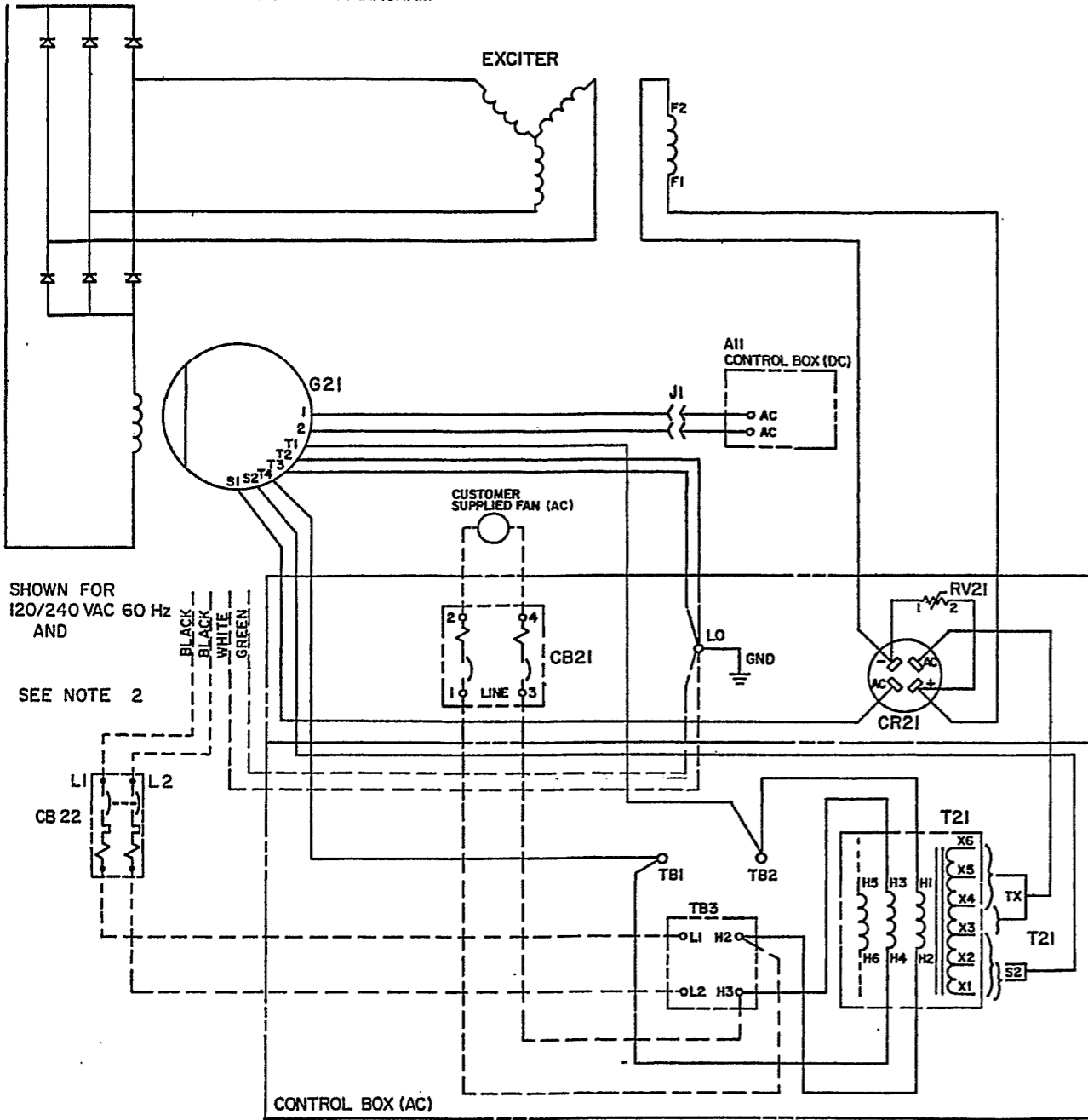




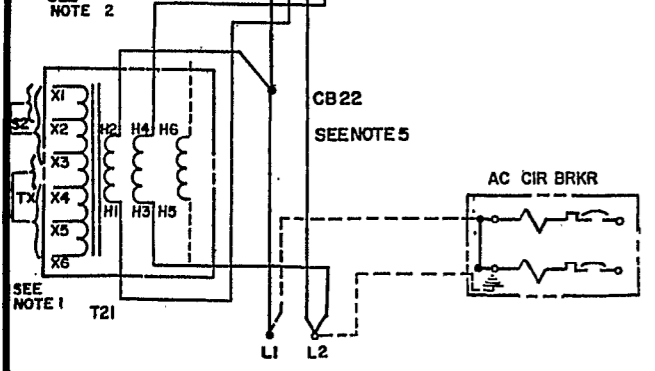
PARTS LIST (REF)				
REF	PART NO.	QTY	DESCRIPTION	
B1		1	STARTER & SOLENOID	
BT1		1	BATTERY (12V)	
E1		1	SENDER-OIL PRESSURE	
E2		1	SENDER-COOLANT TEMP	
HR1-3		3	HEATER-GLOW PLUG	
E5		1	FUEL PUMP-ELECTRIC	
M1		1	FUEL SOLENOID	
S1		1	SWITCH-LOW OIL PRESSURE	
S2		1	SWITCH-HIGH COOLANT TEMP	
G1		1	ALTERNATOR	
VR11		1	REGULATOR	
S5		1	SWITCH-CONTROL POWER LATCH	
CONTROL BOX PARTS LIST				
A11	300-2804	D	1	PCB ASSY-ENGINE MONITOR
CBI1,13	320-1140	C	2	CIRCUIT BREAKER (CONTROL)
CBI2	320-1141	A	1	CIRCUIT BREAKER (FAULT)
CR1	357-0088	A	1	RECTIFIER ASSY (STOP)
K11	307-1617	B	1	RELAY-START SOLENOID (STARTER)(12V)
A11-K12			1	RELAY-POWER
REF K13	307-1886	P	1	RELAY-HEATER (12V)
REF K14	307-1886	P	1	RELAY-FUEL SOLENOID
REF A11-K15			1	RELAY-STARTER PROTECTION
A11-R1			1	RESISTOR (K12)
A11-R2			1	RESISTOR (LOF TIMING)
M11	302-0885	A	1	METER TIME TOTALIZING 4-40VDC
REF M12	193-0352	P	1	GAUGE-OIL PRESSURE
REF M13	193-0351	P	1	GAUGE-COOLANT TEMP
REF M14	302-1641	P	1	VOLTMETER
REF S11	308-0739	A	1	SWITCH-START,STOP
402-0527	A	4	ISOLATOR-VIBRATION	
508-0115	P	1	GROMMET (2 1/8 I.D.)	
508-0117	P	1	GROMMET (1 1/8 I.D.)	
518-0437	A	1	CLIP-HOLDDOWN (TINNERMAN)	
(INSTALL BEHIND CONTROL TRAY ON BOTTOM)				
870-0398	A	4	CLIP NUT-RETAINING (10-32 TINNERMAN)	
(INSTALL ON TOP HOLES OF CONTROL BOX)				
919-1850	B	1	BOX ASSY-CONTROL	
301-8454	D	1	TRAY-CONTROL	
319-0201	B	1	PANEL ASSY-CONTROL	
98-6507	B	1	SILKSCREEN-PANEL	
98-0994	A	1	SILKSCREEN GRN	
319-1681	C	1	PANEL-DC CONTROL	
338-2854 E 1 WIRING HARNESS				
815-0385	-	2	SCREW-RHM (6-32 X 1/2) (M11)	
870-0131	-	2	NUT-HEX W/ET (10-32)	
821-0004	-	13	SCREW-LK HD (10-32 X 3/16)(BOX ASSY)	
812-0188	-	1	SCREW-LK HD (1/4-20X1.50)(GND)	
871-0016	-	1	NUT-HMS (GND)	
856-0006	-	2	WASHER-EIT LK (1/4-20)(GND)	
821-0008	-	2	SCREW-LK HD (1/4-20X3/16)(K11)	
815-0544	-	12	SCREW-RHM XREC W/IT (6-32 X 1/2)	
870-0183	-	2	NUT-W/ET (6-32)(M11)	

**NO. 612-6624**  
**REV. A**  
**MODIFIED**

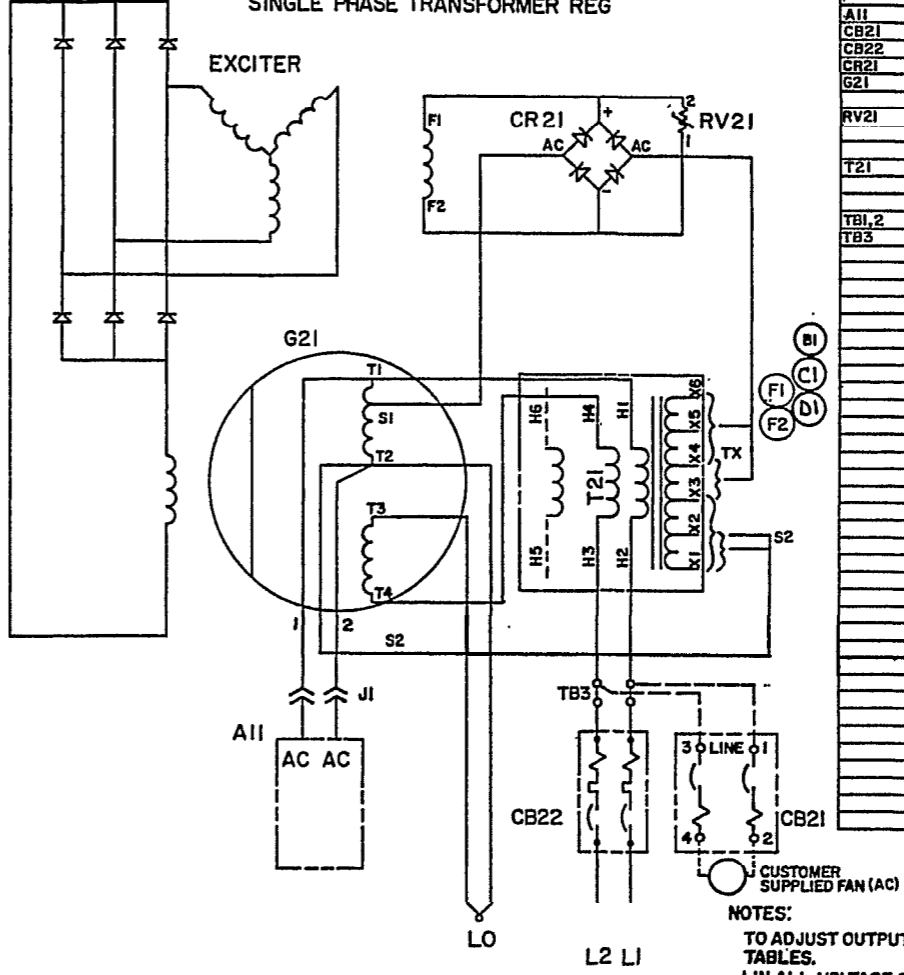
AC WIRING DIAGRAM



RECONNECTION DIAGRAM FOR 120V AC 60 Hz



AC SCHEMATIC SINGLE PHASE TRANSFORMER REG



REF PARTS LIST - (ALL DASH NOS.)

REF DES	PART NO.	QTY	DESCRIPTION
A11			REF PCB ASSY-ENGINE MONITOR
CB21	320-1876	B	REF CIRCUIT BREAKER
CB22			REF CIRCUIT BREAKER (LOAD)
CR21	305-0696	B	REF BRIDGE-RECTIFIER
G21			REF GENERATOR
RV21	305-0703	A	REF SUPPRESSOR ASSY
T21	315-0572	C	REF TRANSFORMER ASSY (-01)
	315-0571	C	REF TRANSFORMER ASSY (-02)
	315-0553	C	REF TRANSFORMER ASSY (-03)
TB1,2	332-2370	P	REF STANDOFF-INSULATOR
TB3			REF TERMINAL BLOCK

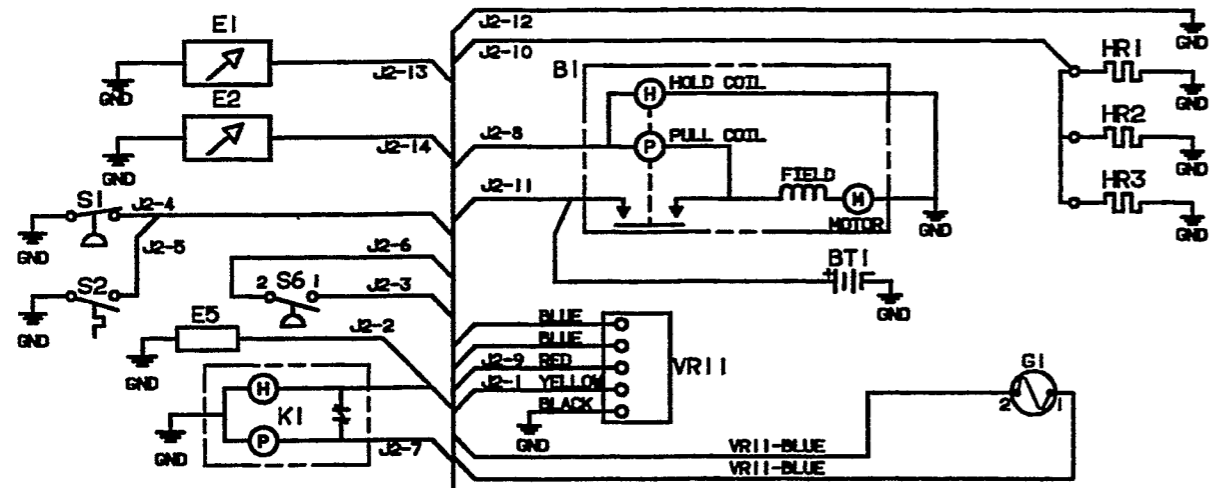
PARTS LIST

REF DES	PART NO.	QTY	DESCRIPTION
	300-3135	C	CONTROL ASSY-AC (-01)
	300-3158	C	CONTROL ASSY-AC (-02)
	300-3199	C	CONTROL ASSY-AC (-03)
	300-3155-01	C	CONTROL ASSY-AC (-04)
	300-4236	C	CONTROL ASSY-AC (-05)
	300-4237	C	CONTROL ASSY-AC (-06)

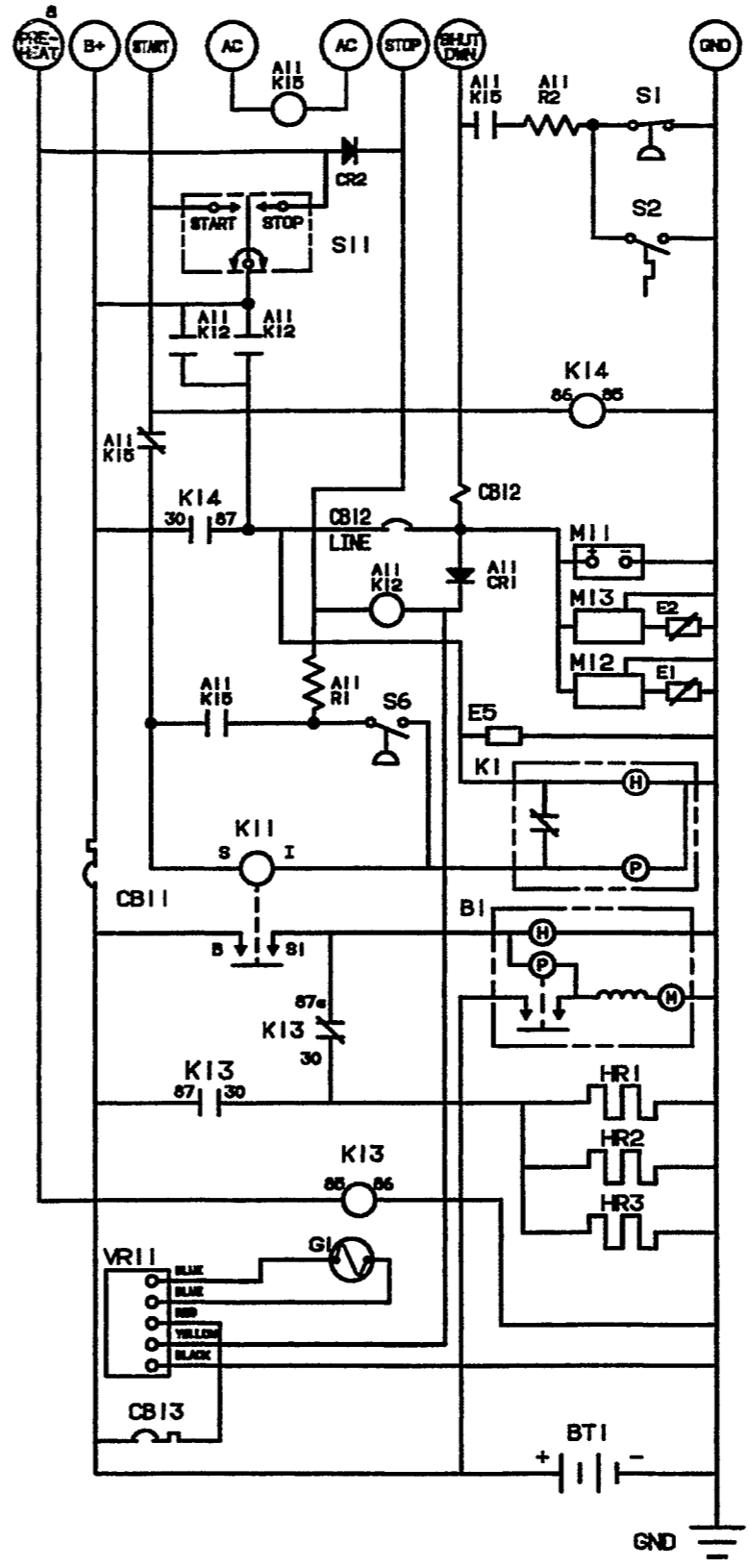
OUTPUT VOLTAGE ADJUSTMENT	60Hz (-01)		60Hz (-02)		60Hz (-03)	
	120, 120/240V TAP POSITION		120, 120/240V TAP POSITION		120, 120/240V TAP POSITION	
↑ INCREASE STD ↓ DECREASE	INCREASE	X2 X3	INCREASE	X2 X3	INCREASE	X3 X4
	STD	X1 X4	STD	X1 X3	STD	X3 X5
	DECREASE	X1 X4	DECREASE	X2 X4	DECREASE	X2 X5 X3 X6 X2 X6 X1 X6

NO. 612-6442  
REV. F  
MODIFIED

DC WIRING DIAGRAM



SCHEMATIC

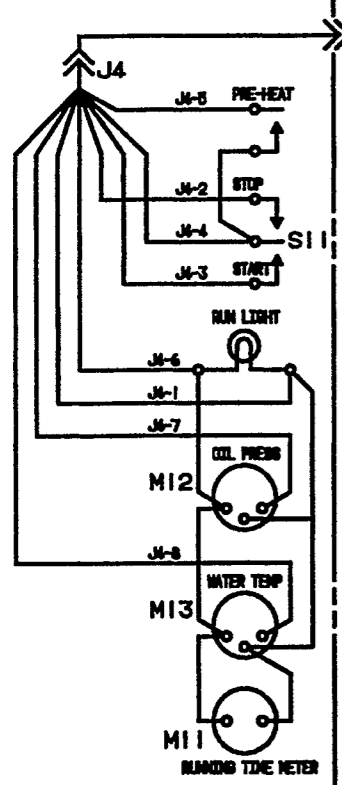


ENGINE PARTS LIST (FOR REF ONLY)			
B1		(1)	STARTER & SOLENOID
BT1		(1)	BATTERY (12V)
E1		(1)	SENDER-OIL PRESSURE
E2		(1)	SENDER-COOLANT TEMP
E5		(1)	FUEL PUMP-ELECTRIC
G1		(1)	ALTERNATOR
HR1-3		(3)	HEATER-BLOW PLUG
K1		(1)	SOLENOID-FUEL
S1		(1)	SWITCH-LOW OIL PRESSURE
S2		(1)	SWITCH-HIGH COOLANT TEMP
S6		(1)	SWITCH-CONTROL POWER LATCH
VR11		(1)	VOLTAGE REGULATOR

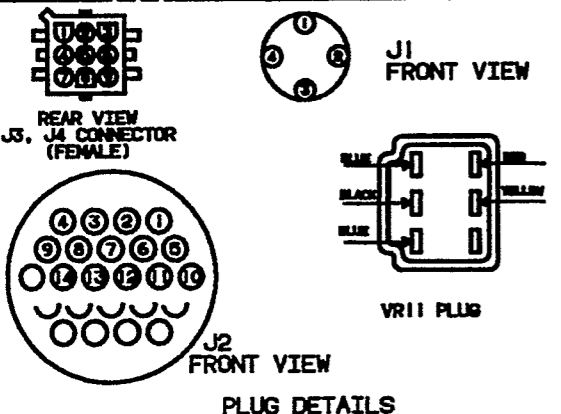
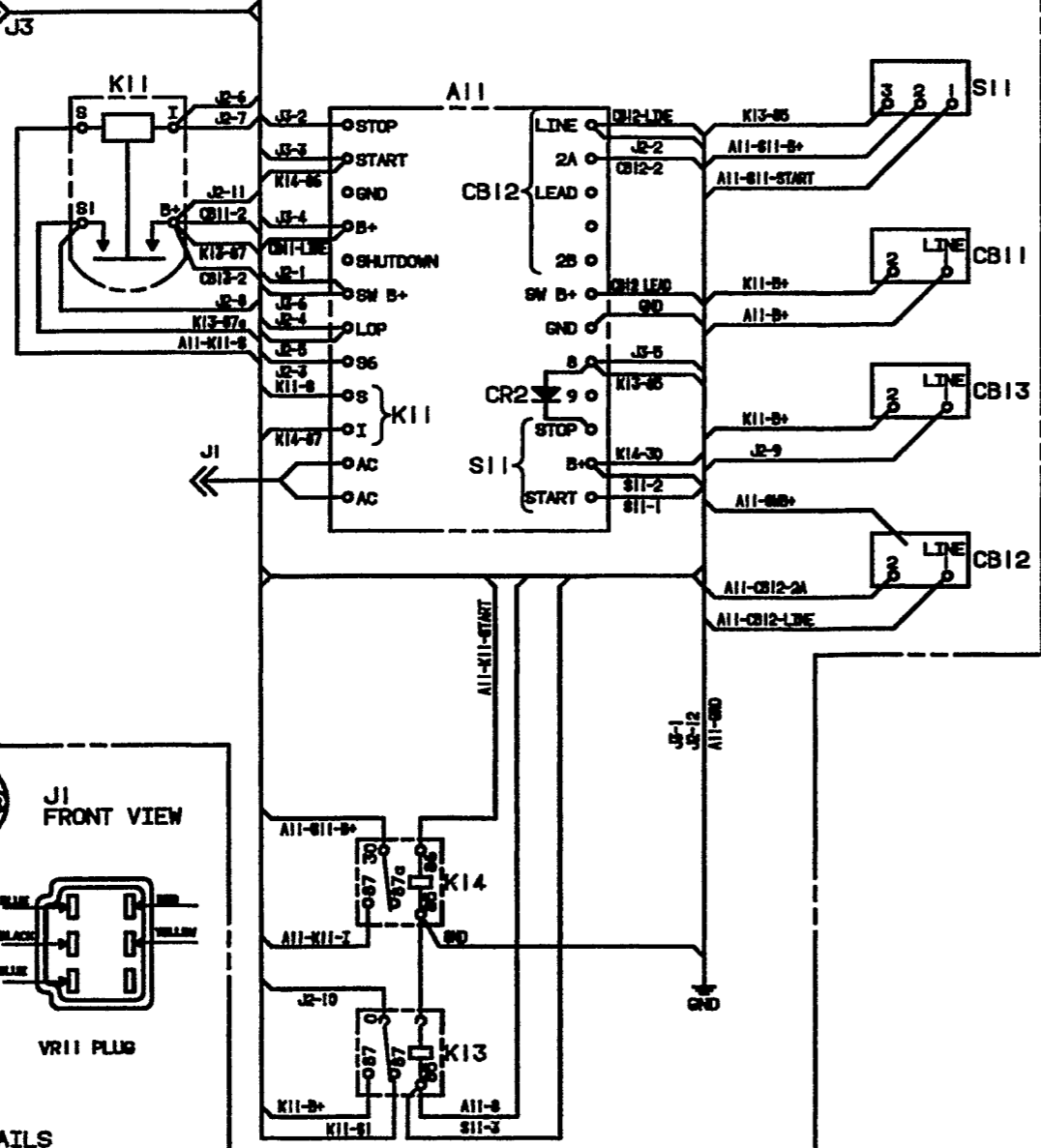
  

CONTROL BOX PARTS LIST -01, -02			
300-1737	D	1	CONTROL ASSY
A11 300-2604	D	(1)	PCB ASSY-ENGINE MONITOR
CB1, CB2-1140	C	(2)	CIRCUIT BREAKER (CONTROL)
CB12 320-1141	A	(1)	CIRCUIT BREAKER (FAULT)
J3-J4		REF	CONNECTOR-REMOTE
K11 307-1617	B	(1)	RELAY-START SOLENOID(STARTER)(12V)
A11-K12		REF	RELAY-POWER
K13 307-1886	P	(1)	RELAY-HEATER (12V)
K14 307-1886	P	(1)	RELAY-FUEL SOLENOID
A11-K14		REF	RELAY-STARTER PROTECTION
A11-R1		REF	RESISTOR (K12)
A11-R2		REF	RESISTOR (LOP TIMING)
S11 308-0739	A	(1)	SWITCH-START STOP
S12 308-0778	A	(1)	SWITCH-PREHEAT

REMOTE



CONTROL BOX



NO. 612-6631  
REV. A  
MODIFIED







Cummins Power Generation  
1400 73rd Avenue N.E.  
Minneapolis, MN 55432  
763-574-5000  
Fax: 763-574-8087

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